Agnel Charities

Fr. C. Rodrigues Institute of Technology

Sector 9A, Vashi, Navi Mumbai, 400703, Maharashtra, India

www.fcrit.ac.in

An Autonomous Institute Affiliated to the University of Mumbai

Department of Information Technology

Curriculum Structure FY to B.Tech

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First , Second and Third Year Syllabus

Prepared by : Board of Studies for Department of Information Technology

Approved By: Academic Council of Fr.C.Rodrigues Institute of Technology

Revision: 2024

Effective from :2024-25

PREAMBLE FROM DEAN ACADEMICS

Accelerating Towards Excellence: Unveiling a New Era in Education

Dear Students, Faculty, and Stakeholders,

It is with great pleasure and anticipation that we introduce the newly designed curriculum for autonomy at Agnel Charities' Fr. C. Rodrigues Institute of Technology. This pioneering initiative aims to revolutionize engineering education, ensuring our graduates are equipped with not only technical prowess but also the holistic skills necessary for thriving in today's dynamic professional landscape.

1. **Purpose of Autonomy:** Our commitment to autonomy is rooted in the imperative to bridge the gap between academia and industry. We envision education as a catalyst for individual growth, fostering self-sustainability and enhancing employability. Through our curriculum, we strive to nurture engineers who not only excel in their fields but also contribute meaningfully to society.

2. **Curriculum Design: A Top-to-Down Approach:** Our curriculum is meticulously crafted with a top-to-down approach, encompassing all 12 attributes of Program Outcomes mandated by regulatory bodies. Emphasizing a blend of theoretical knowledge and practical application, it is designed to cultivate well-rounded professionals capable of tackling real-world challenges with confidence and competence.

3. **Alignment with National Education Policy-2020:** In adherence to the guidelines laid out in the National Education Policy-2020, our curriculum embodies a multidisciplinary approach, offering a diverse array of core and elective courses. It integrates hands-on learning experiences such as mini and major projects, skill-based labs, and one-semester internships to nurture innovation and problem-solving skills. Additionally, the inclusion of value-added courses, honours, and minors ensures a comprehensive educational journey tailored to individual interests and aspirations.

4. **Opportunities for Teachers in Innovation:** We recognize the pivotal role of our faculty in shaping the educational experience. Our curriculum provides ample opportunities for teachers to innovate in teaching-learning methodologies and evaluation techniques. Through continuous professional development programs and collaborative platforms, we empower our educators to experiment with innovative pedagogies, leverage technology for enhanced learning outcomes, and implement novel assessment strategies. By fostering a culture of innovation among our faculty, we aim to enrich the learning experience and inspire a passion for lifelong learning among our students.

As we embark on this transformative journey, we invite all stakeholders to join us in shaping the future of engineering education. Together, let us strive towards excellence, innovation, and societal impact.

Sincerely,

Dean of Academics Agnel Charities' Fr. C. Rodrigues Institute of Technology

PREAMBLE FROM BOS CHAIRMAN

Dear Students and Stakeholders,

It is with great pleasure and anticipation that Board of Studies of Information Technology introduce the newly designed curriculum at Agnel Charities' Fr. C. Rodrigues Institute of Technology. This pioneering initiative aims to equip students with a robust foundation in theoretical principles, practical skills, and ethical considerations essential for success in the IT industry. Through a multidisciplinary curriculum designed under Autonomy, students are empowered to tackle complex challenges with confidence and creativity in an era defined by technological innovation and rapid advancements. Furthermore, the course is designed to cultivate critical thinking, problem-solving abilities, teamwork, and effective communication skills, fostering well-rounded professionals capable of thriving in dynamic work environments.

Department has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development. Curriculum is aligned with Institute, Department vision and mission and with National Education Policy-2020. Designed curriculum is responsive to the diverse needs of students, the larger society and even the global community. At the core of our educational philosophy lies a commitment to holistic development, recognizing that true excellence encompasses not only technical proficiency but also personal growth, ethical integrity, and social responsibility

While designing the curriculum framework, explicit and clear learning purpose is established through vision, mission and program outcomes. Program outcomes are referred as per the guidelines mentioned in NBA SAR-January 2016. Positioning of learning in real world is ensured to keep abreast of latest trends and technologies as per industry requirement. Well thought has been given to selection of courses while structuring the curriculum. Core courses, elective courses, Lab courses, skill based lab courses and Honours/Minor verticals such as Security, Artificial Intelligence & Machine Learning, Internet of Things, Data science are identified. Information Technology course integrates a range of experiential learning opportunities, including internships, mini and major projects, industry projects and collaborative research initiatives. Additionally, emphasis is placed on promoting a culture of lifelong learning, encouraging students to stay abreast of emerging trends, engage in continuous professional development, and contribute meaningfully to the advancement of the field.

Department has taken an initiative to design course syllabus by adapting leaner centered approach through backward design method facilitating the creation of more cohesive, clear and intentional learning experiences for learners. While designing the syllabus teacher has identified the desired results through setting the course and learning objectives aligned with Bloom taxonomy and Performance Indicators. Teacher has identified the assessments that students will complete in order to demonstrate evidence of learning and even progress towards achievement of learning objectives. Based on this teacher has planned the contents. While planning the content points are considered as what enabling knowledge & skills will learner need in order to achieve desired results, what ways they will be evaluated along the way, what activities will equip learner with needed knowledge and skills, what will need to be taught and how should it best be done using pedagogical and innovative methods. The draft scheme and syllabus were presented to all stakeholders for receiving critical feedback and suggestions. Important and relevant suggestions were incorporated.

We invite all stakeholders to join us on this transformative educational journey, where students are empowered to become catalysts of innovation, drivers of change, and leaders of tomorrow's digital landscape. By embracing a holistic approach to learning, grounded in academic rigor, practical relevance, and ethical values, we strive to nurture a new generation of IT professionals poised to make a positive impact on society and shape a brighter future for generations to come.

Sincerely,
Chairman, Board of Studies-Information Technology, Agnel Charities' Fr. C. Rodrigues Institute of Technology

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A. Abbreviations

AEC	Ability Enhancement Course
AU	Audit Course
BSC	Basic Science Course including Mathematics
BSL	Basic Science Laboratory Course
ELC	Experiential Learning Course
ESC	Engineering Sciences Course
ESL	Engineering Sciences Laboratory Course
HMC	Honours or Minor Core Course
HML	Honours or Minor Laboratory
HMP	Honours or Minor Mini Project
HSS	Humanities Social Sciences and Management Course
IKS	Indian Knowledge System Course
INT	Internship
L	Lecture
LBC	Laboratory Course
LLC	Liberal Learning Course
MDM	Multidisciplinary Minor Course
MDL	Multidisciplinary Laboratory Course
MJP	Major Project
MNP	Mini Project
OEC	Open Elective Course
P	Practical
PCC	Program Core Course
PEC	Program Elective Course
RPC	Research Project Coursework
RPR	Research Project
SBL	Skill Based Laboratory
SEC	Skill Enhancement Course
T	Tutorial
VEC	Value Education Course

B. Credit Structure

1. B. Tech in Information Technology											
Type of Course	**Semester-wise Credit Distribution**									**FCRIT Credit Distribution**	**DTE Credit Distribution**
	I	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	**Total**		
Basic Science Course (BSC)	08	08	--	--	--	--	--	--	**16**	**18**	**14-18**
Basic Science Laboratory Course (BSL)	01	01	--	--	--	--	--	--	**02**		
Engineering Science Course (ESC)	05	02	--	--	--	--	--	--	**07**	**16**	**12-16**
Engineering Science Laboratory Course (ESL)	04	05	--	--	--	--	--	--	**09**		
Program Core Course (PCC)	--	--	14	13	06	03	03	--	**39**	**50**	**44-56**
Laboratory Course (LBC)	--	--	02	03	02	02	02	--	**11**		
Program Elective Course (PEC)	--	--	--	--	03	03	06	03	**15**	**15**	**20**
Multidisciplinary Minor (MDM)	--	--	03	03	03	04	—	--	**13**	**13**	**14**
Multidisciplinary Laboratory Course (MDL)†	--	--	--	--	01	--	--	--	**01**	**01**	
Open Elective Course (OEC)	--	--	--	--	--	--	03	03	**06**	**06**	**08**
Skill Enhancement Course (SEC)	01	01	--	--	--	--	--	--	**02**	**08**	**08**
Skill Based Laboratory (SBL)	--	--	02	02	--	02	--	--	**06**		
Ability Enhancement Course (AEC)	--	03	--	--	02	--	--	--	**05**	**05**	**04**
Humanities Social Sciences and Management (HSS)	--	--	02	--	02	--	02	--	**06**	**06**	**04**
Indian Knowledge System (IKS)	--	02	--	--	--	--	--	--	**02**	**02**	**02**
Value Education Course (VEC)	02	--	--	02	--	--	--	--	**04**	**04**	**04**
Experiential Learning Course (ELC)	--	--	--	--	--	02	--	--	**02**	**02**	**04**
Mini Project (MNP)	--	--	01	01	01	01	--	--	**04**	**10**	**04**
Major Project (MJP)	--	--	--	--	--	--	02	04	**06**		
Internship (INT)	--	--	--	--	--	--	--	08	**08**	**08**	**12**
Liberal Learning Course (LLC)	--	--	--	--	--	02	--	---	**02**	**02**	**04**
Total Credits	**21**	**22**	**24**	**24**	**20**	**19**	**18**	**18**	**166**	**166**	**160-176**

C. Curriculum Structure and Examination Scheme for B. Tech in Information Technology

(FY and SY with Effect from AY 2024-2025)
Curriculum Structure – FY Semester-I

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		L	P	T	L	P	T	Total
BSC101	Engineering Mathematics I	3	--	1	3	--	1	4
BSC102	Engineering Physics-I	2	--	--	2	--	--	2
BSC103	Engineering Chemistry-I	2	--	--	2	--	--	2
ESC101	Engineering Mechanics	3	--	--	3	--	--	3
ESC102	Basic Electrical Engineering	2	--	--	2	--	--	2
BSL101	Engineering Physics-I Laboratory	--	1	--	--	0.5	--	0.5
BSL102	Engineering Chemistry-I Laboratory	--	1	--	--	0.5	--	0.5
ESL101	Engineering Mechanics Laboratory	--	2	--	--	1	--	1
ESL102	Basic Electrical Engineering Laboratory	--	2	--	--	1	--	1
ESL103	Programming Laboratory-I (C)	--	2*+2	--	--	2	--	2
SEC101	Basic Workshop Practice-I	--	2	--	--	1	--	1
VEC101	Universal Human Values	2	--	--	2	--	--	2
Total		**14**	**12**	**1**	**14**	**6**	**1**	**21**

*** Instructions should be conducted for the entire class.**

NOTE 1: Compulsory Non-Credit Activities: Participation and/or coordination of co-curricular and extra-curricular events at the Institute or Department level is mandatory for all students from semesters I to VIII as part of non-credit liberal education. Please consult the department's Curriculum Book for more information. These activities do not yield credits. Upon successful participation or organization of activities, a certificate will be awarded at the conclusion of semester VIII.

NOTE 2: Please note that during semesters I to VIII some of the non-technical courses such as Humanities Social Sciences and Management (HSS), Open Electives Course (OEC), Value Education Course (VEC), and Liberal Learning Course (LLC) may be conducted either online synchronously or asynchronously. For more information, please consult the curriculum book of department.

Examination Scheme – FY Semester-I

Course Code	Course Name	Examination Scheme					Total
		In-Semester Assessment$		End Sem Exam (ESE)	Exam Duration for Theory (in Hrs)		
		Continuous Assessment	Mid-Sem Exam		Mid-Sem	End-Sem	
BSC101	Engineering Mathematics-I	20+25@	30	50	1.5	2	125
BSC102	Engineering Physics-I	15	20	40	1.0	1.5	75
BSC103	Engineering Chemistry-I	15	20	40	1.0	1.5	75
ESC101	Engineering Mechanics	20	30	50	1.5	2	100
ESC102	Basic Electrical Engineering	15	20	40	1.0	1.5	75
BSL101	Engineering Physics-I Laboratory	25	--	--	--	--	25
BSL102	Engineering Chemistry-I Laboratory	25	--	--	--	--	25
ESL101	Engineering Mechanics Laboratory	25	--	--	--	--	25
ESL102	Basic Electrical Engineering Laboratory	25	--	25	--	--	50
ESL103	Programming Laboratory-I (C)	50	--	50	--	--	100
SEC101	Basic Workshop Practice-I	50	--	--	--	--	50
VEC101	Universal Human Values	50	--	--	--	--	50
	Total	**360**	**120**	**295**	--	--	**775**

$Please refer to the Curriculum Book of respective departments for guidelines on in-semester assessments for both theory and laboratory courses.

@For continuous assessment of tutorials.

Curriculum Structure – FY Semester-II

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		L	P	T	L	P	T	Total
BSC204	Engineering Mathematics-II	3	--	1	3	--	1	4
BSC205	Engineering Physics-II	2	--	--	2	--	--	2
BSC206	Engineering Chemistry-II	2	--	--	2	--	--	2
AEC201	Professional Communication and Ethics-I	2	2	--	2	1	--	3
ESC203	Basic Electronics Engineering	2	--	--	2	--	--	2
BSL203	Engineering Physics-II Laboratory	--	1	--	--	0.5	--	0.5
BSL204	Engineering Chemistry-II Laboratory	--	1	--	--	0.5	--	0.5
ESL204	Engineering Graphics Laboratory	--	2*+2	--	--	2	--	2
ESL205	Programming Laboratory-II (Java)	--	2*+2	--	--	2	--	2
ESL206	Basic Electronics Engineering Laboratory	--	2	--	--	1	--	1
SEC202	Basic Workshop Practice-II	--	2	--	--	1	--	1
IKS201	Indian Knowledge System	2	--	--	2	--	--	2
	Total	**13**	**16**	**1**	**13**	**8**	**1**	**22**

*** Instructions should be conducted for the entire class.**

Examination Scheme – FY Semester-II

Course Code	Course Name	Examination Scheme					Total
		In-Semester Assessment$		End Sem Exam (ESE)	Exam Duration for Theory (in Hrs)		
		Continuous Assessment	Mid-Sem Exam		Mid-Sem	End-Sem	
BSC204	Engineering Mathematics-II	20+25@	30	50	1.5	2	125
BSC205	Engineering Physics-II	15	20	40	1.0	1.5	75
BSC206	Engineering Chemistry-II	15	20	40	1.0	1.5	75
AEC201	Professional Communication and Ethics-I	50	--	--	--	--	50
ESC203	Basic Electronics Engineering	15	20	40	1.0	1.5	75
BSL203	Engineering Physics-II Laboratory	25	--	--	--	--	25
BSL204	Engineering Chemistry-II Laboratory	25	--	--	--	--	25
ESL204	Engineering Graphics Laboratory	50	--	50	--	--	100
ESL205	Programming Laboratory-II (Java)	50	--	50	--	--	100
ESL206	Basic Electronics Engineering Laboratory	25	--	25	--	--	50
SEC202	Basic Workshop Practice-II	50	--	--	--	--	50
IKS201	Indian Knowledge System	50	--	--	--	--	50
	Total	**415**	**90**	**295**	--	--	**800**

$Please refer to the Curriculum Book of respective departments for guidelines on in-semester assessments for both theory and laboratory courses.

@For continuous assessment of tutorials.

Curriculum Structure – SY Semester-III

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		L	P	T	L	P	T	Total
ITPCC301	Engineering Mathematics-III	3	--	1	3	--	1	4
ITPCC302	Computer Organization & Architecture	3	--	1	3	--	1	4
ITPCC303	Data Structure & Analysis	3	--	--	3	--	--	3
ITPCC304	Database Management System	3	--	--	3	--	--	3
XXMDM301	--	3	--	--	3	--	--	3
ITLBC301	Data Structure Laboratory	--	2	--	--	1	--	1
ITLBC302	SQL Laboratory	--	2	--	--	1	--	1
ITSBL301	Python Laboratory	--	4	--	--	2	--	2
ITMNP301	Mini Project-1A	--	3	--	--	1	--	1
HSS301	Product Design	2	--	--	2	--	--	2
	Total	**17**	**11**	**2**	**17**	**5**	**2**	**24**

NOTE:Four theory courses(Three 3-credit and one 4-credit) and one laboratory course (1-credit) offered by other department has to be taken by IT students, to complete 14-credit requirement for MDM.

Examination Scheme – SY Semester-III

Course Code	Course Name	Examination Scheme					Total
		In-Semester Assessment$		End Sem Exam (ESE)	Exam Duration for Theory (in Hrs)		
		Continuous Assessment	Mid-Sem Exam		Mid-Sem	End-Sem	
ITPCC301	Engineering Mathematics-III	20+25@	30	50	1.5	2	125
ITPCC302	Computer Organization & Architecture	20+25@	30	50	1.5	2	125
ITPCC303	Data Structure & Analysis	20	30	50	1.5	2	100
ITPCC304	Database Management System	20	30	50	1.5	2	100
XXMDM301	--	20	30	50	1.5	2	100
ITLBC301	Data Structure Laboratory	25	--	25	--	--	50
ITLBC302	SQL Laboratory	25	--	25	--	--	50
ITSBL301	Python Laboratory	50	--	50	--	--	100
ITMNP301	Mini Project-1A	50	--	--	--	--	50
HSS301	Product Design	50	--	--	--	--	50
	Total	**350**	**150**	**350**	--	--	**850**

$Please refer to the Curriculum Book of department for guidelines on in-semester assessments for both theory and laboratory courses.

@For continuous assessment of tutorials.

Curriculum Structure – SY Semester-IV

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		L	P	T	L	P	T	Total
ITPCC405	Engineering Mathematics-IV	3	--	1	3	--	1	4
ITPCC406	Computer Network	3		--	3	--	--	3
ITPCC407	Operating System	3	--	--	3	--	--	3
ITPCC408	Software Engineering	3	--	--	3	--	--	3
XXMDM402	--	3	--	--	3	--	--	3
ITLBC403	Networks Laboratory	--	2	--	--	1	--	1
ITLBC404	Linux Laboratory	--	2	--	--	1	--	1
ITLBC405	Software Development Laboratory	--	2	--	--	1	--	1
ITSBL402	Full stack Development Laboratory	--	4	--	--	2	--	2
ITMNP402	Mini Project-1B	--	3	--	--	1	--	1
VEC402	Environment and Sustainability	2	--	--	2	--	--	2
	Total	**17**	**13**	**1**	**17**	**6**	**1**	**24**

Examination Scheme – SY Semester-IV

Course Code	Course Name	Examination Scheme					Total
		In-Semester Assessment$		End Sem Exam (ESE)	Exam Duration for Theory (in Hrs)		
		Continuous Assessment	Mid-Sem Exam		Mid-Sem	End-Sem	
ITPCC405	Engineering Mathematics-IV	20+25@	30	50	1.5	2	125
ITPCC406	Computer Network	20	30	50	1.5	2	100
ITPCC407	Operating System	20	30	50	1.5	2	100
ITPCC408	Software Engineering	20	30	50	1.5	2	100
XXMDM402	--	20	30	50	1.5	2	100
ITLBC403	Networks Laboratory	25	--	25	--	--	50
ITLBC404	Linux Laboratory	25	--	25	--	--	50
ITLBC405	Software Development Laboratory	25	--	25	--	--	50
ITSBL402	Full stack Development Laboratory	50	--	50	--	--	100
ITMNP402	Mini Project-1B	50	--	50	--	--	100
VEC402	Environment and Sustainability	50	--	--	--	--	50
	Total	**350**	**150**	**425**	--	--	**925**

$Please refer to the Curriculum Book of department for guidelines on in-semester assessments for both theory and laboratory courses.

@For continuous assessment of tutorials.

Curriculum Structure – TY Semester-V

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		L	P	T	L	P	T	Total
ITPCC509	Automata Theory	3	--	--	3	--	--	3
ITPCC510	Artificial Intelligence	3	--	--	3	--	--	3
XXMDM503	--	3	--	--	3	--	--	3
ITPEC501Y	Program Elective Course-I	3	--	--	3	--	--	3
ITLBC506	Cloud Computing Laboratory	--	2	--	--	1	--	1
ITLBC507	Mobile Application Development Laboratory	--	2	--	--	1	--	1
XXMDL501	--	--	2	--	--	1	--	1
AEC502	Professional Communication and Ethics-II	1	2	--	1	1	--	2
ITMNP503	Mini Project-2A	--	3	--	--	1	--	1
HSS502	Entrepreneurship	2	--	--	2	--	--	2
	Total	**15**	**11**	**--**	**15**	**5**	**--**	**20**

NOTE: Students who choose not to pursue Honours or Minor are welcome to register for the initial two courses of the fifth and sixth semesters' Honours or Minor track in 'Audit' mode (AU). This allows them to explore the course material without the expectation of earning a letter grade. Upon fulfilling the requirements in 'Audit' mode, their participation will be acknowledged on the grade sheet. Audit courses are excluded from grade point averages and have no impact on SGPI/CGPI calculations. For more information on Honours and Minor track courses, please refer to the Institute Handbook for Honours/Minor/Honours in Research degree programs.

Program Elective Course-I:

Students should take one PE from the following list of Program Elective Course- I.

Course Code	Program Elective Course-I
ITPEC5011	Analysis of Algorithms
ITPEC5012	Cloud Computing Services
ITPEC5013	Data ware Housing & Mining

Examination Scheme – TY Semester-V

Course Code	Course Name	Examination Scheme					Total
		In-Semester Assessment$		End Sem Exam (ESE)	Exam Duration for Theory (in Hrs)		
		Continuous Assessment	Mid-Sem Exam		Mid-Sem	End-Sem	
ITPCC509	Automata Theory	20	30	50	1.5	2	100
ITPCC510	Artificial Intelligence	20	30	50	1.5	2	100
XXMDM503	--	20	30	50	1.5	2	100
ITPEC501Y	Program Elective Course-I	20	30	50	1.5	2	100
ITLBC506	Cloud Computing Laboratory	25	--	25	--	--	50
ITLBC507	Mobile Application Development Laboratory	25	--	25	--	--	50
XXMDL501	--	25	--	25	--	--	50
AEC502	Professional Communication and Ethics-II	50	--	--	--	--	50
ITMNP503	Mini Project-2A	50	--	--	--	--	50
HSS502	Entrepreneurship	50	--	--	--	--	50
	Total	**305**	**120**	**275**	--	--	**700**

$Please refer to the Curriculum Book of department for guidelines on in-semester assessments for both theory and laboratory courses.

Curriculum Structure – TY Semester-VI

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		L	P	T	L	P	T	Total
ITPCC611	Cryptography & Network Security	3		--	3	--	--	3
XXMDM604	--	4		--	4	--	--	4
ITPEC602Y	Program Elective Course-II	3	--	--	3	--	--	3
ITLBC608	Cryptography & Network Security Laboratory	--	2	--	--	1	--	1
ITLBC609	Data Science Laboratory	--	2	--	--	1	--	1
ITSBL603	Devops Laboratory	--	4	--	--	2	--	2
ITMNP604	Mini Project-2B	--	3	--	--	1	--	1
ELC601	Research Methodology	2	--	--	2	--	--	2
LLC601Y*	Liberal Learning Course	2	--	--	2	--	--	2
	Total	**14**	**11**	**--**	**14**	**5**	**--**	**19**

NOTE: Students who choose not to pursue Honours or Minor are welcome to register for the initial two courses of the fifth and sixth semesters' Honours or Minor track in 'Audit' mode (AU). This allows them to explore the course material without the expectation of earning a letter grade. Upon fulfilling the requirements in 'Audit' mode, their participation will be acknowledged on the grade sheet. Audit courses are excluded from grade point averages and have no impact on SGPI/CGPI calculations. For more information on Honours and Minor track courses, please refer to the Institute Handbook for Honours/Minor/Honours in Research degree prorams.

***Liberal Learning Course:**

Every student should take Liberal Learning Course for Semester VI. Students can take this course from the following list of Liberal Learning Courses.

Liberal Learning Courses	
Course Code	**Course Name**
LLC6011	Art of Living
LLC6012	Yoga and Meditation
LLC6013	Health and Wellness
LLC6014	Diet and Nutrition
LLC6015	Personality Development

Program Elective Course-II:

Students should take one PE from the following list of Program Elective Course- II.

Course Code	**Program Elective Course-II**
ITPEC6021	Infrastructure Management
ITPEC6022	Machine Learning**
ITPEC6023	Wireless Technology

** Students who opted the Honours/Minors vertical as Artificial Intelligence & Machine Learning should not opt Machine Learning as Program Elective-II.

Examination Scheme – TY Semester-VI

Course Code	Course Name	Examination Scheme					Total
		In-Semester Assessment$		End Sem. Exam (ESE)	Exam Duration for Theory (in Hrs)		
		Continuous Assessment	Mid-Sem Exam		Mid-Sem	End-Sem	
ITPCC611	Cryptography & Network Security	20	30	50	1.5	2	100
XXMDM604	--	20	30	50	1.5	2	100
ITPEC602Y	Program Elective Course-II	20	30	50	1.5	2	100
ITLBC608	Cryptography & Network Security Laboratory	25	--	25	--	--	50
ITLBC609	Data Science Laboratory	25	--	25	--	--	50
ITSBL603	Devops Laboratory	50	--	50	--	--	100
ITMNP604	Mini Project-2B	50	--	50	--	--	100
ELC601	Research Methodology	50	--	--	--	--	50
LLC601	Liberal Learning Course	50	--	--	--	--	50
	Total	**310**	**90**	**300**	--	--	**700**

$Please refer to the Curriculum Book of department for guidelines on in-semester assessments for both theory and laboratory courses.

Curriculum Structure – B. Tech Semester-VII

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		L	P	T	L	P	T	Total
ITPCC712	Edge Computing	3	--	--	3	--	--	3
ITPEC703Y	Program Elective Course-III	3	--	--	3	--	--	3
ITPEC704Y	Program Elective Course-IV	3	--	--	3	--	--	3
OEC701Y	Open Elective Course –I	3	--	--	3	--	--	3
ITLBC710	Edge Computing Laboratory	--	2	--	--	1	--	1
ITLBC711	High Performance Computing Laboratory	--	2	--	--	1	--	1
ITMJP701	Major Project-A	--	6	--	--	2	--	2
HSS703	Financial Planning	2	--	--	2	--	--	2
Total		**14**	**10**	**--**	**14**	**4**	**--**	**18**

Program Elective Course-III and IV:
Every student is required to take two Program Elective Course for Semester VII. Students can take this course from the following list of Program Elective Course-III and IV.

Course Code	Program Elective Course-III
ITPEC7031	Quantum Computing
ITPEC7032	Human Computer Interaction
ITPEC7033	Ethical Hacking & Digital Forensic

Course Code	Program Elective Course-IV
ITPEC7041	Big Data Analytics
ITPEC7042	Augmented Reality/Virtual Reality
ITPEC7043	Information Retrieval System

Open Elective Course-I:
Every student is required to take one Open Elective Course-I for Semester VII. Students can take this course from the following list of Open Elective Course-I.

Course Code	Open Elective Course-I
OEC7011	Product Lifecycle Management
OEC7012	Reliability Engineering
OEC7013	Management Information System
OEC7014	Design of Experiments
OEC7015	Operation Research
OEC7016 @@	Cyber Security and Laws
OEC7017	Disaster Management and Mitigation Measures
OEC7018	Energy Audit and Management
OEC7019	Development Engineering

@@Students opting for Honours/Minor degree in Cybersecurity or relevant domain need to select other Open Elective.

Examination Scheme – B. Tech Semester-VII

Course Code	Course Name	Examination Scheme					Total
		In-Semester Assessment$		End Sem Exam (ESE)	Exam Duration for Theory (in Hrs)		
		Continuous Assessment	Mid-Sem Exam		Mid-Sem	End-Sem	
ITPCC712	Edge Computing	20	30	50	1.5	2	100
ITPEC703Y	Program Elective Course-III	20	30	50	1.5	2	100
ITPEC704Y	Program Elective Course-IV	20	30	50	1.5	2	100
OEC701Y	Open Elective Course –I	20	30	50	1.5	2	100
ITLBC710	Edge Computing Laboratory	25	--	25	--	--	50
ITLBC711	High Performance Computing Laboratory	25	--	25	--	--	50
ITMJP701	Major Project-A	50	--	--	--	--	50
HSS703	Financial Planning	50	--	--	--	--	50
	Total	**230**	**120**	**250**	--	--	**600**

$Please refer to the Curriculum Book of department for guidelines on in-semester assessments for both theory and laboratory courses.

Curriculum Structure – B. Tech Semester-VIII

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		L	P	T	L	P	T	Total
ITPEC805Y	Program Elective Course-V	3	--	--	3	--	--	3
OEC802Y	Open Elective Course-II	3	--	--	3	--	--	3
ITMJP802	Major Project-B	--	12	--	--	4	--	4
INT801	Internship~	--	--	--	--	8	--	8
Total		**6**	**12**	**--**	**6**	**12**	**--**	**18**
~ Students have the opportunity to engage in a three-month internship within industry, research organizations, foreign universities, or internal internship for research and product development during the 8th semester, provided they meet the semester requirements and receive approval from the institute.								

Program Elective Course-V:

Every student is required to take Program Elective Course for Semester VIII. Students can choose program Elective Course-V, from one of domains listed below. The list of courses within the individual domains will be made available before the course registration.

Course Code	Program Elective Course-V
ITPEC8051	Block Chain Technology
ITPEC8052	Network and Security
ITPEC8053	Computational Intelligence
ITPEC8054	Internet of Things

Open Elective Course-II:

Every student is required to take one Open Elective Course-II for Semester VIII. Students can take this course from the following list of Open Elective Course-II.

Course Code	Open Elective Course-II
OEC8021	Project Management
OEC8022	Finance Management
OEC8023	Entrepreneurship Development and Management
OEC8024	Human Resource Management
OEC8025	Professional Ethics and CSR
OEC8026	Circular Economy
OEC8027	IPR and Patenting
OEC8028	Digital Business Management
OEC8029	Environmental Management

Examination Scheme – B. Tech Semester-VIII

Course Code	Course Name	Examination Scheme					
		In-Semester Assessment$		End Sem Exam (ESE)	Exam Duration for Theory (in Hrs)		Total
		Continuous Assessment	Mid-Sem Exam		Mid-Sem	End-Sem	
ITPEC805Y	Program Elective Course-V	20	30	50	1.5	2	100
OEC802Y	Open Elective Course-II	20	30	50	1.5	2	100
ITMJP802	Major Project-B	50	--	50	--	--	100
INT801	Internship	50	--	50	--	--	100
Total		**140**	**60**	**200**	--	--	**400**

$Please refer to the Curriculum Book of department for guidelines on in-semester assessments for theory, laboratory, and internship courses.

NOTE: Please note that due to the internship requirement in the VIII semester, theory courses during this semester will be conducted either online synchronously or asynchronously. For more information, please consult the curriculum book of your department.

D. Multidisciplinary Minor Courses Offered by the Department of Information Technology for the Other Program Students

Curriculum Structure for MDM Courses

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		L	P	T	L	P	T	Total
ITMDM301	Data Structures and Algorithms	3	--	--	3	--	--	3
ITMDM402	Database Management System	3	--	--	3	--	--	3
ITMDM503	Cloud Computing	3	--	--	3	--	--	3
ITMDL501	Machine Learning Laboratory	--	2	--	--	1	--	1
ITMDM604	Soft Computing	4	--	--	4	--	--	4
	Total	**13**	**2**	**--**	**13**	**1**	**--**	**14**

Examination Scheme for MDM Courses

Course Code	Course Name	Examination Scheme					
		In-Semester Assessment$		End Sem Exam (ESE)	Exam Duration for Theory (in Hrs)		Total
		Continuous Assessment	Mid-Sem Exam		Mid-Sem	End-Sem	
ITMDM301	Data Structures and Algorithms	20	30	50	1.5	2	100
ITMDM402	Database Management System	20	30	50	1.5	2	100
ITMDM503	Cloud Computing	20	30	50	1.5	2	100
ITMDL501	Machine Learning Laboratory	25	--	25	--	--	50
ITMDM604	Soft Computing	20	30	50	1.5	2	100
	Total	**105**	**120**	**225**	--	--	**450**

E. Honours, Minor, and Honours in Reseach Degree Program

The Honours, Minor, and Honours in Research degree programs aim to empower students by offering specialized courses/research internships or projects in emerging fields of their interest, thus enhancing their proficiency in those areas. Students who achieve a CGPI of 7.5 or higher by the end of the fourth semester are eligible to pursue an additional 18 credits from the fifth to eighth semesters to qualify for a B. Tech degree with Honours, Minor, or Honours in Research designation. Students need to refer to the Institute level Handbook for Honours/Minor/Honours in Research Degree Programs for further details.

Course Type	Course Code	Course Name	Credits
BSC	BSC101	ENGINEERING MATHEMATICS-I	03+01*

Examination Scheme					
Distribution of Marks			Exam Duration (Hrs.)		Total Marks
In-semester Assessment		End Semester Examination (ESE)			
Continuous Assessment	Mid-Semester Exam (MSE)		MSE	ESE	
20 + 25*	30	50	1.5	2	125

*For Tutorial

Pre-requisite:

1. Differentiation of function of a single variable.
2. Types of matrices and their basic operations.
3. Vector Algebra.

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem analysis

Course Objectives:

1. To provide the basic knowledge of the concepts of Mathematics applicable to the field of engineering.
2. To build a mathematical foundation of the methodology required for solving application based problems in the field of engineering.

Module	Details	Hrs.
00.	**Course Introduction** Mathematics is the fundamental step which creates a solid foundation for all Applied fields of Engineering. Professional Engineering applications have Mathematics as an integral part of their evolution. For example: Formulation in Mathematics to various engineering field using case study. Application of matrices in control systems, wireless signals and computer graphics, Introduction to function of several variables to apply in Marginal rate of technical substitution, Elasticity of substitution, Use the concept of vector differentiation into Fluid Mechanics. Hence, Formulation Based Mathematics is a fundamental requisite to all fields of Engineering for analyzing their performances.	01
01.	**Matrices - I** ***Learning Objective:*** *Learner will be able to* • *Analyze and interpret the basic fundamentals of matrices.* • *Determine the rank of a matrix by applying the concepts of elementary transformation of a matrix.*	7-9

	Contents: Type of Matrices and Properties, Symmetric, Skew-Symmetric, Orthogonal Matrices, Complex Matrix, Hermitian, skew-Hermitian, Unitary Matrices, Rank of a Matrix, Elementary transformation, Normal Form, Echelon Form.	
	Self-Learning Topics:	
	Learning Outcomes: *A learner will be able to* *LO 1.1: Identify the correct procedure to express a square matrix as the sum of a Symmetric and Skew-Symmetric Matrix. (PI:2.1.1 & 2.2.3)* *LO 1.2: Identify the correct procedure to express a square matrix as the sum of a Hermitian and Skew-Hermitian Matrix. (PI:2.1.1 & 2.2.3)* *LO 1.3: Use elementary transformations to determine the rank of a matrix by finding its normal form. (PI:1.1.1 & 1.2.1)*	
02.	**Matrices - II** ***Learning Objective:*** *Learner will be able to* • *Analyze the differences between homogeneous and non-homogeneous simultaneous equations* • *Apply these concepts to find their solutions, if they exist.*	**5-7**
	Contents: Solution of system of Linear Equations, Condition for consistency of Non-Homogeneous Equations, Condition for consistency of Homogeneous Equations, Row Vector and Column Vector, Linearly dependence and Independence of vectors, Linear Combination of Vectors	
	Self-Learning Topics: ***Coding Theory***	
	Learning Outcomes: *A learner will be able to* *LO.2.1: Identify homogeneous and non-homogeneous simultaneous equations, express them into matrix form and use appropriate method to solve them. (PI-2.1.1 & 2.2.3)* *LO.2.2: Interpret & use the concept of rank to determine whether a given vector is linearly dependent or linearly independent (PI-1.1.1 & 1.2.1)*	
03.	**Matrices - III** ***Learning Objective:*** *Learner will be able to* • *Analyze the differences between homogeneous and non-homogeneous simultaneous equations* • *Apply these concepts to find their solutions, if they exist.*	**6-8**
	Contents: Introduction to Eigen Values, Characteristic equation, Characteristic roots & Eigen vectors. Finding Eigen values and Eigen vectors for different types of Matrices: Non Symmetric Matrices with non-repeated Eigen Values, Non Symmetric Matrices with Repeated Eigen Values, Symmetric Matrices with non-repeated Eigen Values, Symmetric Matrices with Repeated Eigen Values	

	Cayley-Hamilton Theorem (Without proof), Statement and verification, Function of square matrix as an application.	
	Self-Learning Topics: *Singular value Decomposition*	
	Learning Outcomes: *A learner will be able to* *LO 3.1: Apply fundamentals of determinant to find Eigen Values and Eigen Vectors. (PI-1.1.1 & 1.2.1)* *LO 3.2: Analyze, identify and use Cramer's Rule/homogeneous equation to determine Eigen vectors for corresponding Eigen values. (PI-2.1.3 & 2.2.4)*	
04.	**Differential Calculus of Several Variables-I** ***Learning Objectives:*** *Analyse the fundamentals of Differentiations of functions of two or more independent variables and apply this concept in function of functions, composite functions and implicit functions.*	**7-9**
	Contents: Introduction to Partial Differentiation, Geometrical meaning of $\frac{\partial u}{\partial x}$ & $\frac{\partial u}{\partial y}$ Partial derivatives of first and higher order, Differentiation of function of function, Differentiation of composite function.	
	Self-Learning Topics: *Jacobian of two and Three variable*	
	Learning Outcomes: *A learner will be able to* *LO 4.1: Identify the basic concepts of partial differentiation (PD) with the prerequisite of differentiation of function of a single variable and apply suitable procedure to partially differentiate a function of several variables. (PI-2.2.3 & 2.1.3)* *LO 4.2: Apply the suitable method to solve a particular problem from the set of different types of learned functions. (PI-1.1.1 & 1.2.1)*	
05.	**Differential Calculus of Several Variables-II** ***Learning Objective/s:*** • *Apply the concept of PD to solve problems by using Euler 's Theorem on Homogeneous functions with two independent variables.* • *Analyse the learned concept of PD and apply it to find maxima and minima of functions of two variables*	**5-7**
	Contents: Homogeneous functions, Euler's Theorem on Homogeneous functions with two Independent variables(With Proof) , Deductions from Euler's Theorem, Maxima and Minima of a function of two independent variables.	
	Self-Learning Topics: *Euler's Theorem on Homogeneous functions with three Independent variables*	
	Learning Outcomes : *A learner will be able to* *LO 5.1: Apply Euler's Theorem to solve problems based on homogeneous function of two variables. (PI-1.1.1 & 1.2.1)*	

	LO 5.2: Identify the conditions for maxima and minima of functions of two variables and determine it. (PI-2.1.3 & 2.2.3)	
06.	**Vector Differentiation** ***Learning Objective/s:*** *Analyze the fundamentals of Gradient of scalar point function, Divergence & Curl of a vector point function and apply it to verify whether the field is irrotational or solenoidal.*	**7-9**
	Contents: Scalar and Vector point function, Differentiation of vector, Level surface, Gradient of scalar point function and its properties, Vector differential operator, geometrical meaning of $\nabla\emptyset$, directional derivative Divergence of a vector point function, Curl of a vector point function.	
	Self-Learning Topics: *Tangent and normal to the surface,angle between two surfaces at a common point*	
	Learning Outcomes: *A learner will be able to* *LO 6.1*: *Apply fundamentals of vector algebra and differentiation of several variables to evaluate Gradient, Divergence & Curl. (PI-1.1.1 & 1.2.1)* *LO 6.2: Identify whether the given vector field is irrational or solenoidal and solve the problem by identifying the appropriate procedure. (PI-2.1.3 & 2.2.3).*	
	Course Conclusion	**01**
	Total	**45**

Performance Indicators:

P.I. No.	**P.I. Statement**
1.1.1	Apply mathematical techniques as calculus/algebra to solve problems.
1.2.1	Apply laws of natural science to an engineering problem.
2.1.1	Articulate problem statements and identify objectives.
2.1.3	Identify the mathematical knowledge that applies to a given problem.
2.2.3	Identify existing processes/solution methods for solving the Problems.
2.2.4	Compare and contrast alternative solution processes to select the best process.

Course Outcomes: A learner will be able to -

1. Apply the concept of rank of a matrix to find the solution of homogeneous and non-homogeneous system of equations by analyzing their consistency. (*LO 1.1, LO 1.2, LO 1.3, LO 2.1, LO 2.2*)
2. Analyse the characteristic equation to determine the Eigen value, Eigen vector, also function of a matrix by applying Cayley-Hamilton theorem. (*LO 3.1, LO 3.2*)
3. Implement the fundamentals of partial differentiation to evaluate the maxima and minima of functions of several variables. (*LO 4.1, LO 4.2, LO 5.1, LO 5.2*)
4. Apply the concepts of Gradient, Divergence, and Curl in order to analyse and state the two types of fields, Irrotational and Solenoidal(*LO 6.1, LO 6.2*)

CO-PO Mapping Table with Correlation Level

CO ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
BSC101.1	3	3	-	-	-	-	-	-	-	-	-
BSC101.2	3	3	-	-	-	-	-	-	-	-	-
BSC101.3	3	3	-	-	-	-	-	-	-	-	-
BSC101.4	3	3	-	-	-	-	-	-	-	-	-
Average	**3**	**3**	-	-	-	-	-	-	-	-	-

Text Books :

1. Higher Engineering Mathematics, Dr. B. S. Grewal, Khanna Publication, forty fourth Edition, 2021
2. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Eastern Limited, Tenth Edition, 2011.

Reference Books :

1. Engineering Mathematics by Srimanta Pal and Subodh, C. Bhunia, Oxford University Press, First Edition, 2015
2. Engineering Mathematics by P. Sivaramakrishna Das and C. Vijayakumari, Pearson, First Edition, 2017

A. IN-SEMESTER ASSESSMENT (75 MARKS)

1. Continuous Assessment - Theory-(20 Marks)

1. Numerical Assignments (Minimum 20 problems): 5 marks
2. Class test based on above Numerical assignment: 5 marks
3. Team – Pair - Solo: 5 marks
4. Regularity and active participation: 5 marks

2. Continuous Assessment – Tutorial -(25 Marks)

1. Tutorials: 20 Marks
   Students must be encouraged to write at least 6 class tutorials. Each tutorial carries 20 Marks. Average will be taken of all six tutorials out of 20 marks.
2. Regularity and active participation: 5 marks

3. Mid Semester Exam (30 Marks)

Mid semester examination will be based on 40% to 50% syllabus.

B.END SEMESTER EXAMINATION (50 MARKS)

End Semester Examination will be based on syllabus coverage up to the Mid Semester Examination (MSE) carrying 20%-30% weightage, and the syllabus covered from MSE to ESE carrying 70%-80% weightage.

Course Type	Course Code	Course Name	Credits
BSC	BSC102	ENGINEERING PHYSICS-I	02

Examination Scheme					
Distribution of Marks			Exam Duration (Hrs.)		Total Marks
In-semester Assessment		End Semester Examination (ESE)			
Continuous Assessment	Mid-Semester Exam (MSE)		MSE	ESE	
15	20	40	1	1.5	75

Pre-requisite:

NIL

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO6: The Engineer and The World

Course Objectives:

1. To provide the Basic knowledge on the concepts of physics pertaining to the field of engineering.
2. To build a foundation to the methodology necessary for solving problems by applying the knowledge of physics in the field of engineering

Module	Details	Hrs.
00.	**Course Introduction** Importance of physics in various engineering field: Application of thin film Interference and diffraction in measurement techniques: Introduction to laser and fibre optics its utilization in optoelectronics field: Use of semiconductor devices and superconductors in technology.	01
01.	**Interference in Thin Film and Diffraction** ***Learning Objective:*** *•To apply the basic concept of interference and diffraction phenomena in various measurements* *•To identify the principles of interference and diffraction to solve practical problems.*	6-8
	Contents: Interference: Interference by division of amplitude; Interference in thin film of constant thickness: Application in Anti-reflecting films. Wedge shaped film: Newton's rings - Diameters of dark Newton's rings; Applications in determination of refractive index of liquid. Diffraction: Diffraction Grating, Diffraction due to grating; Resolving power of a grating; Applications of diffraction grating; Determination of wavelength of light using plane transmission grating.	

	Self-Learning Topics: *Origin of colours in thin film, Diameters of Bright Newton's rings, Determination of wavelength of incident light using Newton's rings experiment.*	
	Learning Outcomes: *A learner will be able to* *LO 1.1: diagrammatically represent the mechanism of thin film interference and diffraction and write the parameters required for their application. (P.I.- 1.2.1)* *LO 1.2: interpret the interference and diffraction phenomena in real life examples. (P.I.- 1.2.1)* *LO 1.3: solve problems using the concepts of thin film interference and diffraction. (P.I.- 1.2.2)* *LO 1.4: identify the parameters which defines the quality of a grating. (P.I.- 2.1.2)* *LO 1.5: derive the expressions for various parameters and conditions of maxima and minima of intensity of a problem using the concepts of interference and diffraction. (P.I.- 2.1.3)*	
02.	**Laser** ***Learning Objective:*** • *To apply knowledge of absorption and emission in production of laser.* • *To identify the use of lasers in technical fields and associate the impact of laser applications in environment and societal context.*	**3-5**
	Contents: Laser: Stimulated emission and multiplication process; Population inversion; Pumping; Metastable state: Resonant cavity; Helium Neon laser: Principle, construction and working; Nd:YAG laser: Principle, construction and working; Applications of LASER.	
	Self-Learning Topics: *Spontaneous emission, Methods of Pumping, Advantages, disadvantages and limitations of He-Ne and Nd:YAG laser.*	
	Learning Outcomes: *A learner will be able to* *LO 2.1: state various parameters and phenomena related to lasers and their importance in LASER production. (P.I.-1.2.1)* *LO 2.2: identify different types of lasers in terms of principle, construction and working (P.I.-2.2.3)* *LO 2.3: identify the industrial and medical applications of laser. (P.I.-6.1.1)* *LO 2.4: state the disadvantages and limitations of using lasers in public. (P.I.-6.1.2)*	
03.	**Fiber Optics** ***Learning Objective:*** *•To apply knowledge of optical phenomena in propagation of light through optical fibre.* *•To analyze the role of optical fibre in fibre optics communication.* *•To associate the use of fibre optics communication in societal issues and identify the principle of fibre optics to solve engineering problem.*	**3-5**
	Contents: Optical Fibre; Numerical aperture; Angle of acceptance; V-number; Types of optical fibres; Numerical aperture for step index fibre; Fibre optic communication system.	

	Self-Learning Topics: *Critical angle, Fractional index change, Modes of propagation.*	
	Learning Outcomes: *A learner will be able to* *LO 3.1: state various parameters related to the optical fibre and its application in fibre optics. (P.I.-1.2.1)* *LO 3.2: solve problems on optical fibre using the concepts and basic formulae. (P.I.- 1.2.2)* *LO 3.3: identify different types of optical fibre in terms of its relevant parameters. (P.I.-2.1.2)* *LO 3.4: derive the expressions for various parameters relevant to fibre optics. (P.I.-2.1.3)* *LO 3.5: apply the concept of optical fibre in fibre optic communication system. (P.I.- 6.1.1)*	
04.	**Semiconductor Physics** ***Learning Objectives:*** *•To apply the fundamental knowledge of band gap in semiconductors* *•To evaluate the concept of fermi level in semiconductor for solving problems.*	**4-6**
	Contents: Energy bands in semiconductor; Direct & indirect band gap semiconductor; Determination of energy band gap in semiconductor. Fermi level; Fermi Dirac distribution, Fermi level in intrinsic semiconductors, Fermi level in extrinsic semiconductors: Effect of temperature and impurity concentration on fermi level in extrinsic semiconductors, Significance of Fermi level.	
	Self-Learning Topics: *Effect of temperature on fermi level in P-type semiconductor, Effect of impurity concentration on fermi level in N-type semiconductors, p-n junction diode.*	
	Learning Outcomes: *A learner will be able to* *LO 4.1: state various parameters which defines a semiconductor and its applications of devices. (P.I.-1.2.1)* *LO 4.2: solve the problems involving fermi level. (P.I.-1.2.2)* *LO 4.3: identify the types of semiconductors based on band gap and Interpret the applications of semiconductors based on its band gap property. (P.I.-2.1.2)* *LO 4.4: sketch the effect of temperature and impurities on fermi level of semiconductor. (P.I.-2.1.3)*	
	Contents: Semiconductor Devices: Hall sensor: Principle, construction, working and application; Semiconductor laser: Principle, construction, working and application; Solar cell: Principle, construction, working and application. Importance of semiconductor devices in terms of sustainability.	
	Self-Learning Topics: *Light Emitting Diode (LED), Photodiode.*	
	Learning Outcomes :	
	A learner will be able to	

	LO 5.1: state the principles of various semiconductor devices and their applications. (P.I.-1.2.1) *LO 5.2: use the semiconductor devices for various measurements. (P.I.-2.1.3)* *LO 5.3: analyse Semiconductor devices in terms of their principle, construction, working. (P.I.-2.2.3)*	
06.	**Superconductors** ***Learning Objective/s:*** *•To summarize the properties of superconductors.* *•To evaluate practical problems using the principles of superconductors.* *•To apply the concept of superconductors in MAGLEV train.*	**3-5**
	Contents: Superconductivity, critical temperature, critical magnetic field, Meissner effect; Type I and Type II superconductors; Applications of superconductor in MAGLEV.	
	Self-Learning Topics: *High temperature superconductor and its importance.*	
	Learning Outcomes: *A learner will be able to* *LO 6.1: recall different parameters, phenomena related to superconductor and its importance in superconductor and MAGLEV. (P.I.-1.2.1)* *LO 6.2: solve problems on superconductor using the concepts and basic formulae. (P.I.-1.2.2)* *LO 6.3: identify the type of superconductors in terms of various parameters. (P.I.-2.1.2)*	
	Course Conclusion	**01**
	Total	**30**

Performance Indicators:

P.I. No.	**P.I. Statement**
1.2.1	Apply laws of physics to an engineering problem.
1.2.2	Apply the formulae derived from the concept to solve engineering problem.
2.1.2	Identify engineering systems, variables, and parameters to solve the problems
2.1.3	Identify the mathematical, engineering and other relevant knowledge that applies to a given problem
2.2.3	Identify existing processes/solution methods for solving the problem, including forming justified approximations and assumptions.
6.1.1	Identify and describe various role of science particularly as pertains to protection of the public and public interest at global, regional and local level.
6.1.2	Identify and explain the limitations in the usage of devices for public.

Course Outcomes:
A learner will be able to -

1. Apply the fundamental knowledge of optical phenomena to analyse the relevant basic engineering problems and draw the conclusions. (*LO 1.1, LO 1.2, LO 1.3, LO 1.4, LO 1.5*)
2. apply to use the fundamental knowledge of semiconductor physics to identify the various parameters to solve the problem. (*LO 4.1, LO 4.2, LO 4.3, LO 4.4*)
3. apply the knowledge of Laser, fiber optics for health and safety issues by analyzing their properties and parameters. (*LO 2.1, LO2.1, LO 2.3, LO 2.4, LO 3.1, LO 3.2, LO 3.3, LO 3.4, LO 3.5*)
4. identify the role and impact of the semiconductor devices and superconductors by knowing their applications. (*LO 5.1, LO5.2, LO 5.3, LO 6.1, LO 6.2, LO 6.3*)

CO-PO Mapping Table with Correlation Level

CO ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
BSC102.1	3	3	-	-	-	-	-	-	-	-	-
BSC102.2	3	3	-	-	-	-	-	-	-	-	-
BSC102.3	3	-	-	-	-	3	-	-	-	-	-
BSC102.4	3	3	-	-	-	-	-	-	-	-	-
Average	**3**	**3**	**-**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**

Text Books :

1. A Textbook of Engineering physics, Dr. M. N. Avadhanulu and Dr. P. G. Kshirsagar Revised Edition, 2014, S. Chand Publishing.
2. Engineering physics, R. K. Gaur and S. L. Gupta, Revised Edition, 2012, Dhanpat Rai Publications.

Reference Books :

1. Fundamentals of Physics, Halliday /Resnick/Walker, Twelve Edition, 2021, Wiley
2. Optics, Ajoy Ghatak, Seventh Edition, 2020, Tata McGraw Hill
3. Introduction to solid state physics, Charles Kittel, Eighth Edition, 2005, Wiley
4. A textbook of Optics - N. Subramanyam, Brijlal and Avadhanulu, 23rd Edition, 2006, S.Chand Publishing.

Other Resources :

1. Online physics library, California State University:-Web link- https://phys.libretexts.org/

2. Physics website, The State University of New Jersey :-Web link- www.physics.rutgers.edu

3. NPTEL Course: Fundamentals of semiconductor devices, by Prof. Digbijoy N. Nath, IISc Bangal https://nptel.ac.in/courses/108108122

A. IN-SEMESTER ASSESSMENT (35 MARKS)

1. Continuous Assessment - Theory-(15 Marks)

1. MCQ test: 4 marks
2. Class test: 4 marks
3. Open book test/Open notes test: 4 marks
4. Regularity and active participation: 3 marks

2. Mid Semester Exam (20 Marks)

Mid semester examination will be based on 40% to 50% syllabus.

B. END SEMESTER EXAMINATION (40 MARKS)

End Semester Examination will be based on syllabus coverage up to the Mid Semester Examination (MSE) carrying 20%-30% weightage, and the syllabus covered from MSE to ESE carrying 70%-80% weightage.

Course Type	Course Code	Course Name	Credits
BSC	BSC103	ENGINEERING CHEMISTRY- I	02

Examination Scheme					
Distribution of Marks			Exam Duration (Hrs.)		Total Marks
In-semester Assessment		End Semester Examination (ESE)			
Continuous Assessment	Mid-Semester Exam (MSE)		MSE	ESE	
15	20	40	1	1.5	75

Pre-requisite:

1. Nil

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO6 -The engineer and the world

Course Objectives:

1. To enable the students to apply the laws of chemistry to an engineering problem.
2. To enable the students to appreciate material properties and their engineering applications.
3. To enable the students to analyze and select the most appropriate engineering material
4. To acknowledge the current developments in the field of nanotechnology, energy storage systems and green chemistry for sustainable development.

Module	Details	Hrs.
00.	**Course Introduction** Engineering chemistry provides the fundamental understanding of materials, substances and processes that engineers need to design, develop and manufacture products and systems.	01
01.	**Green Chemistry** ***Learning Objective:*** *To state the principles of green chemistry and apply them in the synthesis of various industrially important chemical substances and drugs in order to exhibit the social and environmental impact of chemical industry practices for the sustainable design and development.*	4-6
	Contents: Introduction, 12 principles of green chemistry with examples as Conventional and green synthesis of carbaryl and ibuprofen, adipic acid and Indigo with special emphasis on bioenzymes. Numericals on atom economy. Carbon Sequestering and Carbon Credit. Green solvents:- water as green solvent, supercritical solvents and DMC.	

	Self-Learning Topics: ***Latest research areas in the field of green chemistry.***	
	Learning Outcomes: *A learner will be able to* *LO1.1 : State the principles green chemistry. (1.3.1)* *LO 1.2: Identify the hazards involved in the conventional industrial chemical reactions in order to protect health and environment. (6.1.1)* *LO 1.3: Synthesize drugs, chemical pesticides and industrial precursors using green chemistry principles as standard guidelines. (2.2.3) (6.2.1)* *LO 1.4: Analyze Bhopal gas tragedy reaction (2.1.3)* *LO 1.5: Apply the concept of green solvents in chemical industries for the sustainable development, (6.1.2)* *LO 1.6: Use the concept of Carbon Sequestering and Carbon Credit to assess public health and environment. (6.1.1)* *LO 1.7:* Calculate atom economy of the given reaction. (1.2.2)	
02.	**Water quality management**	**4-6**
	Learning Objective: *To analyze the quality of water and use the modern methods of water treatment and to understand the impact of water pollution in order to practice the sustainable water quality management.*	
	Contents: Quality of water: Boiler troubles (Scale and Sludge, Boiler Corrosion, Caustic Embrittlement) Hardness and its types and numericals. Determination of hardness by EDTA method and Numericals. Membrane filtration technology: - Ion exchange and reverse osmosis. Numericals based on ion exchange method. Water pollution: - Water quality indices- BOD and COD with numericals.	
	Learning Outcomes: *A learner will be able to* *LO 2.1: Classify the impurities of water into various types of hardness. (2.1.3)* *LO 2.2: Analyze different types of hardness in water using numerical problems (2.1.3)* *LO 2.3: Identify the effect of hard water in boiler and other chemical industries for assessing the public safety. (6.1.1)* *LO 2.4: Calculate the various types of hardness in water sample using EDTA method. (1.2.2)* *LO 2.5: Apply various water treatments for assessing the public health (6.1.1)* *LO 2.6: Identify and estimate water quality indices to control pollution of water (6.1.2)* *LO 2.7: Calculate BOD and COD of sewage sample (1.2.2)*	
03.	**Science of Corrosion**	**4-6**
	Learning Objective: *To identify the different types of corrosion using the theories of electrochemistry and suggest the corrosion control methods for the same in Industry.*	
	Contents: Introduction to corrosion, mechanism of dry corrosion – Oxidation	

	corrosion, Pilling Bedworth rule and wet Corrosion-Mechanisms of wet corrosion, Types of wet corrosion (galvanic, differential aeration, stress and Intergranular corrosion). Methods of prevention of Corrosion- cathodic protection (Sacrificial, impressed current) Protective coatings- Metallic coatings (tinning and galvanizing).	
	Self-Learning Topics: *Factors affecting rate of corrosion-size of electrodes, passivity, position of metal in galvanic series and polarization.*	
	Learning Outcomes: *A learner will be able to* *LO 3.1: Define corrosion and its types. (1.3.1)* *LO 3.2: State the mechanism of oxidation corrosion. (1.3.1)* *LO 3.3: Define the role of oxide layers in deciding the rate of corrosion. (1.3.1)* *LO 3.4: State and Apply the Pilling Bedworth rule to predict corrosion resistance of metals and alloys. (1.2.1) (1.3.1)* *LO 3.5: state the conditions for wet corrosion (1.2.1)* *LO 3.6: State the mechanisms of wet corrosion with the help of diagram and reactions. (1.3.1)* *LO 3.7: State different types wet corrosion with the help of examples. (1.3.1)* *LO 3.8: Apply the various protection methods for safety of metallic equipment and structures. (6.1.1)* *LO 3.9: Apply the metallic coatings on various metal surfaces for protection of machine health. (6.1.1)*	
04.	**Introduction to Thermodynamics** ***Learning Objectives:*** ***To state the fundamentals of thermodynamics and apply them in engineering.***	**4-6**
	Contents: Concepts of system, types of systems, surroundings. Extensive and intensive properties, Macroscopic and microscopic approach, heat and work, Thermodynamic equilibrium, reversible and irreversible process, First law of thermodynamics – internal energy and enthalpy. Applications of thermodynamics in engineering.	
	Learning Outcomes:	
	A learner will be able to *LO 4.1: Define a system, surroundings and variables. (1.3.1)* *LO 4.2: State first law of thermodynamics (1.2.1)* *LO 4.3: Apply first law of thermodynamics for calculation of work done or heat evolved. (1.2.2)* *LO 4.4: To show energy conversion in different forms. (1.3.1)* *LO 4.5: To calculate the enthalpy of given chemical system. (1.2.2)* *LO 4.6: To apply the concepts of thermodynamics in engineering (1.3.1)*	
05.	**Phase Equilibria** ***Learning Objective/s:*** *To interpret the various phase transformations using thermodynamics.*	**3-5**

	Contents: Gibb's Phase Rule, Terms involved with examples, One Component System (Water) and its applications, reduced Phase Rule, Two Component System (Pb- Ag), and Eutectic system: Applications in solder alloys and Numericals.	
	Learning Outcomes : *A learner will be able to* *LO 5.1: State and apply Gibb's phase rule equation to the given system, (1.2.1)* *LO 5.2: State the terms in the Gibb's phase rule equation. (1.2.1)* *LO 5.3: Draw the phase diagrams and state the salient features of the same. (1.3.1)* *LO 5.4: Calculate the number of degrees of freedom for each phase in a phase diagram using phase rule equations. (1.2.2)* *LO 5.5: State and apply the condensed phase rule to the eutectic alloys. (1.2.1)* *LO 5.6: State the applications of eutectics in the solder alloys (1.3.1)*	
06.	**Energy from non-conventional sources** ***Learning Objective/s:*** *To apply the knowledge of synthesis of non-conventional chemical fuels and deal with the challenges involved in their implementation with respect to sustainable development.*	
	Contents: Synthesis and applications of Biodiesel, Hydrogen production by steam reforming of methane and electrolysis of water, challenges in hydrogen storage and transport.	
	Learning Outcomes: *A learner will be able to* *LO 6.1: Apply the concept of transesterification for the production of biodiesel (1.3.1)* *LO 6.2: Identify the properties of biodiesel as a green fuel for sustainability. (6.1.2)* *LO 6.3: Synthesize hydrogen by steam reforming of methane and electrolysis of water. (2.2.3)* *LO 6.4: Identify the challenges in hydrogen production, storage and transport for the benefit of society. (6.1.1)*	
	Course Conclusion	**01**
	Total	**30**

Performance Indicators:

P.I. No.	**P.I. Statement**
1.2.1	Apply laws of natural science to an engineering problem.
1.2.2	Apply the formulae based on the concepts of engineering chemistry for solving the numerical problems.
1.3.1	Apply fundamental engineering chemistry concepts to solve engineering problems.
2.1.3	Identify the engineering chemistry concepts to analyze the given problem
2.2.3	Identify the existing processes/ solution methods for solving the problems

6.1.1 Identify and describe the various roles of materials particularly as pertains to protection of the public and public interest at global, regional and local level.

6.1.2 Analyse the environmental aspects of engineering problems for its impact on sustainability.

6.2.1 To identify and interpret standard guidelines for various standard chemical industry practices.

Course Outcomes:

A learner will be able to

1. Apply the laws of electrochemistry and thermodynamics for solving engineering problems. *(LO-3.1, LO-3.2, LO-3.3, LO-3.4,LO-3.5,LO-3.6, LO-3.7, LO-3.8, LO-3.9, LO-4.1, LO-4.1, LO-4.2, LO-4.3, LO-4.4, LO-4.5, LO- 4.6, LO- 5.1, LO- 5.2, LO- 5.3, LO- 5.4, LO- 5.5, LO-5.6, LO- 6.1, LO- 6.2, LO- 6.3, LO- 6.4)*
2. Analyze the quality of water and challenges in non-conventional energy sources for solving the real-world problems *(LO-1.1, LO- 1.2, LO-1.3, LO-1.4, LO- 1.5, LO-1.6, LO-1.7, LO- 2.1, LO- 2.2, LO- 2.3, LO- 2.4, LO- 2.5, LO- 2.6, LO- 2.7, LO- 6.1, LO- 6.2, LO- 6.3, LO- 6.4)*
3. Identify the suitable chemical product or material for the protection of environment and public health. *(LO-1.1, LO- 1.2, LO-1.3,LO-1.4,LO-1.5,LO-1.6,LO-1.7, LO- 2.1, LO- 2.2, LO-2.3,LO-2.4,LO-2.5,LO-2.6,LO- 2.7, LO-3.1, LO-3.2, LO-3.3,* LO-3.4,*LO-3.5,LO-3.6, LO-3.7, LO-3.8, LO-3.9, LO- 6.1, LO- 6.2, LO- 6.3, LO- 6.4)*
4. Interpret the impact of modern chemical industrial practices and energy sources for sustainable development. *(LO-1.1, LO- 1.2, LO-1.3,LO-1.4,LO-1.5,LO-1.6,LO-1.7, LO- 2.1, LO- 2.2, LO-2.3, LO- 2.4, LO- 2.5, LO- 2.6, LO- 2.7)*

CO-PO Mapping Table with Correlation Level

C O ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
BSC103.1	3	2	-	-	-	3	-	-	-	-	-
BSC103.2	3	3	-	-	-	3	-	-	-	-	-
BSC103.3	3	3	-	-	-	3	-	-	-	-	-
BSC103.4	3	3	-	-	-	3	-	-	-	-	-
Average	**3**	**2.75**	-	-	-	**3**	-	-	-	-	-

Text Books :

1. A textbook of engineering chemistry by S. Dara, 2014 edition, Chand Publication.
2. A Textbook of chemistry by Shashi Chawla, First edition, 2019, Dhanpatrai and Co.
3. Textbook of green chemistry by AK Ahluwalia, 2008, Ane Book India

Reference Books :

1. Engineering Chemistry by Jain and Jain, 17th edition, 2018, Dhanpatrai Publications.
2. Engineering Chemistry by Raghupati Mukhopadhyay, First edition, 2007, New Age International Publisher
3. Engineering Chemistry by Payal Joshi and Shashank Deep, First edition, 2019, Oxford University Press

Other Resources :

1. Online chemistry library for open access text books: https://chem.libretexts.org

A. IN-SEMESTER ASSESSMENT (35 MARKS)

1. Continuous Assessment - Theory-(15 Marks)

1. Numerical Assignment/s (min 20 problems):4 Marks
2. Class test based on numerical assignment: 4 Marks
3. Article reading & summarization: 4 Marks
4. Regularity and active participation: 3 Marks

2. Mid Semester Exam (20 Marks)

Mid semester examination will be based on 40% to 50% syllabus.

B. END SEMESTER EXAMINATION (40 MARKS)

End Semester Examination will be based on syllabus coverage up to the Mid Semester Examination (MSE) carrying 20%-30% weightage, and the syllabus covered from MSE to ESE carrying 70%-80% weightage.

Course Type	Course Code	Course Name	Credits
ESC	ESC101	ENGINEERING MECHANICS	03

Examination Scheme					
Distribution of Marks			Exam Duration (Hrs.)		Total Marks
In-semester Assessment		End Semester Examination (ESE)			
Continuous Assessment	Mid-Semester Exam (MSE)		MSE	ESE	
20	30	50	1.5	2	100

Pre-requisite :

NIL

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem analysis

Course Objectives:

1. To familiarize with the concepts of force, moment, Resultant and Equilibrium of system of coplanar force.
2. To acquaint with the basic concept of friction and its application in real-life problems.
3. To understand the parameters required to quantify the Kinematics of Particle and Rigid body.
4. To understand the parameters required to quantify the Kinetics of rigid body.
5. To acquaint with basic principles of centroid and its application

Module	Details	Hrs.
00.	**Course Introduction** The Engineering Mechanics Course marks the transition from physics to engineering applications. This course develops the ability to apply and analyze, which are paramount in engineering profession.	**01**
01.	***Coplanar force System: System of Coplanar Forces*** ***Learning Objective:*** *To impart the knowledge of fundamental concepts of Mathematics and Physics to analyze forces in engineering system..*	**5-7**
	Contents: Classification of force systems (Concurrent, Parallel and General Force systems). Principle of Transmissibility, Composition and Resolution of Forces. Resultant of Coplanar Force Systems: Resultant of coplanar force system (Concurrent, Parallel and non- concurrent non-parallel force systems). Moment of force about a point, Couples, Varignon's Theorem and its significance. Force couple system.	
	Self-Learning Topics: *Composition and Resolution of Forces.*	

	Learning Outcomes: *A learner will be able to* *LO 1.1*: *To apply fundamental engineering concepts for resolution of system of forces. (P.I.-1.3.1)* *LO 1.2: Apply mechanical engineering concepts to find resultant forces acting in a system under the action of load. (PI-1.4.1)* *LO 1.3: To identify unknown forces in engineering systems due to application of load. (PI-2.1.2)* *LO 1.4: To apply the concepts of physics and mathematics to locate the position on resultant forces acting on a structural member in engineering application. (P.I.-2.1.3).*	
02.	**Equilibrium of Rigid Bodies in Statics. Equilibrium of Coplanar Force System:** ***Learning Objective:*** *To use fundamental concepts of engineering knowledge of equilibrium and to analyze reactions under the influence different types of loading conditions.*	**7-9**
	Contents: Conditions of equilibrium for Concurrent, Parallel and General Force System (Non-Concurrent Non- Parallel forces) and Couples. Application of Equilibrium Concepts on rigid bodies in Equilibrium. Equilibrium of Beams: Different Types of Supports and Loading. Determination of reactions at supports for various types of loads including distributed system on beams. (Excluding problems on internal hinges). Friction: Concepts of Angle of Friction, Angle of Repose, Cone of Friction. Equilibrium of bodies kept on inclined plane. Application of Friction Concepts to problems involving ladders and the tipping over of bodies.	
	Self-Learning Topics:	
	Learning Outcomes: *A learner will be able to* *LO 2.1: Apply fundamental mathematical knowledge for application of equilibrium concepts on rigid bodies(P.I.-1.1.2).* *LO 2.2: Apply mechanical concepts to coplanar force systems and calculate reactions in beams(P.I.-1.4.1).* *LO 2.3: Apply fundamental mathematical knowledge to find frictional parameters of a rigid body (P.I.-2.1.2).* *LO 2.4: Apply friction concepts to real-world scenarios involving inclined planes and ladders (P.I.-2.2.1).*	
03.	**Kinematics of Particle** ***Learning Objective:*** *Learner will be able to understand kinematics, including variable acceleration, motion curves, curvilinear motion, and projectile motion, applying concepts to real-life situations through problem-solving.*	**8-10**
	Contents: Motion of particle with Variable Acceleration. Motion Curves (a-t, v- t, s-t curves). General Curvilinear Motion. Tangential and Normal	

	Component of Acceleration. Projectile Motion: Trajectory Equation of Projectile. Application of the concepts of Projectile Motion in real life and related numerical.	
	Self-Learning Topics: *Projectile Motion Basics, Variable acceleration concept*	
	Learning Outcomes: *A learner will be able to* *LO 3.1: apply knowledge to identify the motion of the object using the equations of motion (P.I.- 1.2.1).* *LO 3.2: apply the fundamental mathematics and mechanical engineering concepts to analyze different types of motions (P.I.-1.4.1).* *LO 3.3: Identify system variables to formulate trajectory equation of projectile motion (P.I.2.1.2).* *LO 3.4: Apply mathematical and engineering knowledge to find motion of the object in the real life situations (P.I.-2.1.3).*	
04.	**Kinematics of Rigid Body** ***Learning Objectives:*** *To understand the parameters required to quantify the Kinematics of Particle and Rigid body.*	**5-7**
	Contents: Rigid Body Motions: Translation, Rotation and General Plane motion. Kinematics of Rotation and related numerical. The concept of Instantaneous center of rotation (ICR) for the velocity. Location of ICR for 2 link mechanism. Velocity analysis of rigid body using ICR.	
	Self-Learning Topics:	
	Learning Outcomes: *A learner will be able to* *LO 4.1: Apply engineering knowledge to identify the general plane motion(P.I.-1.3.1).* *LO 4.2: Apply mathematical knowledge to find translational, rotational and general plane motion of rigid bodies(P.I.-1.4.1).* *LO 4.3: Identify engineering systems and variables to find instantaneous center of rotation for link mechanism (P.I-2.2.1).* *LO 4.4: Use mathematical knowledge to find general plane motion analytically. (P.I.- 2.1.3).*	
05.	**Kinetics of Particle: D'Alembert's** ***Learning Objective/s:*** *To understand the concept of kinetics of particle and the different methods to solve the engineering problems.*	**9-11**
	Contents:	
	Introduction to basic concepts of D'Alemberts Principle, Concept of Inertia force, Equations of Dynamic Equilibrium,. (Analysis limited to simple systems only.) **Work – Energy Principle:** Work Energy principle for a particle in motion. Application of Work – Energy principle to a system consists of connected masses and Springs. **Impulse – Momentum Principle:** Principle of linear Impulse and Momentum. Application of Impulse Momentum Principle to particles in motion. **Impact and Collisions:** Law of conservation of momentum,	

	Coefficient of Restitution, Direct Central Impact and Oblique Central Impact. Loss of Kinetic Energy in collision of inelastic bodies. Self-Learning Topics: *basic concepts and application in dynamic equilibrium for simple systems.* ***Learning Outcomes :*** *A learner will be able to* *LO 5.1: Apply D'Alembert's Principle to analyze the particles in dynamic equilibrium, (P.I.-1.3.1)* *LO 5.2: Apply mechanical engineering knowledge to use work-energy principle for mechanical systems(P.I.-1.4.1).* *LO 5.3: To use mathematical knowledge, to analyze the systems using Work-Energy and Impulse-Momentum Principles(P.I.-2.1.3).* *LO 5.4: To reframe complex problem in to sub problems to analyze the collisions occurring in the force system(P.I-2.2.1).*	
06.	**Centroid** ***Learning Objective:*** *To understand the importance of Centroid which can affect the stability of the objects in the real life situations.* **Contents:** **First Moment of Area. Centroid of Composite Plane Lamina.** ***Self-Learning Topics:*** *Explore methods for calculating the First Moment of Area.* ***Learning Outcomes:*** *A learner will be able to* *LO 6.1: Apply fundamental knowledge to find first moment of area. (P.I.-1.1.1).* *LO 6.2: Apply mechanical engineering knowledge to find centroid of composite body(P.I.-1.4.1).*	**3-5**
	Course Conclusion	**01**
	Total	**45**

Performance Indicators:

P.I. No.	P.I. Statement
1.1.1	Apply mathematical techniques such as calculus, linear algebra, and statistics to solve problems.
1.1.2	Apply advanced mathematical techniques to model and solve mechanical engineering problems.
1.2.1	Apply laws of natural science to an engineering problem.
1.3.1	Apply fundamental engineering concepts to solve engineering problems.
1.4.1	Apply Mechanical engineering concepts to solve engineering problems.
2.1.2	Identify engineering systems, variables, and parameters to solve the problems
2.1.3	Identify the mathematical, engineering and other relevant knowledge that applies to a given problem
2.2.1	Reframe complex problems into interconnected sub problems.

Course Outcomes: A learner will be able to -

1. Apply the concepts of resolution and composition of forces to find the Resultant and static equilibrium to find reactive forces with and without friction. *(LO 1.1, LO 1.2, LO 1.3, LO 1.4, LO 2.1, LO 2.2, LO 2.3, LO 2.4)*
2. Analyse the motion of a particle using kinematic equations. *(LO 3.1, LO 3.2, LO 3.3, LO 3.4)*
3. Analyse the General plane motion of a rigid body using the concepts of instantaneous Centre of Rotation to find velocity and acceleration for a link Mechanism. *(LO 4.1, LO 4.2, LO 4.3, LO 4.4)*
4. Analyse the motion of a Particle using Kinetic equations. *(LO 5.1, LO 5.2, LO 5.3, LO 5.4*)
5. Apply the concept of Centroid to locate it for a plane lamina. *(LO 6.1, LO 6.2)*

CO-PO Mapping Table with Correlation Level

CO ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
ESC101.1	3	3	-	-	-	-	-	-	-	-	-
ESC101.2	3	3	-	-	-	-	-	-	-	-	-
ESC101.3	3	3	-	-	-	-	-	-	-	-	-
ESC101.4	3	3	-	-	-	-	-	-	-	-	-
ESC101.5	2	-	-	-	-	-	-	-	-	-	-
Average	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

Text Books :

1. Engineering Mechanics by A K Tayal, Fourteenth Edition, 2011 Umesh Publication.
2. Engineering Mechanics by Kumar, Fourth Edition, 2017 Tata McGraw Hill
3. Engineering Mechanics by F. L. Singer, Third Edition, 1975, Harper & Raw
4. Engineering Mechanics by R. C.Hibbeler , Fourth Edition, 2017, Pearson Education

Reference Books :

1. Engineering Mechanics by Beer &Johnston, Fourth Edition, 1987 ,Tata McGrawHill
2. Engineering Mechanics (Statics) by Meriam and Kraige, Fourth Edition, 1999 WileyBooks
3. Engineering Mechanics by Tmoshenkos Fifth Edition,2015 , generic

Other Resources :

1. NPTEL Course: NOC Engineering Mechanics Statics and Dynamics by Prof. Mahesh Panchagnula offered by IIT Madras Web link- https://nptel.ac.in/courses/112/106/112106180.

A. IN-SEMESTER ASSESSMENT (50 MARKS)

1. Continuous Assessment - Theory-(20 Marks)

1. Numerical Assignments (minimum 20 problems): 5 Marks
2. Class Test based on similar problems which were given as an assignment: 5 Marks
3. Open book test/Open notes test: 5 Marks
4. Regularity and active participation: 5 Marks

2. Mid Semester Exam (30 Marks)

Mid semester examination will be based on 40% to 50% syllabus.

B. END SEMESTER EXAMINATION (50 MARKS)

End Semester Examination will be based on syllabus coverage up to the Mid Semester Examination (MSE) carrying 20%-30% weightage, and the syllabus covered from MSE to ESE carrying 70%-80% weightage.

Course Type	Course Code	Course Name	Credits
ESC	ESC102	BASIC ELECTRICAL ENGINEERING	02

Examination Scheme					
Distribution of Marks			Exam Duration (Hrs.)		Total Marks
In-semester Assessment		End Semester Exam (ESE)			
Continuous Assessment	Mid-Semester Exam (MSE)		MSE	ESE	
15	20	40	1	1.5	75

Pre-requisite :

NIL

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO6: The Engineer and The World
4. PO8: Individual and Collaborative teamwork

Course Objectives:

1. To impart knowledge on fundamentals of electrical power system, conventional and non- conventional energy sources.
2. To impart knowledge on basic electrical systems, DC circuits, AC circuits, Residential Electrical System, Residential Energy Metering and Electrical Machines to solve engineering problems.
3. To introduce concept to analyze DC circuits, AC circuits.
4. To introduce safety devices incorporated in residential electrical system for professional engineering practice.

Module	Detailed Contents	Hrs
00.	**Course Introduction** Overview of Basic Electrical Engineering, application of Basic Electrical Engineering in Industry/real life problem. It is a foundational course designed to provide students with a comprehensive understanding of fundamental electrical concepts and principles.	**1**
01.	**Introduction to Basic Electrical Systems** ***Learning Objective/s:*** *To acquire knowledge on various components of electrical powers system and compare different sources of electrical energy.*	**2-4**
	Contents: Components of Electrical power System, Role of each component, Structure of electrical power system, Introduction to transformer, Conventional sources of electric energy, Renewable energy sources, Comparison of various energy sources.	

	Self-Learning Topics: *Comparison of conventional and nonconventional energy sources.* ***Learning Outcomes:*** *A learner will be able to* *LO1.1 Apply the concepts of electrical engineering to understand role of each component of electrical power system. (P.I.-1.4.1)* *LO1.2 Compare different sources of electrical energy using fundamental engineering concepts. (P.I.-1.3.1)*	
02.	**DC Circuits with independent sources** ***Learning Objective/s:*** *To apply the concepts of various theorems and laws to analyze DC circuits.*	**5-7**
	Contents: Ohm's Law, Kirchhoff's Laws, Star Delta transformation, Ideal and practical voltage and current sources, Mesh and Nodal Analysis, Superposition theorem, Thevenin's theorem, Maximum power transfer theorem.	
	Self-Learning Topics: *Series and parallel connections of resistances.* ***Learning Outcomes:*** *A learner will be able to* *LO2.1 Apply concepts of Ohm's law and Kirchoff's laws to solve DC circuits. (P.I.- 1.4.1)* *LO2.2 Use concepts of star delta transformation to simplify DC circuits. (P.I.-1.3.1)* *LO2.3 Apply network theorems to analyze current distribution in DC circuits. (P.I.- 2.1.3)* *LO2.4 Apply the concepts of ideal and practical electrical sources to solve DC circuits using Thevenin's and Norton's theorems. (P.I.-2.1.2)*	
03.	**AC Fundamentals** ***Learning Objective/s:*** *To analyze AC circuit and interpret the condition of resonance by using concepts of current, voltage, power factor and power calculation in AC circuits.*	**5-7**
	Contents: Single-phase AC series circuits consisting of R, L, C, RL, RC, RLC combinations, definitions -real, reactive, and apparent power. Series Resonance.	
	Self-Learning Topics: *Parallel AC circuits.* ***Learning Outcomes:*** *A learner will be able to* *LO3.1 Analyze the performance of AC circuit by calculating phase angle (power factor) between voltage and current waveform. (P.I.-2.1.2)* *LO3.2 Identify condition of resonance and calculate resonant frequency by overserving current and reactance in series AC circuits. (P.I.-2.1.3)*	

04.	**Residential Electrical Systems** ***Learning Objective/s:*** *To acquire knowledge on residential electrical wiring incorporating suitable safety devices, testing and up-keeping of household electrical appliances and residential lighting system.*	**4-6**
	Contents: Components of residential electrical system, Residential wiring System, load calculation, Electrical safety Devices, Fuse, MCB, ELCB, grounding issues, safety precautions, Testing of domestic appliances and up-keeping, Luminous flux, Luminous intensity, Lumination, Types of lamps in residential lighting. Case study on residential lighting.	
	Self-Learning Topics: *Basic requirements of electrical system.* ***Learning Outcomes:*** *A learner will be able to* *LO4.1 Identify components in residential electrical system by understanding basic system requirements. (P.I.-1.3.1)* *LO4.2 Test and repair domestic appliances by applying concepts of basic electrical engineering. (P.I.-1.4.1)* *LO4.3 Identify safety devices for the protection of residential electrical system. (P.I.-6.1.1)* *LO4.4 Conduct a case study on residential lighting in a group to demonstrate communication, conflict resolution and leadership skills. (P.I.-8.2.1)* *LO4.5 Present the case study on residential lighting system design effectively as a team. (P.I.-8.3.1)*	
05.	**Introduction to Residential Energy Measurements** ***Learning Objective/s:*** *To acquire knowledge on residential energy metering, energy tariff and understanding the residential electricity bill.*	**2-4**
	Contents: Measurement of Energy, Understanding of electricity bill, energy tariff electricity bill calculation.	
	Self-Learning Topics: *Types of meters used for energy metering.* ***Learning Outcomes:*** *A learner will be able to* *LO5.1 Calculate the electrical energy consumed over a specified time by applying concepts of electrical engineering. (P.I.-1.4.1)* *LO5.2 Determine the energy tariff by referring meter reading and government guidelines. (P.I.-1.3.1)*	

06.	**Introduction to Electrical Machines** ***Learning Objective/s:*** *To identify motors for given application using concepts of construction, working and characteristics of different machines.*	**4-6**
	Contents: Construction, working, characteristics and application of DC machines, Single phase Induction Motor, Servo motors, Brushless DC motor, Stepper motor. Factors to be considered for selection of motor and its rating. Selection of motors from motor and load characteristics.	
	Self-Learning Topics: *Working principle of electric motor.* ***Learning Outcomes:*** *A learner will be able to* *LO6.1 Compare and identify electrical motors for given application based on characteristics of load and motor. (P.I.-2.2.4)* *LO6.2 Decide the rating of motor by considering factors like power, speed, torque etc. of the given application. (P.I.-2.2.3)*	
	Course Conclusion	**1**
	Total	**30**

Performance Indicators:

P.I. No.	**P.I. Statement**
1.3.1	Apply fundamental engineering concepts to solve engineering problems.
1.4.1	Apply Electrical engineering concepts to solve engineering problems.
2.1.2	Identify engineering systems, variables, and parameters to solve the problems.
2.1.3	Identify the mathematical, engineering and other relevant knowledge that applies to a given problem.
6.1.1	Identify and describe various engineering roles; particularly as pertains to protection of the public and public interest at global, regional and local level.
8.2.1	Demonstrate effective communication, problem solving, and conflict resolution and leadership skills.
8.3.1	Present results as a team, with smooth integration of contributions from all individual efforts.

Course Outcomes:

Learner will be able to

1. Apply fundamental engineering concept to interpret Basic Electrical Systems, Residential Electrical System and Residential Energy Metering. (*LO1.1, LO1.2, LO4.1, LO5.1)*
2. Apply concepts of electrical engineering to solve problems on DC circuits and AC circuits. *(LO2.1, LO2.2, LO2.3, LO2.4, LO3.1, LO3.2)*
3. Interpret and identify safety devices for professional engineering practice.(*LO4.3, LO4.4*)
4. Conduct case study on residential lighting and present it to demonstrate effective communication and problem solving. *(LO4.4, LO5.2)*
5. Identify electrical motors based on requirement of application and characteristics of motor. *(LO6.1, LO6.2, LO4.5)*

CO-PO Mapping Table with Correlation Level

CO ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
ESC102.1	3	3	-	-	-	-	-	-	-	-	-
ESC102.2	3	3	-	-	-	-	-	-	-	-	-
ESC102.3	-	-	-	-	-	2	-	-	-	-	-
ESC102.4	3	-	-	-	-	-	-	3	-	-	-
ESC102.5	-	3	-	-	-	-	-	-	-	-	-
Average	**3**	**3**	-	-	-	**2**	-	**3**	-	-	-

Text Books:

1. Electrical Power Systems,S.L. Uppal and Prof. Sunil S. Rao 15th Edition, Khanna Publishers
2. Basic Electrical Engineering, B.R Patil, 2nd Edition Oxford Higher Education, 2019
3. Art & Science of Utilization of electrical Energy, H Partab, Dhanpat Rai & Co., 2004.
4. Electrical and Electronic Measurements and Measuring Instruments, A K Sawhney Dhanpat Rai and Sons
5. Special Electrical Machines, E G Janardanan PHI 2014
6. Electrical Power Systems, S.L. Uppal and Prof. Sunil S. Rao, 15th Edition, Khanna Publishers

Reference Books:

1. Power System Engineering, D P Kothari and I J Nagrath, 3rd Edition, Mac Graw Hills,
2. Electrical Engineering Fundamentals, Vincent Del Toro, PHI Second edition, 2011
3. Utilization of Electric Power & Electric Traction, J B Gupta, 10th Edition, Dhanpat Rai and Sons 2012.
4. Electrical Engineering, B.L.Theraja Vol-I and II
5. Basic Electrical Engineering, S.N.Singh PHI, 2011

Other Resources:

1. NPTEL course on Basic Electrical Technology, IISc Bangalore Prof. L. Umanand https://nptelvideos.com/course.php?id=460

A. IN-SEMESTER ASSESSMENT (35 Marks)

1. Continuous Internal Evaluation of Theory (15 Marks)

Numerical Assignments (minimum 20 problems): 4 Marks

Class Test based on similar problems which were given as an assignment: 4 Marks

Open book test/Open notes test: 4 Marks

Regularity and active participation: 3 Marks

2. Mid Semester Exam (20 Marks)

Mid semester examination will be based on 40 % to 50% of the syllabus.

B. End Semester Exam (40 Marks)

End semester will be based on the syllabus coverage upto Mid Semester Examination (MSE) carrying 20% to 30% weightage and the syllabus covered from MSE to ESE carrying 70% to 80% weightage.

Course Type	Course Code	Course Name	Credits
BSL	BSL101	ENGINEERING PHYSICS-I LABORATORY	0.5

Examination Scheme					
Distribution of Marks			Exam Duration (Hrs.)		Total Marks
In-semester Assessment		End Semester Examination (ESE)			
Continuous Assessment	Mid-Semester Exam (MSE)		MSE	ESE	
25	-	-	-	-	25

Pre-requisite:

NIL

Program Outcomes addressed:

1. PO1: Engineering Knowledge
2. PO4: Conduct investigations of complex problems
3. PO8: Individual and collaborative team work
4. PO9: Communication

Course Objectives:

1. To demonstrate the fundamental concepts of physics and evaluate the process of an experiment/project quantitatively and qualitatively.
2. To improve the knowledge gained in the theory course.
3. To develop the abilities of measurements, observations and analyzing data.
4. To develop the experimental skill in assembling and handling laboratory instruments.

Module	Details	Hrs.
00.	**Course Introduction** Introduction to various instruments and components used in physics lab; Rules and regulations to be followed; The fundamental concepts for all experiments, Explanation for performing the experiments.	01
01.	**Experiment 1** ***Learning Objective:*** *1. To apply the knowledge of interference of light in thin film. .* *2. To determine a radius of curvature of lens and write valid conclusion*	
	Contents: Newton's Rings: Determine the radius of curvature (R) of given plano convex lens using Newton's Rings	
	Self-Learning Topics: -	

	Learning Outcome: *LO 1.1: A learner will be able to* *apply the concepts of interference in thin film and analyze the experimental data to calculate radius of curvature of the given plano convex lens. (P.I.1.2.1, P.I.1.2.2, P.I. 4.3.1, P.I..4.3.3)*	
02.	**Experiment 2** ***Learning Objective:*** 1. *To apply the knowledge of diffraction through multiple slit.* 2. *To find the wavelength of the LASER and write valid conclusion*	**02**
	Contents: Diffraction through Grating: Measurement of wavelength of He-Ne laser	
	Self-Learning Topics: -	
	Learning Outcome: *LO 2.1: A learner will be able to apply the concepts of diffraction through multiple slit and analyze the experimental data to calculate wavelength of the laser source. (P.I.1.2.1, P.I.1.2.2, P.I. 4.3.1, P.I..4.3.3)*	
03.	**Experiment 3** ***Learning Objective:*** 1. *To apply the knowledge of optical fibre.* 2. *To determine the numerical aperture of an optical fibre and write the conclusion.*	**02**
	Contents: Optical Fibre: Measurement of Numerical aperture.	
	Self-Learning Topics: -	
	Learning Outcome: *LO 3.1: A learner will be able to apply the knowledge of numerical aperture and analyze the experimental data to calculate numerical aperture of the given fibre. (P.I.1.2.1, P.I.1.2.2, P.I. 4.3.1, P.I..4.3.3)*	
04.	**Experiment 4** ***Learning Objectives:*** 1. *To apply the knowledge of Hall effect.* 2. *To determine a magnetic field using Hall effect in semiconductors*	**02**
	Contents: Hall effect**:** Determination of magnetic field.	
	Self-Learning Topics: -	
	Learning Outcome: *LO 4.1: A learner will be able to apply the concept of Hall effect phenomena and analyze the experimental data to calculate magnetic field generated by electromagnet. (P.I.1.2.1, P.I.1.2.2, P.I. 4.3.1, P.I..4.3.3)*	
05.	**Experiment 5** ***Learning Objective/s:***	**02**

	Contents: Photodiode: Drawing the I-V characteristics of photo diode	
	Self-Learning Topics: -	
	Learning Outcomes: *LO 5.1: A learner will be able to apply the working principle of photodiode and analyze the V-I characteristic curve to draw conclusion.* ***(P.I.1.2.1, P.I.1.2.2, P.I. 4.3.1, P.I..4.3.3)***	
06.	**Course Project** ***Learning Objective/s:*** *1. To apply various concepts of physics in a project.* ***2.*** *To develop the skill of execution of project through practical demonstration.*	**03**
	Contents: Selection of a project based on physics concepts, Literature survey, and Topic presentation.	
	Self-Learning Topics: -	
	Learning Outcome: *LO 6.1 : A learner will be able to identify a project based upon the concepts of physics and present the topic effectively as a team.* ***(P.I.1.2.1, P.I.1.2.2, P.I..8..1.2, P.I. 8.3.1, P.I. 9.1.1, P.I. 9.2.2)***	
	Course Conclusion	**01**
	Total	**15**

Performance Indicators:

P.I. No.	**P.I. Statement**
1.2.1	Apply laws of natural science to an engineering problem.
1.2.2	Apply the formulae derived from the concept to solve engineering problem.
4.3.1	Use appropriate procedures, tools and techniques to conduct experiments and collect data.
4.3.3	Represent data (in tabular and/or graphical forms) so as to facilitate analysis and explanation of the data, and drawing of conclusions.
8.1.2.	Implement the norms of practice (e.g. rules, roles, charters, agendas, etc.) of effective teamwork,to accomplish a goal
8.3.1	Present results as a team, with smooth integration of contributions from all individual efforts.
9.1.1	Produce clear, well-constructed, and well- supported written engineering documents.
9.2.2	Deliver effective oral presentations to technical and non- technical audiences.

Course Outcomes: A learner will be able to -

1. A learner will be able to apply the fundamental knowledge of optical phenomena to determine various parameters through relevant experiments.(*LO 1.1, LO 2.1, LO3.1*)
2. A learner will be able to apply the fundamental knowledge of semiconductor devices to determine various parameters through relevant experiments. (*LO4.1, LO5.1*)

3. A learner will be able to apply the fundamental knowledge of physics to present proposed project work, write effective reports as a team. (*LO 6.1)*

CO-PO Mapping Table with Correlation Level

CO ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
BSL101.1	3	-	-	3	-	-	-	-	-	-	-
BSL101.2	3	-	-	3	-	-	-	-	-	-	-
BSL101.3	3	-	-	3	-	-	-	3	3	-	-
Average	**3**	-	-	**3**	-	-	-	**3**	**3**	-	-

Text Books :

1. A Textbook of Engineering physics, Dr. M. N. Avadhanulu and Dr. P. G. Kshirsagar RevisedEdition, 2014, S. Chand Publishing.
2. Engineering physics, R. K. Gaur and S. L. Gupta, Revised Edition, 2012, Dhanpat RaiPublications

Reference Books :

1. Fundamentals of Physics, Halliday /Resnick/Walker, Twelve Edition, 2021, Wiley
2. Introduction to solid state physics, Charles Kittel, Eighth Edition, 2005, Wiley
3. Introduction to nanotechnology, Charles P Poole and Frank J Owens, 1 st Edition, Wiley-Interscience.

Other Resources :

1. Online physics library, California State University:-Web linkhttps://phys.libretexts.org/
2. Physics website, The State University of New Jersey :-Web linkwww.physics.rutgers.ed

IN-SEMESTER ASSESSMENT (25 MARKS)

1. Lab Performance: 10 Marks
2. Project (Final Report and Demonstration): 10 marks
3. Regularity and active participation: 5 marks

Course Type	Course Code	Course Name	Credits
BSL	BSL102	ENGINEERING CHEMISTRY - I LABORATORY	0.5

Examination Scheme					
Distribution of Marks			Exam Duration (Hrs.)		Total Marks
In-semester Assessment		End Semester Examination (ESE)			
Continuous Assessment	Mid-Semester Exam (MSE)		MSE	ESE	
25	-	25	25	-	25

Pre-requisite:

1. Nil

Program Outcomes addressed:

1. PO1: Engineering Knowledge
2. PO2: Problem Analysis
3. PO6: The engineer and the world
4. PO8: Individual and collaborative teamwork

Course Objectives:

1. To enable the students to utilize fundamental laboratory techniques for analysis and synthesis of chemical products.
2. To enable the students to learn various laboratory safety rules in standard laboratory practices.

Module	Details	Hrs.
00.	**Course Introduction** 1. Laboratory familiarization 2. Code of conduct in chemistry laboratory 3. Safety and precautions to be observed in chemistry laboratory 4. Orientation on evaluation of laboratory performance	01
01.	**Experiment 1** ***Learning Objective/s:*** *To estimate the total, temporary and permanent hardness of water using EDTA method to understand its quality for industrial use.*	02
	Estimation of Total, temporary and permanent hardness of water by EDTA method.	
	Self-Learning Topics: Nil	
	Learning Outcomes: *A learner will be able to* *LO-1.1 Analyse the quality of the industrial water by calculating the total hardness using complexometric titration method. (1.3.1), (2.1.3), (2.2.3), (6.1.1)*	

02.	**Experiment 2** ***Learning Objective/s:*** *To determine the chloride content of water to understand its suitability for domestic use* **Contents:** Estimation of chloride content of water sample ***Self-Learning Topics: Nil*** ***Learning Outcomes:*** *A learner will be able to* *LO- 2.1 Analyse the quality of the drinking water by calculating the chloride content using precipitation titration method.* *(1.3.1) (2.1.3) (2.2.3) (6.1.1)*	**02**
03.	**Experiment 3** ***Learning Objective/s:*** *To synthesise aspirin by using acetylation process and calculate its percent yield and atom economy to determine the nature of reaction.* To synthesize aspirin from salicylic acid ***Self-Learning Topics: Nil*** ***Learning Outcomes:*** *A learner will be able to* *LO-3.1 Synthesize aspirin using acetylation process and calculate its percentage yield (1.3.1) (2.2.3)*	**02**
04.	**Experiment 4** ***Learning Objective/s:*** *To calculate the enthalpy of dissolution of copper sulphate in water using simple calorimeter.* To determine the enthalpy of dissolution of copper sulphate at room temperature using water as a reaction medium. ***Self-Learning Topics: Nil*** ***Learning Outcomes:*** *A learner will be able to* *LO-4.1 Calculate enthalpy of the given system using first law of thermodynamics. (1.2.1), (1.3.1), (2.2.3)*	**02**
05.	**Experiment 5** ***Learning Objective/s:*** *To determine the effect of various factors affecting the rate of corrosion of iron* *To determine the factors affecting the rate of corrosion.* ***Self-Learning Topics: Nil*** ***Learning Outcomes:*** *A learner will be able to* *LO-5.1 Determine the effect of various factors on the rate of corrosion by applying the knowledge of electrochemistry (1.2.1) (1.3.1)*	**02**

06.	**Designing of experiment and presentation:** ***Learning Objective/s:*** *To develop the basic knowledge of analytical chemistry using titrimetric experiments*	**03**
	Contents: Standardization/estimation of chemical substances using titrimetric analysis.	
	Self-Learning Topics: Nil	
	Learning Outcomes: *A learner will be able to* *LO-6.1 Identify the existing titrimetric analysis to estimate the given substance and present the result as a team. (1.3.1)(2.2.3), (8.1.1), (8.3.1)*	
	Course Conclusion	**01**
	Total	**15**

Performance Indicators:

P.I. No.	**P.I. Statement**
1.2.1	Apply laws of natural science to an engineering problem.
1.3.1	Apply fundamental engineering chemistry concepts to solve engineering problems.
2.1.3	Identify the engineering chemistry concepts to analyze the given problem
2.2.3	Identify the existing processes/ solution methods for solving the problems
6.1.1	Identify and describe the various roles of materials particularly as pertains to protection of thepublic and public interest at global, regional and local level
8.1.1	Recognize a variety of working and learning preferences; appreciate the value of diversity on a team.
8.3.1	Present result as a team with smooth integration of contributions from all individual efforts.

Course Outcomes: A learner will be able to -

1. Apply the laws of electrochemistry and thermodynamics for performing the practicals. *(LO-4.1, LO-5.1)*
2. Formulate a drug by applying the concepts of chemistry. *(LO-3.1)*
3. Analyse the quality of water for assessing the public health. *(LO-1.1, LO-2.1)*
4. Demonstrate an ability to work effectively in a team for project-based activity. *(LO-6.1)*

CO-PO Mapping Table with Correlation Level

-CO ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
BSL102.1	3	2	-	-	-	-	-	-	-	-	-
BSL102.2	2	2	-	-	-	-	-	-	-	-	-
BSL102.3	2	3	-	-	-	2	-	-	-	-	-
BSL102.4	2	2	-	-	-	-	-	3	-	-	-
Average	**2**	**2**	**-**	**-**	**-**	**2**	**-**	**3**	**-**	**-**	**-**

Textbooks:

1. Practical book in Engineering Chemistry by Dr. Pijus Khatua and Debashree Singh, First edition, 2016, Platinum Publishers
2. Textbook of green chemistry by AK Ahluwalia, 2008, Ane Book India

Reference Books:

1. Engineering Chemistry by Jain and Jain, 17th edition, 2018, Dhanpatrai publications
2. Experiments in Engineering Chemistry by Payal Joshi, first edition, 2016, I.K. International Publishing House Pvt. Ltd.

Other Resources:

1. Online chemistry library for open access textbooks: https://chem.libretexts.org
2. Lab Simulation: https://vlab.amrita.edu/?sub=2&brch=190&sim=1546&cnt=1

IN-SEMESTER ASSESSMENT (25 MARKS)

1. Lab Performance: 10 Marks
2. Design experiment and presentation: 10 marks
3. Regularity and active participation: 5 marks

Course Type	Course Code	Course Name	Credits
ESL	ESL101	ENGINEERING MECHANICS LABORATORY	01

Examination Scheme		
Continuous Assessment	**End Semester Exam**	**Total Marks**
25	--	25

Pre-requisite :
NIL

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO8: Individual and Collaborative team work

Course Objectives:

1. To demonstrate the equilibrium of coplanar forces
2. To demonstrate law of moments.
3. To determine coefficient of friction between two different surfaces in contact.
4. To analyse the motion of particle.

Module	Details	Hrs.
	Course Introduction The Engineering Mechanics Lab Course marks the transition from physics to engineering applications. This course develops the ability to apply and analyze, which are paramount in engineering profession.	**01**
01.	**Coplanar Force System** ***Learning Objective:*** *Learner will be able to apply fundamental engineering concepts to demonstrate the concept of equilibrium of coplanar forces.*	**07**
	Contents: Equilibrium of concurrent co-planer force system, general co-planer system, Reactions on the beam, Jib crane study. Experiment 1: To verify polygon law of forces (Concurrent force system) Experiment 2: To verify Lami's theorem using simple jib crane. Experiment 3: To determine the reactions of simply supported beam**.**	
	Self-Learning Topics:	
	Learning Outcomes: *A learner will be able to* *LO 1.1: Identify the type of force system in a team. (P.I.-1.3.1)* *LO 1.2: Determine the whether the system is in equilibrium or not and present the results in a team. (2.2.3,8.3.1)*	

	LO 1.3: Convert different mechanical systems into sub-stems by using free body diagram. (2.2.1) *LO 1.4: Determine the reactions of the beam for various loading conditions as a team.(P.I.-1.4.1,8.2.1).*	
02.	**Principle of Moment** ***Learning Objective:*** *Learner will be able to apply mechanical engineering concepts to demonstrate the principle of Moments using the Bell Crank Lever apparatus.* **Contents:** To demonstrate law of moments. Experiment 4: To verify moment equilibrium condition using bell crank lever. ***Self-Learning Topics:*** ***Learning Outcomes:*** *A learner will be able to* *LO 2.1: differentiate between moment and couple (P.I.-1.4.1).* *LO 2.2: verify moment equilibrium condition using bell crank lever and present the results as a team (P.I-1.3.1,8.3.1).* *LO 2.3: convert the bell crank lever diagram into subsystems by using free body diagram. (2.2.1)* *LO 2.4: Demonstrate effective communication while working as team for conducting the experiments (P.I-8.2.1).* *LO 2.5: Verify moment equilibrium condition using bell crank lever and present results as a team(P.I.-2.2.3,8.3.1).*	**07**
03.	**Friction** ***Learning Objective:*** *Learner will be able to determine coefficient of friction between two different surfaces in contact.* **Contents:** Concept of Friction, coefficient of friction, angle of repose. Experiment 5: To determine coefficient of friction using friction plane. Experiment 6: To determine coefficient of friction using angle of repose method. ***Self-Learning Topics:*** ***Learning Outcomes:*** *A learner will be able to* *LO 3.1: Identify the effects of friction on different surfaces. (P.I.-1.4.1,8.2.1).* *LO 3.2: Identify the parameters affecting the friction values. (P.I.-2.1.2).* *LO 3.3: determine the coefficient of friction and present the results as a team. (P.I.-1.3.1,8.3.1)* *LO 3.4: compare and select the accurate method to determine coefficient of friction. (P.I.-2.2.3)*	**07**
04.	**Kinematics of particles**	**07**

	Learning Objectives: *Learner will be able to analyze the motion of particle.*	
	Contents: Study of translational motion and projectile motion **Experiment 7:** To study the motion of the projectile. **Experiment 8:** To measure and verify average speed of the vehicle.	
	Self-Learning Topics:	
	Learning Outcomes: *A learner will be able to* *LO 4.1: Identify the variables associated with the projectile motion (P.I-1.2.1).* *LO 4.2: Determine the range and height of the particle during projectile motion and present the result as a team. (P.I.2.1.2,8.3.1)* *LO 4.3: Estimate velocities and distance travelled by the particle with a collaborative effort of a team. (P.I.-2.2.3,8.2.1).* *LO 4.4: Measure the speed of the particle. (P.I.-1.4.1).*	
	Course Conclusion	**01**
	Total	**30**

Performance Indicators:

P.I. No.	P.I. Statement
1.2.1	Apply laws of natural science to an engineering problem.
1.3.1	Apply fundamental engineering concepts to solve engineering problems.
1.4.1	Apply Mechanical engineering concepts to solve engineering problem.
2.1.2	Identify engineering systems, variables, and parameters to solve the problems.
2.2.1	Reframe complex problems into interconnected sub-problems.
2.2.3	Identify existing processes/solution methods for solving the problem, including forming justified approximations and assumptions.
8.2.1	Demonstrate effective communication, problem solving, conflict resolution and leadership skills.
8.3.1	Present results as a team, with smooth integration of contributions from all individual efforts.

Course Outcomes: A learner will be able to

1. Learner will be able to Demonstrate the Equilibrium of Coplanar Force System. *(LO 1.1, LO 1.2, LO 1.3, LO 1.4, LO 2.2)*
2. Learner will be able to demonstrate law of moments. *(LO 2.1, LO 2.2, LO 2.3, LO 2.4, LO 2.5)*
3. Learner will be able to determine coefficient of friction between two different

surfaces in contact. *(LO 3.1, LO 3.2, LO 3.3, LO 3.4)*

4. Learner will be able to analyse motion of a particle. *(LO 4.1, LO 4.2, LO 4.3, LO 4.4, LO 3.3)*

CO-PO Mapping Table with Correlation Level

CO ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
ESL101.1	3	3	-	-	-	-	-	3	-	-	-
ESL101.2	3	3	-	-	-	-	-	3	-	-	-
ESL101.3	3	3	-	-	-	-	-	3	-	-	-
ESL101.4	3	3	-	-	-	-	-	3	-	-	-
Average	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**-**	**-**

Text Books :

1. Engineering Mechanics by A K Tayal, Fourteenth Edition, 2011 Umesh Publication.
2. Engineering Mechanics by Kumar, Fourth Edition, 2017 Tata McGraw Hill
3. Engineering Mechanics by F. L. Singer, Third Edition, 1975, Harper & Raw
4. Engineering Mechanics by R. C.Hibbeler , Fourth Edition, 2017, Pearson Education

Reference Books :

1. Engineering Mechanics by Beer &Johnston, Fourth Edition, 1987 ,Tata McGrawHill
2. Engineering Mechanics (Statics) by Meriam and Kraige, Fourth Edition, 1999 WileyBooks
3. Engineering Mechanics by TImoshenkos Fifth Edition,2015, generic

IN-SEMESTER ASSESSMENT (25 MARKS)

1. Practical performance based on all the experiments mentioned in the syllabus with proper understanding : 10 Marks
2. Oral evaluation on experiments conducted on Statics :5 Marks
3. Oral evaluation on experiments conducted on Dynamics:5 Marks
4. Regularity and active participation: 5 Marks

Course Type	Course Code	Course Name	Credits
ESL	ESL102	BASIC ELECTRICAL ENGINEERING LABORATORY	01

Examination Scheme		
Continuous Assessment	**End Semester Exam(ESE)**	**Total Marks**
25	25	50

Pre-requisite:

1. ESC102: Basic Electrical Engineering

Program Outcomes addressed:

1. PO2: Problem analysis
2. PO4: Conduct investigations of complex problems
3. PO6: The Engineer and The World
4. PO8: Individual and Collaborative teamwork

Course Objectives:

1. To impart the knowledge on the analysis and applications of D.C. circuits and single-phase AC circuits.
2. To impart the knowledge on the elements of residential electrical system, appliances and electrical safety.
3. To impart the knowledge on the construction, working principle of transformer and motors and selection of motor for a specific application.

Module	Detailed Contents	Hrs
00.	**Course Introduction** The Basic Electrical Lab course is designed to introduce fundamental concepts in electrical engineering through hands-on laboratory experiments. Through a series of practical exercises, students will develop essential skills for working with basic electrical components and circuits.	**01**
01.	***Learning Objective:*** *To impart knowledge on circuit mounting on breadboard, meters used and concept of theorems and laws required for analysis of DC circuits.*	**08**
	Experiment: Verify network theorems and laws to interpret the current and voltage distribution in DC circuits.	
	Self-Learning Topics: *Concepts of Series and parallel circuits and Superposition Theorem.*	

	Learning Outcomes: *A learner will be able to* *LO1.1 Assemble circuit on breadboard and use DC power supply, multimeter, ammeter and voltmeter for measuring current and voltage in DC circuits in a group. (P.I.-4.1,3, 8.3.1)* *LO1.2 Measure current and voltage in electrical circuits and verify Ohm's law, Kirchhoff's laws, mesh analysis and nodal analysis practically and theoretically and submit a report. (P.I.- 4.1.4, 8.3.1)* *LO1.3 Verify Thevenin's theorem, Norton's theorem and Maximum power transfer theorem in a DC circuit and summarize results in a report. (P.I.-4.1.4, 8.2.1)*	
02.	***Learning Objective/s:*** *To impart knowledge on circuit assembly on breadboard and analysis of Alternating Current (AC) circuits.*	**08**
	Experiment: Analyze series and parallel connected AC circuits by determining circuit elements and resonant conditions.	
	Learning Outcomes: *A learner will be able to* *LO2.1 Determine the inductance of a choke coil by measuring the voltage across and current through a series and parallel connected resistance and choke coil and summarize the results in a report. (4.1.3, 8.2.1)* *LO2.2 Measure the resonance frequency in RLC series and parallel circuit and plot resonance curve. (4.1.4,8.3.1)*	
03.	***Learning Objective/s:*** *To impart knowledge on household electrical wiring and safety devices, maintenance and up keeping of home appliances used in our day-to-day life.*	**08**
	Experiment: Implementation of given residential electrical system incorporating safety devices and up-keeping of home appliances.	
	Learning Outcomes: *A learner will be able to* *LO3.1 Assemble small electrical circuits similar to residential wiring system along with safety devices and submit a report. (4.1.3, 8.3.1)* *LO3.2 Prepare test boards / extension boards and mount accessories like lamp holders, various switches, sockets, fuses, MCB, ELCB, MCCB etc. (6.1.1, 9.3.1)* *LO3.3 Wire up PVC conduit wiring to control one lamp from two different places in a group. (Staircase wiring) (4.2.1, 8.3.1)* *LO3.4 Maintenance and up-keeping of household electrical appliances and submit a report. (4.1.3, 8.2.1)*	
04	***Learning Objective/s:*** *To introduce concept of motor selection for given application, transformer connections and its testing.*	**05**
	Experiment: • Identify electrical motors for given application. • Analyse transformer by identifying name plate details, transformation ratio, polarity and regulation.	

	Learning Outcomes: *LO4.1 Identify electrical motors for various electrical appliances like Fan, mixer, Vacuum cleaner, Washing machine, Water pump etc. and submit a report. (2.2.4, 8.2.1)* *LO4.1 Verify terminals, study the name plate details and calculate transformation ratio of single-phase transformers. (4.1.3, 8.3.1)* *LO4.1 Perform polarity test on transformers. (2.1.2,8.3.1)* *LO4.1 Determine voltage regulation of single-phase transformer by conducting direct load test and summarize results in a report. (4.2.1, 8.3.1)*	
	Total	**30**

Performance Indicators:

P.I. No.	**P.I. Statement**
2.1.2	Identify engineering systems, variables, and parameters to solve the problems.
2.2.4	Compare and contrast alternative solution processes to select the best process.
4.1.3	Apply appropriate instrumentation and/or software tools to make measurements of physical quantities.
4.1.4	Establish a relationship between measured data and underlying physical principles.
4.2.1	Design and develop experimental approach, specify appropriate equipment and procedures
6.1.1	Identify and describe various engineering roles; particularly as pertains to protection of the public and public interest at global, regional and local level
8.2.1	Demonstrate effective communication, problem solving, conflict resolution and leadership skills.
8.3.1	Present results as a team, with smooth integration of contributions from all individual efforts

Course Outcomes:

Learner will be able to

1. Assemble the DC and AC circuits on breadboard and test the continuity. *(LO1.1, LO2.1, LO3.1)*
2. Select the meters to measure the required variables and analyse the performance of DC and AC circuits. (*LO1.2, LO1.3, LO2.2)*
3. Assemble simple residential electrical wiring incorporating safety devices. (*LO3.2, LO3.3, LO3.4)*
4. Select motor for household applications and test the transformer. (*LO4.1, LO4.2, LO4.3, LO4.4)*

CO-PO Mapping Table with Correlation Level

CO ID	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
ESL102.1	-	-	-	3	-	-	-	3	-	-	-
ESL102.2	-	-	-	3	-	-	-	3	-	-	-
ESL102.3	-	-	-	3	-	2	-	3	-	-	-
ESL102.4	-	3	-	3	-	-	-	3	-	-	-
Average	**-**	**3**	**-**	**3**	**-**	**2**	**-**	**3**	**-**	**-**	**-**

Text Books:

1. Electrical Power Systems, S.L. Uppal and Prof. Sunil S. Rao 15th Edition, Khanna Publishers
2. Basic Electrical Engineering, B.R Patil, 2nd Edition Oxford Higher Education, 2019
3. Art & Science of Utilization of electrical Energy, H Partab, Dhanpat Rai & Co., 2004.
4. Electrical and Electronic Measurements and Measuring Instruments, A K Sawhney Dhanpat Rai and Sons
5. Special Electrical Machines, E G Janardanan PHI 2014
6. Electrical Power Systems, S.L. Uppal and Prof. Sunil S. Rao, 15th Edition, Khanna Publishers

Reference Books:

1. Power System Engineering, D P Kothari and I J Nagrath 3rd Edition, Mac Graw Hills,
2. Electrical Engineering Fundamentals, Vincent Del Toro, PHI Second edition, 2011
3. Utilization of Electric Power & Electric Traction, J B Gupta, 10th Edition, Dhanpat Rai and Sons 2012
4. Electrical Engineering, B.L.Theraja Vol-I and II
5. Basic Electrical Engineering, S.N.Singh PHI, 2011

Other Resources:

1. NPTEL course on Basic Electrical Technology, IISc Bangalore Prof. L. Umanand https://nptelvideos.com/course.php?id=460
2. Virtual Lab - https://asnm-iitkgp.vlabs.ac.in

A. IN-SEMESTER ASSESSMENT (25 Marks)

1. Practical Exercises – 10 Marks

1. Readiness to perform experiment (2 Marks),
2. Performance (2 Marks),
3. Report writing (2 Marks),
4. Interpretation of result (2 Marks)
5. Regularity in submission (2 Marks).

2. Practical Test 1 (Based on first 50% of practical list) – 5 Marks

3. Practical Test 2 (Based on remaining 50% of practical list) – 5 Marks

4. Regularity and active participation – 5 Marks

B. END SEMESTER ASSESSMENT (25 Marks)

Two examiners, one internal and one external will do the evaluation

1. Students will be randomly allocated and experiment from the list of laboratory exercises and will be asked to draw circuit diagram, observation table with relevant formulae. It will be checked by the examiners and evaluated out of 05 Marks.
2. Then the student will be allowed to start with the performance of the experiment.

3. Students will be given 1 hour to complete the circuit connection and take readings. The connections and output are verified by the examiners. The weightages 05 Marks.
4. Students will do sample calculations, draw relevant graphs and write conclusion of the experiment. It will be checked by the examiners and evaluated out of 05 Marks.
5. Students will be appearing for Oral test front of both Internal and External examiners. The weightage of Oral test will be of 10 marks.

Course Type	Course Code	Course Name	Credits
ESL	ESL103	PROGRAMMING LABORATORY-I (C)	02

Examination Scheme		
Continuous Assessment	**End Semester Exam(ESE)**	**Total Marks**
50	50	100

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO5: Engineering tool usage
4. PO11: Life-long learning

Course Objectives:

1. To provide exposure to problem-solving by developing an algorithm, flowchart and implement the logic using C programming language.
2. To familiarize basics of Conditional and Looping Control Structures in C.
3. To provide exposure about function definition, declaration and its usage and recursive functions.
4. To familiarize one and multi-dimensional arrays, structures and strings in C.
5. To provide exposure about pointers, operations on pointers and dynamic memory allocation in C programming language.

Module	Details	Hrs.
00.	**Course Introduction** Knowledge of problem solving and programming concepts is essential for those who develop applications for users. This course imparts basic knowledge in C programming along with the concepts of design and development of programs using C.	**01**
01.	**Introduction to Algorithm, Flowchart and C.** ***Learning Objective:*** *Learner is expected to recall basics of algorithm, flowchart and C. Also expected to understand problem-solving approach and apply the logic to implement program using C. Investigate the functioning of various components of the given control system as a team*	
	Contents: Basic Concept of Problem solving, Introduction to Algorithm and Flowchart. Character Set, Identifiers and keywords, Data types, Constants, Variables. Operators-Arithmetic, Relational and logical, Assignment, Unary, Conditional, Bitwise, Comma, other operators. Expression, statements, Library Functions, Preprocessor. Data Input and Output – getchar( ), putchar( ), scanf( ), printf( ), gets( ), puts( ), Structure of C program . **Task 1:** Algorithm and flowchart to find greatest of three numbers, sum of N natural numbers.	**07**

	Task 2: C program to calculate 40% da from basics, 20% hra from basics. Also calculate the gross salary of an employee. (GS=BS+DA+HRA)	
	Learning Outcomes: *A learner will be able to* *LO 1.1: Apply algorithms on problem statements. (P.I.- 1.1.1)* *LO 1.2: Use symbols to draw flowcharts for problems. (P.I.- 1.3.1)* *LO 1.3: Identify data types, variables and operators to be used in C according to a problem. (P.I.- 2.1.2)* *LO 1.4: Solve the problem using operators in C. (P.I.- 2.2.3)* *LO 1.5: Adapt modern tool VS code to solve problem using data input/output, operators. (P.I.- 5.1.2)* *LO 1.6: Use VS code to check if the result of the C program using operators is accurate(P.I.- 5.3.2)*	
02.	**Control Structures in C** ***Learning Objective:*** *Learner is expected to recall basics of Control Structures and understand Conditional structures. Also expected to apply it to solve problems in C.*	**16**
	Contents: Branching - If statement, If-else Statement, Multiway decision. Looping – while, do-while, for Nested control structure- Switch statement, Continue statement, Break statement, Goto statement. **Task 3:** C Program to compare two numbers and determine whether they are odd or even. **Task 4:** C Program to find percentage marks of four subjects. Then determine whether the student has secured distinction, first class, second class or fail. Percentage >=75 Distinction, Percentage >= 60 First class, Percentage >= 40 second class etc. **Task 5:** C Program to print numbers between 1 and 100 which are multiples of 5 by using do while loop.	
	Self-Learning Topics: *Differentiate between break and continue statements based on their usage in loops.*	
	Learning Outcomes: *A learner will be able to* *LO 2.1: Apply if control statements in C. (P.I.- 1.1.1)* *LO 2.2: Use if else control statements in C. (P.I.- 1.3.1)* *LO 2.3: Identify data types, variables and loops to be used in C for a problem. (P.I.- 2.1.2)* *LO 2.4: Reframe the problem and use nested control structure to solve problems in C. (P.I.- 2.2.1)* *LO 2.5: Adapt modern tool VS code to solve problem using control structures (P.I.- 5.1.2)* *LO 2.6: Use VS code to check if the result of the C program using loops is accurate (P.I.- 5.3.2)*	
03.	**Functions in C**	

	Learning Objective: *Learner is expected to recall function definition, declaration. and understand its usage. Also expected to apply it to solve problems in C.*	
	Contents: Function -Introduction of Function, Function Main, Defining a Function, Accessing a Function, Function Prototype, Passing Arguments to a Function, Recursion. Storage Classes –Auto, Extern , Static, Register **Task 6:** C Program to create four types of user defined function for addition ( ) of two numbers. **Task 7:** C Program to find Fibonacci series for given no of elements using recursive function.	
	Self-Learning Topics: *Write two programs using functions which have been written using loops.*	**12**
	Learning Outcomes: *A learner will be able to* *LO 3.1: Apply functions to write program in C. (P.I.- 1.1.1)* *LO 3.2: Use appropriate storage class in C. (P.I.- 1.3.1)* *LO 3.3: Identify data types, variables and type of user defined function to be used in C according to a problem. (P.I.- 2.1.2)* *LO 3.4: Reframe the problem and use recursive function to solve problems in C. (P.I.- 2.2.1)* *LO 3.5: Adapt modern tool VS code to solve problem using functions. (P.I.- 5.1.2)* *LO 3.6: Use VS code to check if the result of the C program using functions is accurate(P.I.- 5.3.2)*	
04.	***Arrays, Strings in C***	**12**
	Learning Objectives: *Learner is expected to recall one dimensional arrays and understand its usage and apply it to solve problems in C.*	
	Contents: Array-Concepts, Declaration, Definition, Accessing array element, One- dimensional and Multidimensional array. String- Basic of String, Array of String, Functions in String.h **Task 8:** C Program to sort elements in ascending order in an array. **Task 9:** C Program to check if string is palindrome or not.	
	Self-Learning Topics: *Write two-dimensional array programs for matrix addition and multiplication.*	
	Learning Outcomes:	
	A learner will be able to *LO 4.1: Use 1D arrays to write program in C. (P.I.- 1.1.1)* *LO 4.2: Apply strings to write programs in C. (P.I.- 1.3.1)* *LO 4.3: Identify data types, variables and type of arrays to be used in C according to a problem. (P.I.- 2.1.2)* *LO 4.4: Reframe the problem and use arrays to solve problems in C. (P.I.- 2.2.1)* *LO 4.5: Adapt modern tool VS code to solve problem using arrays. (P.I.- 5.1.2)*	

	LO 4.6: Use VS code to check if the result of the C program using arrays is accurate(P.I.- 5.3.2)	
05.	**Structures and Pointers in C** ***Learning Objective/s:*** *Learner is expected to recall pointers, operations on pointers and its usage and apply it to solve problems in C.*	**12**
	Contents: Structure- Declaration, Initialization, structure within structure, Operation on structures, Array of Structure. Pointer: Introduction, Definition and uses of Pointers, Address Operator, Pointer Variables, Pointer Arithmetic, Pointers to Pointers, Pointers and Array, Passing Arrays to Function, Pointers and Function, Pointers and two-dimensional Array, Array of Pointers, Dynamic Memory Allocation **Task 10:** C Program to create a structure to enter details for 5 students. The details are name, branch, roll no and marks of five different subjects. Also calculate the total marks and arrange them in ascending order. **Task 11:** C Program to create, initialize, assign and access a pointer variable. **Task 12:** C Program to Swap two numbers using call by value and call by reference functions.	
	Learning Outcomes : *A learner will be able to* *LO 5.1: Apply structures to write program in C. (P.I.- 1.1.1)* *LO 5.2: Use pointers in C to write programs. (P.I.- 1.3.1)* *LO 5.3: Identify data types, variables and type of function for dynamic memory allocation to be used in C according to a given problem. (P.I.- 2.1.2)* *LO 5.4: Reframe the problem and use pointer arithmetic to solve problems in C. (P.I.- 2.2.1)* *LO 5.5: Adapt modern tool VS code to solve problem using pointers, structures. (P.I.- 5.1.2)* *LO 5.6: Use VS code to check if the result of the C program using pointers is accurate (P.I.- 5.3.2)* *LO 5.7: Learn new ways to use pointers and structures in professional work. (P.I.- 11.1.1)* *LO 5.8: Identify new updates like dynamic memory management in C programming so that they can use it for writing efficient programs in future. (P.I.- 11.2.1)*	
	Course Conclusion	**01**
	Total	**60**

Performance Indicators:

P.I. No.	**P.I. Statement**
1.1.1	Apply the knowledge of discrete structures, linear algebra, statistics and numerical techniques to solve problems.
1.3.1	Apply engineering fundamentals.
2.1.2	Identifies processes/modules/algorithms of a computer based system and parameters to solve a problem
2.2.1	Reframe the computer-based system into interconnected subsystems

2.2.3 Identify existing solution/methods to solve the problem, including forming justified approximations and assumptions
5.1.2 Create/adapt/modify/extend tools and techniques to solve engineering problems
5.3.2 Verify the credibility of results from tool use with reference to the accuracy and limitations, and the assumptions inherent in their use
11.1.1 Describe the rationale for the requirement for continuing professional development
11.2.1 Identify historic points of technological advance in engineering that required practitioners to seek education in order to stay current.

Course Outcomes: A learner will be able to -

1. Illustrate the basic terminology used in computer programming concept of data types, variables and operators using C. (*LO 1.1, LO 1.2, LO 1.3, LO 1.4, LO 1.5, LO 1.6*)
2. Use control structure concepts in C programming (*LO 2.1, LO 2.2, LO2.3 LO 2.4, LO 2.5, LO 2.6*)
3. Develop functions and use it to solve problems in C using modern tools. (*LO 3.1, LO 3.2, LO 3.3, LO 3.4, LO 3.5, LO 3.6*)
4. Apply arrays and strings to solve problems in C. (*LO 4.1, LO 4.2, LO 4.3, LO 4.4, LO 4.5, LO 4.6*)
5. Demonstrate the use of structures, dynamic memory allocation and pointers in C. (*LO 5.1, LO 5.2, LO 5.3, LO 5.4, LO 5.5, LO 5.6, LO 5.7, LO 5.8*)

CO-PO Mapping Table with Correlation Level

CO ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
ESL103.1	3	3	-	-	3	-	-	-	-	-	-
ESL103.2	3	3	-	-	3	-	-	-	-	-	-
ESL103.3	3	3	-	-	3	-	-	-	-	-	-
ESL103.4	3	3	-	-	3	-	-	-	-	-	-
ESL103.5	3	3	-	-	3	-	-	-	-	-	3
Average	**3**	**3**	-	-	**3**	-	-	-	-	-	**3**

Text Books :

1. The C Programming Language, Brian W. Kernighan, Dennis M. Ritchie, Second Edition, 2015, Pearson Education India.
2. Programming with C, Byron S. Gottfried, Fourth Edition, 2018, Tata McGraw-Hill Publications.
3. Programming in ANSI C, E. Balaguruswamy, Eighth edition, 2019, Tata McGraw-Hill Publications.

Reference Books :

1. Programming in C, Pradeep Day and Manas Gosh, Second Edition, 2013, Oxford University Press.
2. Let Us C: Authentic Guide to C Programming Language, Yashwant Kanetkar, Nineteenth Edition, 2023, BPB Publication.

Other Resources :

1. NPTEL Course: Introduction to Programming in C By Prof. Satyadev Nandakumar, Department of Computer Science and Engineering, IIT Kanpur

Web link- https://archive.nptel.ac.in/courses/106/104/106104128/

2. Problem Solving through Programming in C By Prof. Anupam Basu, Department of Computer Science and Engineering Engineering, IIT Kharagpur
Web link- https://archive.nptel.ac.in/courses/106/105/106105171/

IN-SEMESTER ASSESSMENT (50 MARKS)

1. Task Execution (30 Marks)

Students will be given minimum 12 tasks.
Students are expected to

1. Identify variables, data types methods/approach required to write the code for the given task and apply the same.
2. Gain knowledge of Operators, data input and output concept
3. Recall basics control structures, understand conditional structures and apply it to solve problems in C.
4. Execute given task for different inputs and verify the result
5. Execute the function and integrate the functions for task completion.
6. Create a 1D, 2D array to solve problem.
7. Apply structure concept to solve the problem.
8. Apply concept of pointers to solve the problem.

Students will be evaluated based on following:

1. Logic building for the given task (10 marks)
2. Rectifying logical errors and syntax errors (06 marks)
3. Well-structured and organized program (06 marks)
4. Verification of experiment output for different inputs (08 marks)

Refer the sample task given below.
Example: Write a menu driven (use Switch, do --- while) C program to perform different calculations using function,
Students are expected to,

1. Identify variables, data types methods/approach required to create teacher class and add methods to display details of a given teacher
2. Execute given task for different inputs and verify the result
3. Follow the coding standards
4. Identify errors and rectify the errors.

Students are evaluated based on following:

1. Logic building for the given task (10 marks)
2. Rectifying logical errors and syntax errors (06 marks)
3. Well-structured and organized program (06 marks)
4. Verification of experiment output for different inputs (08 marks)

2. Regularity and active participation: (05 Marks)

3. Practical Test (15 Marks)

a) Task Execution: 10 Marks

1. Logic building for the given task (04marks)
2. Rectifying logical errors and syntax errors (02 marks)

2. Well-structured and organized program (02 marks)
3. Verification of experiment output for different inputs (02 marks)

b) Oral: 05 Marks

END SEMESTER EXAMINATION (Practical & Oral Exam) (50 Marks)

1. Task Execution: 30 Marks

   Students will be given task (different task for every student) to execute and will be evaluated as per the parameters mentioned in continuous evaluation
2. Presentation of Results and conclusion, Inferences drawn: 05 Marks
3. Oral based on entire syllabus: 15 Marks

Two examiners, one Internal and one External will do the evaluation.

Course Type	Course Code	Course Name	Credits
SEC	SEC101	BASIC WORKSHOP PRACTICE- I	01

Examination Scheme		
Term Work	**Practical /Oral**	**Total**
50	--	50

Pre-requisite:

NIL

Program Outcomes addressed :

1. PO1:Engineering knowledge
2. PO5: Engineering tool usage
3. PO6: The Engineer and The World
4. PO8: Individual and collaborative team work
5. PO11: Life-long learning

Course Objectives :

1. To impart training to help the students develop engineering skill sets.
2. To inculcate respect for physical work and hard labour.
3. To get exposure to interdisciplinary engineering domain.

Module	Details	Hrs
00.	**Course Introduction** The Basic Workshop Practice I course is intended to give participants with the core information and abilities required for working safely and effectively in a workshop environment. This hands-on course introduces the fundamental principles, equipment, and techniques utilised in a variety of workshop scenarios, such as fitting, hardware and networking, and welding.	**01**
01.	***Learning Objectives:*** *1. To familiarize participants with reading and interpreting technical drawings, and schematics related to fitting tasks.* *2. To enhance participants' proficiency in fitting various components or materials together accurately and securely using various fitting tools.* *3. To make participants learn to use precision measuring tools to verify part dimensions and ensure quality control.*	**09**
	Content: Fitting • Use and setting of fitting tools for chipping, cutting, filing, marking, center punching, drilling, tapping. • Term work to include one job involving following operations: filing to size, one simple male- female joint, drilling and tapping.	
	Learning Outcomes :	

	A learner will be able to *LO1.1: Read and interpret technical drawings, or schematics related to fitting tasks, identifying dimensions, tolerances, and other specifications accurately. (P.I.- 1.3.1, 11.3.1)* *LO1.2: Demonstrate proficiency in fitting techniques. (P.I.- 5.3.1)* *LO1.3: Competent in the effective use of precision measuring tools to examine work pieces, confirm dimensions, and ensure adherence to quality requirements and standards. (P.I.- 1.4.1, 5.2.2, 11.3.1, 11.3.2)*	
02.	***Learning Objectives:*** *1. To gain a comprehensive understanding of computer hardware components and peripheral devices.* *2. To learn how to assemble a computer system, set up and configure network infrastructure components, including routers, switches, access points, and cables, to create a functional network environment.* *3. To develop the skills to diagnose and troubleshoot common hardware and network problems.*	**10**
	Content: Hardware and Networking • Dismantling of a Personal Computer (PC), Identification of components of a PC such as power supply, motherboard, processor, hard disk, memory (RAM, ROM), CMOS battery, CD drive, monitor, keyboard, mouse, printer, scanner, pen drives, disk drives, etc. • Assembling of PC, Installation of Operating System (Any one) and Device drivers, Boot-up sequence. Installation of application software (at least one). • Basic troubleshooting and maintenance. • Identification of network components: LAN card, wireless card, switch, hub, router, different types of network cables (straight cables, crossover cables, rollover cables) Basic networking and crimping.	
	Learning Outcomes : *A learner will be able to* *LO2.1: Identify and understand the various hardware components of a computer system. (P.I.- 5.1.2, 11.1.1)* *LO2.2: Assemble a computer system, set up and configure network infrastructure components to create a functional network environment. (P.I.- 1.2.1, 5.2.2, 11.2.1)* *LO2.3: Develop the skills to diagnose and troubleshoot common hardware and network problems. (P.I.- 1.3.1, 6.1.1, 6.3.1)*	
03.	***Learning Objectives:*** *1. To understand welding symbols and their meanings as per standard welding blueprints. Interpret welding drawings and specifications accurately.* *2. To become familiar with welding equipment, including welding machines, electrodes, torches, gas cylinders, filler metals, and other tools. Learn how to set up and operate welding equipment safely and efficiently.* *3. To develop proficiency in various welding techniques such as lap welding, butt welding, fillet welding, and groove welding. Practice achieving proper weld bead geometry, penetration and fusion.*	**08**
	Content: Welding	

	• Introduction to welding equipment. Edge preparation for welding jobs. Arc welding for different job like, lap welding of two plates, butt welding of plates with simple cover, arc welding to join plates at right angles. One job on gas welding.	
	Learning Outcomes : *A learner will be able to* *LO3.1: Interpret welding symbols and blueprints accurately, understanding weld joint designs, dimensions, and specifications as per industry standards. (P.I.- 8.3.1, 11.3.1)* *LO3.2: Produce welds that meet industry standards and specifications, demonstrating the ability to achieve proper weld penetration, fusion, and surface finish while minimizing defects such as porosity, lack of fusion, and undercutting. (P.I.- 1.3.1, 1.4.1, 5.2.2, 5.3.1, 6.1.1, 6.3.1, 8.1.1, 11.3.2)*	
04.	***Learning Objectives:*** *1. To gain knowledge of the different parts of a lathe machine, including the bed, headstock, tailstock, carriage, tool post, chuck, and various controls.* *2. To gain an understanding of lathe operations such as turning between centers, chucking, facing, taper turning, and threading. Understand the sequence of operations and the appropriate use of cutting tools and feeds for each operation.*	**02**
	Content: Machine Shop • Machine Shop (Demo of one simple lathe job) (Only for Mechanical Engineering students, other department students can utilized this time to complete the pending work, if any).	
	Learning Outcomes : *A learner will be able to* *LO4.1: Identify different parts of a lathe machine and understand operations that can be carried out on it. (P.I.- 11.1.1, 11.3.1)*	

Performance Indicators:

P.I. No.	P.I. Statement
1.2.1	Apply laws of natural science to an engineering problem.
1.3.1	Apply fundamental engineering concepts to solve engineering problems.
1.4.1	Apply Mechanical engineering concepts to solve engineering problems.
5.1.2	Create/adapt/modify/extend tools and techniques to solve engineering problems.
5.2.2	Demonstrate proficiency in using discipline-specific tools.
5.3.1	Discuss limitations and validate tools, techniques and resources.
6.1.1	Identify and describe various engineering roles; particularly as pertains to protection of the public and public interest at the global, regional and local level.
6.3.1	Identify risks/impacts in the life-cycle of an engineering product or activity
8.1.1	Recognize a variety of working and learning preferences; appreciate the value of diversity on a team.
8.3.1	Present results as a team, with smooth integration of contributions from all individual efforts.

11.1.1 Describe the rationale for the requirement for continuing professional development.

11.2.1 Identify historic points of technological advance in engineering that required practitioners to seek education in order to stay current.

11.3.1 Source and comprehend technical literature and other credible sources of information.

11.3.2 Analyse sourced technical and popular information for feasibility, viability, sustainability, etc.

Course Outcomes: A learner will be able to

1. Develop the necessary skill required to handle/use different fitting tools. (*LO 1.1, LO 1.2, LO 1.3*)
2. Develop skill required for hardware maintenance and installation of operating system. (*LO 2.1, LO 2.2, LO 2.3*)
3. Identify the network components and perform basic networking and crimping. (*LO 2.1, LO 2.2, LO 2.3*)
4. Prepare the edges of jobs and do simple arc welding. (*LO 3.1, LO 3.2*)

CO-PO Mapping Table with Correlation Level

CO ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
SEC101.1	3	-	-	-	3	-	-	-	-	-	3
SEC101.2	3	-	-	-	3	3	-	-	-	-	3
SEC101.3	3	-	-	-	3	3	-	-	-	-	3
SEC101.4	3	-	-	-	3	3		3	-	-	3
Average	**3**	**-**	**-**	**-**	**3**	**3**	**-**	**3**	**-**	**-**	**3**

Continuous Internal Assessment (CIA) - (50 Marks)

Job Work with complete workshop book : 40 Marks

Attendance and Active participation : 10 marks

Course Type	Course Code	Course Name	Credits
VEC	VEC101	UNIVERSAL HUMAN VALUES	02

Program Outcomes addressed:

1. PO6 : The Engineer & The World
2. PO7 : Ethics
3. PO11: Life-long learning

Course Objectives :

1. To help the student see the need for developing a holistic perspective of life.
2. To sensitize the student about the scope of life – individual, family (inter-personal relationship), society and nature/existence
3. To strengthen self-reflection.
4. To develop more confidence and commitment to understand, learn and act accordingly

Topic Title	Aspirations and Issues	Basic Realities (underlying harmony)
Welcome and Introductions	Getting to know each other	Self-exploration
Aspirations and Concerns	Individual academic, career… Expectations of family, peers, society, nation… Fixing one's goals	Basic human aspirations Need for a holistic perspective Role of UHV
Self-Management	Self-confidence, peer pressure, time management, anger, stress… Personality development, self-improvement…	Harmony in the human being
Health	Health issues, healthy diet, healthy lifestyle Hostel life	Harmony of the Self and Body Mental and physical health
Relationships	Home sickness, gratitude towards parents, teachers and others Ragging and interaction Competition and cooperation Peer pressure	Harmony in relationship Feelings of trust, respect… gratitude, glory, love
Society	Participation in society	Harmony in the society
Natural Environment	Participation in nature	Harmony in nature/existence
Total no. of hours: **30**		

Course Outcomes :

1. Analyze the significance of value inputs provided in formal education along with skills and develop a broader perspective about life and education
2. Formulate their aspirations and concerns at different levels of living, and the way to fulfill them in a sustainable manner.
3. Evaluate their current state of understanding and living, and model a healthy lifestyle
4. Examine the issues of home sickness, interactions with seniors on the campus, peer pressure with better understanding and feel grateful towards parents, teachers and others
5. Develop more confidence and commitment for value-based living in family, society and nature

Text Books :

1. Human values & Professional Ethics by R. R.Gaur, R Sangal, G. P.Bagaria, 2010, Excel Books , New Delhi

Reference Books :

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, Published by 2004 by New Age Intl. Publishers, New Delhi.
3. The Story of Stuff by Annie Leonard, published in 2010 by Free Press.
4. Small is Beautiful by E. F. Schumacher, published in 1973 by Harper & Row.
5. Slow is Beautiful by Cecile Andrews, published in 2006 by New Society Publishers

Other Resources :

1. NPTEL Course: Exploring Human Values: Visions of Happiness and Perfect Society, By Prof. A.K. Sharma, Department of Humanities and Social Sciences, IIT Kanpur:-Web link- https://nptel.ac.in/courses/109104068
2. NPTEL Course: Moral Thinking: An Introduction To Values And Ethics By Prof. Vineet Sahu, IIT Kanpur:-Web link- https://onlinecourses.nptel.ac.in/noc23_hs89/preview

Course Type	Course Code	Course Name	Credits
BSC	BSC204	ENGINEERING MATHEMATICS-II	03+01*

Examination Scheme					
Distribution of Marks			Exam Duration (Hrs.)		Total Marks
In-semester Assessment		End Semester Examination (ESE)			
Continuous Assessment	Mid-Semester Exam (MSE)		MSE	ESE	
20 + 25*	30	50	1.5	2	125

Pre-requisite:

1. Differentiation of several variable I & II
2. Vector Differentiation

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem analysis

Course Objectives:

1. To provide the Basic knowledge of the concepts of Mathematics applicable to the field of engineering.
2. To build a mathematical foundation of the methodology required for solving application based problems in the field of Engineering.

Module	Details	Hrs.
00.	**Course Introduction** Mathematics is the fundamental step which creates a solid foundation for all Applied fields of Engineering. Professional Engineering applications have Mathematics as an integral part of their evolution. Forexample: Formulation in Mathematics to various engineering field using case study. Introduction to differential equations from Electrical circuit. Introduction to Multiple Integration from real life application.Use the concept of vector integration into Fluid Mechanics**.** Hence, Formulation Based Mathematics is a fundamental requisite to all fields of Engineering for analyzing their performances.	01
01.	**Differential Equations of First Order and First Degree** ***Learning Objective/s:*** *Learner will be able to* ***1.*** *Analyse and interpret the basic fundamentals of differential equations (D.E)of first order & first degree.* ***2.*** *Determine the solution of a first order D.E by applying the basic concepts*	6-8

	ofexact and linear DE.	
	Contents: Definition, Formation of Differential equation, Exact differential Equations, Non Exact Differential Equation, Integrating Factors, Rules for finding the integrating factor, Linear Differential Equations, Equation reducible to Linear form , Bernoulli's equation.	
	Self-Learning Topics: ***Self-Learning Topics:*** *Application of differential equations of First Order and First Degree in electricalcircuits and thermodynamics.*	
	Learning Outcomes: *A learner will be able to* *LO 1.1* : *Identify the exact differential equation and linear differential equations and solve them using appropriate method by applying the fundamentals of differentiation and integration. (PI-2.1.3 , 2.2.3 & 1.1.1)* *LO 1.2 : Apply the fundamental engineering concepts to model a first order DE and solve it.(PI-1.3.1)*	
02.	**Linear Differential Equations with Constant Coefficients of Higher Order type f(D)y = X** ***Learning Objective:*** *Learner will be able to* 1. *Analyse and interpret the basic fundamentals of higher order differentialequations (HODE).* 2. *Determine the solution of a HODE by applying the basic concepts of complementary function and particular integral.*	**7-9**
	Contents: Complementary Function, Particular Integral, Type 1. X = e^{ax} , Type 2 X = x^n ,Type 3 X = $cos(ax+b) or\ sin(ax+b)$,Type 4 X = $e^{ax}V$ Type 5 X= xV, General Type - Method of variation of parameters	
	Self-Learning Topics: 1. *Differential equations with Variable Coefficients* 2. *(Cauchy's and Legendre's Linear Differential Equations)* 3. *Applications of Higher Order Linear Differential Equations to develop amathematical model of linear differential equations.*	
	Learning Outcomes: *LO 2.1: Identify the nature of HODE and solve them by applying the concept of complementary function and particular integral using the fundamentals of differentiation and integrations. (PI-2.1.3, 2.2.3 & 1.1.1)* *LO 2.2 : Apply the fundamental engineering concepts to model a higher order DE and solve it.(PI-2.3.1 & 1.3.1)*	
03.	**Beta and Gamma Functions** ***Learning Objective:*** ***1.*** *Analyse and interpret the basic definition of Beta and Gamma Functions andtheir properties.* ***2.*** *Apply the definition and properties of Beta and Gamma Functions to solve definite integrals.*	**5-7**
	Contents:	

	Definitions, Gamma Function, Beta Function, Properties of Beta and Gamma Function, Relationship between Beta and Gamma Function, Duplication Formula.	
	Self-Learning Topics:	
	Learning Outcomes: *A learner will be able to* *LO 3.1: Analyze a definite integral, apply the basic definition & properties of beta and gamma function to solve it by identifying the appropriate substitution. (PI-2.1.1, 1.1.1, 1.2.1 & 2.2.3).*	
04.	**Double Integration** ***Learning Objectives:*** 1. *Analyze the fundamentals of Double integration in different coordinate systems (Cartesian and polar) and apply it to solve problem.* 2. ***Apply the concepts of double integrations to evaluate area and mass of the Lamina.***	**7-9**
	Contents: Definition, Evaluation of Double Integration in Cartesian Coordinates and Polar Coordinates, Evaluation of double integrals by changing the order of Integration, Evaluation of integrals over the given region, Evaluation of double integrals by changing to polar Co-ordinates, Application of double integrals to compute Area.	
	Self-Learning Topics: *Mass of a Lamina*	
	Learning Outcomes: *A learner will be able to* *LO 4.1: Identify the region of integration. (P.I.-2.1.3)* *LO 4.2: Apply the fundamentals of integration to solve problem in double integration by changing the coordinate systems if applicable. (P.I.-1.1.1, 2.2.1)* *LO 4.3: Apply the concept of double integration to find area of bounded regions. (P.I.-1.2.1).*	
05.	**Triple Integration** ***Learning Objective/s:*** 1. *Analyze the fundamentals of Triple integration in different coordinate systemsand apply it to solve problem.* 2. *Apply the concepts of triple integrations to evaluate volume of a solid.*	**5-7**
	Contents: Definition, Evaluation of Triple Integral using Cartesian coordinates, Evaluation of Triple Integral using cylindrical coordinates, Evaluation of Triple Integral using Spherical coordinates.	
	Self-Learning Topics: ***Volume of a solid***	
	Learning Outcomes : *A learner will be able to* *LO 5.1: Identify the region of integration. (P.I.-2.1.3)* *LO 5.2: Apply the fundamentals of integration to solve problem in triple integration by changing the coordinate systems if applicable. (PI-1.1.1 & 2.2.1)* *LO 5.3 : Apply the concept of triple integration to find the volume of a solid. (PI- 1.2.1)*	

06.	**Integration of vector function** ***Learning Objective/s:*** Analyze the fundamentals of Line integral, surface integral and volume integral andapply it to solve problems using Green's Theorem, Stoke's Theorem & Gauss Divergence Theorem.	**7-9**
	Contents: Integration of vector function, Line Integral, Green's Theorem (without proof), Surface Integral, Volume Integral, Stoke's Theorem & Gauss Divergence Theorem(without proof)	
	Self-Learning Topics: ***Work done by a force***	
	Learning Outcomes: *A learner will be able to* *LO 6.1: Identify and apply the concept of vector differentiation & definite integral to evaluate Line integral, surface integral and volume integral.(PI-1.1.1, 1.2.1 & 2.1.3).* *LO 6.2: Differentiate between the problems and solve using appropriate theorem (Green's Theorem, Stoke's Theorem & Gauss Divergence Theorem). (P.I.- 2.2.4)*	
	Course Conclusion	**01**
	Total	**45**

Performance Indicators:

P.I. No.	**P.I. Statement**
1.1.1	Apply mathematical techniques as calculus/algebra to solve problems.
1.2.1	Apply laws of natural science to an engineering problem.
1.3.1	Apply fundamental engineering concepts to solve engineering problem.
2.1.1	Articulate problem statements and identify objectives.
2.1.3	Identify the mathematical knowledge that applies to a given problem.
2.2.1	Reframe complex problems into interconnected sub-problems
2.2.3	Identify existing processes/solution methods for solving the Problems.
2.2.4	Compare and contrast alternative solution processes to select the best process.
2.3.1	Combine mathematical principles and engineering concepts to formulate mathematical models of an engineering problem.

Course Outcomes: A learner will be able to -

1. Analyse whether the first order Differential equation is exact or Linear and solve it by applying the appropriate method (*LO 1.1, LO 1.2*)
2. Analyse the procedure to find complementary function and particular integral of higher order differential equation solve it by applying the suitable method. *(LO 2.1, LO 2.2)*
3. Implement the fundamentals of Beta and Gamma Function to evaluate the definite integral. *(LO 3.1)*
4. Apply the fundamentals of multiple integration to analyse and evaluate the area of a lamina and volume of a solid. *(LO 4.1 , LO 4.2, LO 4.3, LO 5.1, LO 5.2, LO 5.3)*
5. Apply the concepts of line integral, surface integral and volume integral in order to

analyse and evaluate problems using Green's theorem, Stoke's theorem, Gauss-divergence theorem. *(LO 6.1, LO 6.2)*

CO-PO Mapping Table with Correlation Level

CO ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
BSC204.1	3	3	-	-	-	-	-	-	-	-	-
BSC204.2	3	3	-	-	-	-	-	-	-	-	-
BSC204.3	3	3	-	-	-	-	-	-	-	-	-
BSC204.4	3	3	-	-	-	-	-	-	-	-	-
BSC204.5	3	3	-	-	-	-	-	-	-	-	-
Average	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

Text Books :

1. Higher Engineering Mathematics, Dr. B. S. Grewal, Khanna Publication, forty fourth Edition, 2021
2. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Eastern Limited, Tenth Edition, 2011

Reference Books :

1. Engineering Mathematics by Srimanta Pal and Subodh, C. Bhunia, Oxford University Press, First Edition, 2015
2. Engineering Mathematics by P. Sivaramakrishna Das and C. Vijayakumari, Pearson, First Edition, 2017

A. IN-SEMESTER ASSESSMENT (75 MARKS)

1. Continuous Assessment - Theory-(20 Marks)

1. Numerical Assignments (Minimum 20 problems): 5 marks
2. Class test based on above Numerical assignment: 5 marks
3. Team - Pair - Solo: 5 marks
4. Regularity and active participation: 5 marks

2. Continuous internal evaluation of Tutorial (25 Marks)

1. Tutorials: 20 Marks

   Students must be encouraged to write at least 6 class tutorials. Each tutorial carries 20 Marks.

   Average will be taken of all six tutorials out of 20 marks.
2. Regularity and active participation: 5 marks

3. Mid Semester Exam (30 Marks)

Mid semester examination will be based on 40% to 50% syllabus.

B. END SEMESTER EXAMINATION (50 MARKS)

End Semester Examination will be based on syllabus coverage up to the Mid Semester Examination (MSE) carrying 20%-30% weightage, and the syllabus covered from MSE to ESE carrying 70%-80% weightage.

Course Type	Course Code	Course Name	Credits
BSC	BSC205	ENGINEERING PHYSICS-II	02

Examination Scheme					
Distribution of Marks			Exam Duration (Hrs.)		Total Marks
In-semester Assessment		End Semester Examination (ESE)			
Continuous Assessment	Mid-Semester Exam (MSE)		MSE	ESE	
15	20	40	1	1.5	75

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO6: The Engineer and The World

Course Objectives:

1. To provide the Basic knowledge on the concepts of physics pertaining to the field of engineering.
2. To build a foundation to the methodology necessary for solving problems by applying the knowledge of physics in the field of engineering.

Module	Details	Hrs.
00.	**Course Introduction** Significances of Crystals and non–crystalline solid: Need of analysis of crystal: Applications of magnetic, dielectric and nanomaterials in Engineering.	01
01.	**Crystal Structure** ***Learning Objective:*** *1. To introduce the fundamental knowledge of cubic crystal structures.* *2. To apply the knowledge of crystal parameters to identity the simple cubic structure.*	3-5
	Contents: Crystals: Unit cell: Space lattice, Basis and Crystal structure: Cubic Structures (SC, BCC and FCC): Unit cell characteristics for simple cubic: Unit cell volume, Number of atoms per unit cell, Coordination number, Atomic radius, Nearest neighbour distance, Packing fraction, Percentage of void space and Density.	
	Self-Learning Topics: *Crystals: Lattice parameters.*	
	Learning Outcomes: *A learner will be able to* *LO 1.1: state various parameters of unit cell of a crystal and its importance to identify crystal structures. (P.I.- 1.2.1)* *LO 1.2: diagrammatically describe the structure of different cubic unit cell. (P.I.- 1.2.1)*	

	LO 1.3: solve the problems related to crystal structure. (P.I.- 1.2.2.) *LO 1.4: identify cubic crystal structure knowing their various parameters. (P.I.- 2.1.2)* *LO 1.5. derive the unit cell parameters of cubic crystal structure. (P.I.- 2.1.3)*	
02.	**Analysis of Crystal Structure** ***Learning Objective:*** 1. *To interpret the use of X-ray law.* 2. *2. To apply the concept of Miller Indices and law to identify the crystal planes* **Contents:** Crystal planes and Miller indices; Interplanar spacing: Relation between interplanar spacing and Miller indices for cubic unit cell. Diffraction of X-ray and Bragg's law; Bragg's spectrometer: Principle, Construction and working; Determination of crystal structure using Bragg's spectrometer. ***Self-Learning Topics: -*** *Crystals: Lattice parameters.* ***Learning Outcomes:*** *A learner will be able to* *A learner will be able to* *LO2.1: apply the hall effect phenomena for execution of experiment. (P.I.- 1.2.1)* *LO2.2: write the required theory and procedure for the experiment. (P.I.- 4.3.1)* *LO2.3: draw the principal planes of simple cubic structure. (P.I.- 4.3.3)* *LO2.4: identify the principal planes of simple cubic structure from the given models. (P.I.- 1.2.1)* *LO2.5: determine the miller indices for the same and interplanar distance and write the result. (P.I.- 1.2.2, P.I.- 4.3.3)*	**4-6**
03.	**Non-Crystalline Materials** ***Learning Objective:*** 1. *To gain the basic knowledge of non-crystalline solids.* 2. *2. To recognize the solids with amorphous structure and their importance in various applications* **Contents:** Structure: order and disorder, importance of short range order, properties of non-crystalline solid; Classes: metals/metalloid glasses, alloys of transitions metals with rare earth atoms. Silica glasses and related alloys. ***Self-Learning Topics: Application of non-crystalline materials.*** ***Learning Outcomes:*** *A learner will be able to A learner will be able to* *LO 3.1: differentiate crystalline and non-crystalline material. (P.I.- 1.2.1)* *LO 3.2: define non-crystalline material and list the properties of non-crystalline solid for various applications. (P.I.- 1.2.1)* *LO 3.3: identify the importance of short range order in non-crystalline materials. (P.I.- 2.1.2)* *LO 3.4: identify various non crystalline materials by knowing their properties. (P.I.- 2.2.3)*	**3-5**
04.	**Magnetic and Dielectric Materials**	**6-8**

	Learning Objectives: 1. *To identify the properties of magnetic and dielectric materials.* 2. *To apply magnetic and dielectric materials as solutions to enhance existing and future technology*	
	Contents: Magnetic materials: Ferromagnetism: Magnetization of ferromagnetic materials, hysteresis loop: soft and hard magnetic materials, Magnetoresistive materials, Applications of magnetic materials. Dielectric materials: Dielectric materials: Dielectric constant; Dielecctric polarization; Dielectric susceptibility; Dipoles; Nonpolar and polar dielectric, Applications of dielectric materials.	
	Self-Learning Topics: *Magnetization of materials.*	
	Learning Outcomes: *A learner will be able to* *LO 4.1: state various parameters related to magnetic and dielectric materials and their importance in various applications (P.I.- 1.2.1)* *LO 4.2: solve the problems involving magnetic and dielectric materials using the concepts and basic formulae. (P.I.- 1.2.2)* *LO 4.3: identify the types of ferromagnetic materials and dielectric materials in terms of their poperties. (P.I.- 2.1.2).* *LO 4.4: Draw the hysteresis loop for ferromagnetic materials by knowing the concept of magnetization. (2.1.3)* *LO 4.5: use magnetic materials and dielectric materials in various applications. (P.I.- 6.1.1)* *LO 4.6: state the advantages, disadvantages of using magnetic and dielectric materials in various devices. (P.I.- 6.2.2)*	
05.	**Nanomaterials** ***Learning Objective/s:*** *1. To explore the basics of nanomaterials.* *2. To identify the applications of nanomaterials in current technology.*	**3-5**
	Contents: Introduction; Properties (Optical, electrical, magnetic, mechanical); Surface to volume ratio; Two main approaches in nanotechnology to synthesize Nanomaterials (Bottom up technique and Top down technique); Synthesis methods: Ball milling; Chemical vapour deposition; Applications.	
	Self-Learning Topics : *Advantages and disadvantages of Ball milling and Chemical vapour deposition methods*	
	Learning Outcomes :	
	A learner will be able to *LO 5.1: define nanomaterial and differentiate between two approaches of synthesizing nanomaterials. (P.I.- 1.2.1)* *LO 5.2: solve the problems related to surface area to volume ratio. (P.I.- 1.2.2)* *LO 5.3: classify various synthesis methods of nanomaterials in terms of approaches. (2.1.2).*	

	LO 5.4: write about various synthesis methods and identify the suitable method for the preparation of a different nanomaterials. (P.I.- 2.2.3) *LO 5.5: analyse the properties of nanomaterials. (P.I.- 6.1.1)*	
06.	**Characterization Techniques of Nanomaterials** ***Learning Objective/s:*** *The learner will be able to predict the tools for specific characterization of nanomaterials.*	**3-5**
	Contents: Tools for characterization of Nanomaterials: Scanning Electron Microscope (SEM), Transmission Electron Microscope (TEM), Atomic Force Microscope (AFM).	
	Self-Learning Topics: *Difference between optical and electron microscope*	
	Learning Outcomes: *A learner will be able to* *LO 6.1*: *state working principle of different tools (SEM, TEM and AFM).and its application in analysing various properties of nanomaterials (P.I.- 1.2.1)* *LO 6.2*: *interpret the importance of electron microscope over optical microscope. to characterize nanomaterials (P.I.- 2.2.3)* *LO 6.3*: *analyse different characterization tools in terms of their principle, construction, working. (P.I.- 2.2.3)* *LO 6.4*: *identify merits, demerits and challenges in using the characterization tools. (P.I.- 6.2.2)*	
	Course Conclusion	**01**
	Total	**30**

Performance Indicators:

P.I. No.	P.I. Statement
1.2.1	Apply laws of physics to an engineering problem.
1.2.2	Apply the formulae derived from the concept to solve engineering problem.
2.1.2	Identify engineering systems, variables, and parameters to solve the problems
2.1.3	Identify the mathematical, engineering and other relevant knowledge that applies to a given problem
2.2.3	Identify existing processes/solution methods for solving the problem, including forming justified approximations and assumptions.
6.1.1	Identify and describe various role of science particularly as pertains to protection of the public and public interest at global, regional and local level.
6.2.2	Interpret and explain the limitations in the usage of devices for protection of the public.

Course Outcomes:
A learner will be able to -

1. Learner will be able to apply the knowledge of crystal parameters to analyse the relevant basic engineering problems.
   (*LO 1.1, LO 1.2, LO 1.3, LO 1.4, LO1.5, LO 2.1, LO 2.2, LO 2.3, LO 2.4, LO2.5*)
2. Learner will be able to apply the fundamental knowledge of non-crystalline solids for various applications of it.
   (*LO 3.1, LO 3.2, LO 3.3, LO 3.4)*
3. Learner will be able to apply the fundamental knowledge of magnetic and dielectric materials in various technical fields by analyzing their intrinsic behaviours.
   (*LO 4.1, LO 4.2, LO 4.3, LO 4.4, LO 4.5, LO 4.6)*
4. Learner will be able to use the basic knowledge of nanomaterials and their characterization techniques to identify their applications in societal issues.
   (*LO 5.1, LO 5.2, LO 5.3, LO 5.4, LO 5.5, LO 6.1, LO 6.2, LO 6.3, LO 6.4*)

CO-PO Mapping Table with Correlation Level

CO ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
BSC205.1	3	3	-	-	-	-	-	-	-	-	-
BSC205.2	3	3	-	-	-	-	-	-	-	-	-
BSC205.3	3	3	-	-	-	3	-	-	-	-	-
BSC205.4	3	3	-	-	-	3	-	-	-	-	-
Average	**3**	**3**	**-**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**

Text Books :

1. A Textbook of Engineering physics, Dr. M. N. Avadhanulu and Dr. P. G. Kshirsagar Revised Edition, 2014, S. Chand Publishing.
2. Engineering physics, R. K. Gaur and S. L. Gupta, Revised Edition, 2012, Dhanpat Rai Publications.

Reference Books :

1. Fundamentals of Physics, Halliday /Resnick/Walker, Twelve Edition, 2021, Wiley
2. Introduction to solid state physics, Charles Kittel, Eighth Edition, 2005, Wiley
3. The Physics of Amorphous Solids, Richard Zallen, Wiley - VCH
4. Introduction to nanotechnology, Charles P Poole and Frank J Owens, 1st Edition, Wiley-Interscience.
5. Nano: The essentials: Understanding Nanoscience and Nanotechnology, T Pradeep, 1 st Edition, 2017, McGraw Hill.

Other Resources :

1. Online physics library, California State University:-Web link- https://phys.libretexts.org/
2. Physics website, The State University of New Jersey :-Web linkwww.physics.rutgers.edu
3. Theory of the structure of Non-Crystalline Solids, Conference Review Paper, Int. conf. on Theory of the structure of Non-Crystalline Solids. Jozef Bicerano et al.
4. NPTEL Course: Nano structured materials-synthesis, properties, self-assembly and applications by Prof. A. K. Ganguli, IIT Delhi:- Web linkhttps://nptel.ac.in/courses/118102003.

A. IN-SEMESTER ASSESSMENT (35 MARKS)

Continuous Assessment - Theory-(15 Marks)

1. MCQ test: 4 marks
2. Class test: 4 marks
3. Open book test/Open notes test: 4 marks
4. Regularity and active participation: 3 marks

Mid Semester Exam (20 Marks)

Mid semester examination will be based on 40 % to 50% of the syllabus.

B. END SEMESTER EXAMINATION (40 MARKS)

End semester will be based on the syllabus coverage upto Mid Semester Examination (MSE) carrying 20% to 30% weightage and the syllabus covered from MSE to ESE carrying 70% to 80% weightage.

Course Type	Course Code	Course Name	Credits
BSC	BSC206	ENGINEERING CHEMISTRY- II	02

Examination Scheme					
Distribution of Marks			Exam Duration (Hrs.)		Total Marks
In-semester Assessment		End Semester Examination (ESE)			
Continuous Assessment	Mid-Semester Exam (MSE)		MSE	ESE	
15	20	40	1	1.5	75

Pre-requisite: NIL

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO6: The engineer and the world

Course Objectives:

1. To enable the students to apply the laws of chemistry to an engineering problem.
2. To enable the students to appreciate material properties and their engineering applications.
3. To enable the students to analyse and select the most appropriate engineering material.
4. To acknowledge the current developments in the field of nanotechnology, energy storage systems and green chemistry for sustainable development.

Module	Details	Hrs.
00.	**Course Introduction** This course provides the insights into the properties, composition and behavior of materials and enables engineers to understand how differentmaterials react under various conditions, allowing them to select appropriate materials for specific applications.	**01**
01.	**Alloys** ***Learning Objective:*** *To classify the different types of alloys and interpret their properties and applications in industry.*	**4-6**
	Contents: Introduction, Significance of alloying, Ferrous Alloys-Plain carbon steels and special steels: - Nichrome and Stainless steel, Non-ferrous: -Duralumin, Alclad, Shape memory alloys: definition, properties and uses.	

	Self-Learning Topics: *Applications of aluminum alloys in aeronautical engineering.*	
	Learning Outcomes: *A learner will be able to* *LO 1.1 State the significance of making alloys (P.I.-1.3.1)* *LO- 1.2 State the role of carbon in steels (P.I.-1.3.1)* *LO-1.3 Classify the plain carbon steels on the basis of their carbon content. (P.I.-2.1.3)* *LO-1.4 Distinguish between plain carbon steels and alloy steels (P.I.-2.1.3)* *LO-1.5 Identify the role of various alloying elements in alloy steel (P.I.-2.1.3)* *LO-1.6 State the composition, properties and uses of SS and Heat resistant steel. (P.I.-1.3.1)* *LO-1.7 State the composition, properties and applications of duralumin in alclad. (P.I.-1.3.1)* *LO 1.8 State the concept of shape memory alloys and their applications in various industries. (P.I.-1.3.1)*	
02.	**Polymers**	**4-6**
	Learning Objective: To use the knowledge of synthesis, properties and uses of various polymers in industry. This will aid in identifying the impact of disposal of plastics on general health and the environment.	
	Contents: Preparation, properties and uses of Phenol formaldehyde, PMMA, Kevlar. Effect of heat on the polymers (Glass transition temperature). Molecular weight of polymer and numericals. Conducting polymers and their applications. Electroluminescent polymer, Biodegradable polymers.	
	Self-Learning Topics: *Classification of polymers, Thermoplastic and Thermosetting plastics.*	
	Learning Outcomes: *A learner will be able to* *LO 2.1 Apply the basic concepts of polymer chemistry (P.I.-1.3.1)* *LO -2.2 Synthesize thermoplastic and thermosetting polymers for industrial use. (P.I.-2.2.3)* *LO-2.3 Calculate the molecular weight of polymer by number average and weight average methods. (P.I.-1.2.2)* *LO-2.4 Apply the knowledge of high-performance polymeric materials for the protection of public health. (P.I.-6.1.1)* *LO-2.5 State the concept of glass transition temperature, factors affecting the same. (P.I.-1.3.1)* *LO-2.6 Identify the correct polymer for various applications on the basis of glass transition temperature. (P.I.-2.1.3)* *LO-2.7 State the concept of conducting polymers, electroluminescent polymer and biodegradablepolymers for various applications in industry. (P.I.-1.3.1)* *LO-2.8 Apply the knowledge of disposal of biodegradable polymers for protection of environment and sustainable development. (P.I.-7.2.1)*	
03.	**Advanced Functional materials**	**4-6**

	Learning Objective: *To familiarize with the composite materials, their properties and applications in various industries and for the protection and safety of society.*	
	Contents: Introduction, Constitution- i) Matrix phase ii) Dispersed phase. Classification- (A) Particle - reinforced composites- i) Large – particle reinforced composites ii) Dispersion – strengthened composites. (B) Fiber – reinforced composites- i) Continuous – aligned ii) Discontinuous – aligned (short)- (a) aligned (b) randomly oriented (C) Structural Composites- i) Laminates (ii) Sandwich Panels. Their applications in aeronautical engineering and other industries.	
	Self-Learning Topics:	
	Learning Outcomes: *A learner will be able to* *LO-3.1 State the properties of composite materials (P.I.-1.3.1)* *LO-3.2 State the functions of matrix and dispersed phase (P.I.-1.3.1)* *LO- 3.3 Classify the composite materials on the basis of types of reinforcedmaterials used. (P.I.-2.3.1)* *LO- 3.4 Analyze the structural and mechanical properties of composites for industrial use. (P.I.-2.3.1)* *LO- 3.5 Analyze the properties of composite materials for the applications in aeronautical engineering. (P.I.-2.3.1).*	
04.	**Carbon Nanomaterials** ***Learning Objectives:*** *To use carbon nanomaterials on the basis of their mechanical and electrical properties in various industrial applications and modern devices.*	**3-5**
	Contents: Introduction to carbon nanomaterials, structure, electrical and mechanical properties of graphene, CNTs and Fullerenes. Application of Nanomaterials in various industries.	
	Self-Learning Topics: *Inorganic nanomaterials like metals, metal oxides etc.*	
	Learning Outcomes: *A learner will be able to* *LO-4.1 Define Carbon nanomaterials (P.I.-1.3.1)* *LO-4.2 Analyze the structures of graphene, CNTs and fullerene for their electrical and mechanical properties. (P.I.-2.3.1)* *LO-4.3 Apply the knowledge of properties of carbon nanomaterials in industry. (P.I.-1.3.1)*	
05.	**Batteries**	**4-6**
	Contents:	

	Introduction and Characteristics of batteries. Construction, working andapplications of Lithium-ion batteries, Hydrogen oxygen alkaline fuel cells. E-waste Management, Battery e-waste management.	
	Self-Learning Topics: *Classification of batteries.*	
	Learning Outcomes: *A learner will be able to* *LO-5.1 State the characteristic properties of batteries (1.3.1)* *LO-5.2 Write the construction and working of Li-ion and fuel cell batteries. (1.3.1)* *LO-5.3 Analyze the uses of batteries in various devices for solving real-worldproblems. (2.1.3)* *LO-5.4 Identify the impact of disposal of batteries on the environment and society.(6.1.1)* *LO-5.5 Apply e-waste management of batteries for sustainable development and environment protection. (6.1.2)*	
06.	**Spectroscopic Techniques**	**3-5**
	Learning Objective/s: *To differentiate between the various ranges of electromagnetic spectrum used in the different types of spectroscopic techniques like absorption and emission spectroscopy*	
	Contents: Spectroscopy - Principle, atomic and molecular spectroscopy. Beer lambert's law and UV-Visible Spectroscopy, Selection rules. Introduction to fluorescence and phosphorescence, Jablonski diagram. Material Characterization using different Spectroscopic Techniques.	
	Self-Learning Topics: *Electromagnetic radiation, characteristics of electromagneticradiation, electromagnetic spectrum.*	
	Learning Outcomes:	
	A learner will be able to *LO-6.1 Classify spectroscopic techniques on the basis of atomic or molecular level of study. (P.I.-2.1.3)* *LO-6.2 State the fundamental selection rules in spectroscopic technique (P.I.-1.3.1)* *LO-6.3 State the Beer Lambert's law (P.I.-1.2.1)* *LO-6.4 To calculate absorbance, concentration and molar extinction coefficientof given compounds using Beer Lambert's law. (P.I.-1.2.2)* *LO-6.5 State the phenomena of fluorescence and phosphorescence. (P.I.-1.3.1)* *LO-6.6 Analyze the various radiative and non-radiative transitions occurring ina photo excited electron with the help of Jablonsky diagram. (P.I.-2.1.3)*	
	Course Conclusion	**01**
	Total	**30**

Performance Indicators:

P.I. No.	**P.I. Statement**
1.2.1	Apply laws of natural science to an engineering problem.
1.2.2	Apply the formulae based on the concepts of engineering chemistry for solving the numerical problems.
1.3.1	Apply fundamental engineering chemistry concepts to solve engineering problems.
2.1.3	Identify the engineering chemistry concepts to analyze the given problem
2.2.3	Identify the existing processes/ solution methods for solving the problems
6.1.1	Identify and describe the various roles of materials particularly as pertains to protection of the public and public interest at global, regional and local level
6.1.2	Analyse the environmental aspects of engineering problems for its impact on sustainability.

Course Outcomes: A learner will be able to -

1. Apply the concepts of engineering chemistry for solving the engineering problems (*LO-1.1, LO-1.2, LO-1.3, LO-1.4, LO-1.5, LO-1.6, LO-1.7, LO-1.8, LO-2.1, LO-2.2, LO-2.3, LO-2.4, LO-2.5, LO-2.6, LO-2.7, LO-2.8, LO-3.1, LO-3.2, LO-3.3, LO-3.4, LO-3.5, LO-4.1, LO-4.2, 4.3, LO-5.1, LO-5.2, LO-5.3, LO-5.4, LO-5.5, LO-6.1, LO-6.2, LO-6.3, LO-6.4, LO-6.5, LO-6.6)*
2. Analyse the quality and properties of engineering materials for solving real world problems. (*LO-1.1, LO-1.2, LO-1.3, LO-1.4, LO-1.5, LO-1.6, LO-1.7, LO-1.8, LO-2.1, LO-2.2, LO-2.3, LO-2.4, LO-2.5, LO-2.6, LO-2.7, LO-2.8, LO-3.1, LO-3.2, LO-3.3, LO-3.4, LO-3.5, LO-4.1, LO-4.2, 4.3, LO-5.1, LO-5.2, LO-5.3, LO-5.4, LO-5.5, LO-6.1, LO-6.2, LO-6.3, LO-6.4, LO-6.5, LO-6.6)*
3. Identify the suitable engineering material for the protection of the environment and public health. (*LO-2.1, LO-2.2, LO-2.3, LO-2.4, LO-2.5, LO-2.6, LO-2.7, LO-2.8, LO-3.1, LO-3.2, LO-3.3, LO-3.4, LO-3.5, LO-5.1, LO-5.2, LO-5.3, LO-5.4, LO-5.5,)*
4. Apply the knowledge of e-waste management and biodegradable polymers for the sustainable development. (*LO-2.1, LO-2.2, LO-2.3, LO-2.4, LO-2.5, LO-2.6, LO-2.7, LO-2.8, LO-5.1, LO-5.2, LO-5.3, LO-5.4, LO-5.5,)*

CO-PO Mapping Table with Correlation Level

CO ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
BSC206.1	3	3	-	-	-	3	-	-	-	-	-
BSC206.2	3	3	-	-	-	3	-	-	-	-	-
BSC206.3	3	3	-	-	-	3	-	-	-	-	-

BSC206.4	3	3				3					
Average	3	3				3					

Text Books:

1. A textbook of engineering chemistry by S. Dara, 2014 edition, Chand Publication.
2. Engineering Chemistry by Jain and Jain, 17th edition, 2018, Dhanpatrai publications.

Reference Books :

1. Engineering Chemistry by Jain and Jain, 17th edition, 2018, Dhanpatrai publications
2. Elements of 2017 by Y. R. Sharma, Spectroscopy 29th edition, Pragati Prakashan
3. Nano forms of carbon and its Applications by Prof Maheshwar Sharon and Dr. Madhuri Sharon, First edition, 2007, Monad nanotech Pvt Ltd

Other Resources:

1. Online chemistry library for open access text books: https://chem.libretexts.org

A. IN-SEMESTER ASSESSMENT (35 MARKS)

1. Continuous Assessment - Theory-(15 Marks)

1. Assignment on live problems: 8 marks
2. Poster making: 4 marks
3. Regularity and active participation: 3 marks

2. Mid Semester Exam (20 Marks)

Mid semester examination will be based on 40% to 50% syllabus.

B. END SEMESTER EXAMINATION (40 MARKS)

End Semester Examination will be based on syllabus coverage up to the Mid Semester Examination (MSE) carrying 20%-30% weightage, and the syllabus covered from MSE to ESE carrying 70%-80% weightage.

Course Type	Course Code	Course Name	Credits
AEC	AEC 201	PROFESSIONAL COMMUNICATION & ETHICS-I	02+01

Examination Scheme					
Distribution of Marks			Exam Duration (Hrs.)		Total Marks
In-semester Assessment		End Semester Examination (ESE)			
Continuous Assessment	Mid-Semester Exam (MSE)		MSE	ESE	
50	--	--	--	--	50

Pre-requisite:

1. Keen desire to build confidence, develop language skills and reduce fear of public speaking
2. Intermediate knowledge of Spoken English
3. Intermediate level grasp of English Grammar and Vocabulary

Program Outcomes addressed:

1. PO 7: Ethics
2. PO 8: Individual and Collaborative Teamwork
3. PO 9: Communication
4. PO 11: Life-long learning

Course Objectives:

1. To demonstrate the fundamental concepts of interpersonal and professional communication.
2. To encourage active listening with focus on content, purpose, ideas and tone.
3. To facilitate fluent speaking skills in social, academic and professional situations.
4. To train in reading strategies for comprehending academic and business correspondence.
5. To promote effective writing skills in business, technology and academic arenas.
6. To inculcate confident personality traits along with grooming and social etiquettes.

Module	Details	Hrs.
00.	**Course Introduction** Every learning should lead toward the building of a holistic individual and a good citizen. Communication Skills and Ethics as a subject is the very fundamental requirement of a human being in any social and/or professional ecosystem. The syllabus has been compiled with the strategic idea of helping individual students to enhance, incorporate and implement the four pillars of Communication, Listening, Speaking, Reading and Writing (LSRW Skills), in all walks of life. There is an added emphasis on Ethical behavior and communication which is an integral value that every good human being, who also aims at being an impressive professional, should imbibe. The learner will also gain basic skills in professional writing and public speaking, exude confidence in presenting themselves and their work, with hands on training in real time.	**01**

01.	***Fundamentals of Communication*** ***Learning Objective:*** *To aid the learner in understanding the importance of communication in the spoken and written form so that they can express themselves effectively and ethically in any professional or social setting.* *To encourage active listening with focus on content, purpose and ideas which can then be shared using ICT tools, ethical use of social media and appropriate professional etiquette, as individuals and team members.*	**7-9**
	Contents: 1.1 Introduction to Theory of Communication a) Definition b) Objectives c) The Process of Communication 1.2 Methods of Communication i. Verbal (Written & Oral) ii. Non-verbal a. Non-verbal cues perceived through the five senses: (Visual, Auditory, Tactile, Olfactory and Gustatory cues) b. Non-verbal cues transmitted using: (Body, Voice, Space, Time and Silence) 1.3 Barriers to Communication a) Mechanical/External b) Physical/Internal c) Semantic & Linguistic d) Psychological e) Socio-Cultural 1.4 Communication at the Workplace a) Corporate Communication - Case Studies b) Short Group Presentations on Business Plans c) Selecting Effective Communication Channels 1.5 Professional Etiquette a) Formal Dress Code b) Cubicle Étiquette c) Formal Dining Étiquette d) Responsibility in Using Social Media e) Showing Empathy and Respect f) Learning Accountability and Accepting Criticism g) Demonstrating Flexibility and Cooperation	
	Self-Learning Topics: *Visit nearby Government office e.g. Passport/Post/Electricity/Telephone, as such, communicate with employees and get related information. Evaluate your communication with them & find out the flaws and/or barriers in the communication process that you faced. Document it for further discussion.* *Reading up on various case studies depicting barriers in communication which led to conflicts; finding alternative methods of resolving them*	

	Learning Outcomes: *A learner will be able to* *LO1.1: Identify the various channels of communication in a business organization (9.2.1)* *LO1.2: Differentiate between verbal and non-verbal communication. (8.2.3)* *LO1.3: Apply verbal and non-verbal cues to communicate more effectively in a group (8.2.1)* *LO1.4: Identify barriers in communication and overcome them efficiently (7.1.1)* *LO1.5: Implement the correct method of listening, speaking, reading and writing keeping 'You-attitude' in perspective. (7.2.2)* *LO1.6: Deliver a short speech for special occasions or an extempore with appropriate professional tools and social etiquette. (9.2.2, 9.3.2))* *LO1.7: Introduce self with confidence and composure to the class. (8.2.4)* *LO1.8: Implement appropriate grooming and ethical way of presenting oneself (11.1.1)* *LO1.9: Utilise the knowledge of responsible and ethical use of social media (7.1.1)* *LO1.10: Exhibit flexibility and empathy in the professional space (8.2.2)* *LO1.11: Identify conflict situations and attempt to come up with a resolution. (8.2.1)*	
02.	***Verbal Aptitude For Employment***	**2-4**
	Learning Objective: *To facilitate clear comprehension, interpretation, and evaluation of verbal technical and non-technical data.* *To facilitate fluent and precise presentation skills, in social, academic, and professional situations, with correct syntax, lexicon and semantics.*	
	Contents: 2.1 Vocabulary Building a) Meaning of Words in Context b) Synonyms & Antonyms c) Avoiding redundancy d) Word Form Charts e) Prefixes & Suffixes 2.2 Grammar a) Identifying Common Errors b) Subject - Verb Agreement c) Articles d) Preposition e) Pronunciation	
	Self-Learning Topics: *Maintain a journal of new vocabulary; add, learn and apply in conversation 3 new words daily.*	
	Learning Outcomes:	
	A learner will be able to *LO2.1: Identify the commonly found grammatical errors in the written and spoken format of communication. (9.1.1)* *LO2.2: Apply appropriate words and parts of speech such as prefixes, suffixes, synonyms and antonyms in the written and oral form of communication. (9.2.2)* *LO2.3: Eliminate the use of pleonasms, tautologies and redundancies during communication (9.1.3)* *LO2.4: Employ proper idioms, proverbs and clichés in their written and*	

	spoken communication (9.1.3) *LO2.5: Listen to grammatically correct input, understand and analyse the same (11.3.1)*	
03.	***Developing Basic Language Skills-LSRW Skills*** ***Learning Objective:*** *To listen, read, write, summarise and present concrete technical and non-technical data precisely with minimum errors keeping the audience in mind.* *To comprehend the need for ethical concepts such as Plagiarism checks and Copyright in professional writing.* *To generate and deliver a speech and/or presentation using both rational and out of the box thinking.*	**4-6**
	Contents: 3.1 Listening Skill- Listening to recordings of Formal and Informal communication situations and Activity sheets (Listening Tasks with Recordings and Activity Sheets) 3.2 Speaking Skill- Developing and Delivering Short Speeches, Informative Speeches (that center on people, events, processes, places, or things), Persuasive Speeches (to persuade, motivate or take action) and Special Occasion Speeches- (anchoring, hosting, compering events in institute) a) Pair-work Conversational Activities / Role play b) Introducing Self and/or a Classmate 3.3 Reading Skill Reading Short and long passages for comprehension 3.4 Writing Skill- Summarization of non-technical passages, reports. Writing review of Short Stories- *Lamb to the Slaughter- by Roald Dahl*, *The Green Leaves* by Grace Ogot, *Uncle Podger Hangs a Picture* by Jerome K Jerome, R.K. Narayan (*Malgudi Days*), Ruskin Bond (*Celestial Omnibus*) a) Graphic Organizers for Summaries i. Radial Diagrams like Mind Maps ○ Flow Charts ○ Tree Diagrams Cyclic Diagrams ii. Linear Diagrams like Timelines ○ Pyramids ○ Venn Diagrams b) Point-form Summaries c) One-sentence Summaries of Central Idea 3.5 Intellectual Property Rights - a) Understanding the importance of Copyrights b) Paraphrasing, referencing and In-text citations c) Running a Plagiarism Check on Paraphrased Passages	
	Self-Learning Topics: *Read either autobiography or biography of A.P.J. Kalam, Nelson Mandela, or any such revolutionary thinker and write its summary*	

	Learning Outcomes: *A learner will be able to* *LO 3.1: Listen to team members, peers respectfully, without prejudice to understand ideas and opinions. (8.2.2, 8.2.3, 9.2.1)* *LO3.2: Read and comprehend long/short, technical/non-technical passages. (9.1.1)* *LO3.3: Comprehend and derive appropriate answers to the questions related to each passage. (9.2.1)* *LO3.4: Analyse and derive significant information from a given passage (9.1.1)* *LO3.5: Summarise passages in paragraph format and as graphical organisers (9.1.3)* *LO3.6: Identify the utility and importance of Copyrights (7.2.2, 9.3.1, 11.1.1)* *LO3.7: Generate plagiarism reports by running a plagiarism check (7.2.2, 9.3.2, 11.3.1)*	
04.	***Business Correspondence*** ***Learning Objectives:*** *To train in writing strategies for comprehensive academic and business correspondence.* *To promote competent writing skills in business, technology and academic areas using effective media.* *To find and fill gaps in knowledge required for basic written business correspondence and continued professional growth.*	**6-8**
	Contents: 4.1. Seven Cs of Business Correspondence 1) Completeness 2) Conciseness 3) Consideration 4) Concreteness 5) Clarity 6) Courtesy 7) Correctness 4.2. Parts of a Formal Letter and Formats 1)Parts/Elements of a Formal Letter i. Letterheads and/or Sender's Address ii. Dateline iii. Reference Number iv. Inside Address v. Attention Line (Optional) vi. Salutation vii. Subject Line / Caption Line / Reference Line viii. Body of the Letter ix. Complimentary Close x. Signature Block xi. Identification Marks xii. Enclosures/Attachments xiii. Carbon Copy Notation (courtesy copy) xiv. Postscript 2)Complete/ Full Block Format 4.3 Emails 1) Format of Emails 2) Features of Effective Emails	

	3) Language and style of emails 4.4 Types of Letters in Both Formal Letter Format and Emails - 1) Enquiry letter (internship, placement, workshop) 2)Request/Permission Letters (Leave letter, apology letter, seeking permission for facilities)	
	Self-Learning Topics: *Collect Official letters and evaluate them for language, tone, format and content*	
	Learning Outcomes: *A learner will be able to* *LO 4.1: Apply the 7 C's of Business correspondence? Why is 'You attitude' important in business communication? (7.1.1, 7.2.2)* *LO 4.2: Write a Sales/Complaint/Adjustment/Request letter using the correct format. (9.3.2)* *LO 4.3: Generate a job application letter? State: How does it promote your growth? (11.1.1)*	
05.	***Basic Technical Writing*** *Learning Objective/s*: *To promote effective technical writing skills in business, technology and academic arenas.* *To create easy to understand technical documents with logical flow of ideas keeping the end user in mind.* *To identify gaps in research papers and attempt to source information for the same.*	**4-6**
	Contents: 5.1. Introduction 1) What is Technical Writing? 2) Importance and Principles of Technical Writing 3)Difference between Technical Writing & Literary Writing 4)Framing Definitions 5.2. Writing User Instructions 1) User Instructions 2) Hazard Notations /Special Instructions- (Note, Precaution Warning, Caution and Danger) 5.3 Basics of Research Methodology Importance of Research, Types of research, How to select topic? 1) Structure of a Technical Research Paper 2) Referencing styles (APA, IEEE)	
	Self-Learning Topics: *Collect User Manuals and study them for language and tone of instructions, hazard notations, and order of instructions.*	
	Learning Outcomes : *A learner will be able to* *LO 5.1: Delineate the difference between technical writing, academic writing and literary writing. (9.1.1)* *LO5.2: Frame clear definitions (9.1.3)* *LO5.3: Write and present a clear set of instructions for the end user for a particular task (9.1.3, 9.2.2)* *LO5.4Critically choose a research topic and write a research paper (11.3.1)*	

	Activities for Practical:	**4**
	1. Listening skill - Listening to audio and video content of various types like Monologues, dialogues, formal talk and discussion about the same.	**2**
	2. Self-Introduction and introducing others - Learning formal self-introduction and introducing colleagues through practice activity.	**6**
	3. Group Discussion on various relevant topics - Minimum three rounds to be conducted for facilitating enough practice.	**4**
	4. Debates on several relevant issues- Two rounds to be conducted.	**2**
	5. Selection of Ethical Case Study, Analysis, discussion and report documentation.	**2**
	6. Reading of short stories, writing summaries and learning to critically evaluate the stories – Students will be given selected list of short stories and guided for writing summaries after critical evaluation of the same.	**2**
	7. Selecting a socio-psychological or socio-technical or socio economic problem, creating a short paper in the relevant format. Detailed discussion about format for technical paper will be held. Students will create a short research paper using the given template.	**4**
	8. Team activity: Poster Presentation on a specific theme based awareness creation- students will work as a team of 4 members to create the poster as per the given guidelines, followed by presentation.	**2**
	9. Assignment on Business Correspondence- practice for drafting various business letters	**2**
	10. Assignment on writing accurate technical instructions for the end user.	**2**
	Course Conclusion	**01**
	Total	**60**

Performance Indicators:

P.I. No.	P.I. Statement
7.1.1	Identify situations of unethical professional conduct and propose ethical alternatives
7.2.2	Examine and apply moral & ethical principles to known case studies
8.2.1	Demonstrate effective communication, problem-solving, conflict resolution and leadership skills
8.2.2	Treat other team members respectfully
8.2.3	Listen to other members
8.2.4	Maintain composure in difficult situations
9.1.1	Read, understand and interpret technical and non-technical information
9.1.3	Create flow in a document or presentation - a logical progression of ideas so that the main point is clear
9.2.1	Listen to and comprehend information, instructions, and viewpoints of others

9.2.2 Deliver effective oral presentations to technical and non-technical audiences

9.3.1 Create technical figures, reports with data to complement reports and presentations

9.3.2 Use a variety of media effectively to convey a message in a document or a presentation

11.1.1 Describe the rationale for the requirement for continuing professional development

11.3.1 Source and comprehend technical literature and other credible sources of information

Course Outcomes: A learner will be able to -

1. Evaluate information they listen to and express their ideas ethically and with greater clarity. (*LOs 1.1, 1.2, 1.5, 2.1, 2.2, 2.4, 2.5, 3.1, 3.4, 4.3, 5.1)*
2. Present convincingly before an audience using accurate and appropriate lexis and enhanced digital content. (*LOs 1.5, 1.6, 1.7, 1.8, 1.9, 3.6)*
3. Read and analyse objectively, summarize graphically and paraphrase effectively. (*LOs 2.1, 2.2, 2.3, 2.4, 2.5, 3.2, 3.3, 3.4, 3.5)*
4. Communicate effectively and ethically along the various channels of communication within a business organization and follow the general code of conduct and professional etiquette of the organization. (*LOs 1.3, 1.4, 1.5, 1.7, 1.8, 1.9, 1.10, 3.7, 3.6, 4.1, 4.2, 4.3)*
5. Write a set of effective and easy to understand academic articles and technical instructions and convey the same using global information technology and Netiquette. *(LOs 1.9, 2.3, 4.1, 4.2, 4.3, 5.1, 5.2, 5.3, 5.4)*
6. Conduct ably and ethically within the social circles with empathy and confidence, thus exhibiting a well-groomed and balanced personality(*LOs 1.10, 1,11, 2.4, 3.1, 3.6, 3.7)*

CO-PO Mapping Table with Correlation Level

CO ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
AEC201.1	-	-	-	-	-	-	-	3	3	-	2
AEC201.2	-	-	-	-	-	-	-	-	3	-	-
AEC201.3	-	-	-	-	-	-	-	-	3	-	2
AEC201.4	-	-	-	-	-	-	3	-	2	-	2
AEC201.5	-	-	-	-	-	-	-	-	3	-	2
AEC201.6	-	-	-	-	-	-	2	3	2	-	2
Average	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**3**	**-**	**2**

Text Books :

1. SanjayKumar&PushpLata(2018).CommunicationSkills,NewDelhi:OxfordUniversityPress
2. Rizvi, A. M. (2010). Effective Technical Communication: A guide for Scientists and Engineers.
3. Dahl, R. (1953), "Lamb to the Slaughter". *Harper's Magazine*. Harpers.
4. *"*The Green Leaves*", Land without Thunder, Short Story* by Grace Ogot, East African Publishing House, Kenya, 1068
5. Sanjay Kumar & Pushp Lata (2018). Communication Skills, New Delhi: Oxford University Press

Reference Books:

1. Soft Skills, Dr. k. Alex, S. Chand Publication, 2009
2. English Grammar and Composition, S.C. Gupta, Arihant Publication, 2014
3. Oxford handbook of Commercial Correspondence, A. Ashley, Raman, M., & Sharma, S. (2016). Technical Communication: Principles and practice. New Delhi: Oxford University Press
4. Lewis, N. (2014). Word power made easy. Random House USA.

IN- SEMESTER ASSESSMENT (50 Marks)

1. Speaking Listening
   GD/Debating Skills + group dynamics (10)
2. Ethical Case Study a project (10)
   (Continuous work as individual with set due date)
3. Critical Analysis of a SS or novella + report (Individual) (10)

   OR

   Short Technical Paper on any socio Technical problem,
   Presentation 7 minutes. (Individual) (10)
4. Poster Presentation on a given theme teams of
   4 Students can choose any 2 out of 3 (10 marks each)
5. Assignments until End Semester syllabus (05)
6. Regularity and active participation (05)

Course Type	Course Code	Course Name	Credits
ESC	ESC203	BASIC ELECTRONICS ENGINEERING	02

Examination Scheme					
Distribution of Marks			Exam Duration (Hrs.)		Total Marks
In-semester Assessment		End Semester Examination (ESE)			
Continuous Assessment	Mid-Semester Exam (MSE)		MSE	ESE	
15	20	40	1	1.5	75

Pre-requisite:

1. ESC102: Basics of Electrical Engineering
2. BSC102-: Engineering Physics-I

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO3: Design/ Development of Solutions
4. PO11: Life-long learning

Course Objectives:

1. To impart the knowledge to demonstrate competence in comprehending the concepts of semiconductor diodes and solve the problems to analyse its applications.
2. To demonstrate the ability to execute a solution process and analyse results to design real life applications such as an amplifier, switch, etc.
3. To introduce number system and use logic gates to analyse and design circuits for a given expression.
4. To recognize the utilisation of measuring devices and its working.
5. To introduce various transducers and sensors to adapt to the current technologies regarding new developments in the relevant fields.

Module	Details	Hrs.
00.	**Course Introduction** Electronics is a branch of engineering that has grown exponentially in recent years, and now electronics has become a very important part of our lives. This is foundation course deals with fundamental concepts of semiconductors devices, transistors, number system, logic gates, measuring instruments, transducers and sensors. With the growing popularity and production of electric vehicles (EVs) in India, it is projected that semiconductor use in fields including safety, electrification, communication, and networking would rise.	01
01.	**Introduction to Basic Electronic system**	5-7

	Learning Objective: 1. *To demonstrate competence in engineering fundamentals and specialized engineering knowledge to comprehend the concepts of semiconductor diodes.* 2. *To identify the engineering systems, variables, and parameters to solve the problems for analyzing the applications of semiconductor diodes.*	
	Contents: Semiconductor Diode - Ideal versus Practical, Characteristics and Parameters, Diode Approximations, Diode Equivalent Circuits, Load Line Analysis; Diode as a Switch, Diode as a Rectifier, Half Wave and Full Wave Rectifiers with and without Filters; Diode as clipper and clampers; Zener diode- Operation and Applications; Opto-Electronic Devices – LEDs, Photo Diode and Applications.	
	***Self-Learning Topics**: LASER diode*	
	Learning Outcomes: *A learner will be able to* *LO 1.1: Apply fundamental engineering concepts to comprehend the characteristics and parameters of semiconductor diodes. (P.I.-1.3.1)* *LO 1.2: Apply concepts of electronics and communication engineering and allied disciplines to comprehend diode equivalent circuit and its load line analysis. (P.I.-1.4.1)* *LO 1.3: Identify engineering systems to analyze the applications of diode such as switch, rectifier, clipper, clampers etc. (P.I.-2.1.2)* *LO 1.4: Identify existing methods for analyzing voltage, currents of zener diode and opto –electronic devices. (P.I.-2.2.3)*	
02.	**Introduction to Transistor**	**6-8**
	Learning Objective: ***1.*** *To demonstrate competence in engineering fundamentals and specialized engineering knowledge to comprehend the concepts of bipolar junction transistor.* ***2.*** *To identify the engineering systems, variables, and parameters for analyzing the applications of bipolar junction transistor as an amplifier and also as a switch.*	
	Contents: Bipolar Junction Transistor (BJT) – Construction, Operation, Amplifying Action, Common Base, Common Emitter and Common Collector Configurations, Operating Point, Potential Divider Bias circuit; DC load line analysis, Q point, comparison of characteristics of transistors in different configurations, Applications: Transistor as an amplifier, transistor as a switch.	
	***Self-Learning Topics:** Self-biasing.*	
	Learning Outcomes: *A learner will be able to* *LO 2.1: Apply fundamental engineering concepts to comprehend the concept of biasing with potential divider bias circuit. (P.I.-1.3.1)*	

	LO 2.2: Apply concepts of electronics and communication engineering and allied disciplines to comprehend the types and characteristics of bipolar junction transistor. (P.I.-1.4.1) *LO 2.3: Identify engineering systems to find gain, operating point of bipolar junction transistor etc. (P.I.-2.1.2)* *LO 2.4: Identify solution methods to use bipolar junction transistor as an amplifier and switch. (P.I.-2.2.3)*	
03.	**Introduction to Number system and Logic gates** ***Learning Objective:*** 1. *To analyze the number systems, different types of numbers and Boolean algebra.* 2. *To Demonstrate the ability to generate alternative design solutions using logic gates.*	**5-7**
	Contents: Number System: Binary Numbers systems, Decimal to Binary and Binary to Decimal Conversion, BCD, Octal and Hexadecimal numbers, Negative numbers representation, 1's, 2's, Complements, BCD codes, Excess-3 code, Gray code. Boolean Algebra, Basic Theorems and properties of Boolean Algebra, Logic gates: Truth Tables and Functionality of Logic Gates – NOT, OR, AND, NOR, NAND, XOR and XNOR Integrated Circuits (ICs).	
	Self-Learning Topics: *Flip- flops*	
	Learning Outcomes: *A learner will be able to* *LO 3.1: Integrate mathematical tools to perform conversion in number System. (P.I.- 2.2.2)* *LO 3.2: Compare alternative solutions to select the best methodology to implement logic gates. (P.I.-2.2.4)* *LO3.3: Determine design objectives to implement electronic circuits using logicgates (P.I.-3.1.6)* *LO3.4: Apply formal design principles to build simplified circuits using universal gates. (P.I.-3.3.3)*	
04.	**Electronic Instruments** ***Learning Objectives:*** *To comprehend the working of CRO, DSO, function generators, power supply and access sources to read technical datasheets of instruments.*	**1-3**
	Contents: Introduction to Basic instruments: Components of generalized measurement system Concept of accuracy, precision, linearity, sensitivity, resolution, hysteresis, calibration.	
	Self-Learning Topics: ----	
	Learning Outcomes:	
	A learner will be able to	

	LO 4.1: Apply concepts of electronics and communication engineering and allied disciplines to comprehend the working principle of CRO and DSO. (P.I.-1.4.1) *LO 4.2: Comprehend technical datasheets of instruments. (P.I.-11.3.1)*	
05.	**Introduction to Transducers** ***Learning Objective/s:*** *To demonstrate competence in engineering fundamentals to introduce the concept transducer for the desired application.* **Contents:** Transducers, classification of transducers, selection of transducers, Resistance- temperature detector (RTD), inductive transducers, Linear variable differential transformer (LVDT). ***Self-Learning Topics:*** ***Learning Outcomes :*** *A learner will be able to* *LO 5.1: Apply fundamental engineering concepts to comprehend the concept of transducers and its working. (P.I.-1.3.1)* *LO 5.2: Apply concepts of electronics and communication engineering to comprehend various types of transducers used in electronics. (P.I.-1.4.1)*	**2-4**
06.	**Introduction to Sensors** ***Learning Objective/s:*** *To demonstrate competence in engineering fundamentals to comprehend the concepts of sensor as per the application.* **Contents:** Definition, Classification & selection of sensors, Proximity sensors: Inductive & Capacitive, Use of proximity sensor as accelerometer and vibration sensor, Flow Sensors: Ultrasonic & Laser, Level Sensors: Ultrasonic & Capacitive. ***Self-Learning Topics:*** *Sensors used in IOT.* ***Learning Outcomes:*** *A learner will be able to* *LO 6.1: Apply laws of natural science to an engineering problem to understand the concept of sensors. (P.I.-1.2.1)* *LO 6.2: Apply concepts of electronics and communication engineering and allied disciplines to comprehend the types of sensors. (P.I.-1.4.1)*	**3-5**
	Course Conclusion	**01**
	Total	**30**

Performance Indicators:

P.I. No.	P.I. Statement
1.2.1	Apply laws of natural science to an engineering problem
1.3.1	Apply fundamental engineering concepts to solve engineering problems.
1.4.1	Apply concepts of electronics and communication engineering and allied disciplines to solve engineering problems.
2.1.2	Identify engineering systems, variables, and parameters to solve the problems.
2.2.2	Identify/ assemble/integrate mathematical tools to information and resources.
2.2.3	Identify existing processes/solution methods for solving the problem, including forming justified approximations and assumptions.
2.2.4	Compare and contrast alternative solutions to select the best methodology.
3.1.6	Determine design objectives, functional requirements and arrive at specifications.
3.3.3	Identify relevant data from the given resources and arrive at an optimal design solution for particular specifications.
11.3.1	Source and comprehend technical literature and other credible sources of information.

Course Outcomes: A learner will be able to -

1. Apply the fundamentals of engineering to demonstrate the concepts of semiconductor diodes and analyse its applications. *(LO 1.1, LO 1.2, LO1.3, LO1.4*)
2. Apply the fundamentals of engineering to design transistor-based applications such as an amplifier, switch, etc. *(LO 2.1, LO 2.2, LO2.3, LO2.4*)
3. Formulate mathematical models to introduce number system and use logic gates to design circuits for a given expression. *(LO 3.1, LO 3.2, LO3.3, LO3.4*)
4. Recognize the utilisation of measuring devices and its working. *(LO 4.1, LO 4.2*)
5. Apply the fundamentals of engineering to introduce various transducers and sensors to adapt to the current technologies regarding new developments in the relevant fields. *(LO 5.1, LO 5.2, LO6.1, LO6.2*)

CO-PO Mapping Table with Correlation Level

CO ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
ESC203.1	3	3	-	-	-	-	-	-	-	-	-
ESC203.2	3	3	-	-	-	-	-	-	-	-	-
ESC203.3	-	3	3	-	-	-	-	-	-	-	-
ESC203.4	2	-	-	-	-	-	-	-	-	-	2
ESC203.5	3	-	-	-	-	-	-	-	-	-	-

Average	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**

Text Books :

1. Basic Electronics- Devices, Circuits and IT Fundamentals, Prentice Hall, India, 3rd edition, 2019.
2. Electronics A Systems Approach, Neil Storey, 2011, 4th edition, Pearson Education Publishing Company Pvt. Ltd.
3. Electronic Devices and Circuits, Salivahanan, N Suresh Kumar, 2013, 3rd edition, McGraw Hill Publications.
4. Basic Electronics & Linear Circuits, Bhargava N. N., D C Kulshreshtha and S C Gupta, 2013, 2nd edition, Tata McGraw Hill.
5. Electronic Devices and Circuit Theory Robert L. Boylestad Louis Nashelsky,11th edition, Pearson New International Edition.

Reference Books :

1. Electronic Devices and Circuits, David A Bell, 2016, 5th Edition, Oxford.
2. The Art of Electronics 3rd Edition by Horowitz and Hill, 3rd edition, 2015.
3. Digital Logic and Computer Design, M. Morris Mano, 2008 ISBN-978-81-203-0417-8, PHI Learning.
4. Electronic Instrumentation and Measurements (3rd Edition) – David A. Bell, 2013, Oxford University Press.
5. Electronic Communication Systems, George Kennedy, 4th Edition, TMH, 2009.

Other Resources :

1. NPTEL Course: Introduction to Basic Electronics By Prof. T.S. Natarajan, Basic Electronics andLab, IIT Madras :-Web link- https://nptel.ac.in/courses/122106025
2. NPTEL Course: Digital Electronic Circuits By Prof. Goutam Saha, NOC:Digital ElectronicCircuits, IIT Kharagpur :-Web link- https://nptel.ac.in/courses/108105132
3. NPTEL Course: Introduction to Microcontrollers & Microprocessors By Prof. Dr. S.P. DasMicrocontrollers and Applications, IIT Kanpur :- Web link- https://nptel.ac.in/courses/107/106/10710608

IN-SEMESTER ASSESSMENT (50 MARKS)

1. Continuous Assessment - Theory-(20 Marks)

1. *Numerical Assignment/s (min 20 problems) – 04 Marks*
2. *Class test based on above numerical assignment – 04 Marks*
3. *Open book test/ Open notes test: 04 Marks*
4. *Regularity and active participation:05 Marks*

2. Mid Semester Exam (30 Marks)

Mid semester examination will be based on 40% to 50% syllabus.

END SEMESTER EXAMINATION (50 MARKS)

End Semester Examination will be based on syllabus coverage up to the Mid Semester Examination(MSE) carrying 30% weightage, and the syllabus covered from MSE to ESE carrying 70% weightage.

Course Type	Course Code	Course Name	Credits
BSL	BSL203	ENGINEERING PHYSICS-II LABORATORY	0.5

Examination Scheme					
Distribution of Marks			Exam Duration (Hrs.)		Total Marks
In-semester Assessment		End Semester Examination (ESE)			
Continuous Assessment	Mid-Semester Exam (MSE)		MSE	ESE	
25	-	-	-	-	25

Program Outcomes addressed:

1. PO1: Engineering Knowledge
2. PO4: Conduct investigations of complex problems
3. PO8: Individual and Collaborative Team Work
4. PO9: Communication

Course Objectives:

1. To demonstrate the fundamental concepts of physics and evaluate the process of an experiment/project quantitatively and qualitatively.
2. To improve the knowledge gained in the theory course.
3. To develop the abilities of modelling, measurements, observations and analysing data.
4. To develop the experimental skill in assembling and handling laboratory instruments.

Module	Details	Hrs.
00.	**Course Introduction** Introduction to various instruments and components used in physics lab; Rules and regulations to be followed; The fundamental concepts for all experiments, Explanation for performing the experiments.	01
01.	**Experiment 1** ***Learning Objective:*** *To apply the concept of miller indices to identify principal crystal planes. To determine the interplanar distance in simple cubic structure.*	02
	Contents: Miller Indices: Study of miller indices for planes in simple cubic structure.	
	Self-Learning Topics: -	
	Learning Outcome: *LO1.1: A learner will be able to apply the concept of miller indices and analyze principal crystal planes to determine the interplanar distance in simple cubic structure. (P.I.- 1.2.1, 1.2.2, 4.3.1, 4.3.3)*	

02.	**Experiment 2** ***Learning Objective:*** *To simulate XRD pattern for a given crystal system* **Contents:** X-ray Diffraction: Simulation of X-ray Diffraction (XRD) pattern of a material. ***Self-Learning Topics: -*** ***Learning Outcome:*** *LO2.1. A learner will be able to apply the knowledge of x-ray diffraction and analyze the crystal structure by simulating XRD pattern for various materials using software and write the result. (P.I.- 1.2.1, 1.2., 4.1.3, 4.3.3)*	**02**
03.	**Experiment 3** ***Learning Objective:*** 1. *To apply the knowledge magnetic materials in order to study the phenomena of magnetic hysteresis.* 2. *To gain the knowledge of importance of hysteresis loop.* **Contents:** Magnetization: Drawing hysteresis curve (B-H curve) of a magnetic material. ***Self-Learning Topics: -*** ***Learning Outcome:*** *LO 3.1: A learner will be able to apply basic concepts of magnetization and analyze the B-H curve of a ferromagnetic material to determine the loss of energy per unit volume to magnetize the material and write the result. (P.I.- 1.2.1, 1.2., 4.3.1, 4.3.3).*	**02**
04.	**Experiment 4** ***Learning Objectives:*** 1. *To apply the knowledge of dielectric materials.* 2. *To determine the dielectric constant of a given material.* **Contents:** Dielectrics: Determination of dielectric constant of a given material. ***Self-Learning Topics: -*** ***Learning Outcome:*** *LO4.1: A learner will be able to apply the knowledge of dielectrics and analyse experimental data to determine the dielectric constant of the given material and write the result. (P.I.- 1.2.1, 1.2.2, 4.3.1, 4.3.3)*	**02**
05.	**Experiment 5** ***Learning Objective/s:*** *To simulate and visualize nanostructures.* **Contents:** Nanomaterials: Simulation experiment for structure of nanomaterials.	**02**

	Self-Learning Topics : -	
	Learning Outcome : LO5.1: *A learner will be able to apply the knowledge of nanomaterials and analyse the structure of the nanomaterials using simulation software and write the result. (P.I.- 1.2.1, 1.2., 4.1.3, 4.3.3)*	
06.	**Course Project** ***Learning Objective/s:*** 1. *To apply various concepts of physics in a project.* 2. *To execute the chosen project through practical demonstration*	**03**
	Contents: Report writing and Demonstration of the project.	
	Self-Learning Topics: -	
	Learning Outcomes: *A learner will be able to* *LO6.1: apply the concepts of physics to execute, demonstrate and present the project effectively as a team. (P.I.- 1.2.1, 1.2.2, 4.2.1, 4.3.1, 8.1.2, 8.3.1,9.1.2, 9.2.2)*	
	Course Conclusion	**01**
	Total	**15**

Performance Indicators:

P.I. No.	**P.I. Statement**
1.2.1	Apply laws of physics to an engineering problem.
1.2.2	Apply the formulae derived from the concept to solve engineering problem.
4.1.3	Apply appropriate instrumentation and/or software tools to make measurements of physical quantities.
4.2.1	Design and develop experimental approach, specify appropriate equipment and procedures.
4.3.1	Use appropriate procedures, tools and techniques to conduct experiments and collect data.
4.3.3	Represent data (in tabular and/or graphical forms) so as to facilitate analysis and explanation of the data, and drawing of conclusions.
8.1.2	Implement the norms of practice (e.g. rules, roles, charters, agendas, etc.) of effective teamwork, to accomplish a goal.
8.3.1	Present results as a team, with smooth integration of contributions from all individual efforts.
9.1.2	Produce clear, well-constructed, and well- supported written engineering documents.
9.2.2	Deliver effective oral presentations to technical and non- technical audiences.

Course Outcomes:

1. Learners will be able to apply the fundamental knowledge of different materials to determine various parameters through relevant experiments.
   (*LO 1.1, LO3.1, LO 4.1*)

2. Learners will be able to apply the basic concept of different materials to simulate their structures and diffraction pattern using relevant software. (*LO 2.1, LO5.1*)

3. Learners will be able to use fundamental knowledge of physics for the execution, presentation of the chosen project as a team and write effective report. (*LO 6.1*)

CO-PO Mapping Table with Correlation Level

CO ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
BSCLC203.1	3	-	-	3	-	-	-	-	-	-	-
BSCLC203.2	3	-	-	3	-	-	-	-	-	-	-
BSCLC203.3	3	-	-	3	-	-	-	-	-	-	-
BSCLC203.4	3	-	-	3	-	-	-	3	3	-	-
Average	**3**	**-**	**-**	**3**	**-**	**-**	**-**	**3**	**3**	**-**	**-**

Text Books:

1. A Textbook of Engineering physics, Dr. M. N. Avadhanulu and Dr. P. G. Kshirsagar Revised Edition, 2014, S. Chand Publishing.
2. Engineering physics, R. K. Gaur and S. L. Gupta, Revised Edition, 2012, Dhanpat Rai Publications.

Reference Books:

1. Fundamentals of Physics, Halliday /Resnick/Walker, Twelve Edition, 2021, Wiley
2. Introduction to solid state physics, Charles Kittel, Eighth Edition, 2005, Wiley
3. Introduction to nanotechnology, Charles P Poole and Frank J Owens, 1st Edition, Wiley-Interscience.

Other Resources:

1. Online physics library, California State University:-Web link- https://phys.libretexts.org/
2. Physics website, The State University of New Jersey :-Web linkwww.physics.rutgers.edu

IN-SEMESTER ASSESSMENT (25 MARKS)

1. Lab Performance: 10 marks
2. Project (Final Report and Demonstration): 10 marks
3. Regularity and active participation: 5 marks

Course Type	Course Code	Course Name	Credits
BSL	BSL204	ENGINEERING CHEMISTRY -II LABORATORY	0.5

Examination Scheme					
Distribution of Marks			Exam Duration (Hrs.)		Total Marks
In-semester Assessment		End Semester Examination (ESE)			
Continuous Assessment	Mid-Semester Exam (MSE)		MSE	ESE	
25	-	25	25	-	25

Pre-requisite: Nil

Program Outcomes addressed:

1. PO1: Engineering Knowledge
2. PO2: Problem Analysis
3. PO6: The engineer and the world
4. PO8: Individual and collaborative teamwork

Course Objectives:

1. To enable the students to apply the laws of chemistry to an engineering problem.
2. To acquaint the students with practical knowledge of the basic concepts of chemistry to gainexperimental skill.
3. To enable the students to utilize the fundamental laboratory techniques for analysis.

Module	Details	Hrs.
00.	**Course Introduction** 1. Code of conduct in chemistry laboratory 2. Safety and precautions to be observed in chemistry laboratory 3. Orientation on evaluation of laboratory performance	01
01.	**Experiment 1** ***Learning Objective/s:*** ***To calculate percentage of iron in plain carbon steel and relate it with the classification of plain carbon steel.***	02
	To determine the percentage of iron present in a plain carbon steel	
	Self-Learning Topics: Nil	
	Learning Outcomes: *LO -1.1 A learner will be able to calculate the percentage of iron in plain carbon steel by redox titration method. (1.2.1), (1.3.1), (2.2.3).*	
	Experiment 2	

02.	*Learning Objective/s:* *To apply the knowledge of condensation polymerization for the synthesis of urea formaldehyde.* **Synthesis of Urea formaldehyde.** ***Self-Learning Topics: Nil*** ***Learning Outcomes:*** *LO-2.1 A learner will be able to synthesize thermosetting resin using condensation polymerization reaction and calculate its yield and state its societal benefits. (1.2.1), (1.3.1), (2.2.3), (6.1.1).*	**02**
03.	**Experiment 3** *Learning Objective/s:* *To compare the viscosity of pure solvent and the solution of polymer for calculating the molecular weight of polymer.* To Determine molecular weight of a polymer using Ostwald's viscometer. ***Self-Learning Topics: Nil*** ***Learning Outcomes:*** *LO-3.1 A learner will be able to c*alculate the specific viscosity of polymer with respect to pure solvent and its molecular weight using Ostwald's Viscometer (1.2.1), (1.3.1), (2.2.3).	**02**
04.	**Experiment 4** *Learning Objective/s:* *To construct the Daniel cell and calculate its E^0 using Nernst equation.* To determine the emf of galvanic cell-Daniel cell. ***Self-Learning Topics: Nil*** ***Learning Outcomes:*** *LO-4.1 A learner will be able to construct and calculate E^0 of Daniel cell using electrode reactions and compare with theoretical values to conclude whether Daniel cell is working or not. (1.2.1), (1.3.1), (2.2.3).*	**02**
05.	**Experiment 5** *Learning Objective/s:* *To determine the concentration of iron and verify Beer Lambert's law.* To determine iron from the given sample using UV-Visible spectrophotometer. ***Self-Learning Topics: Nil*** ***Learning Outcomes :***	**02**

	LO-5.1 A learner will be able to measure the absorbance of standard and unknown concentrations of given analyte using UV-Visible spectrophotometer and verify Beer Lambert's law (1.2.1), (1.3.1), (2.2.3).	
06.	***Demonstration*** *Learning Objective:* *To develop the basic knowledge of analytical chemistry using titrimetric experiment.*	**04**
	Demonstration of titrimetric experiment and conclusion.	
	Self-Learning Topics: Nil	
	Learning Outcomes: *LO-6.1 A learner will be able to analyze and calculate the proposed substances in an experiment using fundamental laws and basic concepts of engineering chemistry and demonstrate the results as a team (1.2.1), (1.2.2), (1.3.1), (2.1.3) (8.1.1), (8.3.1).*	
	Total	**15**

Performance Indicators:

P.I. No.	**P.I. Statement**
1.2.1	Apply laws of natural science to an engineering Problem.
1.2.2	Apply the formulae based on the concepts of engineering chemistry for solving the numerical problems.
1.3.1	Apply fundamental engineering chemistry concepts to solve engineering problems.
2.1.3	Identify the engineering chemistry concepts to analyze the given problem
2.2.3	Identify the existing processes/ solution methods for solving the problems
6.1.1	Identify and describe the various roles of materials particularly as pertains to protection of the public and public interest at global, regional and local level
8.1.1	Recognize a variety of working and learning preferences; appreciate the value of diversity on a team.
8.3.1	Present result as a team with smooth integration of contributions from all individual efforts.

Course Outcomes: A learner will be able to -

1. Apply the laws of electrochemistry and spectroscopy for performing the practicals. (*LO- 4.1, LO-5.1)*
2. Analyze the materials for engineering applications. (*LO-1.1, LO-3.1, LO-5.1)*
3. Synthesize the polymer and use it for societal benefits. (*LO-2.1)*
4. Demonstrate an ability to work effectively in a team for the project. (*LO-6.1)*

CO-PO Mapping Table with Correlation Level

CO ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
BSL204.1	3	2	-	-	-	-	-	-	-	-	-
BSL204.2	3	2	-	-	-	-	-	-	-	-	-
BSL204.3	2	2	-	-	-	2	-	-	-	-	-
BSL204.4	3	2	-	-	-	-	-	3	-	-	-
Average	**3**	**2**	-	-	-	**2**	-	**3**	-	-	-

Text Books:

1. Practical book in Engineering Chemistry by Dr. Pijus Khatua and Debashree Singh, First edition, 2016, Platinum Publishers
2. Textbook of green chemistry by AK Ahluwalia, 2008, Ane Book India

Reference Books:

1. Experiments in Engineering Chemistry by Payal Joshi, first edition, 2016, I.K. International Publishing House Pvt. Ltd.

Other Resources:

1. Online chemistry library for open access text books: https://chem.libretexts.org
2. https://vlab.amrita.edu/?sub=2&brch=190&sim=1546&cnt=1

IN-SEMESTER ASSESSMENT (25 MARKS)

1. Lab Performance: 10 Marks
2. Demonstration of the experiment: 10 marks
3. Regularity and active participation: 5 marks

Course Type	Course Code	Course Name	Credits
ESL	ESL204	ENGINEERING GRAPHICS LABORATORY	02

Examination Scheme		
Continuous Assessment	End Semester Exam (ESE)	Total Marks
50	50	100

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem Analysis
3. PO5: Engineering tool usage
4. PO9: Communication

Course Objectives:

1. To inculcate proper understanding of the theory of projection.
2. To enable students to understand and represent three-dimensional objects on a two-dimensional surface in a way that accurately conveys their shape, size, and orientation.
3. To acquaint students with representing internal features of a three-dimensional object by way of section that accurately conveys their internal orientation.
4. To communicate proper ideas by representing the two-dimensional views into a three-dimensional object.
5. To enable students to read and interpret a given orthographic projection to draw the missing view.

Module	Details	Hrs.
00.	**Course Introduction** This is foundation course which deals with fundamental concepts of technical drawing and modern tools associated with it. This course will empower the imagination and visualization which will help in communicating the technicality of the product.	01
01.	**Introduction to Engineering Graphics** ***Learning Objective:*** *To identify different types of lines and dimensioning standards as per IS system.* **Contents:** Principles of Engineering Graphics and their significance, Types of Lines,Dimensioning Systems as per IS conventions Introduction to CAD tool (AutoCAD): An overview of AutoCAD software to make simple drawings. **Experiment:** To demonstrate the basic commands in AutoCAD software.	08

	Learning Outcomes: *A learner will be able to* *LO 1.1: represent the fundamental drawing essentials such as line types, line weights, dimensioning systems, tolerance, etc. (P.I.-2.2.3)* *LO1.2: Identify standard procedures according to IS conventions. (P.I.-2.2.2)* *LO1.3: Demonstrate the use of basic AutoCAD commands. (P.I.-5.1.1)* *LO1.4: Draw simple drawings with the use of basic AutoCAD commands. (P.I.-5.2.2)*	
02.	**Projection of Points and Lines, Orthographic and Sectional Views** ***Learning Objective:*** *To develop the imagination in creating the orthogonal and sectional orthographic viewsfor communicating the features in the product.*	**20**
	Contents: 2.1 Projection of Points and Lines: Projection of points in different quadrants. Projection of lines keeping the ends in different quadrants. 2.2 Orthographic Projections: Concept of First Angle and Third Angle Projection. Fundamentals of Orthographic Projections. Different views of a simple machine part as per the first angle projection method recommended by I.S. Multi view drawing from pictorial views using CADSoftware (AutoCAD) 2.3 Sectional Orthographic Projections: Full or Half Sectional views of the Simple Machine parts. Sectional view using CAD Software (AutoCAD). **Experiment:** To demonstrate the ability to convert the isometric drawings intoorthogonal and sectional orthographic drawings.	
	Learning Outcomes: *A learner will be able to* *LO 2.1: Differentiate between the apparent length and true length of the lines by projecting the lines in a two-dimensional space from different quadrants and represent the procedure in the form of drawing or report. (P.I.-1.3.1,9.3.1)* *LO 2.2: Develop the ability to create orthographic projections of objects in different views, including front, top, and side views. (P.I.-1.4.1,9.1.1)* *LO 2.3: Create sectional orthographic projections of objects including half and full sections. (P.I.-2.1.3, 9.1.1)* *LO 2.4: Demonstrate the application of orthographic and sectional orthographic projections in different fields, including engineering, architecture, and manufacturing by representing them in a report. (P.I.-2.2.3,9.3.1)* *LO 2.5: Demonstrate the use of basic AutoCAD commands. (P.I.- 5.1.1)* *LO2.6: Apply the basics of AutoCAD to create the simple orthographic drawings. (P.I.- 5.2.2,9.3.1)*	
03.	**Isometric Drawing**	
	Learning Objective: *To develop the ability in visualization of the two-dimensional views of the object*	

	to produce the isometric drawing.	
	Contents: Isometric Drawing: Principles of Isometric Projection, Isometric Views, Conversion of Orthographic Views to Isometric Views. (Excluding Sphere). Construction of Isometric View from Orthographic views with CAD Software (Auto CAD) **Experiment:** To demonstrate the ability to convert the orthographic views into isometricdrawings.	**12**
	Learning Outcomes: *A learner will be able to* *LO 3.1: Identify the nature of simple geometries when plotted on isometric plane. (P.I.- 1.3.1)* *LO3.2: apply the fundamental geometrical procedures from mathematics to draw the given isometric views. (P.I.-1.2.1)* *LO3.3: Develop their ability to visualize three-dimensional objects and represent them on a two-dimensional surface. (P.I.-2.1.3,9.3.1)* *LO3.4: Draw the isometric drawings from the two-dimensional views. (P.I.-2.2.3)* *LO3.5: create isometric drawings of objects in AutoCAD. (P.I.-5.1.1,9.1.1)* *LO 3.6: develop proficiency in the orientation and scale of the object while drawing the AutoCAD (P.I.-5.2.2,9.1.1)*	
04.	**Orthographic Reading** ***Learning Objectives:*** ***To develop the ability of the students to read the orthographic and sectional orthographicprojections to draw the missing views.***	**05**
	Contents: Orthographic Reading: The identification of missing views from the givenviews. Creation of the third view from the two available views so that all the details of the object are obtained using CAD Software (AutoCAD). **Experiment:** To demonstrate the ability to visualize and interpret the missing views ofOrthographic projections.	
	Learning Outcomes: *A learner will be able to* *LO 4.1: Read and interpret technical drawings that use orthographic and sectionalorthographic projections. (P.I.-,2.2.3,9.1.1)* *LO 4.2: identify the missing view by visualizing the two views in combined manner. (P.I.-1.3.1)* *LO 4.3: redraw the simple orthographic view into sectional orthographic view (P.I.-1.2.1)* *LO 4.4: identify the position and orientation of the missing view. (P.I.-2.2.1)* *LO 4.5: Demonstrate the use of basic AutoCAD commands to produce the missing viewby reading the orthographic projections on a two-dimensional space. (P.I.- 5.1.1, 9.3.1)* *LO 4.6: use the theory of projection efficiently to create the missing view in AutoCAD (P.I.-5.2.2)*	

05.	**Projection of Planes and Solids, and Sectioning of Solids** ***Learning Objective/s:*** *To develop the ability to imagine the solid geometries and represent the views in a twodimensional space.*	**14**
	Contents: 1.1 Projection of Planes: Projection of Triangular, Square, Rectangular, Pentagonal, Hexagonal or Circular planes inclined to either HP or VP only. 1.2 Projection of Solids: Solid projection (of Prism, Pyramid, Cylinder, Cone only) with the axis inclined to HP or VP. (Exclude Spheres, Composite, Hollow solids and frustum of solids). Use change of position or Auxiliary plane method. 1.3 Section of Solids: Section of Prism, Pyramid, Cylinder and Cone cut by plane perpendicular to at least one reference plane and incline to other in simple positions of the solid. (Section in initial position only)	
	Learning Outcomes : *A learner will be able to* *LO 5.1: create orthographic projections of planes and different types of solids. (P.I.- 1.3.1)* *LO 5.2: create different views of solid geometries. (P.I.-1.2.1)* *LO 5.3: develop the ability to create auxiliary views, which are used to show the true shape and size of features that are not parallel to the principal planes of projection (P.I.-2.2.4,9.1.1)* *LO 5.4: create section views of solids using different cutting planes in different orientations and represent them in the form of two-dimensional drawings. (P.I.- 2.2.3,9.3.1)*	
	Total	**60**
MINIMUM 2 experiments should be conducted from each module.		

Performance Indicators:

P.I. No.	**P.I. Statement**
1.2.1	Apply laws of natural science to an engineering problem
1.3.1	Apply fundamental engineering concepts to solve engineering problems.
1.4.1	Apply mechanical engineering concepts to solve engineering problems.
2.1.3	Identify the mathematical, engineering and other relevant knowledge that applies to a given problem.
2.2.2	Identify, assemble and evaluate information and resources.
2.2.3	Identify existing processes/solution methods for solving the problem, including forming justified approximations and assumptions.
2.2.4	Compare and contrast alternative solution processes to select the best process.
5.1.1	Identify modern engineering tools such as computer aided drafting, modelling and analysis; techniques and resources for engineering activities
5.2.2	Demonstrate proficiency in using discipline specific tools.
9.1.1	Read, understand and interpret technical and non-technical information.
9.3.1	Create engineering-standard figures, reports and drawings to complement writing and presentations.

Course Outcomes: A learner will be able to -

1. Apply the basic concepts and standards in accordance with IS conventions and demonstrate basic commands using AUTOCAD. *(LO 1.1, LO 1.2, LO1.3, LO1.4, LO 2.1)*
2. Apply the basic principles of projections in converting pictorial views into orthographic Views and draw using AUTOCAD. *(LO 2.1, LO 2.2, LO 2.3, LO 2.4, LO 2.5, LO 2.6, LO 5.1, LO 5.2)*
3. Apply the basic principles of projections in converting orthographic Views into isometric drawing using conventional method and AUTOCAD. (*LO 2.2, LO 3.1, LO 3.2, LO 3.3, LO 3.4, LO 3.5, LO 3.6)*
4. Represent the internal features of the objects by providing the sectional views of the object. *(LO 2.3, LO 2.4, LO 5.1, LO 5.2, LO 5.3, LO 5.4)*
5. Apply the basic principles of projections to draw the missing views using AUTOCAD. *(LO 4.1, LO 4.2, LO 4.3, LO 4.4, LO 4.5, LO 4.6)*

CO-PO Mapping Table with Correlation Level

CO ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
ESL204.1	2	3	-	-	3	-	-	-	2	-	-
ESL204.2	3	3	-	-	3	-	-	-	2	-	-
ESL204.3	3	3	-	-	3	-	-	-	3	-	-
ESL204.4	3	3	-	-		-	-	-	3	-	-
ESL204.5	3	3	-	-	3	-	-	-	3	-	-
Average	**3**	**3**	**-**	**-**	**3**	**-**	**-**	**-**	**3**	**-**	**-**

Text Books:

1. Engineering Drawing (Plane and solid geometry), N.D. Bhatt, 54th Edition, 2023, CharotarPublishing House Pvt. Ltd.
2. Engineering Drawing, N.H.Dubey, 16th Edition, 2015, Nandu Publications
3. Machine Drawing, N.D. Bhatt & V.M. Panchal, 49th Edition, 2014, Charotar Publishing HousePvt. Ltd.

Reference Books:

1. Engineering Drawing, Narayana, K.L. & P Kannaiah ,3rd Edition, 2012, Scitech Publisher
2. AutoCAD 2024: A Problem-Solving Approach, Basic and Intermediate, , Prof. Sham Tickoo,30th Edition, 2023, CADCIM Technologies

Other Resources:

1. NPTEL Course: Engineering Drawing by Prof. P.S. Robi, Department of Mechanical Engineering, IIT Guwahati:-Web link- https://nptel.ac.in/courses/112103019.
2. NPTEL Course: Engineering Graphics and Design by Prof. S.R.Kale, Department of Mechanical Engineering, IIT Delhi :-

   Web link- https://onlinecourses.nptel.ac.in/noc21_me128

A. IN-SEMESTER ASSESSMENT (50 MARKS)

1. **AutoCAD Assignments (10 Marks):** AutoCAD assignments will be evaluated as a part of continuous laboratory experiments which will be done in AutoCAD software. The Assignments will be based on the following topics:
   i. Redraw the given views using basic AutoCAD Commands. (2 Problems)
   ii. Orthographic Projections (2 Problems)
   iii. Sectional Orthographic Projections (2 Problems)
   iv. Isometric Projections (3 Problems)
   v. Reading of Orthographic Drawings (1 Problems)

2. **Sketchbook Assignments (10 Marks)*:*** Regular Assignments will be given based on the topic covered in the class and will be evaluated at regular intervals as a part of continuous assessment. The Assignments will be based on the following topics:
   1) Projection of Lines (2 Problems)
   2) Orthographic Projections (2 Problems)
   3) Sectional Orthographic Projections (2 Problems)
   4) Reading of Orthographic Projections (1 Problems)
   5) Isometric Projections (2 Problems)
   6) Projection of Planes (2 Problems)
   7) Projections of Solids (2 Problems)
   8) Section of Solids (2 Problems)
3. **Regularity and active participation: 5 marks**
4. **Class Tests (25 Marks) :**
   1. **AutoCAD (15 Marks):** The test will be based on Orthographic Projections on AutoCAD software.

      Evaluation Criterion:

      1. Completion and accuracy of the drawing.
      2. Presentation of labels, dimensions, title block on the sheet.
   2. **Manual Drawing Exam (10 Marks):** The test will be based on projections of lines and projections of Solids.

      Evaluation Criterion:

      1. Completion and accuracy of the drawing.
      2. Neatness of the drawing.

3. Proper space management of the sheet.

B. END SEMESTER EXAMINATION (50 MARKS)

Topic for the End Semester Practical Examination (Auto CAD) (2.5 hours)

1. **Isometric drawing. (1 problem) (20 Marks) (Excluding the curves on an inclined plane):**

   The two-dimensional views will be provided such as Front view, Top View and Side view of the object. The task will be to convert the given views in to an isometric drawing (three-dimensional model)

2. **Sectional Orthographic Projection (1 problem). (15 Marks):**

   An isometric figure will be given and the task will be to convert the isometric figure in a sectional 2D view which will include the sectional Front view, Top View and Side view of the three-dimensional figure.

3. **Reading of Orthographic Projections (1 problem) (15 Marks):**

   The two views of the model will be given as an AutoCAD file and the task will be to generate the missing view of the drawing.

Note:

1. Printout of the answers have to be taken preferably in A4 size sheets and should be assessed by External Examiner only.

2. Knowledge of Auto CAD software, concepts of Engineering Graphics related to specified problem and accuracy of drawing should be considered during evaluation.

Two examiners, one Internal and one External will do the evaluation

Course Type	Course Code	Course Name	Credits
ESL	ESL205	PROGRAMMING LABORATORY-II (JAVA)	02

Examination Scheme		
Continuous Assessment	**End Semester Exam(ESE)**	**Total Marks**
50	50	100

Pre-requisite:

1. ESL103: Programming Laboratory-I (C)

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO3: Design/development of solutions
4. PO5: Engineering tool usage
5. PO11: Life-long learning

Course Objectives:

1. To impart the knowledge in object-oriented paradigm in the Java programming language.
2. To inculcate the importance of Classes & objects along with constructors,
3. To impart skills of inheritance, interface and packages and demonstrate the concept of reusability for faster development.
4. To introduce usage of Exception Handling, Multithreading, Input Output streams in various applications.
5. To impart the knowledge of designing, implementing, testing, and debugging graphical user interfaces in Java using Swings and AWT components that can react to different user events.

Module	Details	Hrs.
00.	**Course Introduction** Java is platform independent, open-source object-oriented programming language enriched with free and open source libraries. In current industrial scenario Java has the broad industry support and is prerequisite with many allied technologies like Advanced Java, Java Server Pages, and Android Application Development. Thus, current industrial trends necessitate acquiring Java knowledge for graduates.	**01**
01.	**Introduction to Java** ***Learning Objective:*** ***Learner is expected to gain proficiency in concept like programming tokens like variables, data types, operators, control structures, function. Also expected to apply the concepts for writing program***	**11**
	Contents: OOP concepts: Objects, class, Encapsulation, Abstraction, Inheritance, Polymorphism, message passing.	

	Java development kit, Java Virtual Machine, Garbage collection in java Basic programming constructs: variables, data types operators, expressions, branching and looping. Setup a Java Programming development environment by using: a) Command prompt. (Classpath and path setup) b) Any IDE (Eclipse, Netbeans etc.) **Demonstration** 1. How to Install Java? 2. Setting environment Variables to Run Java Programs. 3. Editing a Java Program and its Compilation and Execution. 4. About main () Method 5. Few Simple Java Programs 6. Writing and running simple Java programs 7. Explain control structures in java **Task 1**: Write simple java program 1. To show basic syntax, variables, and data types 2. Implement basic arithmetic operations using Java. 3. Write a program using if statement (eg. to check if a number is even or odd.) 4. Implement a simple calculator using methods for arithmetic operations. Use switch control to write menu driven program. **Task 2:** Practice method overloading by creating multiple methods with different parameters.	
	Learning Outcomes: *A learner will be able to* *LO 1.1: Illustrate the concept of keywords, data types, variables, operators, and expressions (PI-1.1.1)* *LO 1.2: Apply the fundamental control structures to solve problem (PI-1.3.1)* *LO 1.3: Identify mathematical expression or formula to write and execute a program (PI-2.1.3)* *LO 1.4: Write java code using keywords, data types, variables, operators, and expressions in notepad, then compile and execute the program. Implement a java program using control structure (PI-2.2.3)* *LO 1.5: Use modern JAVA IDE like eclipse, NetBeans (PI-5.1.1).* *LO 1.6: Install JDK and adapt JAVA IDE like eclipse and Set path in command prompt for executing java program (PI-5.1.2)*	
02.	**Class and object** ***Learning Objective:*** 1. *To investigate the functioning of various components of the given control systemas a team.* 2. *To grasp the fundamental concept of input output. Also expected to writeprogram using different input output constructs.*	**08**
	Contents: Classes, objects, data members, member functions, Constructors, methodoverloading. Input and output functions in Java, scanner class	

	Demonstration 1. Encapsulation: creating a class. 2. Creating objects in a program. 3. Defining more method in a class. 4. Constructor in a class and its use 5. Demonstration of constructor overloading. 6. Use of this keyword: to avoid name space collision. **Task 3:** Create a simple Java class representing an entity(e.g., Person, Car) with attributes and methods. • Instantiate objects of the class and demonstrate basicoperations. **Task 4:** Practice encapsulation by defining private variables with public accessors /mutators. **Demonstration** 1. Use of print (), println () and printf (). 2. Command Line Input in Java 3. Take Input using Scanner Class 4. Read Input with DataInputStream **Task 5:** Write a Java program that prints out informationabout any entity (eg. Student, Animal etc.) **Task 6:** Write a Java program that takes input from userwith following ways 1. Command line arguments. 2. Use the Scanner class to prompt the user for the required input Read information with DataInputStream	
	Learning Outcomes: *A learner will be able to* *LO 2.1: Use print statement (PI-1.1.1)* *LO 2.2: Implement a program by taking input from user (PI-1.3.1)* *LO 2.3: Identify classes and objects for problem statement (PI-2.1.1)* *LO 2.4: Apply concept of constructors overloading to write java program (PI-2.3.1)* *LO 2.5: Explore the concept and write recursive function (PI-3.2.1)* *LO 2.6: Write static, non-static and recursive method in java program (PI-3.4.2)*	
03.	**Inheritance, Interfaces, Packages** ***Learning Objective:*** 1. *Learner is expected to gain knowledge of code reusability. Also expected to write program using inheritance.* 2. *Learner is expected to grasp the concept of total abstraction and multiple inheritance Also expected to apply interface concept to achieve multiple inheritance.* 3. *Learner is expected to gain the knowledge in concept of grouping related classes, interfaces, and sub-packages. Also expected to apply the concept of packages to write well-structured application.*	**16**
	Contents:	

	Types of inheritance, Method overriding, super, Abstract class and abstract method, final, Interface. Define package, types of package, naming and creating packages.accessing package. **Demonstration** 1. Simple Inheritance 2. Multilevel Inheritance 3. Use of super Keyword 4. Method Overriding in Inheritance 5. Abstract Class 6. Create a base class (e.g., Shape) with common properties and methods, and derived classes (e.g., Circle, Rectangle) inheritingfrom it. 7. Method overriding and dynamic method dispatch 8. Override methods in the derived classes to demonstrate dynamic method dispatch. **Task 7:** Write a program using inheritance for given problem statement **Demonstration** 1. Some properties of Interface 2. Define Interface 3. Interface and single Inheritance 4. Interface and multiple Inheritance **Task 8:** Develop a program with the interface for given problem statement. **Demonstration** 1. Importing a Java Built-in API package. 2. Creating a User's Own Package 3. Package with Default Access Specifier for its Classes 4. Utilization of a Package in a Java Program 5. Inheritance with a Class in a Package 6. Access Protection of Classes in Package **Task 9:** Write a program to import built-in packages **Task 10:** Create user defined package for the given problem. 1. Write a class and interface to the package.	
	Learning Outcomes: *A learner will be able to* *LO 3.1: Summarize the concept of polymorphism using inheritance, concept ofabstraction using interfaces, and packages in java (PI-2.4.1)* *LO 3.2: Show polymorphism by inheriting the features of one class to other class (PI-2.4.4)* *LO 3.3: Explore the single inheritance and multilevel inheritance (PI-3.2.1)* *LO 3.4: Implement the program using inheritance and interfaces to achieve reusability.Also implement the packages to group classes and interfaces in the package (PI-3.4.2)*	
04.	**Exception Handling and Multi-threading** ***Learning Objectives:*** *1. To impart skills that can enable students to check and handle the proper functioning of applications. Also expected to apply the exception handling for proper functioning of applications.* *2. Learner is expected to know the concept of multithreading. Also expected toapply it for multitasking.*	**08**

	Contents: Exception handling using try, catch, finally, throw and throws, Multipletry and catch blocks, user defined exception. Thread lifecycle, thread class methods, creating threads using extends andimplements keyword. **Demonstration** 1. Exception handling using try, catch, finally, throw and throws, 2. Exception handling Multiple try and catch blocks, 3. Exception handling user defined exception **Task 11:** Write a program for handling the given exceptionusing try, catch, finally, throw and throws. **Demonstration** 1. Creating Threads using the Thread Class. 2. Creating Threads Implementing the Runnable Interface. 3. Life cycle of thread: Thread Methods: wait(). sleep(), notify(),resume(), suspend(). stop(). **Task 12:** Create threads to run the given multiple processesin the given program.	
	Learning Outcomes: *A learner will be able to* *LO 4.1: Illustrate the concept the exception handling and threads in java (PI-1.1.1)* *LO 4.2: Apply the fundamentals of exception handling to handle error (PI-1.3.1)* *LO 4.3: Write a program to show exception handling in java (PI-2.1.3)* *LO 4.4: Create user-defined exception handling (PI-2.2.3)* *LO 4.5: Explore the multiple task handling with threads (PI-3.2.1).* *LO 4.6: Implement threads to achieve multi-tasking(PI-3.4.2)*	
05.	**Graphical User Interface** ***Learning Objective/s:*** 1. *Learner will gain the knowledge of handling events through GUI. Also expectedto apply it for creating small applications.* 2. *Learner is expected to develop proficiency in the concept of swing. Also expected to apply it for developing GUI with good look and feel* 3. *Learner will learn the concept of connecting database with business logic. Alsoexpected to apply it for retrieving and saving data.*	**16**
	Contents: Applet and applet life cycle, creating applets, graphics class functions, parameter passing to applet, Font and color class. Event handling using event class. GUI design with Swing class in JAVA Introduction to JDBC, JDBC-ODBC connectivity **Demonstration** 1. Java Programming for Applet 2. Structure of an Applet 3. A Simple Java Applet Program 4. An Applet using Methods 5. An HTML File Hosting Applet Programs 6. GUIs with AWT Component Frame, Panel, Button,	

	TextField,TextArea, List, Choice, ChoiceBox, Label, Scrollbar, etc. **Task 13:** Develop a program using applet (Applet tag. Adding Applet to HTM file, passing parameter to applet, embedding <applet> tags in java code, adding controls to applets.) **Task 14:** Develop a program for GUI using appletExample 	
	Demonstration: 1. Create a JFrame container 2. Create a JPanel container 3. Create a Swing button 4. Creating JFrame, JButton and method call inside the java constructor 5. Inherit the JFrame class 6. Button with ActionListner 7. Button with image **Task 15:** Develop a GUI using layouts and components of swing	
	Learning Outcomes : *A learner will be able to* *LO 5.1: List all data and techniques to solve problem (PI-1.1.1)* *LO 5.2: Determine different layout manager to develop software (PI-1.4.1)* *LO 5.3: Examine layout managers for flexible window layouts while creating GUI (PI-3.1.6)* *LO 5.4: Write modules to handle events through components of GUI using applets and Abstract Window Toolkit (AWT) (PI-3.4.2)* *LO 5.5: Extend study on eclipse to solve problem (PI-5.1.1)* *LO 5.6: Adapt eclipse and HTML to create GUI using applet and AWT (PI-5.1.2)* *LO 5.7: Illustrate the path from CLI to GUI (PI-11.2.1)* *LO 5.8: Summarize the advantages of GUI of problem (PI-11.2.2)*	
	Course Conclusion	
		Total **60**

Self-Learning Topics

- **MySQL**
  1. Installation of MySQL
  2. DBMS related Tasks with MySQL
  3. Steps to connect to the Database,
  4. Connectivity with MySQL using JDBC

- **Micro-projects**

  A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:
  1. Mini Banking System for handling deposits and withdrawal.
  2. Medical Store Stock Management System.
  3. Bus Reservation System.

4. Student Information System
5. Library Management System
6. Attendance Management System.
7. Develop a small animation using applet, graphics and multithreading

Guidelines for developing micro projects:

1. Declare four to five classes and may include Interfaces if required.
2. Must use Most of the Object Oriented Concepts.
3. Must implement concepts of Inheritance and Exception Handling.
4. Must Create Own Package.
5. May use the constructor overloading and overriding.
6. May Use Multithreading if required.

Performance Indicators:

P.I. No.	P.I. Statement
1.1.1	Apply the knowledge of discrete structures, linear algebra, statistics and numerical techniques to solve problems
1.3.1	Apply fundamental engineering concepts to solve engineering problems.
1.4.1	Apply theory and principles of computer science engineering to solve an engineeringproblem
2.1.1	Identifies processes/modules of a computer based system and parameters to solve a problem
2.1.3	Identifies mathematical algorithmic knowledge that applies to a given problem
2.2.3	Identify existing solution/methods to solve the problem, including forming justifiedapproximations and assumptions.
2.3.1	Able to apply computer engineering principles to formulate modules of a system withrequired applicability and performance
2.4.1	Applies engineering mathematics to implement the solution.
2.4.4	Arrive at conclusions with respect to the objectives.
3.1.6	Ability to develop software requirement specifications
3.2.1	Ability to explore design alternatives.
3.4.2	Ability to implement and integrate the modules.
5.1.1	Identify modern engineering tools, techniques and resources for engineering activities
5.1.2	Create/adapt/modify/extend tools and techniques to solve engineering problems.
11.2.1	Identify historic points of technological advance in engineering that required practitioners toseek education in order to stay current
11.2.1	Recognize the need and be able to clearly explain why it is vitally important to keep currentregarding new developments in your field

Course Outcomes: A learner will be able to -

1. Install java environment and write a java program using fundamental concepts. *(LO 1.1, LO 1.2, LO 1.3, LO 1.4, LO 1.5, LO 1.6*)
2. Apply concepts of classes, objects, members of a class and the relationships among them needed for a finding the solution to specific problem*(LO 2.1, LO 2.2, LO 2.3, LO 2.4, LO 2.5, LO 2.6*)
3. Achieve reusability in programming by using concept of Inheritance, Interface and Packages. *(LO 3.1, LO 3.2, LO 3.3, LO 3.4*)
4. Implement concept of Multithreading, and exceptions to obtain robust and faster programmed solutions to problems. *(LO 4.1, LO 4.2, LO 4.3, LO 4.4, LO 4.5, LO 4.6*)
5. Design and develop application using Abstract Window Toolkit, Swings with database connectivity *(LO 5.1, LO 5.2, LO 5.3, LO 5.4, LO 5.5, LO 5.6, LO 5.7, LO 5.8*)

CO-PO Mapping Table with Correlation Level

CO ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
ESL205.1	3	3	-	-	3	-	-	-	-	-	-
ESL205.2	3	3	3	-	-	-	-	-	-	-	-
ESL205.3	-	3	3	-	-	-	-	-	-	-	-
ESL205.4	3	3	3	-	-	-	-	-	-	-	-
ESL205.5	3		3	-	3	-	-	-	-	-	3
Average	**3**	**3**	**3**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**3**

Text Books :

1. Java: The Complete Reference, Herbert Schildt, Ninth Edition, 2017, McGraw Hill Education.
2. Programming with Java, E. Balagurusamy, Seventh Edition, 2019, McGraw Hill Education

Reference Books :

1. Beginning JAVA, Ivor Horton, Seventh Edition, 2011, Wrox.
2. JAVA Programming Black Book, by D.T. Editorial Services, 2015, Dreamtech Press.
3. Java One Step Ahead, Anita Seth, B.L.Juneja, First Edition, 2017, oxford university press.

Other Resources :

1. NPTEL Course: Programming in Java, By Debasis Samanta, Computer Science and Engineering, Indian Institute of Technology Kharagpur.:-Web link-https://onlinecourses.nptel.ac.in/noc23_cs74/co
2. Web link-www.w3schools.com

3. Web link-www.tutorialspoint.com
4. Web link-https://starcertification.org/Certifications/Certificate/securejava

A. IN-SEMESTER ASSESSMENT (TERM WORK) (50 MARKS)

1. Task Execution (30 Marks)

Students will be given minimum 15 experiments.
Students are expected to

1. Identify variables, data types methods/approach required to write the code for the given task and apply the same.
2. Execute given task for different inputs and verify the result
3. Create a simple Java class representing an entity (e.g., Person, Car) with attributes and methods. Instantiate objects of the class and demonstrate basic operations.
4. Apply simple inheritance and multilevel inheritance.
5. Import a Java Built-in API package and also create user's own package
6. Handle the proper functioning of applications by applying the exception handling.
7. Develop proficiency in the concept of swing and apply it for creating small applications (GUI)

Students are evaluated based on following:

1. Logic building for the given task (10 marks)
2. Rectifying logical errors and syntax errors (06 marks)
3. Well-structured and organized program (06 marks)
4. Verification of experiment output for different inputs (08 marks)

Refer the sample task given below.
Example:
Create a Persona class to add details of the person, inherit features of person class into Employee class and display details using method.
Students are expected to.

1. Identify Variables, data types methods/approach required to create teacher class and add methods to display details of a given teacher
2. Execute given task for different inputs and verify the result
3. Follow the coding standards
4. Identify errors and rectify the errors.

Students are evaluated based on following:

1. Logic building for the given task (10 marks)
2. Rectifying logical errors and syntax errors (06 marks)
3. Well-structured and organized program (06 marks)
4. Verification of experiment output for different inputs (08 marks)

2. Regularity and active Participation (05 Marks)

3. Mid Semester Examination (15 Marks)

a) Task Execution: 10 Marks

Students are evaluated based on following:

1. Logic building for the given task (04 marks)

2. Rectifying logical errors and syntax errors (02 marks)
3. Well-structured and organized program (02 marks)
4. Verification of experiment output for different inputs (02 marks)

b) Oral: 05 Marks

B. END SEMESTER EXAMINATION (Practical & Oral Exam) (50 Marks)

1. Task Execution: 30 Marks
   Students will be given task (different task for every student) to execute and will be evaluated as per the parameters mentioned in continuous evaluation
2. Presentation of Results and conclusion, Inferences drawn: 05 Marks
3. Oral: 15 Marks

Two examiners, one Internal and one External will do the evaluation.

Course Type	Course Code	Course Name	Credits
ESL	ESL206	BASIC ELECTRONICS ENGINEERING LABORATORY	01

Examination Scheme		
Continuous Assessment	**End Semester Exam (ESE)**	**Total Marks**
25	25	50

Pre-requisite:

1. ESC102: Basic Electrical Engineering
2. BSC102: Engineering Physics -I

Program Outcomes addressed:

1 PO2: Problem Analysis
2 PO3: Design / Development of Solutions
3 PO4: Conduct investigations of complex problems
4 PO5: Engineering tool usage
5 PO6: The engineer and the world
6 PO8: Individual and Collaborative Team work
7 PO9: Communication
8 P11: Life-long learning

Course Objectives:

1. To familiarize with electronics components, measuring devices, source devices for building and analysing analog as well as digital circuits.
2. To provide practical exposure to sensors and transducers and build a basic data acquisition system
3. To provide hands-on experience in designing real time application circuits.

Module	Details	Hrs.
00.	**Course Introduction** Electronics is pervasive in the modern era which provides a platform to comprehend the basics of components, ICs devices with some practical application. This provides a roadmap to venture in the field of electronics. The electronic circuits form the integral part for almost all used in industrial machinery, computers, microprocessors, household appliances,medical equipment, internet and e-commerce.	**01**
01.	Name of the Module*:* Electronic Devices ***Learning Objective:*** *Analyze experimental results to validate theoretical concepts and understand practical implications. Evaluatecircuit parameters to achieve desired performancecharacteristics.*	**10**
	Contents: 1. Study of CRO & Measurement of Voltage Amplitude & Frequency. 2. Testing of Components using Instruments and fault detection.	

	3. V. I. Characteristics of Si & Ge diode. 4. Zener Diode Characteristics 5. Applications of Diode: a. Clipper – positive, negative, combinational, biased and combinational b. Clamper – positive and negative c. Rectifier – Half Wave / Full wave with/without filter. 6. Characteristics of BJT in Common Emitter Configuration.	
	Self-Learning Topics: *Advanced Component Testing using LCR Meters*	
	Learning Outcomes: *A learner will be able to* *LO 1.1*: *Analyze an electronic device model by observing and plotting the response withvarious inputs and make a document in the form of report. (P.I.- 2.4.1, P.I.- 9.3.1).* *LO 1.2: Use a systematic approach to measure data and analyze the system's performance across various parametric variation in a team. (P.I.- 4.3.1, P.I.- 8.3.1).*	
02.	**Name of the Module: Digital Circuits** ***Learning Objective:*** *Explore digital circuit fundamentals by understanding logic gates, Boolean expressions,universal gates, and their practical applications.*	**8**
	Contents: **Suggested List of Experiments: (Any Two)** 1. Introduction to Logic Gates – NOT, AND, OR, NAND NOR andXOR 2. For a given Boolean expression, design and verify the circuit usingUniversal Gates. 3. Basics of AND gate and its application in car wiper control 4. Basics of NOT gate and its application in fuel level Indicator.	
	Self-Learning Topics: *Simulation based exploration for all the hardware based digital circuits*	
	Learning Outcomes: *A learner will be able to* *LO 2.1*: *Identify and analyze various IC's required for a digital system, use systematic techniques to test and verify with the help of truth table as a team. (P.I.-2.4.1, P.I.-8.3.1)* *LO 2.2: Devise an optimal design, verify a given Boolean expression and make a document in form of report. (P.I.- 3.3.3, P.I.- 9.3.1)*	
03.	Name of the Module*:* **Sensor/ Transducer Applications** Learning Objective: *To teach the fundamentals of sensor/transducer and model the basic data acquisitionsystem.*	**4**
	Suggested List of Experiments: (Any One) **Contents:** 1. Intruder detection using IR sensor	

	2. Collision avoidance using ultrasonic sensor 3. Fire alarm system using temperature sensor 4. Movement detection using flex sensor 5. Light detection using LDR 6. Interactive doorbell system using Proximity sensor 7. Gas detection using gas sensors	
	Self-Learning Topics: ***Explore and compare software simulations to carry out basic real-life projects in thefield of data acquisition system.***	
	Learning Outcomes: *A learner will be able to* *LO 3.1*: *Identify and analyze various sensors/transducers required for a data acquisition system, use systematic techniques to test and verify same as a team.(P.I.- 2.4.1, P.I.-.8.3.1)* *LO 3.2*: *Design, a prototype of a simple Data Acquisition system, test and convey a document in report form. (P.I.- 3.3.3, P.I.- 9.3.1)*	
04.	**Name of the Module: Real Time Applications** ***Learning Objectives:*** ***Develop practical electronic skills through designing and implementing real-life applications.***	**6**
	Contents: 1. Regulated Power Supply using transistor and zener diode 2. Electronic lock using basic logic gates 3. Cockpit warning light control using basic logic gates. 4. Universal NOR gate and its application in automobile alarm system 5. Universal NAND gate and its application in level monitoring inchemical plant 6. Mosquito Trap bat. 7. Electronic safety lock using vibration sensor 8. Water Level Indicator 9. Smoke Detector 10. Smart Trash Bin 11. Virtual Piano 12. Voltage Doubler Circuit	
	Self-Learning Topics: *Smart sensors in the field of IoT.*	
	Learning Outcomes:	
	A learner will be able to *LO 4.1*: *To demonstrate the analysis with clear, well-constructed presentations to a group of technical and non-technical group with concrete well written documents (P.I.- 2.4.1, P.I.- 9.3.1)* *LO 4.2*: *To design for real life scenarios and check for the sustainability and*	

	feasibility of the application (P.I.- 3.3.3, P.I.- 11.3.1). *LO 4.3: To demonstrate proficiency by recognizing the sources of error in measurements, modelling or simulations and verify credibility of results as a team. (P.I.- 5.3.3, P.I.- 8.3.1).* *LO 4.4: Measure the impact of technological development on society considering factors like environment, user needs, safety and protection (P.I.-6.2.2).*	
	Course Conclusion	**01**
	Total	**30**

Performance Indicators:

P.I. No. P.I. Statement

2.4.1 Extract desired understanding and conclusions consistent with objectives and limitations ofthe analysis
3.3.3 Identify relevant data from the given resources and arrive at an optimal design solution for particular specifications.
4.3.1 Use appropriate procedures, tools, and techniques to conduct experiments and collect data
5.3.3 Recognize sources of error in measurements, modelling or simulations and verify credibility of results.
6.2.2 Comprehend legal requirements relevant to engineering design with reference to standards/regulations.
8.3.1 Present results as a team, with smooth integration of contributions from all individual efforts
9.3.1 Create engineering-standard figures, reports and drawings to complement writing and presentations
11.3.1 Source and comprehend technical literature and other credible sources of information

Course Outcomes: A learner will be able to –

1. Apply knowledge about the electronic equipment such as oscilloscopes, function generators, multimeter, timers etc. for analog testing, measuring the parameters electronics devices such as diode, Zener diode, Transistor etc (*LO 1.1, LO 1.2*)
2. Demonstrate and analyze the use of basic gates and apply it in various applications in digital domain. (*LO 2.1, LO 2.2*)
3. Analyse sensors/transducers and assemble a prototype for a basic data acquisition system. (*LO 3.1, LO 3.2*)
4. Design analyse, test, and ensure functionality of real-life electronic applications using acquired skills and electronic test instruments. (*LO 4.1, LO 4.2, LO 4.3, LO 4.4*)

CO-PO Mapping Table with Correlation Level

CO ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
ESL206.1	-	2	-	2	-	-	-	2	2	-	-
ESL206.2	-	2	2	-	-	-	-	2	2	-	-
ESL206.3	-	2	2	-	-	-	-	2	2	-	-
ESL206.4	-	2	2	-	2	2	-	2	2	-	2

Average	**-**	**2**	**2**	**2**	**2**	**2**	**-**	**2**	**2**	**-**	**2**

Text Books:

1. Basic Electronics By B.L.Theraja,S Chand Publications.
2. Basic Electronics Engineering. Satya Sai Srikant, Prakash Kumar Chaturvedi, Springer, Year:2020
3. A Textbook of Basic Electronics, Dr. Barun RayChaudhuri Chhaya Prakashan Pvt. Ltd.

Reference Books:

1. Learning Art of Electronics: A Hands-on Lab Course By. Paul Horowitz and Thomas, C. Hayes, 2020
2. Basic Electronics--theory and practice J. A. Sam Wilson, Publisher, Gregg Division,McGraw-Hill, 1977.
3. Practical Electronics for Inventors, 4th Edition by Paul Scherz, Simon Monk, 2016
4. Getting started in Electronics – Forest M. Mims Publisher. Fort Worth: Radio Shack,12th edition, 1994.
5. Self-teaching guide: All new electronics – Harry Kybett and Earl Boysen, 3rd edition 2008.

Other Resources:

1. Basic Electronics Course – NPTEL By Dr. M.B. Patil, IIT Bombay.
2. Virtual Lab of Basic Electronics. Basic Electronics (iitkgp.ac.in).

A. IN-SEMESTER ASSESSMENT (50 MARKS)

1. Continuous Assessment - Theory-(25 Marks)

1. Lab Experiments: 10 Marks
2. Internal Assessment:
   i. Practical Test 1 (Based on 50% of the Practical list): 5
   ii. Practical Test 2 (Based on remaining 50% of the Practical list):5
3. Regularity and active participation: 5 marks

B. END SEMESTER EXAMINATION (Pract. /Oral Exam) (25 Marks)

Performance of experiments based on the course content.

Students will have to:

1. Draw the circuit diagram.: 03 Marks
2. Identify the components.: 01Marks
3. Make proper connections on breadboard.:03Marks
4. Take accurate readings from instruments.:03 Marks
5. Tabulate the readings and plot graphs if required.:05 Marks
6. Orals:10 Marks

Two examiners, one Internal and one External will do the evaluation

Course Type	Course Code	Course Name	Credits
SEC	SEC202	BASIC WORKSHOP PRACTICE - II	01

Examination Scheme		
Continuous Assessment	**End Semester Examination (ESE)**	**Total**
50	--	50

Pre-requisite:

1. SEC101: Basic Workshop Practice -I

Program Outcomes addressed :

1. PO1: Engineering knowledge
2. PO5: Engineering tool usage
3. PO6: The engineer and the world
4. PO8: Individual and collaborative team work
5. PO11: Life-long learning

Course Objectives :

1. To impart training to help the students develop engineering skill sets.
2. To inculcate respect for physical work and hard labour.
3. To get exposure to interdisciplinary engineering domain.

Module	Detailed Contents	Hrs
00.	**Course Introduction** The Workshop Practice II course is intended to give students with the core information and abilities required for developing engineering skill sets and getting an exposure to work in an interdisciplinary engineering domain including basic electronic work shop. This hands-on course introduces the fundamental principles, equipment, and techniques utilised in workshop scenarios, such as carpentry, sheet metal working, brazing and forging.	**01**
01.	***Learning Objectives:*** *1. To gain proficiency in accurate measuring, marking, and layout techniques, including the use of squares, levels, and other layout tools.* *2. To develop proficiency in the use of basic carpentry hand tools such as hammers, saws, chisels, planes, and measuring devices.*	**09**
	Content: Carpentry • Use and setting of hand tools like hacksaws, jack planes, chisels and gauges for construction of various joints, wood turning and modern wood turning methods. • Term work to include one carpentry job involving a joint and report on demonstration of a job involving wood turning.	

	Learning Outcomes : *A learner will be able to* *LO1.1: Accurately measure and layout components of carpentry projects using appropriate tools and techniques, ensuring precision and alignment. (P.I. - 1.3.1, 5.2.1, 11.3.1)* *LO1.2:Exhibit proficiency in the use of common carpentry hand tools and power tools, including accurate handling, operation, and maintenance. (P.I. - 1.4.1, 5.2.2, 11.3.2)*	
02.	***Learning Objectives:*** *1. To provide hands-on experience in measuring instruments, electronic components, PCB circuit design and to familiarize students with PCB fabrication process.* *2. To provide hands-on experience in assembly and testing of electronics circuit.*	**10**
	Content: Basic Electronic work shop • Introduction to measuring instruments and electronic components like resistors, capacitors, inductors, diodes, transistors, etc. • Demonstration of PCB simulation software for making the layout, layout transfer to PCB, etching, drilling and soldering technique. • Assembling and testing the circuit for correct functionality.	
	Learning Outcomes : *A learner will be able to* *LO2.1: Select appropriate electronic components based on design requirements and place them effectively on the PCB layout. (P.I. - 5.2.1, 5.2.2, 11.3.1)* *LO2.2: Demonstrate a clear understanding of what PCBs are, how they function, and their importance in electronic devices and systems. (P.I. - 8.2.1, 8.3.1)* *LO2.3: Comprehend the basic principles of PCB design, including component placement, routing, signal integrity, and manufacturability. (P.I. - 6.1.1, 6.4.2, 8.2.1, 8.3.1, 11.3.2)*	
03.	***Learning Objectives:*** *1. To become proficient in the use of various sheet metal working tools and equipment, such as shears, brakes, punches, rollers, and spot welders.* *2. To grasp the fundamental principles and techniques involved in forging, which includes heating, shaping, and cooling metal through the application of force.*	**10**
	Content: Sheet metal working, Brazing and Forging (Smithy) • Use of sheet metal, working hand tools, cutting, bending, spot welding. One job covering maximum operation with soldering or brazing. • At least one forging job to be demonstrated and a simple job to be made for Term Work in a group of 4 students.	
	Learning Outcomes : *A learner will be able to* *LO3.1: Use various sheet metal working tools and equipment proficiently. (P.I. - 5.2.2, 5.3.2, 11.1.1, 11.3.2)* *LO3.2: Demonstrate competence in operating forging equipment and tools, including heating furnaces, power hammers, presses, and hand tools, to manipulate metal effectively. (P.I. - 5.2.2, 8.1.1, 8.3.1, 11.1.1, 11.3.2)*	

Performance Indicators:

P.I. No.	P.I. Statement
1.3.1	Apply fundamental engineering concepts to solve engineering problems
1.4.1	Apply Mechanical engineering concepts to solve engineering problems.
5.2.1	Identify the strengths and limitations of tools for creating engineering designs.
5.2.2	Demonstrate proficiency in using discipline-specific tools.
5.3.2	Verify the credibility of results from tool use with reference to the accuracy and limitations, and the assumptions inherent in their use.
6.1.1	Identify and describe various engineering roles; particularly as pertains to protection of the public and public interest at the global, regional and local level.
6.4.2	Apply principles of preventive engineering and sustainable development to an engineering activity or product relevant to the discipline.
8.1.1	Recognize a variety of working and learning preferences; appreciate the value of diversity on a team.
8.2.1	Demonstrate effective communication, problem-solving, conflict resolution and leadership skills.
8.3.1	Present results as a team, with smooth integration of contributions from all individual efforts.
11.1.1	Describe the rationale for the requirement for continuing professional development.
11.3.1	Source and comprehend technical literature and other credible sources of information.
11.3.2	Analyse sourced technical and popular information for feasibility, viability, sustainability, etc.

Course Outcomes :

A learner will be able to

1. Develop the necessary skill required to handle/use different carpentry tools. (*LO 1.1, LO 1.2*)
2. Identify different electronic components to design, fabricate and assemble PCB. (*LO 2.1, LO 2.2, LO 2.3*)
3. Develop the necessary skill required to use different sheet metal and brazing tools. (*LO 3.1, LO 3.2*)
4. Demonstrate the forging operation with the help of a simple job. (*LO 3.1, LO 3.2*)

CO-PO Mapping Table with Correlation Level

CO ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
SEC202.1	3	-	-	-	3	-	-	-	-	-	3
SEC202.2	-	-	-	-	3	3	-	3	-	-	3
SEC202.3	-	-	-	-	3	-	-	3	-	-	3
SEC202.4	-	-	-	-	3	-	-	3	-	-	3
Average	**3**	**-**	**-**	**-**	**3**	**3**	**-**	**3**	**-**	**-**	**3**

Continuous Internal Assessment (CIA) - (50 Marks)

Job Work with complete workshop book: 40 Marks

Attendance and Active participation: 10 marks

Course Type	Course Code	Course Name	Credits
IKS	IKS201	INDIAN KNOWLEDGE SYSTEM	02

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO6: The engineer & The World
3. PO7: Ethics
4. PO11: Life-long learning

Course Objectives:

1. To introduce fundamentals of Ancient Indian Educations to understand the pattern and purpose of studying vedas, vedangas, upangas, upveda, purana & Itihasa
2. To help students to trace, identify and develop the ancient knowledge systems.
3. To help to understand the apparently rational, verifiable and universal solution from ancient Indian knowledge system for the holistic development of physical, mental and spiritual wellbeing
4. To build in the learners a deep rooted pride in Indian knowledge, committed to universal human right, well-being and sustainable development.

Module	Details
01.	**Indian Knowledge System** Caturdaśa Vidyāsthānam, 64 Kalas, Shilpa Śāstra, Four Vedas, Vedāṅga, Indian Philosophical Systems, Vedic Schools of Philosophy (Sāṃkhya and Yoga, Nyaya and Vaiśeṣika, Pūrva-Mīmāṃsā and Vedānta), Non-Vedic schools of Philosophical Systems (Cārvāka, Buddhist, Jain), Puranas (Maha-puranas, Upa-Puranas and Sthala-Puranas), Itihasa (Ramayana, Mahabharata), Niti Sastras, Subhasitas
02.	**Foundation concept for Science & Technology** Linguistics & Phonetics in Sanskrit (panini's), Computational concepts in Astadhyayi Importance of Verbs, Role of Sanskrit in Natural Language Processing, Number System and Units of Measurement, concept of zero and its importance, Large numbers & their representation, Place Value of Numerals, Decimal System, Measurements for time, distance and weight, Unique approaches to represent numbers (Bhūta Saṃkhya System, Kaṭapayādi System), Pingala and the Binary system, Knowledge Pyramid, Prameya – A Vaiśeṣikan approach to physical reality, constituents of the physical reality, Pramāṇa, Saṃśaya
03.	**Indian Mathematics & Astronomy in IKS** Indian Mathematics, Great Mathematicians and their contributions, Arithmetic Operations, Geometry (Sulba Sutras, Aryabhatiya-bhasya), value of π, Trigonometry, Algebra, Chandah Sastra of Pingala, Indian

	Astronomy, celestial coordinate system, Elements of the Indian Calendar Aryabhatiya and the Siddhantic Tradition Pancanga – The Indian Calendar System Astronomical Instruments (Yantras) Jantar Mantar or Raja Jai Singh Sawal.
04.	**Indian Science & Technology in IKS** Indian S & T Heritage ,sixty-four art forms and occupational skills (64 Kalas) Metals and Metalworking technology (Copper, Gold, Zinc, Mercury, Lead and Silver), Iron & Steel, Dyes and Painting Technology), Town & Planning Architecture in India, Temple Architecture, Vastu Sastra
05.	**Humanities & Social Sciences in IKS** Health, Wellness & Psychology, Ayurveda Sleep and Food, Role of water in wellbeing Yoga way of life Indian approach to Psychology, the Triguṇa System Body-Mind-IntellectConsciousness Complex. Governance, Public Administration & Management reference to ramayana, Artha Sastra, Kauṭilyan State
Total no. of hours: **30**	

Course Outcomes :

1. Explore the diverse realms of the Indian Knowledge System, spanning philosophy, literature, and ethics, to appreciate its holistic approach to education.
2. Understand foundational concepts in Science and Technology from ancient Indian perspectives, including linguistics, mathematics, and astronomy.
3. Discover the rich heritage of Indian Mathematics, Astronomy, and Science, exploring their contributions to global knowledge and technological advancement.
4. Engage with interdisciplinary perspectives in Humanities and Social Sciences rooted in ancient Indian wisdom, fostering critical thinking and holistic development.
5. Apply insights from ancient Indian knowledge systems to contemporary challenges, promoting innovation and sustainable solutions.
6. Cultivate a deeper appreciation for Indian heritage while developing analytical skills and interdisciplinary insights for real-world application.

Text Books :

1. Exploring the Indian Knowledge System: Insights from Prof. B Mahadevan, Prof. B Mahadevan, IIM Bengaluru Press
2. Kapur K and Singh A. K (Eds) 2005). Indian Knowledge Systems, Vol. 1. Indian Institute of Advanced Study, Shimla. Tatvabodh of sankaracharya, Central chinmay mission trust,Bombay, 1995.
3. Nair, Shantha N. Echoes of Ancient Indian Wisdom. New Delhi: Hindology Books, 2008

Reference Books:

1. Reshmi ramdhoni, Ancient Indian Culture and Civilisation, star publication ,2018
2. Supriya Lakshmi Mishra, Culture and History of Ancient India (With Special Reference of Sudras), 2020.
3. DK Chakkrabarty, Makkhan Lal, History of Ancient India (Set of 5 Volumes), Aryan book Internation publication, 2014

Other Resources :

1. NPTEL Course: Indian Knowledge System(IKS): Concepts and Applications in Engineering, By By Prof. B. Mahadevan, Dr. Vinayak Rajat Bhat, Dr. R Venkata Raghava, Indian Institute of Management Bangalore (IIMB), Chanakya University, Bangalore :-Web link- https://onlinecourses.swayam2.ac.in/imb23_mg53/preview
2. NPTEL Course: Indian Knowledge System(IKS): Humanities and Social Sciences, By Prof. B. Mahadevan, Dr. Vinayak Rajat Bhat, Dr. R Venkata Raghavan, Indian Institute of Management Bangalore (IIMB), Chanakya University, Bangalore :-Web link- https://onlinecourses.swayam2.ac.in/imb23_mg55/preview

Course Type	Course Code	Course Name	Credits
PCC	ITPCC301	ENGINEERING MATHEMATICS- III	03+01*

Examination Scheme					
Distribution of Marks			Exam Duration (Hrs.)		Total Marks
In-semester Assessment		End Semester Exam (ESE)			
Continuous Assessment	Mid-Semester Exam (MSE)		MSE	ESE	
20 +25*	30	50	1.5	2	125

*For Tutorial

Pre-requisite :

1. BSC101 Engineering Mathematics-I
2. BSC204 Engineering Mathematics-II

Program Outcomes addressed :

1. PO1: Engineering knowledge
2. PO2: Problem analysis

Course Objectives :

1. To provide the basic knowledge on the concepts of Mathematics in the field of Engineering.
2. To build a foundation to the methodology necessary for solving problems by applying the knowledge of Mathematics to the field of Engineering.

Module	Details	Hrs
00.	**Course Introduction** Engineering Mathematics III is often a foundational course designed to provide students with the mathematical tools and concepts essential for various engineering disciplines. Engineering Mathematics III has many applications in Information Technology such as 1) Application of Vector space in Deep Learning, dimension reduction and Neural Networks 2) Application of Linear Mapping in Deep learning and Machine Learning. 3) Application of in Number theory in Cryptography.	**01**
01.	**Vector Space** ***Learning Objective/s:*** *To analyse the definition of basis and apply it to determine the basis of a Vector Space*	**07-09**
	Contents:	
	Vector Spaces, Examples of vector spaces, Subspace, Linear combinations, Spanning Set, Linear Independence and Dependence. Linear spans, Row Space of a matrix , Basis and Dimensions	

	Self-Learning Topics: *Independence and Dependence of functions*	
	Learning Outcomes : *A learner will be able to* *LO 1.1: Apply the axioms of closure, addition and scalar multiplication and prove that the given set of vectors is a Vector Space (P.I.- 1.1.1)* *LO 1.2: Identify the conditions of closure and scalar multiplication and prove that the given space is a Subspace. (P.I.- 2.1.3)* *LO 1.3: Applying the fundamentals of row reductions for linear independency in order to determine the span, basis and dimension of a vector space. (P.I.- 1.3.1)* *LO 1.4: Evaluate the statements given in a problem and thereby identify whether linear dependence or independence of a set is to be considered.(P.I.- 2.1.1)*	
02.	**Linear Mappings** ***Learning Objective/s:*** *To apply concepts of kernel and image of linear maps and be able to compute and analyse them for given linear maps.*	**06-08**
	Contents: Mappings, Function, Linear mapping (Linear transformations), Kernel and Image of a linear mapping, Rank and Nullity, Singular and non-singular mapping, Isomorphism.	
	Self-Learning Topics: *Operations with linear mapping*	
	Learning Outcomes : *A learner will be able to* *LO 2.1: Apply the properties of vector addition and scalar multiplication to examine whether the mapping is a linear mapping. (P.I.- 1.1.1)* *LO 2.2: Apply laws of matrix transformations to obtain the Rank and Nullity of a given mapping. (P.I.-1.2.1)* *LO 2.3: Examine whether the given mapping is an Isomorphism using the results of non-singularity and linear mapping. (P.I.-2.1.3)* *LO 2.4: Identify whether rows and columns are to be formed for a given linear transformation based on whether Image or Kernel is to be found or to determine its non-singularity. (P.I.-2.2.3)*	
03.	**Linear Mappings and Matrices** ***Learning Objective/s:*** *To analyse and compute the change of basis matrix for linear map.*	**06-08**
	Contents: Introduction, Matrix Representations of a linear operator, Change of Basis, Similarity, Matrices and general linear mapping.	
	Self-Learning Topics: *Composition mapping*	

	Learning Outcomes : *A learner will be able to* *LO 3.1: Apply fundamentals of addition and scalar multiplication of mapping to represent it in its matrix form. (P.I.-1.3.1)* *LO3.2: Apply rules of addition, multiplication ad inverses of matrices to check the similarity of two mappings. (P.I.-1.1.1)* *LO 3.3: Identify the domain and codomain given and determine the change of Basis Matrix from one coordinate system to the alternate coordinate system. (P.I.-2.1.3)* *LO 3.4: Identify the existing method of finding inverse from the change of basis matrix using similarity of matrices. (P.I.-2.2.3)*	
04.	**Inner Product spaces, Orthogonality** ***Learning Objective/s:*** *To analyse and apply Gram-Schmidt Technique to determine an Orthonormal Basis.*	**06-08**
	Contents: Introduction, Inner product spaces, Examples of Inner product spaces, Cauchy-Schwartz Inequality, Orthogonality, orthogonal sets and Basis Gram-Schmidt orthogonalization process	
	Self-Learning Topics: *Complex Inner Products Spaces*	
	Learning Outcomes : *A learner will be able to* *LO 4.1: Identify whether the given vector space is an Inner Product Space using linearity, Symmetric and Positive Definite Property of an Inner Product Space. (P.I.-2.1.3)* *LO 4.2: Prove Cauchy's Schwartz inequality using definitions describing the space. (P.I.-1.1.1)* *LO 4.3: Identify whether the set of vectors form an orthogonal or orthonormal basis using the standard operations of Inner Product Space. (P.I. -2.2.3)* *LO 4.4: Apply laws of dot product to determine the orthogonal and orthonormal basis using Gram Schmidt Process. (P.I. -1.2.1)*	
05.	**Number Theory** ***Learning Objective/s:*** *To identify and apply the appropriate theorem of Number Theory to solve the simultaneous system of congruence.*	**06-08**
	Contents:	
	Modular Arithmetic, Divisibility and Euclid Algorithm, Primes and Sieve of Eratosthenes, Euler's and Fermat Little Theorem, Congruence, Computing Inverse in congruence, Legendre and Jacobi Symbol, Chinese Remainder Theorem	
	Self-Learning Topics: *Testing for Primes, Prime Number Theorem*	

	Learning Outcomes : *A learner will be able to* *LO 5.1: Apply Euler's theorem or Fermat little theorem to solve congruent modulo equation. (P.I.-1.1.1)* *LO 5.2: Identify whether modular inverse or Euclidean algorithm is to be applied to the given Linear Diophantine Equation. (P.I.- 2.2.3)* *LO 5.3: Evaluate the information presented in a given problem and thereby identify whether Euler's theorem, Fermat's Theorem or Chinese Remainder Theorem is to be used. (P.I.-2.1.1)* *LO 5.4: Apply fundamental techniques of finding remainders to solve simultaneous linear congruence's using Chinese Remainder theorem. (P.I.-1.3.1)*	
06.	**Numerical Methods** ***Learning Objective/s:*** *To analyse and apply the appropriate numerical method to solve transcendental equation and system of simultaneous equations.*	**06-08**
	Contents: Solution of Transcendental Equations: Newton Ralphson method, Regula –Falsi Method, Solution of system of linear algebraic equations Gauss Jacobi Iteration Method, Gauss Seidel Iteration Method.	
	Self-Learning Topics: *Bisection Method, Gauss Elimination Method.*	
	Learning Outcomes : *A learner will be able to* *LO 6.1: Apply Newton Raphson method or Regula Falsi method to solve the transcendental equation or algebraic equations. (P.I.-1.1.1)* *LO 6.2: Apply the fundamental arithmetic techniques to solve the system of equations using Gauss Siedel or Gauss Jacobi methods. (P.I-1.3.1)* *LO 6.3: Identify the appropriate numerical method which can be applied to solve the given equation or system of equations. (P.I- 2.1.3)* *LO 6.4: Compare the results obtained by Gauss Siedel and Gauss Jordon methods and thereby make conclusions about its rate of convergence. (P.I.-2.2.4)*	
	Course Conclusion Engineering Mathematics provides the language and framework through which engineers model, analyse, and optimize systems.	**01**
Total		**45**

Performance Indicators:

P.I. No.	P.I. Statement
1.1.1	Apply the knowledge of discrete structures, linear algebra, statistics and numerical techniques to solve problems
1.2.1	Apply laws of natural science to an engineering problem
1.3.1	Apply engineering fundamentals

2.1.1 Evaluate problem statements and identifies objectives

2.1.3 Identify mathematical algorithmic knowledge that applies to a given problem

2.2.3 Identify existing solution/methods to solve the problem, including forming justified approximations and assumptions

2.2.4 Compare and contrast alternative solution/methods to select the best methods

Course Outcomes :

1. Apply the fundamentals of Vector Space to analyse the Basis of the Vector Space. *(LO 1.1, LO 1.2, LO 1.3, LO 1.4)*
2. Apply the fundamentals of Linear Mapping to identify the Kernel and Image of the Linear Mapping. *(LO 2.1, LO 2.2, LO 2.3, LO 2.4, LO 3.1, LO 3.2, LO 3.3, LO 3.4)*
3. Analyse the Inner Product Space and apply the properties to determine the orthogonal basis. *(LO 4.1, LO 4.2, LO 4.3, LO 4.4)*
4. Identify and apply the appropriate theorem of Number Theory to solve the congruent equation and the simultaneous congruent equations. *(LO 5.1, LO 5.2, LO 5.3, LO 5.4)*
5. Identify and apply appropriate numerical methods to solve System of equations. *(LO 6.1, LO 6.2, LO 6.3, LO 6.4)*

CO-PO Mapping Table with Correlation Level

CO ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
ITPCC301.1	3	3	-	-	-	-	-	-	-	-	-
ITPCC301.2	3	3	-	-	-	-	-	-	-	-	-
ITPCC301.3	3	3	-	-	-	-	-	-	-	-	-
ITPCC301.4	3	3	-	-	-	-	-	-	-	-	-
ITPCC301.5	3	3	-	-	-	-	-	-	-	-	-
Average	**3**	**3**	-	-	-	-	-	-	-	-	-

Text Books :

1. C. L. Liu: Elements of Discrete Mathematics, 2nd edition, TMH
2. Cryptograph and Network Security by B. A. Forouzan & D. Mukhopadhyay, 11th edition, McGraw Hill Publication

Reference Books :

1. Elementary Number Theory and its applications by Kenneth H. Rosen, 5th edition, Addison Wesley Publication
2. Advanced Engg. Mathematics by C. Ray Wylie & Louis Barrett. TMH International Edition
3. Seymour Lipschutz “Beginning Linear Algebra” Schaum’s outline series, Mc-Graw Hill Publication

Other Resources :

1. NPTEL Course: Applied Linear Algebra IIT Madras: Dr Andrew Thangaraj: :-Web link- https://nptel.ac.in/courses/108106171
2. NPTEL Course: Computational Number Theory and Cryptography IIT Guwahati: Dr Pinaki Mishra:-Web link- https://nptel.ac.in/courses/106103015
3. NPTEL Course:NOC: Numerical Methods, IIT Roorkee Prof. Ameeya Kumar Nayak, Prof. Sanjeev Kumar - Web link- https://nptel.ac.in/courses/111107105

A. IN-SEMESTER ASSESSMENT (75 MARKS)

1. Continuous Assessment - Theory (20 MARKS)

One MCQ test as per Gate exam pattern/ level: 5 Marks
One Class test: 5 Marks
One Team-pair- Solo: 5 Marks
Regularity and attentiveness: 5 Marks

Continuous Assessment - Tutorial (25 MARKS)

Minimum six Tutorials: 20 Marks

Students must be encouraged to write at least 6 class tutorials. At least 6 Class tests will be conducted based on class tutorials on entire syllabus. Each class tests carries 20 Marks. Average will be taken of all class tests.

Regularity and attentiveness: 5 Marks

2. Mid Semester Exam (30 Marks)

Mid semester examination will be based on 40% to 50% of the syllabus.

B. END SEMESTER EXAMINATION (50 MARKS)

End Semester Examination will be based on syllabus coverage up to the Mid Semester Examination (MSE) carrying 20%-30% weightage, and the syllabus covered from MSE to ESE carrying 70%-80% weightage.

Course Type	Course Code	Course Name	Credits
PCC	ITPCC302	COMPUTER ORGANIZATION & ARCHITECTURE	04

Examination Scheme					
Distribution of Marks			Exam Duration (Hrs.)		Total Marks
In-semester Assessment		End Semester Exam (ESE)			
Continuous Assessment	Mid-Semester Exam (MSE)		MSE	ESE	
20+25@	30	50	1.5	2	125

@For continuous assessment of tutorials.

Pre-requisite :

1. ESL103: Programming Laboratory - I (C)

Program Outcomes addressed :

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO3: Design/development of solutions
4. PO5: Engineering tool usage
5. PO8: Individual and collaborative team work

Course Objectives :

1. To familiarize learners with organizational and architectural aspects of a computer system.
2. To make the learners comprehend Instruction Set of 8086 microprocessor and use it to develop Assembly Language Programs for a given task.
3. To make the learners study and apply algorithms to perform computer arithmetic operations.
4. To make the learners aware of the hierarchical organization of computer memory and various data transfer techniques in digital computer.
5. To acquaint learners with processor performance improvement using instruction level parallelism and advanced computer architectures.

Module	Details	Hrs
00.	**Course Introduction** This is a foundation course which deals with fundamentals of design and functions of different components of a computer system that will enable hardware engineers to develop high performance hardware designs and system programmers to design better system software's aiming at optimizing resource usage.	**01**
01.	**Introduction to Computer Organization and Architecture** ***Learning Objective:***	**04-06**

	Learner is expected to identify and summarize the operational units of a computer system and their interconnections that realize the design specifications..	
	Contents: Introduction to Computer Organization and Architecture. Basic functional blocks of a computer: CPU, memory, input-output subsystems, control unit. Fetch-Decode-Execute Cycle, Von Neumann model. Performance measure of Computer Architecture, Amdahl's Law.	
	Self-Learning Topics: *Evolution of Computers.* ***Learning Outcomes :*** *A learner will be able to* *LO 1.1: Apply the theory and principles of computer science engineering to distinguish between the organizational and architectural aspects of a computer system. (P.I.-1.4.1)* *LO 1.2: Apply engineering fundamentals to restate Amdahl's Law and compute the speedup achieved for a system with a specified number of processors. (P.I.-1.3.1)* *LO 1.3: Identify functionalities and computing resources by summarizing the operations of various units within a computer system. (P.I.-2.2.2)* *LO 1.4: Identify parameters impacting computer architecture performance by analyzing key design considerations and functionalities. (P.I.-2.1.2)*	
02.	**Architecture, Instruction set and programming of 8086 microprocessor** ***Learning Objective/s:*** *Learner is expected to familiarize with the different components of a processor architecture, comprehend and apply the instruction set of 8086 microprocessor to write programs that run on the microprocessor.*	**08-10**
	Contents: Architecture of 8086 Family, Instruction formats, Instruction Set, Addressing Modes, Assembler Directives, Assembly Language Programming, Stack, Procedure, Macro.	
	Self-Learning Topics: *8086 Hardware Design, Minimum and Maximum Mode of operation.* ***Learning Outcomes :*** *A learner will be able to* *LO 2.1: Demonstrate the ability to explore design alternatives by differentiating between procedures and macros in assembly language programming. (P.I.-3.2.1)* *LO 2.2: Produce potential design solutions by applying the instruction set of 8086 microprocessors to develop assembly language programs for a given task. (P.I.-3.2.2)* *LO 2.3: Identify modern engineering tools and techniques for developing assembly language programs. (P.I.-5.1.1)* *LO 2.4: Demonstrate proficiency in using the TASM tool to write and debug assembly language programs. (P.I.-5.2.2)*	

	LO 2.5: Demonstrate effective communication and problem-solving skills by presenting solutions to a given problem in a structured manner. (P.I.-8.2.1) *LO 2.6: Collaborate in teams or individually to solve given problems and effectively illustrate the solutions through integrated efforts. (P.I.-8.3.1)*	
03.	**Processor Organization and Architecture** ***Learning Objective:*** *Learner is expected to analyze different approaches to the design of control unit of processor*	**05-07**
	Contents: CPU Architecture, basic instruction cycle with Interrupt processing. Instruction interpretation and sequencing. Control Unit: Soft wired (Microprogrammed) and hardwired control unit design methods. Microinstruction sequencing and execution. Micro operations, concepts of nanoprogramming.	
	Self-Learning Topics: *Architecture of Pentium IV processor.* ***Learning Outcomes :*** *A learner will be able to* *LO 3.1: Apply engineering fundamentals to summarize the concept and advantages of nano-programming. (P.I.-1.3.1)* *LO 3.2: Apply the theory and principles of computer science engineering to paraphrase the steps taken by a processor during instruction execution. (P.I.-1.4.1)* *LO 3.3: Identify functionalities and computing resources by outlining hardwired and microprogrammed control unit design approaches. (P.I.-2.2.2)* *LO 3.4: Compare and contrast alternative design approaches by analyzing the differences between hardwired and microprogrammed control units. (P.I.-2.2.4)*	
04.	**Data Representation and Arithmetic Algorithms** ***Learning Objective:*** *Learner is expected to familiarize with standard floating point data representation formats and apply Algorithms for performing multiplication and division of integers.*	**05-07**
	Contents: Operations on integers: Negation, Addition, subtraction, Multiplication using Booth's algorithm. Division of integers: Restoring and non-restoring division. Floating-point number representation: IEEE 754 (Single & double precision) floating point number representation.	
	Self-Learning Topics: *Implement Booth's Algorithm and Division methods.* ***Learning Outcomes :*** *A learner will be able to* *LO 4.1: Apply engineering fundamentals to summarize the concept of normalized significand and biased exponent with suitable examples. (P.I.-1.3.1)*	

	LO 4.2: Apply the theory and principles of computer science engineering to restate IEEE 754 floating-point number representation formats. (P.I.-1.4.1) *LO 4.3: Identify functionalities and computing resources by paraphrasing how Booth's algorithm performs multiplication of signed integers. (P.I.-2.2.2)* *LO 4.4: Identify existing methods and apply Booth's algorithm to perform multiplication of signed integers. (P.I.-2.2.3)*	
05.	**Memory and I/O Organization** ***Learning Objective/s:*** *Learner is expected to be aware of the different levels of computer memory to make effective utilization of hierarchical organization of computer memory for faster processing. Also comprehend different data transfer techniques.*	**10-12**
	Contents: Memory Organization: Memory parameters, Classifications of memories, Types of RAM and ROM, Memory hierarchy. Cache memory: Concept and Organization, Elements of a cache design, mapping techniques, Cache write policies, Cache Coherency, High speed memories: Interleaved and Associative memory. I/O Organization: Input/output systems, Structure of peripheral devices, data buffering, I/O module- need, functions and structure, Types of data transfer techniques: Programmed I/O, Interrupt driven I/O and DMA .	
	Self-Learning Topics: *Case study on Memory Organization, Address mapping, Comparison of all I/O methods.* ***Learning Outcomes :*** *A learner will be able to* *LO 5.1:Apply engineering fundamentals to restate the necessity of an Input Output module for efficient data handling in computer systems. (P.I.-1.3.1)* *LO 5.2:Apply theory and principles of computer science engineering to summarize the hierarchical structure of computer memory, highlighting its various levels and access speeds. (P.I.-1.4.1)* *LO 5.3:Identify functionalities and computing resources by paraphrasing the role of a Direct Memory Access (DMA) module in transferring data between peripherals and memory without CPU intervention. (P.I.-2.2.2)* *LO 5.4:Compare and contrast alternative data transfer techniques such as programmed I/O, interrupt-driven I/O, and DMA to select the most efficient method for data movement. (P.I.-2.2.4)*	
06.	**Fundamentals of Advanced Computer Architecture** ***Learning Objective/s:*** *Learner is expected to be aware of the advancements in computer hardware design and techniques used for enhancing the performance of a processor.*	**05-07**
	Contents:	

	Parallel Architecture: Introduction to parallel processing concepts, Flynn's classifications, instruction pipelining, pipeline hazards. Introduction to Array Processors, Clusters, and NUMA Computers. Introduction to Multiprocessor, Multi-Core and Many-Core Systems.	
	Self-Learning Topics: *Advance accelerators such as GPGPUs.* ***Learning Outcomes :*** *A learner will be able to* *LO 6.1:Apply engineering fundamentals to analyze how instruction pipelining enhances processor performance. (P.I.- 1.3.1)* *LO 6.2:Apply the theory and principles of computer science engineering to paraphrase Flynn's classification of parallel computers. (P.I.- 1.4.1)* *LO 6.3:Identify functionalities and computing resources to interpret various pipeline hazards and the methods to mitigate them. (P.I.- 2.2.2)* *LO 6.4:Identify existing solutions and methods to summarize how advanced parallel computer architectures enhance processor performance. (P.I.- 2.2.3)*	
	Course Conclusion	**01**
	Total	**45**

Performance Indicators:

P.I. No.	P.I. Statement
1.3.1	Apply engineering fundamentals.
1.4.1	Apply theory and principles of computer science engineering to solve an engineering problem
2.2.2	Identifies functionalities and computing resources.
2.2.3	Identify existing solution/methods to solve the problem, including forming justified approximations and assumptions
2.2.4	Compare and contrast alternative solution/methods to select the best methods
2.4.1	Applies engineering mathematics to implement the solution.
3.2.1	Ability to explore design alternatives.
3.2.2	Ability to produce a variety of potential design solutions suited to meet functional requirements.
5.1.1	Identify modern engineering tools, techniques and resources for engineering activities.
5.2.2	Demonstrate proficiency in using discipline specific tools.
8.2.1	Demonstrate effective communication, problem solving, conflict resolution and leadership skills
8.3.1	Present results as a team, with smooth integration of contributions from all individual efforts

Course Outcomes :

Learner will be able to

1. Restate the basic organization and architecture of a computer. *(LO 1.1,LO 1.2, LO 1.3,LO 1.4)*

2. Develop assembly language programs for given task for 8086 microprocessor by using the instruction set of 8086 architecture. *(LO 2.1,LO 2.2, LO 2.3,LO 2.4, LO 2.5,LO 2.6,LO 3.1,LO 3.2, LO 3.3,LO 3.4)*
3. Apply the algorithms to perform computer arithmetic operations. *(LO 4.1,LO 4.2, LO 4.3,LO 4.4)*
4. Analyse the organization of computer memory and different techniques for I/O data transfer.(*LO 5.1,LO 5.2, LO 5.3,LO 5.4)*
5. Summarize advanced computer architectures including performance enhancement using instruction level parallelism. (*LO 6.1,LO 6.2, LO 6.3,LO 6.4)*

CO-PO Mapping Table with Correlation Level

CO ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
ITPCC302.1	3	3	-	-	-	-	-	-	-	-	-
ITPCC302.2	3	3	3	-	3	-	-	3	-	-	-
ITPCC302.3	3	3	-	-	-	-	-	-	-	-	-
ITPCC302.4	3	3	-	-	-	-	-	-	-	-	-
ITPCC302.5	3	3	-	-	-	-	-	-	-	-	-
Average	**3**	**3**	**3**	**-**	**3**	**-**	**-**	**3**	**-**	**-**	**-**

Text Books :

1. Computer Organization, Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Fifth Edition, 2002, Tata McGraw-Hill.
2. Computer Organization and Architecture: Designing for Performance, William Stallings, Eleventh Edition, 2022, Pearson.
3. 8086/8088 family: Design Programming and Interfacing, John Uffenbeck, First Edition, 1986, Pearson.
4. Advanced Computer Architecture, Smruti R. Sarangi, First Edition, 2021, McGraw Hill.

Reference Books :

1. Computer Architecture and Organization, John P. Hayes, Third Edition, 2017, McGraw-Hill Education.
2. Computer Architecture and Organization: Design Principles and Applications, B. Govindarajulu, Second Edition, 2017, McGraw-Hill Education.
3. Advanced Microprocessors & Peripherals, K Bhurchandi, Third Edition, 2017, McGraw-Hill Education.
4. Advanced Computer Architecture: Parallelism, Scalability, Programmability, Kai Hwang, Naresh Jotwani, Third Edition, 2017, McGraw Hill Education.

Other Resources :

1. NPTEL Course: Computer architecture and organization By Prof. Indranil Sengupta, Prof. Kamalika Datta, Department of Computer Science and Engineering, IIT Kharagpur
   Web link- https://nptel.ac.in/courses/106105163
2. NPTEL Course: Computer Architecture By Prof. Smruti Ranjan Sarangi, Department of Computer Science and Engineering, IIT Delhi
   Web link-https://onlinecourses.nptel.ac.in/noc23_cs67/
3. NPTEL Course: Advanced Computer Architecture By Prof. Smruti Ranjan Sarangi, Department of Computer Science and Engineering, IIT Delhi
   Web link- https://onlinecourses.nptel.ac.in/noc23_cs07/

A. IN-SEMESTER ASSESSMENT (75 MARKS)

1. Continuous Assessment-Theory (20 Marks)

Suggested breakup of distribution

a) One MCQ test as per GATE exam pattern / level: 05 Marks

b) One Class test: 05 Marks

c) One Think Pair Share (TPS) activity: 05 Marks

d) Regularity and active participation: 05 Marks

2. Continuous Assessment - Tutorial (25 Marks)

Suggested breakup of distribution

a) Tutorial Assignments: 20 Marks

Students must be encouraged to write at least 8 class tutorials on entire syllabus in the form of Numerical Assignment, Case Study, Theory Assignment, Programming assignment. Each tutorial assignment carries 20 Marks. Average will be taken of all tutorial assignments.

b) Regularity and active participation: 05 Marks

3. Mid Semester Examination (30 Marks)

Mid semester examination will be based on 40% to 50% syllabus.

B. END SEMESTER EXAMINATION (50 MARKS)

End Semester Examination will be based on syllabus coverage up to the Mid Semester Examination (MSE) carrying 20% to 30% weightage, and the syllabus covered from MSE to ESE carrying 70% to 80% weightage.

Course Type	Course Code	Course Name	Credits
PCC	ITPCC303	DATA STRUCTURE AND ANALYSIS	3

Examination Scheme					
Distribution of Marks			Exam Duration (Hrs.)		Total Marks
In-semester Assessment		End Semester Exam (ESE)			
Continuous Assessment	Mid-Semester Exam (MSE)		MSE	ESE	
20	30	50	1.5	2	100

Pre-requisite:

1. ESL103: Programming Laboratory -I(C)

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem analysis

Course Objectives:

1. Facilitate the way students, comprehend computer automation in addressing engineering difficulties through the use of data structures.
2. Intended to guide learners through developing complex data structures through the application of fundamental programming concepts.
3. Aid learners to learn the basics of basic data structures including linked lists, stacks, and queues.
4. Assist learners in acquiring a strong comprehension of the fundamental concepts of different types of trees and graphs.
5. Asist learners with understanding the concepts of searching, hashing, and sorting.
6. Assist learners in applying linked lists, stacks, queues, trees, and graphs to solve complicated issues.

Module	Detailed Contents	Hrs
00.	**Course Introduction** This course deals with basics of data types and variables, revision of concept of array, structures and pointers. Data is simplified by data structures. Data structures organize information for machines and humans to understand, most importantly. Understanding DSA helps to solve real-world problems quickly. Data structures and algorithms support logical problem-solving.	01
01.	**Introduction of Data Structures and Algorithms Analysis** ***Learning Objective:*** *Learner is expected to recall and interpret data structures and algorithms to solve real time-complex issues and maximize results.*	07-09
	Contents:	
	Introduction of Data Structures: Concept of computation, algorithms, elementary data types, abstract data types and data structures. RAM model of computation. Data Management concepts, Data types – primitive and non-primitive, Types of Data Structures- Linear & Non-Linear Data Structure. Introduction of Algorithm Analysis: Algorithm, pseudo code for expressing algorithms, performance analysis-space complexity, time complexity, asymptotic notation- big (O) notation, omega notation, theta notation and little (o) notation, recurrences, probabilistic analysis, disjoint set operations, union and find algorithms. applications-analysis of binary search.	
	Self-Learning Topics: *Asymptotic Notations, advanced data structures.* ***Learning Outcomes:*** *A learner will be able to* *LO 1.1: Study the asymptotic notations and apply to analyse algorithm performance for various problem statements. (P.I.-1.3.1)* *LO 1.2: Use fundamentals of data structure and apply its mechanism on computer system and programs. (P.I.-1.4.1)* *LO 1.3: Identify the suitable data structure design for given problem statement. (P.I.-2.3.2)* *LO 1.4: Identify the advantages and disadvantages of searching algorithms by applying on sample data. (P.I.-2.4.3)*	

02.	**Linear Data Structure-Stack, Queue, Linked List** ***Learning Objective:*** *Learner is expected to know linear data structures and interpret all linear data and functions.*	**09-11**
	Contents: Array: Representation of arrays, Applications of arrays, sparse matrix and its representation, Stack: Stack-Definitions & Concepts, Operations on Stacks, Applications of Stacks, Polish Expression, Reverse Polish Expression and Their Compilation, Recursion, Tower of Hanoi, Queue: Representation Of Queue, Operations on Queue, Circular Queue, Priority Queue, Array representation of Priority Queue, Double Ended Queue, Applications of Queue. Linked List: Singly Linked List, Doubly Linked list, Circular linked list, Linked implementation of Stack, Linked implementation of Queue, Applications of linked list.	
	Self-Learning Topics: *Linked List Implementation of Stack, Linked List implementation of Queue, Circular Queue, Double Ended Queue, Priority Queue.* ***Learning Outcomes:*** *A learner will be able to* *LO 2.1: Discover the various applications by applying mechanism of queues, linked lists, and stacks. (P.I.- 1.3.1)* *LO 2.2: Apply theory of data structure functions to build various application. (P.I.-1.4.1)* *LO 2.3: Select appropriate data structure for various applications. (P.I.-2.1.2)* *LO 2.4: Identify constraints of static data structure design over dynamic data structures. (P.I.-2.3.2)*	

03.	**Nonlinear Data Structure-Tree, Graph** ***Learning Objective:*** *Learner is expected to know and interpret non-linear data structures, utilize them, and analyse its many functions.*	**10-12**

	Contents: Tree-Definitions and Concepts, Representation of binary tree, Binary tree traversal (In-order, Post-order, Preorder), Threaded binary tree, Binary search trees, Conversion of General Trees to Binary Trees, AVL trees, Height Balanced, Weight Balance. Insertion and deletion cases of tree. Graph-Types of Graphs, Matrix Representation of Graphs, Elementary Graph operations, (Breadth First Search, Depth First Search, Spanning Trees, Shortest path, Minimal spanning tree).	
	Self-Learning Topics: *Implementation of AVL and B+ Tree.* ***Learning Outcomes:*** *A learner will be able to* *LO 3.1: Design MST. Learn MST designing using Prim's and Kruskal's algorithm. (P.I.-1.3.1)* *LO 3.2: Apply non-linear data structure mechanism to construct given type of tree. (P.I.-1.4.1)* *LO 3.3: Apply Prim's and Kruskal algorithm to design MST and compare results. (P.I.-2.3.2)* *LO 3.4: Identify the limitations of BST and use of AVL tree. (P.I.-2.4.3)*	
04.	**Sorting and searching** ***Learning Objective:*** *Learner is expected to recall searching and sorting algorithm. Also expected to apply it to order the data with list and arrays.*	**03-05**
	Contents: Introduction of Sorting methods, Concept, Insertion Sort, Quick Sort, Merge Sort, Selection Sort, Heap Sort, Sorting on Several Keys, List and Table Sort. Introduction of Searching concept, Linear Search, Binary Search, Comparison and Complexity measures.	
	Self-Learning Topics: *Implementation of different sorting techniques and searching.* ***Learning Outcomes:*** *A learner will be able to* *LO 4.1: Explore sorting methods on given data values. (P.I.-1.3.1)* *LO 4.2: Compare searching methods. (P.I.-1.4.1)* *LO 4.3: Compare between sorting techniques and its time complexities. (P.I.-2.3.2)* *LO 4.4: Apply sorting and compare result with another method. (P.I.-2.4.3)*	

05.	**Hashing and File Structures** *Learning Objective:* *Learner is expected to recall and summarize understand hashing and file structures to simplify the process of finding or using the original string.*	**05-07**
	Contents: Hashing: The symbol table, Hashing Functions, Collision-Resolution Techniques, File Structure: Concepts of fields, records and files, Sequential, Indexed and Relative/Random File. Organization, indexing structure for index files, hashing for direct files, multi-key file organization and access methods.	
	Self-Learning Topics: *Implementation of applications of hashing methods and collision techniques.* ***Learning Outcomes:*** *A learner will be able to* *LO 5.1: Apply collision handling methods in hashing. (P.I.-1.3.1)* *LO 5.2: Apply Hash function on given datasets and find suitable solution. (P.I.-1.4.1)* *LO 5.3: Apply and compare various collision handling methods in hashing. (P.I.-2.3.2)* *LO 5.4: Identify limitations of searching and benefit of hashing. (P.I.-2.4.3)*	
06.	**Data Structures for Complex Problems of computations** ***Learning Objective/s:*** *Learner is expected to know and recall the use of data structure for solving and analysing complex problems.*	**03-05**
	Contents: Single-source shortest path computation, topological sorting of a partially ordered set. Convex- hull computation, string matching algorithms, median computation, distributed algorithms.	
	Self-Learning Topics: *Implementation of applications for Stack, Queues, Linked List, Trees and Graph.* ***Learning Outcomes:*** *A learner will be able to* *LO 6.1: Choose data structure to solve topology sort of partially ordered set. (P.I.-1.3.1)* *LO 6.2: Decide best suitable data structure for convex hull computation. (P.I.-1.4.1)* *LO 6.3: Apply various data structure solutions for given problem statement. (P.I.-2.3.2)* *LO 6.4: Analyse topology sorting by using different data structures. (P.I.-2.4.3)*	
	Course Conclusion	**01**

Total	**45**

Performance Indicators:

P.I. No.	P.I. Statement
1.3.1	Apply engineering fundamentals.
1.4.1	Apply theory and principles of computer science engineering to solve an engineering problem.
2.3.2	Identify design constraints for required performance criteria.
2.4.3	Identify the limitations of the solution and sources/causes.

Course Outcomes:

Learner will be able to

1. Determine the principles of algorithms and data structures. *(LO 1.1,LO 1.2, LO 1.3,LO 1.4)*
2. Apply theory of linear data structure to solve the real-life problems. *(LO 2.1,LO 2.2, LO 2.3,LO 2.4, LO 3.1,LO 3.2, LO 3.3,LO 3.4)*
3. Apply the methods of non-linear data structures in real life problem solving. *(LO 4.1,LO 4.2, LO 4.3,LO 4.4)*
4. Analyse the concepts of sorting, searching and hashing techniques in real life problem solving. (*LO 5.1,LO 5.2, LO 5.3,LO 5.4)*
5. Apply and compare functions of linear and non-linear data structure for complex problem solution. (*LO 6.1,LO 6.2, LO 6.3,LO 6.4)*

CO-PO Mapping Table with Correlation Level

CO ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
ITPCC303.1	3	3	-	-	-	-	-	-	-	-	-
ITPCC303.2	3	3	3	-	-	-	-	-	-	-	-
ITPCC303.3	3	3	3	-	-	-	-	-	-	-	-
ITPCC303.4	3	3	3	-	-	-	-	-	-	-	-
ITPCC303.5	3	3	3	-	-	-	-	-	-	-	-
Average	**3**	**3**	**3**	-	-	-	-	-	-	-	-

Text Books:

1. Data Structures through C in Depth, S. K Srivastava, Deepali Srivastava, 5th Edition, 2011, BPB Publications.
2. Data Structures Using C by Aaron M Tenenbaum, 1st Edition ,2018, Pearson India.
3. Data Structures using C, Reema Thareja, 2nd Edition, 2011, Oxford.

Reference Books:

1. Fundamentals of Data Structures, Ellis Horowitz, Sartaj Sahni, 5th Edition, 2010, Galgotia Publications.
2. An introduction to data structures with applications, Jean Paul Tremblay, Paul G. Sorenson; 3rd Edition, 1984, Tata McGraw-Hill.
3. Data Structures using C and C++, Rajesh K. Shukla, 2nd Edition, 2009, Wiley India.

Other Resources:

1. Digital material:
   Web Link-Complete DS Data Structure in one shot | Semester Exam | Hindi (youtube.com)
2. Web Link-https://topperworld.in/dsa-handwritten-notes/

A. IN-SEMESTER ASSESSMENT (50 MARKS)

1. Continuous Assessment (20 Marks)

Suggested breakup of distribution

a) Numerical Assignment/s (Minimum 20 problems) : 05 Marks
b) Class Test based on above numerical assignment: 05 Marks
c) One Flip classroom activity: 05 Marks
d) Regularity and active participation :05 Marks

2. Mid Semester Examination (30 Marks)

Mid semester examination will be based on 40% to 50% syllabus.

B. END SEMESTER EXAMINATION (50 MARKS)

End Semester Examination will be based on syllabus coverage up to the Mid Semester Examination (MSE) carrying 20% to 30% weightage, and the syllabus covered from MSE to ESE carrying 70% to 80% weightage.

Course Type	Course Code	Course Name	Credits
PCC	ITPCC304	DATABASE MANAGEMENT SYSTEM	03

Examination Scheme					
Distribution of Marks			Exam Duration (Hrs.)		Total Marks
In-semester Assessment		End Semester Examination (ESE)			
Continuous Assessment	Mid-Semester Exam (MSE)		MSE	ESE	
20	30	50	1.5	2	100

Pre-requisite:

1. ESL 103: Programming Laboratory-I (C)

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO3: Design/development of solutions
4. PO8: Individual and Collaborative team work
5 PO9: Communication
6 PO11: Life-long learning

Course Objectives:

1. To impart database concepts, including database structures, levels of abstraction, ER modeling, EER modeling, and relational schema design for real-world applications
2. To introduce SQL commands for data definition (DDL), data manipulation (DML), integrity constraints, security management (DCL), indexing, and query optimization for effective database management.
3. To impart Knowledge **of** functional dependencies, schema decomposition, and normalization techniques (1NF, 2NF, 3NF, BCNF) to enhance database efficiency and integrity.
4. To acquaint knowledge of database transaction management, ACID properties, concurrency control mechanisms, deadlock handling, and recovery techniques to ensure data consistency and security.
5. Impart knowledge to students on working collaboratively in teams, communicating database design decisions, and applying security, indexing, and optimization techniques to real-world database solutions

Module	Details	Hrs.
00.	**Course Introduction**	**01**
01.	**Introduction to DBMS** ***Learning Objective:*** ***To impart Learner to recall the concept of database system architecture and interpret the process of data management***	**4-5**

	Contents: Introduction, Difference between data and information, Characteristics of Databases, File system v/s Database system, Data abstraction and Physical Data Independence, DBMS system architecture, Database Administrator (DBA), Role of DBA, significance of Relational Database	
	Self-Learning Topics: ***Identify the types of Databases.***	
	Learning Outcomes: *A learner will be able to* *LO 1.1: Summarize the key characteristics of databases and compare them with file systems. Apply engineering principles to evaluate the advantages of databases, including data integrity, security, scalability, and efficiency in data management. (PI- 1.3.1)* *LO 1.2: Identify and categorize different levels of abstraction in database systems. Apply a structured approach to analyze their roles in data organization, access, and management. (PI- 2.1.1)* *LO 1.3: Draw and explain the structure of a database system using engineering and computer science principles. Analyze the components and their interactions to understand database functionality and management.* (*PI-1.4.1)* *LO 1.4: Apply the principles of physical data independence to ensure flexibility in database management. Analyze how changes in physical storage structures do not affect logical data organization and application programs. (PI-2.1.2)*	
02.	**E-R model** ***Learning Objective:*** ***To introduce learner recall and demonstrate the concept of ER model. Also expected to apply the concept of ER model for conceptual design of database***	**5-7**
	Contents: Conceptual Modeling of a database, The Entity-Relationship (ER) Model, Entity Type, Entity Sets, Attributes and Keys, Relationship Types, Relationship Sets, Weak entity Types. Extended Entity-Relationship (EER) Model: Generalization, Specialization and Aggregation. Design an ER model for real time case study. (e.g. Hospital management system)	
	Self-Learning Topics: ***Design an ER model for any real time case study***	
	Learning Outcomes: *A learner will be able to* *LO 2.1: Recognize and categorize entity sets and relationship sets based on their characteristics and functionalities. Apply a structured approach to represent relationships effectively in database design. (PI-2.1.1)* *LO 2.2: Implement constraints with mapping cardinality to define relationships between entities. Ensure data integrity and consistency by applying structured approaches to enforce database constraints. (PI- 2.1.2)* *LO 2.3: Develop Entity-Relationship (ER) diagrams to model real-time problems. Apply structured engineering approaches to accurately represent entities, attributes, relationships, and constraints in database design. (PI- 3.1.1)* *LO 2.4: Design Enhanced Entity-Relationship (EER) diagrams to model complex real-time problems. Apply structured approaches to represent specialization, generalization, and inheritance in database systems. (PI- 3.1.2)*	

	LO 2.5: Develop conceptual database models using the Entity-Relationship (ER) approach. Identify entity types, attributes, keys, and relationship sets, including weak entities, to ensure structured data representation. (PI- 1.3.1) *LO 2.6: Create ER and Extended ER (EER) models incorporating generalization, specialization, and aggregation. Apply engineering principles to design a comprehensive database model for real-time case studies, such as a hospital management system. (PI- 1.4.1)*	
03.	**Introduction to Relational Model** ***Learning Objective:*** *To impart learner recall and demonstrate the process of conversion of ER into relational model. Also expected apply the process to create a database.*	**5-7**
	Contents: Relational Model Constraints and Relational Database Schemas, Concept of Keys: Primary Kay, Secondary key, Foreign Key, Introduction to Relational Algebra, Relational Algebra expressions for Unary Relational Operations, • Set Theory operations, • Binary Relational operation Relational Algebra Queries, Conversion of ER model in to relational schema by using rules. (e.g. Hospital management system)	
	Self-Learning Topics: *Convert the ER model designed to relational schema by using rules* for real time problem	
	Learning Outcomes: *A learner will be able to* *LO 3.1: Create conceptual database models using the Entity-Relationship (ER) approach. Identify and classify entity types, entity sets, attributes, keys, and relationship types to ensure structured data representation. (PI-1.3.1)* *LO 3.2: Identify and interpret various relationship types, including weak entity types, using engineering and computer science principles. Ensure proper representation of data relationships in database models. (PI- 1.4.1)* *LO 3.3: Analyze and categorize entity sets and relationship sets based on their characteristics and functionalities. Apply a structured approach to effectively represent relationships in conceptual database design. (PI- 2.1.1)* *LO 3.4: Apply integrity constraints and mapping cardinality to define relationships between entities in ER models. Ensure data consistency and accurate representation of business rules in databases. (PI- 2.1.2)* *LO 3.5: Develop ER models to solve real-world problems, such as a hospital management system. Apply structured techniques to accurately model data, relationships, and constraints. Collaborate effectively in teams, communicate database design decisions clearly, and utilize modern tools to enhance problem-solving in database modeling. (PI- 3.1.1, 8.1.1, 9.1.1, 11.2.1)* *LO3.6: Enhance ER models by incorporating Extended Entity-Relationship (EER) concepts such as generalization, specialization, and aggregation. Apply advanced database modeling techniques to design comprehensive real-time systems. Collaborate effectively in teams, communicate design decisions clearly, and stay updated with evolving database technologies to ensure efficient system implementation. (PI- 3.1.2, 8.1.2, 9.1.3, 11.2.2)*	
04.	**Overview of SQL** ***Learning Objectives:*** *To introduce learner recall and illustrate SQL and also expected to build Queries*	**11-12**

	Contents: Overview of SQL, Data Definition Commands, set operations, aggregate function, null values Data Definition language(DDL), Data Manipulation commands(DML), Data Control commands(DCL), Complex Retrieval Queries using Group by, Recursive Queries, nested Queries, Integrity constraints in SQL, Security and authorization: Grant & Revoke in SQL. Indexing: Basic Concepts, Ordered Indices, Index Definition in SQL Physical design of database for the relational model designed (e.g. Hospital management system)	
	Self-Learning Topics:	
	Learning Outcomes: *A learner will be able to* *LO 4.1: Understand and use SQL for defining and managing data. Apply Data Definition Language (DDL) and Data Manipulation Language (DML) commands to create, modify, and manipulate relational databases efficiently. (PI- 1.3.1)* *LO 4.2: Execute SQL set operations, aggregate functions, and handle null values effectively. Apply structured approaches to ensure data integrity and meaningful query results. (PI-1.4.1)* *LO 4.3: Develop advanced SQL queries, including GROUP BY, recursive queries, and nested queries, to retrieve and analyze relational data efficiently. (PI-2.1.1)* *LO 4.4: Implement and enforce integrity constraints in SQL to maintain data consistency and accuracy in relational databases. (PI- 2.1.2)* *LO 4.5: Use GRANT and REVOKE commands to manage security and access control in SQL databases. Ensure proper user role management, data protection, and secure multi-user access. Collaborate effectively to enforce security policies, communicate security measures clearly, and apply best practices for database protection. (PI- 3.1.1, 8.2.1, 9.1.1, 11.2.1)* *LO 4.6: Apply indexing techniques such as ordered indices and define indexes in SQL to enhance database performance. Design the physical structure of relational databases to optimize query execution and storage management. Utilize problem-solving approaches, collaborate effectively in teams, and stay updated with advanced database optimization techniques. (PI- 3.1.2, 8.3.1, 9.1.3, 11.2.2)*	
05.	**Normalization** ***Learning Objective/s:*** *To introduce learner define and interpret the concept of normalization and also expected to convert the given relation in different normalization forms to remove redundancy.*	**6-8**
	Contents: Design guidelines for relational Schema, Functional Dependencies, Database tables and normalization, the need for normalization, the normalization process, Improving the design, Definition of Normal Forms- 1NF, 2NF, 3NF & The Boyce-Codd Normal Form (BCNF).	
	Self-Learning Topics: *Consider any real time application and apply normalization up to 3NF/BCNF to remove anomalies.*	
	Learning Outcomes :	
	A learner will be able to	

	LO 5.1: Implement best practices for designing relational schemas to ensure data consistency, integrity, and efficiency in database management. (PI-1.3.1) *LO 5.2: Identify and evaluate functional dependencies to establish relationships between attributes and enhance database structure.* (PI: 1.4.1) *LO 5.3: Understand the need for normalization and apply normalization techniques to enhance data organization and eliminate redundancy in relational databases.* (PI: 2.1.1) *LO 5.4: Apply structured methodologies to decompose relational tables and improve database design through normalization.* (PI: 2.1.2) *LO 5.5: Explain the characteristics of First Normal Form (1NF), Second Normal Form (2NF), and Third Normal Form (3NF) and apply them to refine relational schemas for efficient data storage and retrieval. Collaborate effectively in teams, communicate database design improvements clearly, and apply best practices to ensure data integrity and system efficiency. (PI- 3.1.1, 8.2.1, 9.1.1, 11.2.1)* *LO 5.6: Implement Boyce-Codd Normal Form (BCNF) to eliminate anomalies and enhance database structures. Ensure higher data integrity and efficiency by applying advanced normalization techniques. Collaborate effectively, communicate database optimizations clearly, and stay updated with best practices in database design. (PI- 3.1.2, 8.3.1, 9.1.3, 11.2.2)*	
06.	**Transaction** ***Learning Objective/s:*** *To introduce learner define and illustrate transaction concept, Concurrency Control and Recovery. Also expected to apply the concept to ensure database consistency.* **Contents:** Transaction concept, State Diagram, ACID Properties, Transaction Control Commands(TCL), Concurrent Executions, Serializability – Conflict and View, Concurrency Control: Lock-based-protocols, Deadlock handling Timestamp-based protocols, Recovery System: Shadow Paging Recovery Concepts, Log based recovery. ***Self-Learning Topics:*** *Study the various deadlock situation which may occur for a database designed in module 5* ***Learning Outcomes:*** *A learner will be able to* *LO 6.1: Interpret the state diagram of transactions and apply Transaction Control Commands (TCL) such as COMMIT, ROLLBACK, and SAVEPOINT to manage database transactions effectively. (PI-1.4.1)* *LO 6.2: Interpret the state diagram of transactions and apply Transaction Control Commands (TCL) such as COMMIT, ROLLBACK, and SAVEPOINT to manage database transactions effectively.* (PI: 1.4.1) *LO 6.3: Analyze concurrent executions in database systems and apply conflict and view serializability techniques to maintain data consistency in multi-user environments. (PI-2.1.1)* *LO 6.4: Implement lock-based protocols, timestamp-based protocols, and deadlock handling strategies to ensure smooth and efficient execution of concurrent transactions. (PI- 2.1.2)*	**6-8**
	Course Conclusion	**01**
	Total	**45**

Performance Indicators:

P.I. No.	P.I. Statement
1.3.1	Apply fundamental engineering concepts to solve engineering problems.
1.4.1	Apply electrical engineering concepts to solve engineering problems.
2.1.1	Evaluate problem statements and identifies objectives
2.3.2	Identify design constraints for required performance criteria.
3.2.1	Ability to explore design alternatives.
3.2.2	Ability to produce a variety of potential design solutions suited to meet functional requirements
8.2.1	Demonstrate effective communication, problem solving, conflict resolution and leadership skills
8.3.1	Present results as a team, with smooth integration of contributions from all individual efforts
9.1.1	Read, understand and interpret technical and nontechnical information
9.1.3	Create flow in a document or presentation - a logical progression of ideas so that the main point is clear
11.2.1	Identify historic points of technological advance in engineering that required practitioners to seek education in order to stay current
11.2.2	Recognize the need and be able to clearly explain why it is vitally important to keep current regarding new developments in your field

Course Outcomes: A learner will be able to -

1. Apply engineering principles to create ER and EER models, define entity relationships, and optimize database schemas for real-world applications. *(LO 1.1, 1.2, 1.3, 1.4, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 3.1, 3.2, 3.3, 3.4)*
2. Demonstrate proficiency in SQL queries, integrity constraints, security commands (GRANT, REVOKE), indexing, and query optimization to efficiently manage databases. *(LO 4.1, 4.2, 4.3, 4.4, 4.5, 4.6)*
3. Evaluate functional dependencies and apply normalization techniques (1NF, 2NF, 3NF, BCNF) to refine relational schemas and eliminate redundancy. *(LO 5.1, 5.2, 5.3, 5.4, 5.5, 5.6)*
4. Write TCL commands, serializability techniques, concurrency control protocols, deadlock handling, and recovery mechanisms to manage transactions securely. *(LO 6.1, 6.2, 6.3, 6.4)*
5. Work collaboratively on database projects, apply security best practices, optimize query execution, and improve database performance using indexing and normalization. *(LO 3.5, 3.6, 4.5, 4.6, 5.5, 5.6, 6.3, 6.4)*

CO ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
ITPCC304.1	3	3	3	-	-	-	-	-	-	-	-
ITPCC304.2	3	3	3	-	-	-	-	3	3	-	3
ITPCC304.3	3	3	3	-	-	-	-	3	3	-	3
ITPCC304.4	3	3	-	-	-	-	-	-	-	-	-
ITPCC304.5	-	3	3	-	-	-	-	3	3	-	3
Average	**3**	**3**	**3**	-	-	-	-	**3**	**3**	-	**3**

Text Books :

1. Database System Concepts, Korth, Slberchatz, Sudarshan , Sixth Edition, 2011, McGraw Hill Education
2. Fundamentals of Database Systems, Elmasri and Navathe, Sixth Edition, 2010, Pearson
3. Database Management Systems, Raghu Ramkrishnan and Johannes Gehrke, ISE Editions, 1997 ,McGraw-Hill Education

Reference Books :

1. Database Systems Design, Implementation and Management , Peter Rob and Carlos Coronel, 9th Edition, 2009, Thomson Learning
2. SQL & PL / SQL for Oracle 11g Black Book, Dr. P. S. Deshpande, ISE Edition, 2011,Dreamtech Press
3. Database Management Systems , G. K. Gupta , 1st edition,2011,McGraw – Hill

Other Resources :

1. NPTEL Course on Database Management system by Prof.P.P.Das, Department of Computer Science and Engineering, IIT Khargpur
   Web link- https://archive.nptel.ac.in/courses/106/105/106105175/
2. Coursera course on Introduction to Relational Databases
   Web link- https://www.coursera.org/learn/introduction-to-relational-databases#modules

A. IN-SEMESTER ASSESSMENT (50 MARKS)

1. Continuous Assessment - Theory-(20 Marks)

Suggested breakup of distribution

a) One Assignment on live problems/ case studies: 10 Marks

Students should be assigned a real life problem statement (different for each student). Students are expected to research and collect required resources to create a backend for the selected problem. Students should prepare a presentation of 10-15 minutes. This assignment should be graded for 10 marks depending on the parameters as analysis, design, conversion to relational schema and database creation for selected problem statement.

b) One Think Pair Share (TPS) activity: 05 Marks

c) Regularity and active participation :05 Marks

1. Mid Semester Exam (30 Marks)

Mid semester examination will be based on 40% to 50% syllabus.

B. END SEMESTER EXAMINATION (50 MARKS)

End Semester Examination will be based on syllabus coverage up to the Mid Semester Examination (MSE) carrying 20%-30% weightage, and the syllabus covered from MSE to ESE carrying 70%-80% weightage.

Course Type	Course Code	Course Name	Credits
LBC	ITLBC301	DATA STRUCTURES LABORATORY	01

Examination Scheme		
Continuous Assessment	**Practical /Oral**	**Total**
25	25	50

Pre-requisite:

1. ESL103: Programming Laboratory –I (C)

Program Outcomes addressed:

1. PO1: Engineering Knowledge
2. PO2: Problem analysis
3. PO3: Design/Development of Solution

Course Objectives:

1. To introduce learners with the use of data structures and algorithm analysis.
2. To instruct learners about creating complex data structures via basic programming concepts.
3. To train learners about creating realistic implementation of linked lists, stacks, and queues.
4. To guide learners in the actual use of various tree and graph types.
5. To provide knowledge to learners on how to develop searching, hashing, and sorting algorithms.
6. To prepare students to use linked lists, stacks, queues, trees, and graphs to complicated problems.

Module	Detailed Contents	Hrs
00.	**Course Introduction** This course is intended to teach the design and analysis of basic data structures and their implementation in an object-oriented language. The data structures concepts are increasingly becoming the default choice of the IT industry especially industries involved in software development at system level.	**--**

01.	**Implementation of basic data structures** ***Learning Objective/s:*** *Learner is expected to apply unions, pointers, 1D arrays, and structures to solve a given problem.* **Experiment 1:** WPC for demonstration of nested structures using function for student having name, id, marks [3]. Demonstrate the structure for 10 students. **Experiment 2:** Demonstrate pointers and character array.	**04**
	Self-Learning Topics: *Pointer implementation of all integrated data types.* ***Learning Outcomes:*** *A learner will be able to* *LO 1.1: Compile and execute C program on Ubuntu OS using CLI. (P.I.-1.3.1)* *LO 1.2: Code array as 1D and 2D data structure. (P.I.-1.4.1)* *LO 1.3: Implement linear search using 1D-array. (P.I.-2.2.3)* *LO 1.4: Identify the capability of 16bit and 32bit machine to use integer data type. (P.I.-2.3.1)* *LO 1.5: Use 2D array for mathematical matrix operation. (P.I.- 3.4.2)* *LO 1.6: Compare the mythology using array and structures. (P.I.- 3.4.3)*	
02.	**Implementation of Static Linear DS** ***Learning Objective:*** *Learner is expected to apply linear data structures and their application in fixed-size scenarios through the use of arrays.* **Experiment 3:** Write menu driven program to implement static stack with push, pop, peek and display functions of it. **Experiment 4:** Write menu driven program to implement static queue and circular queue of size 10 with insert, delete, peek and display functions of it.	**06**
	Self-Learning Topics: *Implement character stack, stack applications.* ***Learning Outcomes:*** *A learner will be able to* *LO 2.1: Restate the principle of stack and queue data structure. (P.I.-1.3.1)* *LO 2.2: Apply concept of array to implement functions of stack data structure. (P.I.-1.4.1)* *LO 2.3: Use array to design functions of queue data structure. (P.I.-2.2.3)* *LO 2.4: Identify and implement static applications at system level. (P.I.-2.3.1)* *LO 2.5: Implement evaluation and conversion of Infix, prefix, postfix expression. (P.I.- 3.4.2)* *LO 2.6: Define problem and find solution using various data structures. (P.I.- 3.4.3)*	

03.	**Implementation of Linear Data Structure using Dynamic Memory Allocation** ***Learning Objective:*** *Learners is expected to comprehend the primary advantage of linked lists compared to arrays and be proficient in using dynamic memory allocation.* **Experiment 5:** Implementation of singly linked list data structure with given function. **Experiment 6:** Implementation of doubly linked list data structure with given function. ***Self-Learning Topics:*** *Study and implement header linked list.* ***Learning Outcomes:*** *A learner will be able to* *LO 3.1: Use of dynamic data memory allocation for implementation. (P.I.-1.3.1)* *LO 3.2: Illustrate the concept and principle of linked list data structure. (P.I.-1.4.1)* *LO 3.3: Design the LL with various functions and compare with other type. (P.I.-2.2.3)* *LO 3.4: Apply the concept of LL in real time applications. (P.I.-2.3.1)* *LO 3.5: Model the application using LL data structure (P.I.- 3.4.2)* *LO 3.6: Demonstrate the LL for system and kernel level functions. (P.I.- 3.4.3)*	**08**

04.	**Implementation of graph and tree** ***Learning Objective:*** *Learner is expected to understand computer file systems and business organizational chart tree structures and implement graph data structures.* **Experiment 7:** Implement binary tree using insertion and deletion of node. **Experiment 8:** Implement tree traversal for in-order, preorder and post order types. **Experiment 9:** Write program to implement adjacency matrix of graph. **Experiment 10:** Implement BFS and DFS traversal of graph.	**04**

	Self-Learning Topics: *Implement 2-3, and B and B+ tree mechanism and graph algorithms.* ***Learning Outcomes:*** *A Learner will be able to* *LO 4.1: Execute the code for tree data structure. (P.I.-1.3.1)* *LO 4.2: Identify use of 2D array to design graph. (P.I.-1.4.1)* *LO 4.3: Compare BFS and DFS traversal of graph. (P.I.-2.2.3)* *LO 4.4: Identify the real time application of Graph for Map optimization. (P.I.-2.3.1)* *LO 4.5: Explore various shortest path algorithms. (P.I.- 3.4.2)* *LO 4.6: Demonstrate system level functions implementation using tree data structures. (P.I.- 3.4.3)*	
05	**Design and Implementation of searching and sorting** ***Learning Objectives:*** *Learner is expected to apply linear data structures and their application in fixed-size scenarios through the use of arrays.* **Experiment 11:** Write program to implement linear and binary search. **Experiment 12:** Write program using recursion for implementation of quick sort. **Experiment 13:** Write program for implementation of insertion/ selection sort.	**04**
	Self-Learning Topics: *Learn to code shell and bucket sort.* ***Learning Outcomes:*** *A learner will be able to* *LO 5.1: Calculate the time complexity of linear and binary search. (P.I.-1.3.1)* *LO 5.2: Code the searching functions. (P.I.-1.4.1)* *LO 5.3: Identify various sorting mechanisms (P.I.-2.2.3)* *LO 5.4: Apply any two types of sorting methods on given set of data. (P.I.-2.3.1)* *LO 5.5: Determine and analyze time complexity of searching and sorting above methods. (P.I.- 3.4.2)* *LO 5.6: Identify best method of sorting for large set of data. (P.I.- 3.4.3)*	
06.	**Implementation of applications of Data structures**	**04**
	Learning Objective: *Learner is expected to implement complex problems using data structures and algorithms, and analysing data structures inside data management models* **Experiment 14:** WPC using stack data structure for infix to postfix algorithm. **Experiment 15:** Implementation of Josephus Problem using circular linked list. **Experiment 16:** Implementation of hashing functions with different collision resolution techniques.	

	Self-Learning Topics**:* *Study advanced data structures for real time problems.* ***Learning Outcomes: *LO 6.1: Study various complex problem in data management and retrieval. (P.I.-1.3.1)* *LO 6.2: Select the data structure to implement the solution of problem. (P.I.-1.4.1)* *LO 6.3: Analyse the working and use various data structure for real world problem. (P.I.-* *2.2.3)* *LO 6.4: Compare the use of stack and queue for various applications. (P.I.-2.3.1)* *LO 6.5: Compare the solution of specific problem by using more than one data structure. (P.I.- 3.4.2)* *LO 6.6: Model the collision resolution for large set of data and find computational speedup on available resources. (P.I.- 3.4.3)*	
	Total	**30**

Performance Indicators:

P.I. No.	**P.I. Statement**
1.3.1	Apply engineering fundamentals
1.4.1	Apply theory and principles of computer science engineering to solve an engineering problem.
2.2.3	Identify existing solution/methods to solve the problem, including forming justified approximations and assumptions.
2.3.1	Able to apply computer engineering principles to formulate modules of a system with required applicability and performance.
3.4.2	Ability to implement and integrate the modules.
3.4.3	Ability to verify the functionalities and validate the design.

Course Outcomes:

Learner will be able to

1. Design and use the basic concepts and principles of various data types. *(LO 1.1,LO 1.2, LO 1.3,LO 1.4, LO 1.5,LO 1.6)*
2. Implement the concepts of the methods of Linear data structures. *(LO 2.1,LO 2.2, LO 2.3,LO 2.4,LO 2.5, LO 2.6, LO 3.1,LO 3.2, LO 3.3,LO 3.4,LO 3.5, LO 3.6)*
3. Design and implement various functions of tree and graph. *(LO 4.1,LO 4.2, LO 4.3,LO 4.4, LO 4.5,LO 4.6)*
4. Design the concepts and compare the techniques of searching, hashing and sorting. *(LO 5.1,LO 5.2, LO 5.3,LO 5.4,LO 5.5,LO 5.6)*
5. Apply and examine the methods of linked lists, stacks, queues, trees and graphs to solve complex problems. *(LO 6.1,LO 6.2, LO 6.3,LO 6.4,LO 6.5,LO 6.6)*

CO-PO Mapping Table with Correlation Level

CO ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
ITLBC301.1	3	3	3	-	-	-	-	-	-	-	-
ITLBC301.2	3	3	3	-	-	-	-	-	-	-	-
ITLBC301.3	3	3	3	-	-	-	-	-	-	-	-
ITLBC301.4	3	3	3	-	-	-	-	-	-	-	-
ITLBC301.5	3	3	3	-	-	-	-	-	-	-	-
Average	**3**	**3**	**3**	-	-	-	-	-	-	-	-

Text Books:

1. Data Structures through C in Depth, S. K Srivastava, Deepali Srivastava, 5th Edition, 2011, BPB Publications.
2. Data Structures Using C by Aaron M Tenenbaum, 1st Edition 2018, Pearson India.
3. Data Structures using C, Reema Thareja, 2nd Edition, 2011, Oxford.

Reference Books:

1. Fundamentals of Data Structures, Ellis Horowitz, Sartaj Sahni, 5th Edition, 2010, Galgotia Publications.
2. An introduction to data structures with applications, Jean Paul Tremblay, Paul G. Sorenson; 3rd Edition, 1984, Tata McGraw-Hill.
3. Data Structures using C and C++, Rajesh K. Shukla, 2nd Edition, 2009, Wiley India.

Other Resources:

1. Digital material:
   Web Link- Complete DS Data Structure in one shot | Semester Exam | Hindi (youtube.com)
2. Web Link- https://topperworld.in/dsa-handwritten-notes/

A. CONTINUOUS ASSESSMENT (25 MARKS)

Suggested breakup of distribution

a) Task Execution :10 Marks

Students will be given minimum 12 tasks based on list as per mentioned in the syllabus. Each task carries 10 Marks. Average will be taken of all tasks. Students are expected to execute the program for given task with respect to given data structure, also expected to perform

searching & sorting operations on given dataset. Students will be evaluated based on logic building for the given task and expected output.

b) Practical Test: 10 Marks

Students will be given task (different for each student) and they will be evaluated based on the parameters mentioned in continuous assessment.

c) Regularity & Active participation: 05 Marks

B. END SEMESTER EXAMINATION (Practical and Oral Exam) (25 Marks)

Suggested breakup of distribution

a) Task Execution: 10 Marks

Students will be given task (different for each student) and they will be evaluated based on the parameters mentioned in continuous assessment.

b) Results and discussion, Inferences drawn based on above task: 05 Marks

c) Oral based on entire syllabus :10 Marks

Two examiners, one Internal and one External will do the evaluation.

Course Type	Course Code	Course Name	Credits
LBC	ITLBC302	SQL LABORATORY	01

Examination Scheme		
Continuous Assessment	**End Semester Exam (ESE)**	**Total**
25	25	50

Pre-requisite:

1. ESL103 : Programming Laboratory-I (C)

Program Outcomes addressed:

1 PO1: Engineering knowledge

2 PO2: Problem analysis

3 PO3: Design/Development of Solutions

4 PO5: Engineering tool usage

5 PO8: Individual and Collaborative team work

6 PO09: Communication

7 PO11: Life-long learning

Course Objectives:

1. To introduce students database modeling concepts, including entity-relationship (ER) and enhanced entity-relationship (EER) diagrams. Train them to establish relationships, apply integrity constraints, and ensure data consistency using engineering principles
2. Familiarize students with SQL commands for creating, modifying, and securing databases. Teach the use of **GRANT**, **REVOKE**, and transaction control commands to enforce access control and optimize database performance.
3. Impart knowledge on implementing views, triggers, and materialized views to automate database operations. Teach structured approaches to enhance database efficiency and performance.
4. To develop designing and implementing real-time database solutions using SQL, functions, procedures, and JDBC connectivity. Develop problem-solving skills by collecting stakeholder requirements and defining problem statements effectively.
5. Foster teamwork by training students to communicate requirements, distribute project tasks, and execute database activities while adhering to deadlines

Module	Details	Hrs.
00.	**Course Introduction** This is foundation course which deals with fundamental concepts of SQL to store, update, remove, search, and retrieve information from the database and it is used in all real time applications for management of data.	**01**
01.	**Introduction to ER and Extended ER diagram** ***Learning Objective:***	**07**

	Learner is expected to gain knowledge of ER, Extended ER diagram to demonstrate conceptual design of database and expected to implement it *Learner is expected to define and interpret rules of conversion of ER into relational model to implement a table in a database. Also expected to analyze it for real time application*	
	Contents: **Notation of ER and Extended ER diagram, Mapping the ER and EER Model to the Relational Model** **Task 1:** Identify real world problem and develop the problem statement. Design an Entity-Relationship (ER) / Extended Entity-Relationship (EER) Model **Task 2:** Mapping ER/EER to Relational schema model for task 1.	
	Self-Learning Topics:	
	Learning Outcomes: *A learner will be able to* *LO 1.1: Apply engineering principles to accurately represent entities, attributes, relationships, and constraints in database modeling. Identify and classify entity and relationship sets based on their characteristics and functionalities. Use primary keys, foreign keys, and mapping cardinality constraints to establish relationships and ensure data integrity in relational databases. (PI- 1.3.1, 2.1.1, 3.2.2)* *LO 1.2: Identify and interpret relationships between entities using engineering and computer science principles to design well-structured database models. Apply structured approaches to create ER and EER diagrams, representing complex entity relationships and hierarchical data. Convert ER diagrams into relational models by defining tables, attributes, keys, and relationships while ensuring normalization and data integrity. (PI- 1.4.1, 2.1.2, 3.1.1)*	
02.	**Types of Language in SQL**	**12**
	Learning Objective: *Learner is expected to list and identify Data Manipulation commands to implement data manipulation in database for real time application* *Learner is expected to define and apply Data Control commands to assign authorization to the database user as per their role and implement it for real time application* *Learner is expected to acquire knowledge and demonstrate retrieval of information as per requirement of organization and implement it for real time application*	
	Contents: **Data Definition Commands, Data Manipulation commands, Data Control commands, Complex SQL queries**	
	Self-Learning Topics:	
	Learning Outcomes:	
	A learner will be able to *LO 2.1: Create tables using SQL while applying integrity constraints to ensure data consistency and accuracy. Perform add, delete, and update operations using SQL commands. Manage database users by defining access controls and permissions. Apply structured approaches to optimize database functionality and performance. (PI- 2.1.1, 2.3.2, 3.1.1, 3.2.2)*	

	*LO 2.2: Apply SQL commands to manage database security and user roles using **GRANT** and **REVOKE** permissions. Execute basic and complex queries to retrieve, update, and manipulate data effectively. Use structured approaches to enforce access control, optimize database performance, and ensure data integrity. (PI- 3.1.2, 5.1.1, 5.1.2, 5.2.2)*	
03.	**Views and Triggers** *Learner is expected to define and demonstrate Views and Triggers to provide access to the required data only and implement it for real time application.*	**02**
	Contents: **Views and Triggers** **Task 7 :** **Implementation of Views and Triggers real time application**	
	Self-Learning Topics:	
	Learning Outcomes: *A learner will be able to* *LO 3.1: Summarize the concept and functionality of views and triggers in database systems. Write the syntax for creating views and develop views for real-time applications. Apply structured approaches to implement triggers for automating database operations and maintaining data integrity.* (PI-2.3.2, 2.1.1, 5.1.1, 3.1.2) *LO 3.2: Write and implement triggers for real-time applications to automate database operations and maintain data consistency. Define materialized views and differentiate them from standard views based on their functionality and performance benefits. Apply structured approaches to enhance database efficiency and optimization.* (PI-3.1.1, 5.1.2, 1.3.1, 1.4.1)	
04.	**TCL and Functions and procedures** ***Learning Objectives:*** ***Learner is expected to define and demonstrate Views and Triggers to provide access to the required data only and implement it for real time application. Learner is expected to define and demonstrate Transaction Control Language to use commit and rollback command to save tables in databases and implement it for real time application***	**07**
	Contents: **Transaction control Language, Functions and procedures, Database Programming , Mini project on real time problem**	
	Self-Learning Topics:	
	Learning Outcomes:	
	A learner will be able to *LO 4.1: Use **COMMIT**, **ROLLBACK**, and **SAVEPOINT** commands to manage* database transactions and ensure data integrity. Summarize the role of functions and procedures in SQL and their importance in automating database operations. Apply structured approaches to enhance database reliability and performance. *(PI- 1.4.1, 1.3.1, 5.1.1, 5.1.2)* LO 4.2: Create functions and procedures in SQL to enhance database automation and efficiency. Demonstrate database connectivity using JDBC for real-time applications. Design and implement real-time database solutions based on problem statements. Collect stakeholder requirements and define problem statements without conflict to ensure effective database system development. *(PI- 3.1.2, 3.1.1, 11.2.2, 11.1.1, 2.3.2, 9.1.1, 8.1.1, 2.1.1, 8.3.1, 9.3.2)* LO 4.3 *Communicate project requirements clearly among team members and allocate tasks based on expertise. Execute assigned activities as per the project plan*	

	while adhering to deadlines. Apply structured approaches to ensure teamwork, efficiency, and successful project completion. Utilize problem-solving skills to optimize workflows and maintain quality standards in database development. (*PI- 9.1.1, 9.3.2, 8.1.1, 8.3.1, 1.3.1, 1.4.1, 2.1.1, 2.3.2, 3.3.3, 3.2.2, 11.1.1, 11.2.2)*	
	Course Conclusion	**01**
	Total	**30**

Performance Indicators:

P.I. No.	**P.I. Statement**
1.3.1	Apply engineering fundamentals
1.4.1	Apply theory and principles of computer science engineering to solve an engineering problem
2.1.1	Evaluate problem statements and identifies objectives
2.1.2	Identifies processes/modules/algorithms of a computer based system and parameters to solve a problem
2.3.2	Identify design constraints for required performance criteria.
3.1.1	Able to define a precise problem statement with objectives and scope
3.1.2	Able to identify and document system requirements from stake holders
3.2.2	Ability to produce a variety of potential design solutions suited to meet functional requirements
5.1.1	Identify modern engineering tools, techniques and resources for engineering activities
5.1.2	Create/adapt/modify/extend tools and techniques to solve engineering problems
8.1.1	Recognize a variety of working and learning preferences; appreciate the value of diversity on a team
8.3.1	Present results as a team, with smooth integration of contributions from all individual efforts
9.1.1	Read, understand and interpret technical and nontechnical information
9.3.1	Create engineering-standard figures, reports and drawings to complement writing and presentations
11.1.1	Describe the rationale for requirement for continuing professional development
11.2.2	Recognize the need and be able to clearly explain why it is vitally important to keep current regarding new developments in your field

Course Outcomes: A learner will be able to -

1. Apply engineering and computer science principles to create well-structured database models, ensuring proper entity relationships, normalization, and integrity constraints. *(LO 1.1, 1.2)*
2. Create, modify, and secure databases using SQL commands, enforcing constraints, executing queries, and applying transaction control mechanisms. *(LO 2.1, 2.2, 4.1)*
3. Implement views and triggers to automate database operations and define materialized views to optimize data retrieval and storage. *(LO 3.1, 3.2)*
4. Design and implement real-time databases using SQL functions, stored procedures, and JDBC connectivity while considering stakeholder requirements. *(LO 4.2)*

5. Communicate project requirements, distribute tasks efficiently, execute database-related activities as per the project plan, and meet deadlines. *(LO 4.3)*

CO ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
ITLBC302.1	3	3	3	-	-	-	-	-	-	-	-
ITLBC302.2	3	3	3	-	3	-	-	-	-	-	-
ITLBC302.3	3	3	3	-	3	-	-	-	-	-	-
ITLBC302.4	-	3	3	-	-	-	-	3	3	-	3
ITLBC302.5	-	3	3	-	-	-	-	3	3	-	3
Average	**3**	**3**	**3**	-	**3**	-	-	**3**	**3**	-	**3**

Text Books :

1. Database System Concepts, Korth, Slberchatz, Sudarshan , Sixth Edition, 2011, McGraw Hill Education
2. Fundamentals of Database Systems, Elmasri and Navathe, Sixth Edition, 2010, Pearson
3. Database Management Systems, Raghu Ramkrishnan and Johannes Gehrke, ISE Editions, 1997 ,McGraw-Hill Education

Reference Books :

1. Database Systems Design, Implementation and Management , Peter Rob and Carlos Coronel, 9th Edition, 2009, Thomson Learning
2. SQL & PL / SQL for Oracle 11g Black Book, Dr. P. S. Deshpande, ISE Edition, 2011,Dreamtech Press
3. Database Management Systems , G. K. Gupta , 1st edition,2011,McGraw – Hill

Other Resources :

1. NPTEL Course on Database Management system by Prof.P.P.Das, Department of Computer Science and Engineering, IIT Khargpur
   Web link- https://archive.nptel.ac.in/courses/106/105/106105175/
2. Coursera course on Introduction to Relational Databases
   Web link- https://www.coursera.org/learn/introduction-to-relational-databases#modules

IN-SEMESTER ASSESSMENT (50 MARKS)

1. Continuous Assessment - Theory-(25 Marks)

Suggested breakup of distribution

a) Task Execution :10 Marks

Students will be given 10 tasks based on list as per mentioned in the syllabus. Each task carries 10 Marks. Average will be taken of all tasks. Students are expected to formulate problem statement, create relational schema, implement relational schema by using constraints and retrieve required information. Students will be evaluated based on logic building for the selected problem, rectification of syntax errors and expected output.

b) Mini Project Evaluation: 10 Marks

A group of 3-4 students should be assigned a real life problem statement. Students are expected to research and collect required resources to create a frontend and backend for the selected problem. Students should prepare a presentation/problem solving of 10-15 minutes. This project should be graded for 10 marks depending on the parameters as analysis, design,

conversion to relational schema, database creation and implementation for selected problem statement.

c) Regularity & Active participation: 05 Marks

END SEMESTER EXAMINATION (25 MARKS)

a) Task Execution: 10 Marks
Students will be given task (different task for every student) and will be evaluated as per the parameters mentioned in continuous assessment.
b) Results and discussion, Inferences drawn from the above task: 05 Marks
c) Oral based on entire syllabus :10 Marks

Two examiners, one Internal and one External will do the evaluation.

Course Type	Course Code	Course Name	Credits
SBL	ITSBL301	PYTHON LABORATORY	02

Examination Scheme		
Continuous Assessment	**End Semester Exam (ESE)**	**Total**
50	50	100

Pre-requisite :

1. ESL103- Programming Laboratory-I (C)
2. ESL205- Programming Laboratory-II (Java)

Program Outcomes addressed :

1. PO 1: Engineering knowledge
2. PO 2: Problem analysis
3. PO 3: Design/Development of Solutions
4. PO 5: Engineering tool usage
5. PO 8: Individual and Collaborative team work
6. PO 9: Communication

Course Objectives :

1. To provide basics of python programming including data types, operator, conditional statements, looping statements, input, and output functions in Python
2. To impart knowledge of advanced data types of python programming.
3. To inculcate knowledge of object oriented programming concepts in python.
4. To impart with concepts of modules, packages, multithreading and exception handling.
5. To acquaint learner with File handling, GUI & database programming.
6. To impart knowledge of data visualization using Matplotlib, Data analysis using Pandas and Web programming using Flask/Django.

Module	Detailed Contents	Hrs
00.	**Course Introduction** This course provides programming concepts of python from basics to advanced concepts. Design and write fully functional Python programs using commonly used data structures, custom functions, and reading and writing to files overview of oops concepts. provides basics of creating modules, packages and importing packages and provides fundamentals of GUI designing, database connectivity and web programming, data visualization and analysis. These concepts are essential for developing skill sets to work in the field of data science.	**01**
01.	**Basics of python and introduction to advanced data types, strings and special functions .**	**11**

	Learning Objective/s: *Learner is expected to infer and apply regular programming constructs to write python programs.* *Learner is expected to illustrate and use advanced data types in python for defining an ordered and unordered collections.* *Learner is expected to summarize string functions and special functions for code optimization.*	
	Contents: Basics of Python: Variables, operators, control structures, conditional structures, functions, lists, tuples, set, dictionary and its built-in functions strings and its built in functions, map reduce and filter function. **Task 1:** Write a program to input details such as rno,name,marks in respective subject of sem I for five students , find rank of each student and display details of each student. **Task 2:** Write a program to modularize task1 using functions to find and display rank of a student. **Task 3:** Identify and use advanced data type to store students detailed information and perform built in operations and also verify the output for any 2 advanced data types identified. **Task4:** Use Map function to find grade of a student for set of iterables from task 3 and filter function to list all students whose grade is "A". **Task 5:** Use String function to search students by roll number and display grade of a particular student.	
	Self-Learning Topics: *Decorators, iterators, generator functions* ***Learning Outcomes :*** *A learner will be able to* *LO 1.1: Use variables, operators, control and conditional structures to write program in python. (P.I.-1.3.1)* *LO 1.2: Use functions in python to modularize a given program with set of statements. (P.I.-1.4.1)* *LO 1.3: Identify, use and analyze advanced data types and their built in operations that applies to a given problem. (P.I.-2.1.2)* *LO 1.4: Use dictionary to implement key value pair elements for storing data of any type (P.I.-2.2.3)* *LO 1.5: Implement string built in functions to meet functional requirements to write a program in python. (P.I.-3.2.2)* *LO 1.6: Apply Map and reduce functions to solve a given program in python as a design alternative for for each function and for loop. (P.I.-3.2.1)*	
02.	**Object oriented programming concepts in python** ***Learning Objective/s:*** *Learner is expected to summarize and apply basic concepts of object-oriented programming in python to make code more reusable and easier to work with larger programs.*	**12**
	Contents:	
	Overview of Object -oriented programming, creating classes and objects, self-Variable, constructors, operator overloading, method overloading	

	Inheritance: Types of Inheritance (Single, Multiple, Multi -level, Hierarchical) constructors in inheritance, method overriding, abstract class, abstract method, interfaces in python.,	
	Task 6: Create a class by name Teacher and add variables to store details of the teacher ,add constructor to initialize member variables and display details of teacher using methods**.** **Task 7:** Create a child class and inherit properties from the Teacher class and add methods to the child class to display details of teacher teaching subjects to sem III and V**.** **Task 8:** Use the child class created in task 7 inherit properties from the Teacher class and demonstrate method overloading in the child class. **Task 9:** Create an fees_details interface add abstract methods to it and implement methods in another class.	
	Self-Learning Topics: *Single Responsibility Principle (SRP), Open/Closed Principle (OCP).* ***Learning Outcomes:*** *A learner will be able to* *LO 2.1: Create a class and declare member variables, add constructors to initialize variables (P.I.-1.3.1)* *LO 2.2: Use concepts of inheritance to achieve code reusability for solving a problem of code maintainability. (P.I -1.4.1).* *LO 2.3: Apply method overloading to implement and integrate the modules. (P.I - 3.2.2)* *LO 2.4: Identify and use alternative for abstraction using interfaces. (P.I - 3.2.1)*	
03.	**Introduction to modules, packages, exception handling multithreading in python.** ***Learning Objective/s:*** *Learner is expected to paraphrase and implement the concepts of user defined and built in modules and packages that are useful for code modularization, code reusability.* *Learner is expected to infer and use multi-threading and exception handling in python and write own exceptions.*	**12**
	Contents: Modules: Writing modules, importing objects from modules, python built -in modules. SciPy: Linear algebra functions using Numpy and Scipy Packages: creating user defined packages and importing packages. Multi -threading: creating threads in python, exception handling: Compile time errors, Runtime errors, exceptions, types of exception, try statement, except block, raise statement, assert statement, user -defined exceptions. **Task 10:** Write a program to create a module by student details,teacher details and add the code of student details and grade calculation from task2, teacher details from task 6 .create a package and add these modules in this user defined package and execute it. **Task 11:** Create two threads by name display students details and calculate grade and add exception handling to handle name error and type errors.	

	Self-Learning Topics: *Study of media related modules in python.*	
	Learning Outcomes : *A learner will be able to* *LO 3.1: Identify and write user defined exception for a given problem. (P.I -2.1.2).* *LO 3.2: Identify and use functions of NumPy and SciPy module to perform matrix operations and solve algebraic equations. (P.I -2.2.3)* *LO 3.3: Create your own module and implement it in another file. (P.I -3.2.1)* *LO3.4: Implement user defined packages to achieve code modularity in programming. (P.I-3.4.2).*	
04.	**File handling and designing graphical user interface in python** ***Learning Objective/s:*** *Learner is expected to summarize and implement basics of File handling in Python.* *Learner is expected to summarize and create backend databases and connect GUI with databases to perform CRUD operations.*	**10**
	Contents: File Handling operations in python,Graphical user interface (GUI): different GUI tools in python (Tkinter, PyQt) Working with containers, Canvas, Frame, Widgets(Button, Label, Text, Scrollbar, Check button, Radio button, Entry, Spinbox, Message etc.) Connecting GUI with databases to perform CRUD operations. (on supported databases like SQLite, MySQL, PostgreSQL) **Task 12:** Write a program to open students details file in append mode and add extra curricular details in the file. **Task 13:** Design student registration form using TKinter. **Task 14:** Create a database to store student registration details using SQLite/MYSQL and connect to frontend created in task 13 and perform CRUD operations.	
	Self-Learning Topics: *Design GUI using Kivy, MongoDB database* ***Learning Outcomes :*** *A learner will be able to* *LO 4.1: Use basics of file handling operations in python. (P.I -1.3.1)* *LO 4.2: Use TKinter to design GUI for a given problem. (P.I.-1.4.1)* *LO 4.3: Create a database using SQLite/MySQL according to the given problem statement. (P.I-3.2.1)* *LO 4.4: Perform and integrate CRUD operations in python. (P.I -3.4.2)* *LO 4.5: Identify tools to install SQLite, MySQL. (P.I -5.1.1)* *LO 4.6: Use tools to install SQLite, MySQL and perform CRUD operations. (P.I -5.1.2)*	
05.	**Data Visualization, analysis and web programming in python** ***Learning Objective/s:*** *Learner is expected to infer concepts of data visualization and analysis of data using matplotlib and pandas.*	**14**

	Learner is expected infer skills of web programming using Flask/Django framework.	
	Content: Visualization using Matplotlib: working with plots (line plot, bar graph, histogram, scatter plot, area plot, pie chart etc.), working with multiple figures. Data manipulation and analysis using Pandas: Introduction to Pandas, importing data into Python, series, data frames, indexing data frames, basic operations with data frame, filtering, combining and merging data frames, removing duplicates. Web programming using Flask, Django, **Task 15:** Write a program to plot graph to display no of students securing grade A,B,C,D from student details file . **Task 16 :** Write a program to create a simple pandas dataframe for student details data**.** **Task 17 :** Write a program to read a csv file containing student details and identify and remove rows that contain empty cells and fix wrong data with the correct values. **Task 18 :** Develop a student details web application using flask.	
	Self-Learning Topics: *API essentials in python, pygame tool* ***Learning Outcomes:*** *A learner will be able to* *LO 5.1: Identify which graph to plot using matplotlib for a given problem. (P.I -2.1.2)* *LO 5.2: Use matplotlib library to plot various graphs for analyzing data visually according to the given problem (P.I -2.4.2)* *LO 5.3: Design and demonstrate web application using flask for a given task. (P.I -3.1.1,8.1.1,8.2.1,9.1.2,9.1.3)* *LO 5.4: Identify and use various ways of cleaning data using pandas. (P.I -3.2.2)* *LO 5.5: Identify tools to install matplotlib and pandas. (P.I -5.1.1)* *LO 5.6: Use tool to install matplotlib and pandas module. (P.I -5.1.2)*	
	Total	**60**

Performance Indicators:

P.I. No.	P.I. Statement
1.3.1	Apply engineering fundamentals
1.4.1	Apply theory and principles of computer science engineering to solve an engineering problem
2.1.2	Identifies processes/modules/algorithms of a computer-based system and parameters to solve a problem
2.2.3	Identify existing solution/methods to solve the problem, including forming justified approximations and assumptions
2.4.2	Analyze and interpret the results using contemporary tools.
3.1.1	Able to define a precise problem statement with objectives and scope.

3.2.1	Ability to explore design alternatives.
3.2.2	Ability to produce a variety of potential design solutions suited to meet functional requirements.
3.4.2	Ability to implement and integrate the modules.
5.1.1	Identify modern engineering tools, techniques and resources for engineering activities .
5.1.2	Create/adapt/modify/extend tools and techniques to solve engineering problems.
8.1.1	Recognize a variety of working and learning preferences; appreciate the value of diversity on a team
8.2.1	Demonstrate effective communication, problem solving, conflict resolution and leadership skills
9.1.2	Produce clear, well-constructed, and well-supported written engineering documents
9.1.3	Create flow in a document or presentation - a logical progression of ideas so that the main point is clear

Course Outcomes :

Learner will be able to

1. Apply basic concepts of structure, syntax, and semantics of the Python language and use advanced data types and functions in python. *(LO 1.1,LO 1.2, LO 1.3,LO 1.4, LO 1.5,LO 1.6)*
2. Apply the concepts of object-oriented programming as used in Python. *(LO 2.1,LO 2.2, LO 2.3,LO 2.4)*
3. Create Python applications using modules, packages, multithreading and exception handling.(*LO 3.1,LO 3.2, LO 3.3,LO 3.4)*
4. Implement File Handling and create GUI applications and perform database operations in Python.*(LO 4.1,LO 4.2, LO 4.3,LO 4.4, LO 4.5,LO 4.6)*
5. Develop cost-effective robust applications using the latest Python trends and technologies.(*LO 5.1,LO 5.2, LO 5.3,LO 5.4,LO 5.5,LO 5.6)*

CO-PO Mapping Table with Correlation Level

CO ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
ITSBL301.1	3	3	3	-	-	-	-	-	-	-	-
ITSBL301.2	3	3	3	-	-	-	-	-	-	-	-
ITSBL301.3	3	3	-	-	3	-	-	-	-	-	-
ITSBL301.4	3	3	-	-	3	-	-	-	-	-	-
ITSBL301.5	3	3	3	-	3	-	-	-	3	3	-
Average	**3**	**3**	**3**	**-**	**3**	**-**	**-**	**-**	**3**	**3**	**-**

Text Books:

1. Introduction to computing and problem-solving using python, E Balagurusamy, First Edition,2017, McGraw Hill Publication.
2. Python Programming Using Problem Solving Approach, Reema Thareja, Second Edition, 2023, Oxford University. Press.
3. Python: The Complete Reference, Martin C. Brown, Fourth Edition, 2018, McGraw-Hill Publication.

Reference Books:

1. Headfirst Python- A Brain Friendly Guide, Paul Barry, 2nd Edition,2016, O'Reilly Media, Inc.
2. Problem Solving and Python Programming, Arockia Mary P, Kindle Edition,2021, Shanlax Publications.

Other Resources :

1. NPTEL Course: The Joy of Computing using Python, By Prof. Sudarshan Iyengar, Department of Computer Science and Engineering, IIT Ropar :-Web link- https://nptel.ac.in/courses/106106182/
2. NPTEL Course: Python for Data science By Prof. Ragunathan Rengasamy, Department of Computer Science and Engineering, IIT Madras :-Web link- https://archive.nptel.ac.in/courses/106/106/106106212/
3. Web link-https://www.w3schools.com/python/
4. Web link-https://www.geeksforgeeks.org/python-programming-language/
5. Web link-https://www.javatpoint.com/python-tutorial

A. IN-SEMESTER ASSESSMENT (50 MARKS)

1. Task Execution (30 Marks)

Students will be given minimum 10 tasks.

Students are expected to

i. Identify variables, data types methods/approach required to write the code for the given task and apply the same.
ii. Execute given task for different inputs and verify the result
iii. Import different Python libraries to solve given problem
iv. Implement basic file handling in Python
v. Create backend databases and connect GUI to perform CRUD operations
vi. Use data visualization tools
vii. Apply appropriate mechanisms to handle unexpected errors.

Students will be evaluated based on following:

i. Logic building for the given task (10 marks)
ii. Rectifying logical errors and syntax errors (06 marks)
iii. Well-structured and organized program (06marks)
iv. Verification of experiment output for different inputs (08 marks)

Refer the sample task given below.

Example:

Create a Teacher class to add details of the teachers their subject to respective class and display details using methods.

Students are expected to identify.

i. variables, data types methods/approach required to create teacher class and add methods to display details of a given teacher
ii. Execute given task for different inputs and verify the result
iii. Follow the coding standards
iv. Identify errors and rectify the errors.

Students will be evaluated based on following:

i. Logic building for the given task (10 marks)
ii. Rectifying logical errors and syntax errors (06 marks)
iii. Well-structured and organized program (06 marks)
iv. Verification of experiment output for different inputs (08 marks)

2. Regularity and active Participation (05 Marks)

3. Practical Test (15 Marks)

a) Task Execution: 10 Marks

Students will be given task (different task for every student) to execute and will be evaluated as per the parameters mentioned in continuous evaluation

Students will be evaluated based on following:

i. Logic building for the given task (04 marks)
ii. Rectifying logical errors and syntax errors (02 marks)
iii. Well-structured and organized program (02 marks)
iv. Verification of experiment output for different inputs (02 marks)

b) Oral based on covered syllabus: 05 Marks

B. END SEMESTER EXAMINATION (Practical & Oral Exam) (50 Marks)

a) Task Execution: 30 Marks
Students will be given task (different task for every student) to execute and will be evaluated as per the parameters mentioned below
i. Logic building for the given task (10 marks)
ii. Rectifying logical errors and syntax errors (06 marks)
iii. Well-structured and organized program (06 marks)
iv. Verification of experiment output for different inputs (08 marks)

b) Presentation of Results and conclusion, Inferences drawn: 05 Marks

c) Oral based on entire syllabus: 15 Marks

Two examiners, one Internal and one External will do the evaluation.

Course Type	Course Code	Course Name	Credits
MNP	ITMNP301	MINI PROJECT- 1A	01

Program Outcomes addressed:

1. PO1 : Engineering knowledge
2. PO2 : Problem Analysis
3. PO3 : Design/Development of Solutions
4. PO4 : Conduct investigations of complex problems
5. PO5 : Engineering Tool Usage
6. PO6 : The Engineer & The World
7. PO7 : Ethics
8. PO8 : Individual & Collaborative team work
9. PO9: Communication
10. PO10: Project Management & Finance
11. PO11: Life-long learning

Course Objectives:

1. To familiarize students about available infrastructure at Department/Institute level, online resources, plagiarism, expectations from MP 1A and 1B, etc.
2. To guide students in identifying societal or research needs and formulating them into problem statements.
3. To facilitate problem-solving in group settings.
4. To apply basic engineering principles to address identified problems.
5. To foster self-learning and research skills.

Course Outcomes:

At the end of the course, students will be able to:

1. Identify problems based on societal or research needs and methodology for solving them.
2. Apply knowledge and skills to solve societal problems collaboratively.
3. Develop interpersonal skills necessary for teamwork.
4. Analyze, verify, and validate results effectively through various methodologies, including, test cases/benchmark data/theoretical/inferences/experiments/simulations, etc.
5. Evaluate the societal and environmental impacts of proposed solutions.
6. Adhere to standard engineering practices.
7. Excel in written and oral communication by technical report writing, oral presentation, and publishing results in
   - Research/white paper/article/blog writing/publication, etc.
   - Business plan for entrepreneurship product creation
   - Patent filing/copyright.
8. Gain technical competencies by participating in competitions, hackathons, etc.
9. Demonstrate lifelong learning capabilities through self-directed group projects.
10. Apply project management principles effectively.

Guidelines for the Mini Project

• At the beginning of semester-III, project guides are required to conduct around 4 hours' orientation sessions including following topics:

- Familiarizing students about infrastructure available at Department/Institute level and how to use it.

- How to identify societal problems and formulate project problem statement.
- How to carry out literature survey.
- What is plagiarism and what care needs to be taken while writing a report.
- What is project report template and how it should be used.
- What are expectations from mini-projects 1A and 1B.

• Mini project may be carried out in one or more form of following:

Product preparations, prototype development model, fabrication of set-ups, laboratory experiment development, process modification/development, simulation, software development, integration of software (frontend-backend) and hardware, statistical data analysis, creating awareness in society/environment etc.

• Students must form groups of 3 to 4 members either from the same or from different departments.
• Groups should conduct surveys to identify needs and develop problem statements in consultation with faculty.
• An implementation plan in Gantt/PERT/CPM chart format covering weekly activities must be submitted.
• Each group must maintain a logbook to record weekly progress, to be verified by the faculty supervisor.
• Faculty input should emphasize guiding by faculty and self-learning by group members.
• Groups should propose multiple solutions, select the best one in consultation with the supervisor, and develop a working model.
• The solution to be validated with proper justification and report to be compiled in standard format of the Institute. Research papers, competition certificates may be submitted as part of annexure to the report.
• With the focus on self-learning, innovation, addressing societal/research/innovation problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that a single project of appropriate level and quality be carried out in two semesters by all the groups of the students.
• However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Mini Project adhering to the qualitative aspects mentioned above, gets completed in odd semester, then that group can be allowed to work on the extension of the Mini Project with suitable improvements/modifications or a completely new project idea in even semester. This policy can be adopted on a case by case basis.

In-Semester Continuous Assessment and End-Semester Examination Guidelines

- The Head of the Departments will assign a guide to each of the mini-projects and shall form a progress monitoring committee. The guide will carry out weekly monitoring of the project's progress. The committee shall carry out in-semester project evaluation based on presentations with a minimum of two evaluations per semester.
- Assessment will be based on individual contributions, understanding, and responses to questions asked.
- **Continuous Assessment marks distribution in semester III (50 marks):**

    - 10 marks for the Topic Approval Presentation in front of the progress monitoring committee
    - 15 marks for the Mid-Semester Progress Presentation in front of the progress monitoring committee
    - 20 marks for the Final Report & Presentation
    - 05 marks for Regularity and active participation
- **Continuous Assessment marks distribution in semester IV (50 marks):**
    - 15 marks for the In-Semester Two Presentations
    - 10 marks for the Participation in Project Competitions, TPP, etc.
    - 20 marks for the Final Report & Presentation
    - 05 marks for Regularity and active participation

The review/progress monitoring committee will assess projects based on the following criteria.

Semester III:

- Theoretical solution completion, including component/system selection/design of software solution and cost analysis.
- Two reviews will occur:
    - The first review will focus on finalizing the problem statement (topic approval).
    - The second review will focus on finalizing the proposed solution.

Semester IV:

- Expected tasks include procuring components/systems, constructing a working prototype, and validating results based on prior semester work.
- Reviews will be conducted as follows:
    - The first review will assess the readiness to build a working prototype.
    - The second review will involve a poster presentation and demonstration of the working model in the last month of the semester.

In addition to the above-mentioned points, the following performance criteria shall be included during the in-semester continuous assessment:

1. Quality of survey and need identification.
2. Clarity and innovativeness in problem definition and solutions.
3. Requirement gathering feasibility study, cost-effectiveness, and societal impact of proposed solutions.
4. Completeness and full functioning of the working model.
5. Effective use of skill sets and engineering norms.
6. Verification & validation of the solutions/test cases.
7. Individual contributions to the group.

8. Clarity in written and oral communication.
9. Participation in technical paper presentations/project competitions/hackathon competitions, etc.

End-Semester Examination in Semester IV (50 marks):

1. Presentation and demonstration to internal and external examiners: 20 marks.
2. Emphasis on problem clarity, innovativeness, societal impact, functioning of the model, skill utilization, and communication clarity: 30 marks.

Course Type	Course Code	Course Name	Credits
HSS	HSS301	PRODUCT DESIGN	02

Program Outcomes addressed:

1. PO2 Problem analysis
2. PO3 Design/Development of solutions
3. PO5 Engineering tool usage
4. PO6 The engineer and the world
5. PO7 Ethics
6. PO8 Individual and collaborative team work
7. PO10 Project management & finance
8. PO11 Life-long learning

Course Objectives:

1. Understand the product design process and its user-centered principles.
2. Apply fundamental design principles to create innovative product designs.
3. Demonstrate proficiency in generating and evaluating design concepts through ideation techniques.
4. Evaluate and synthesize sustainable and user-centric design practices in product development.

Module	Details	Hrs.
00.	**Course Introduction –** The course Product Design provides a thorough understanding of the principles, methods, and methodologies used in developing unique and functional products. Whether you want to be an industrial designer, a UX/UI specialist, or a creative problem solver, this course will provide you the necessary knowledge and abilities to envision, develop, and revise products that fulfill user needs and market demands. Students will investigate many areas of product design, such as aesthetics, usability, and sustainability, using both theory and hands-on practice. Design thinking, prototyping, and research will demonstrate to students how to turn ideas into concrete things that improve user experience and address real-world challenges.	**01**
01.	**Introduction to Product Design** ***Learning Objective:*** *Understand the fundamental principles and key elements that contribute to effective product design.*	**3-5**
	Contents: Overview of product design process, Importance of user-centered design, Design thinking methodologies, Case studies of successful product designs, Introduction to design tools and software (e.g., Sketch, Adobe XD)	

	Learning Outcomes: *A learner will be able to* *LO 1.1: Apply design thinking methodologies to develop user-centered solutions.* (*P.I.- 2.1.1, 2.3.1, 3.2.1, 3.3.1*) *LO 1.2: Gain introductory experience with digital design tools.* (*P.I. – 5.1.1, 5.2.1*)	
02.	**Design Principles and Fundamentals** ***Learning Objective:*** *Understand and apply core design principles to create functional and aesthetically pleasing products.*	**5-7**
	Contents: Understanding design principles (e.g., balance, hierarchy, contrast), Human factors in design (ergonomics, anthropometrics), Material selection and properties, Basics of aesthetics and styling, Hands-on exercises in sketching and prototyping	
	Learning Outcomes: *A learner will be able to* *LO 2.1: Apply fundamental design principles such as balance, contrast, proportion, and harmony to create aesthetically and functionally effective designs.* (*P.I. – 3.1.5, 3.2.3, 6.1.1*) *LO 2.2: Analyze and evaluate design elements to develop user-centered solutions that enhance usability, accessibility, and overall user experience.* (*P.I. – 3.1.1, 6.2.1*)	
03.	**Concept Generation and Ideation** ***Learning Objective:*** *Develop creative ideas and transform them into viable product concepts through structured ideation techniques.*	**5-7**
	Contents: Techniques for brainstorming and idea generation, Sketching and visualization techniques, Developing design briefs and specifications, Evaluating and selecting design concepts, Design for X, Rapid prototyping methods (e.g., 3D printing, CNC machining)	
	Learning Outcomes: *A learner will be able to* *LO 3.1: Apply various ideation techniques such as brainstorming, mind mapping, and SCAMPER to generate innovative and creative product concepts*. (*P.I. – 2.4.4, 3.1.6, 3.2.1*) *LO 3.2: Develop and evaluate multiple design concepts based on user needs, feasibility, and functionality to refine ideas into viable solutions.* (*P.I. – 2.2.4, 3.1.1, 3.1.6*)	
04.	**Product Lifecycle** ***Learning Objectives:*** *Understand the stages of a product's lifecycle and how they influence design, development, and sustainability.*	**3-5**
	Contents: Detailed overview of the product development lifecycle, Cost estimation and budgeting, Marketing and Market research, Regulatory and compliance requirements (e.g., safety standards)	

	Learning Outcomes: *A learner will be able to* *LO 4.1: Understand and analyze the stages of the product lifecycle and their impact on design, marketing, and sustainability decisions.* (*P.I. – 3.1.1, 3.1.6, 6.3.2, 11.3.2*) *LO 4.2: Analyze the influence of lifecycle considerations such as material selection, manufacturing processes, and end-of-life disposal to develop sustainable and cost-effective product solutions.* (*P.I. – 3.1.5, 6.3.1, 6.4.1, 6.4.2, 11.1.1, 11.2.2*)	
05.	**User Experience (UX) Design** ***Learning Objective:*** *Design intuitive and user-friendly products by applying UX principles and usability testing.*	**3-5**
	Contents: Understanding user needs and behaviour, Usability testing and feedback gathering, Wire-framing and prototyping for digital products, Iterative design process, Accessibility and inclusive design principles	
	Learning Outcomes : *A learner will be able to* *LO 5.1: Apply UX design principles such as usability, accessibility, and interaction design to create intuitive and user-friendly products.* (*P.I. – 3.1.6, 3.3.1, 5.2.2*) *LO 5.2: Conduct user research and usability testing to analyze user needs, gather feedback, and refine designs for an enhanced user experience.* (*P.I. – 3.1.1, 3.1.6, 5.1.2, 5.2.1, 10.3.1, 10.3.2*)	
06.	**Sustainability in Product Design** ***Learning Objective:*** *Incorporate sustainable practices and materials to create environmentally responsible product designs.*	**3-5**
	Contents: Environmental impact assessment in product design, Sustainable materials and manufacturing processes, Design for disassembly and recycling, Circular economy principles Case studies of eco-friendly product designs.	
	Learning Outcomes: *A learner will be able to* *LO 6.1: Apply sustainable design principles by selecting eco-friendly materials, optimizing manufacturing processes, and minimizing environmental impact throughout the product lifecycle.* (*P.I. – 3.1.5, 6.3.2, 7.1.1, 11.3.1*) *LO 6.2: Assess the lifecycle impact of products in terms of resource consumption, carbon footprint, and end-of-life disposal to develop eco-friendly and socially responsible design solutions.* (*P.I. – 3.4.1, 6.4.1, 7.2.2, 11.3.2*) *LO 6.3: Demonstrate good communication and collaboration with interdisciplinary teams by incorporating sustainable design concepts, explaining environmental and social implications, and enabling cross-disciplinary discussions to create new, eco-friendly product solutions.* (*P.I. – 8.2.1, 8.3.1*)	
	Course Conclusion	**01**
	Total	**30**

Performance Indicators:

P.I. No.	P.I. Statement
2.1.1	Articulate problem statements and identify objectives.
2.2.4	Compare and contrast alternative solution processes to select the best process.
2.3.1	Combine scientific principles and engineering concepts to formulate model/s (mathematical or otherwise) of a system or process that is appropriate in terms of applicability and required accuracy.
2.4.4	Extract desired understanding and conclusions consistent with objectives and limitations of the analysis.
3.1.1	Recognize that need analysis is key to good problem definition.
3.1.5	Explore and synthesize engineering requirements considering health, safety risks, environmental, cultural and societal issues.
3.1.6	Determine design objectives, functional requirements and arrive at specifications.
3.2.1	Apply formal idea generation tools to develop multiple engineering design solutions.
3.3.1	Apply formal decision-making tools to select optimal engineering design solutions for further development.
3.2.3	Identify suitable criteria for the evaluation of alternate design solutions.
3.4.1	Refine a conceptual design into a detailed design within the existing constraints (of the resources)
5.1.1	Identify modern engineering tools such as computer-aided drafting, 46odelling and analysis; techniques and resources for engineering activities.
5.1.2	Create/adapt/modify/extend tools and techniques to solve engineering problems.
5.2.1	Identify the strengths and limitations of tools for (i) acquiring information, (ii) 46odelling and simulating, (iii) monitoring system performance, and (iv) creating engineering designs.
5.2.2	Demonstrate proficiency in using discipline-specific tools.
6.1.1	Identify and describe various engineering roles; particularly as pertains to protection of the public and public interest at the global, regional and local level.
6.2.1	Interpret legislation, regulations, codes, and standards relevant to your discipline and explain its contribution to the protection of the public.
6.3.1	Identify risks/impacts in the life-cycle of an engineering product or activity.
6.3.2	Understand the relationship between the technical, socio-economic and environmental dimensions of sustainability.
6.4.1	Describe management techniques for sustainable development.
6.4.2	Apply principles of preventive engineering and sustainable development to an engineering activity or product relevant to the discipline.
7.1.1	Identify situations of unethical professional conduct and propose ethical alternatives.
7.2.2	Examine and apply moral & ethical principles to known case studies.
8.2.1	Demonstrate effective communication, problem-solving, conflict resolution and leadership skills.
8.3.1	Present results as a team, with smooth integration of contributions from all individual efforts.
10.3.1	Identify the tasks required to complete an engineering activity, and the resources required to complete the tasks.
10.3.2	Use project management tools to schedule an engineering project, so it is completed on time and on budget.
11.1.1	Describe the rationale for the requirement for continuing professional development.
11.2.2	Recognize the need and be able to clearly explain why it is vitally important to keep current regarding new developments in your field.
11.3.1	Source and comprehend technical literature and other credible sources of information.
11.3.2	Analyze sourced technical and popular information for feasibility, viability, sustainability, etc.

Course Outcomes: A learner will be able to –

1. Apply design thinking methodologies effectively to solve design problems. (*LO 1.1, LO 2.1, LO 2.2, LO 3.1, LO 3.2*)
2. Demonstrate proficiency in utilizing design tools and techniques for product development. (*LO 1.2, LO 5.1*)
3. Communicate and collaborate effectively for interdisciplinary teamwork. (*LO 6.3*)
4. Create functional and aesthetically pleasing product designs. (*LO 5.2*)
5. Integrate sustainable and user-centric design principles into product development processes. (*LO 4.1, LO 4.2, LO 6.1, LO 6.2*)

CO-PO Mapping Table with Correlation Level

CO ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
HSS301.1	--	3	3	--	--	3	--	--	--	--	--
HSS301.2	--	--	3	--	3	--	--	--	--	--	--
HSS301.3	--	--	--	--	--	--	--	3	--	--	--
HSS301.4	--	--	3	--	3	--	--	--	--	3	--
HSS301.5	--	--	3	--	--	3	3	--	--	--	3
Average	--	**3**	**3**	--	**3**	**3**	**3**	**3**	--	**3**	**3**

Text Books :

1. "Product Design and Development" by Karl T. Ulrich and Steven D. Eppinger, published by McGraw-Hill Education; 7th edition (January 25, 2021).
2. "Engineering Design: A Project-Based Introduction" by Clive L. Dym and Patrick Little, published by Wiley; 4th edition (August 26, 2015).
3. "Universal Principles of Design" by William Lidwell, Kritina Holden, and Jill Butler, published by Rockport Publishers; Revised and updated edition (January 1, 2010).

Reference Books :

1. "Sketching: Drawing Techniques for Product Designers" by Koos Eissen and Roselien Steur, published by BIS Publishers; 2nd edition (March 1, 2011).
2. "Materials and Design: The Art and Science of Material Selection in Product Design" by Mike Ashby and Kara Johnson, published by Butterworth-Heinemann; 3rd edition (October 10, 2014).
3. "The Design of Everyday Things" by Don Norman, published by Basic Books; Revisedand expanded edition (November 5, 2013).

Other Resources :

1. NPTEL Course: Product Design and Development, Prof. Inderdeep Singh, IITRoorkee Weblink: https://onlinecourses.nptel.ac.in/noc21_me83/preview
2. NPTEL Course: Product Design and Innovation, By Prof. Supradip Das, Prof. Swati Pal, Prof. Debayan Dhar, IIT Guwahati, IIT Guwahati, Web link: https://onlinecourses.nptel.ac.in/noc21 de01/preview

Continuous Assessment – Theory - (50 Marks)

Suggested breakup of distribution

Multiple Choice Questions	10 Marks
Case Study	20 Marks
Group Project	15 Marks
Regularity and Active participation	05 Marks

Course Type	Course Code	Course Name	Credits
PCC	ITPCC405	ENGINEERING MATHEMATICS-IV	03+01*

Examination Scheme					
Distribution of Marks			Exam Duration (Hrs.)		Total Marks
In-semester Assessment		End Semester Exam (ESE)			
Continuous Assessment	Mid-Semester Exam (MSE)		MSE	ESE	
20 + 25*	30	50	1.5	2	125

Pre-requisite :

Program Outcomes addressed :

1. PO1: Engineering knowledge
2. PO2: Problem analysis

Course Objectives :

1. To provide the basic knowledge on the concepts of Mathematics in the field of Engineering.
2. To build a foundation to the methodology necessary for solving problems by applying the knowledge of Mathematics to the field of Engineering.

Module	Details	Hrs
00.	**Course Introduction** Engineering Mathematics IV aims to equip students with the foundational knowledge and skills necessary for analyzing uncertainty and making informed decisions in engineering contexts. This course has many applications in Information Technology For example 1) Application of in Probability in Machine Learning, NLP part of speech Hidden Markov Model. 2) Application of in Correlation and Regression in Deep learning. 3) Application of Statistics in hypothetical or inferential learning. 4) Application of Algebraic Structure in Cyber Security and Cryptography.	02
01.	**Probability Theory and Random Variable**	06-08
	Learning Objective/s:	
	The learner will be able to analyze random variables using the basic theory of probability and will be able to apply various mathematical techniques in determining probability functions.	
	Contents:	
	Conditional Probability , Bayes Theorem, Total Probability Theorem, Definition of Random Variable. Types of Random Variable: Discrete and Continuous, Probability Mass and Density Function.	

	Self-Learning Topics:	
	Cumulative Distribution and Density Function	
	Learning Outcomes :	
	A learner will be able to *LO 1.1 Identify independents sets and disjoint sets and use its knowledge in the context of conditional probability. (P.I.-2.1.3)* *LO 1.2 Apply mathematical techniques of union, intersection and addition of sets, numbers for finding probabilities of events using Bayes' Theorem and Total Probability Theorem. (P.I.-1.1.2)* *LO 1.3 Identify if a given Random variable is Discrete or continuous in nature using existing definitions and formulas from Probability. (P.I.-2.1.1)* *LO 1.4 Apply mathematical techniques of integration and summation for finding Expectation, Variance, of the Random Variable. (P.I.-1.1.1)*	
02.	**Probability Distribution**	**06-08**
	Learning Objective/s:	
	Learner will be able to analyse and identify standard probability distribution functions and apply the knowledge of distribution for finding probabilities of various events.	
	Contents:	
	Measures of Central Tendency and Dispersion, Binomial distribution, Poisson Distribution , Fitting of a Poisson Curve, Gaussian Distribution, Normal Distribution (Standard Normal distribution , Reverse problem of Normal distribution)	
	Self-Learning Topics:	
	Joint Probability Distribution	
	Learning Outcomes :	
	A learner will be able to *LO 2.1 Apply mathematical techniques of exponents, algebra and basic probability for finding the probabilities of various events using Binomial, Poisson and Normal Distribution. (P.I.-1.1.1)* *LO 2.2 Apply the advance mathematical techniques of probability to find the probabilities the standard probability distribution (P.I. -1.1.2)* *LO 2.3 Identify the area under a Standard Normal Curve (bounded or unbounded) and use its knowledge in the context of Normal Distribution. (P.I.-2.1.3)* *LO 2.4 Identify whether Poisson distribution or Normal Distribution is applicable to a given problem using basic definitions of distribution and the data inferred from the problem. (P.I.-2.2.3)*	
03.	**Sampling Theory-I**	**05-07**
	Learning Objective/s:	
	Learner will be able to formulate the null hypothesis and apply parametric testing to test the hypothesis.	
	Contents:	
	Introduction to Sampling Theory, Testing of Hypothesis, level of significance, Critical region, One tailed and Two tailed test, Students' t-distribution. Test significance of large samples test: single mean, difference between the two means,	

	Self-Learning Topics: *sampling distribution of proportions* ***A learner will be able to*** *LO 3.1 Identify and test the hypothesis of significance difference between the parameter and the statistics (2.1.1)* *LO 3.2 Arrive at the conclusion by testing the hypothesis of significance difference between the two means (2.4.4)* *LO 3.3 Identify and apply appropriate test to be used to test the given hypothesis.(2.1.3)* *LO 3.4 Determine the test statistics using the appropriate formula (1.1.1)* *LO 3.5 Determine frequencies fitting a particular probability distribution (1.1.2)*	
04.	**Sampling Theory-II** ***Learning Objective/s:*** *Learner will be able to formulate the hypothesis and apply non-parametric testing to test the it.* **Contents:** Chi-square test:Test of goodness of fit , Independence of attributes (Contingency table), distribution of sample variance F-test , significant difference between variances of two Samples. ***Self-Learning Topics:*** ***Yate's Correction, ANOVA*** ***Learning Outcomes :*** *A learner will be able to* *LO 4.1 Identify and test the hypothesis of independence of attributes (2.1.1)* *LO 4.2 Identify and test the hypothesis of significance difference between the two variance (2.2.3)* *LO 4.3 Determine the expected frequencies of the assumption. (1.1.1)*	**05-07**
05.	**Correlation and Regression** ***Learning Objective/s:*** *Learner will be able to analyze the mathematical dataset given and apply techniques of correlation and regression to identify the relationships between variables from the dataset.* **Contents:** Correlation, Karl Pearson's coefficients of correlation(r), Spearman's Rank correlation coefficient (R): Repeated Rank, Non-repeated rank, Regression, Line of regression, Curve fitting: Linear and Second-Degree Curves. ***Self-Learning Topics:*** *Fitting of an exponential Curve* ***Learning Outcomes :*** *A learner will be able to* *LO 5.1 Identify whether Karl Pearson's or Spearman's coefficient of correlation is to be used in establishing relationship between two variables depending on the dataset given. (P.I.- 2.1.3)*	**07-09**

	LO 5.2 Apply basic mathematical techniques from algebra in finding the lines of regression and regression coefficients. (P.I.-1.1.1) *LO 5.3 Apply Least Square Method to fit a particular to the given data (P.I.-1.1.2)* *LO 5.4 Identify whether a linear degree curve or a quadratic degree curve is to be fit for the given data set based on the knowledge of Curve Fitting (P.I.-2.2.3)*	
06.	**Algebraic Structure**	**07-09**
	Learning Objective/s: *The learner will be able analyze the Algebraic Structure using the basic properties.*	
	Contents: Rings ,Integral domain, Fields, Ring Homomorphism Ring Isomorphism	
	Self-Learning Topics: *Orthonormal basis, Basis and Dimension.*	
	Learning Outcomes : *A learner will be able to* *LO 6.1 Apply mathematical operations defined on algebraic structures like Rings, Integral domain and Field and demonstrating closure properties under the operations. (P.I.-1.1.1)* *LO 6.2 Identify substructures within algebraic systems and the concept of homomorphism between them. (P.I.-2.1.3)* *LO 6.3 Apply the properties of homomorphism and one-one prove that the homomorphism is an isomorphism (P.I. 1.1.1)* *LO 6.4 Identify and characterize various algebraic structures based on their properties.(P.I.-2.4.1)*	
	Course Conclusion Engineering Mathematics plays an important role in providing the analytical tools necessary for designing, analyzing, and optimizing various electronic systems and communication networks.	**01**
Total		**45**

Performance Indicators:

P.I. No.	**P.I. Statement**
1.1.1	Apply the knowledge of discrete structures, linear algebra, statistics and numerical techniques to solve problems.
1.1.2	Apply the concepts of probability, statistics and queuing theory in modelling of computer-based system, data and network protocols.
2.1.1	Evaluate problem statements and identifies objectives.
2.1.3	Identify mathematical algorithmic knowledge that applies to a given problem.
2.2.3	Identify existing solution/methods to solve the problem, including forming justified approximations and assumptions.
2.4.1	Applies engineering mathematics to implement the solution.
2.4.4	Arrive at conclusions with respect to the objectives.

Course Outcomes :

1. Analyse random variables and apply the concepts of probability for getting the spread of data.*(LO 1.1, LO 1.2, LO 1.3 , LO 1.4)*
2. Analyse the mathematical problem given and apply the concepts of distribution in finding probabilities. *(LO 2.1, LO 2.2, LO 2.3 , LO 2..4)*
3. Apply sampling theory principles and techniques to real-world research problems in various fields and interpret the result. *(LO 3.1, LO 3.2, LO 3.3 , LO 3.4, LO 3.5, LO 4.1, LO 4.2, LO 4.3)*
4. Analyse and interpret the data using Correlation and Regression.(*LO 5.1, LO 5.2, LO 5.3 , LO 5.4)*

CO-PO Mapping Table with Correlation Level

CO ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
ITPCC 405.1	3	2	-	-	-	-	-	-	-	-	-
ITPCC 405.2	3	2	-	-	-	-	-	-	-	-	-
ITPCC 405.3	3	2	-	-	-	-	-	-	-	-	-
ITPCC 405.4	3	2	-	-	-	-	-	-	-	-	-
ITPCC 405.5	3	2	-	-	-	-	-	-	-	-	-
Average	3	2	-	-	-	-	-	-	-	-	-

Text Books :

1. Higher Engineering Mathematics by Grewal B. S. 38th edition, Khanna Publication 2005.
2. Advanced Engineering Mathematics by Kreyszig E. 9th edition, John Wiley.
3. A Text Book of Applied Mathematics Vol. I & II by P.N.Wartikar & J.N.Wartikar, Pune, Vidyarthi Griha Prakashan, Pune.

Reference Books :

1. Topics in Algebra by Herstein.
2. Fundamentals of Probability and Statistics V. K Kapoor and S. C. Gupta,. S . Chand, Publications
3. Advanced engineering mathematics, H.K. Das, S . Chand, Publications

Other Resources :

1. NPTEL Course: NOC: Probability for Computer Science IIT Kanpur: Prof Nitin Saxena:-Web link- https://nptel.ac.in/courses/106104233/
2. NPTEL Course: Sampling Theory, IIT Kanpur: Prof Shalabh :-Web link- https://nptel.ac.in/courses/111104073
3. NPTEL Course::- NOC: Algebra -I IMSc, Prof S Vishwanath, Prof Amritanshu Prasad Web link- https://nptel.ac.in/courses/111106137

A. IN-SEMESTER ASSESSMENT (75 MARKS)

1. Continuous Assessment - Theory (20 MARKS)

One MCQ test as per Gate exam pattern/ level: 5 Marks
One Class test: 5 Marks
One Team-pair- Solo: 5 Marks
Regularity and attentiveness: 5 Marks

Continuous Assessment - Tutorial (25 MARKS)

Minimum six Tutorials: 20 Marks

*Students must be encouraged to write at least 6 class tutorials. At least 6 Class tests will be conducted based on class tutorials on entire syllabus. Each class tests carries 20 Marks. Average will be taken of all class tests***.**

Regularity and attentiveness: 5 Marks

2. Mid Semester Exam (30 Marks)

Mid semester examination will be based on 40% to 50% of the syllabus.

B. END SEMESTER EXAMINATION (50 MARKS)

End Semester Examination will be based on syllabus coverage up to the Mid Semester Examination (MSE) carrying 20%-30% weightage, and the syllabus covered from MSE to ESE carrying 70%-80% weightage.

Course Type	Course Code	Course Name	Credits
PCC	ITPCC406	COMPUTER NETWORK	03

Examination Scheme					
Distribution of Marks			Exam Duration (Hrs.)		Total Marks
In-semester Assessment		End Semester Exam (ESE)			
Continuous Assessment	Mid-Semester Exam (MSE)		MSE	ESE	
20	30	50	1.5	2	100

Pre-requisite:

1. ESC203: Basic Electronics Engineering

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO3: Design/development of solutions
4. PO6: The Engineer and The World
5. PO7: Ethics

Course Objectives:

1. Build an understanding about the concepts and fundamentals of computer networks.
2. Perceive comprehensive knowledge about the principles, protocols, reference models (OSI and TCP/IP) and its functionalities
3. Apply the concepts of Error detection and error correction to identify the errors in data
4. Implement various routing algorithms and analyze them.

Module	Detailed Contents	Hrs
00.	**Course Introduction:** Computer Network is the foundation course which deals with concept of computer network, basis of communication, effective utilization of resources, optimize convenience and flexibility, safety standards and use of computer network in modern society.	01
01.	**Introduction to Computer Networks** ***Learning Objective:*** *To perceive the knowledge of basic network theory, functionalities of each layer of the models and to apply knowledge in designing of network.*	03-04

	Contents: Concept of computer network, categories of networks, Network Component: Hardware and software, Network topology and its types (Ring, mesh, star, bus, hybrid), Network structure and architecture (layering principles, services, protocols and standards), Network devices: Router, Hub, Switch, Repeater, Gateway, Reference Models: ISO/OSI Model and TCP/IP Model	
	Self-Learning Topic: *Identify the different devices used in network connection in college campus.* ***Learning Outcomes:*** *A learner will be able to* *LO 1.1: Apply the fundamental concepts of network theory to identify different networking devices and layered communication architectures and use it ethically to design a network as per the society's requirement. (P.I.-1.3.1,7.2.2)* *LO 1.2: Apply layering principles, services, protocols and standards in different reference models and identify alternatives to be used while designing the network as per organizations need in ethical manner. (P.I.-1.4.1, 7.1.1)* *LO 1.3: Identify different types of network topology for the design of network as per the requirement. (P.I.-2.2.4)* *LO 1.4: Analyze the results of applied topology structure and network devices as per the user's requirement. (P.I.-2.4.4)*	
02.	**Physical Layer** ***Learning Objective:*** *To know and differentiate between various transmission media characteristics and implement understanding in real time applications.* **Contents:** Guided Transmission Media: Twisted pair (STP and UTP), Coaxial (Baseband and broadband), Fibre optics, Unguided Media: Radio waves, Microwaves Infrared, Transmission Impairments, switching: Circuit-Switched Networks, Packet switching, Structure of a switch.	**03-05**
	Self-Learning Topics: *Compare and contrast various transmission media.* ***Learning Outcomes:*** *The learner will be able to* *LO 2.1: Categorize the various types of transmission media and identify the impact of transmission media on environment and its sustainability (P.I.-1.3.1, 7.1.2,7.2.2)* *LO 2.2: Illustrate structure of switch and its different types. (P.I.-1.4.1)* *LO 2.3: Determine physical connections set up to the network. (P.I.-3.1.4)* *LO 2.4: Demonstrate an ability to select optimal design scheme for user's requirement. (P.I.-3.3.2)*	

03.	**Data Link Layer** ***Learning Objectives:*** *To impart the knowledge of error detection, error correction and deploy facts to identify the errors in data. Also expected to implement the various routing algorithms.*	**08-10**
	Contents: Services, Framing, Error Control, Flow Control, Error Detection and Correction (Hamming Code, Parity, CRC, Checksum), Problems based on CRC, Hamming distance etc. Elementary Data Link protocols: Stop and Wait, Sliding Window (Go Back N, Selective Repeat), HDLC, IEEE 802.3 Ethernet, Problems on sliding window protocols. Multiple Access Protocols: ALOHA, Slotted ALOHA, CSMA, CSMA/CD and CSMA/CA.	
	Self-Learning Topics: *Differentiate link layer in IOT network and Normal Network.* ***Learning Outcomes:*** *The learner will be able to* *LO 3.1: Illustrate error control and flow control mechanism. (P.I.-1.3.1)* *LO 3.2: Apply statistics to determine error control and flow control. (P.I.-1.1.2)* *LO 3.3: Interpret different design issues at data link layers. (P.I.-2.2.4)* *LO 3.4: Implement and analyze multiple access protocols in data link layer. (P.I. 2.4.2)* *LO 3.5: Identify IEEE.802.3 Ethernet. (P.I.-3.1.4)* *LO 3.6: Implement and analyze elementary data link protocols and algorithms at data link layer for any communication network task. (P.I.-3.3.2)*	
04.	**Network Layer** ***Learning Objectives:*** *To acquaint the knowledge of various types of IP addressing and apply it in network design. Also expected to analyse and evaluate the performance of different routing protocols.*	**08-10**
	Contents: Network Layer design issues, Communication Primitives: Unicast, Multicast, Broadcast. IPv4 Addressing (class full and classless), numerical (calculation of network id, host ids, last address, first address, address space available etc.) Sub netting, Super netting, design problems, IPv4 Protocol, Network Address Translation (NAT), IPv6, Address resolution protocol (ARP). Routing algorithms: Distance Vector Routing, Shortest Path (Dijkastra), Link state routing, Protocols: RIP, OSPF, BGP	
	Self-Learning Topics: *Study difference between IPV4 and IPV6. Network Class A, B, C, D, E and subnet mask.* ***Learning Outcomes:*** *The learner will be able to* *LO 4.1: Apply the knowledge IP addressing in network design. (P.I.-1.3.1)* *LO 4.2: Apply the knowledge sub netting and super netting to design a network stack in real time application. (P.I.-1.4.1)* *LO 4.3: Identify different design issues at network layer. (P.I.-2.2.4)* *LO 4.4: Conceptualize and design a network stack using IP addressing and sub netting / super netting schemes. (P.I.- 2.4.2)* *LO 4.5: Implement algorithms at network layer like RIP, OSPF, BGP etc. and select the optimal algorithm (P.I.-3.3.2)* *LO 4.6: Explore design alternatives for user's problem. (P.I.-3.2.1)*	
05.	**Transport Layer & Session Layer**	**07-09**

	Learning Objective: *To impart the knowledge of TCP and UDP protocols to provide the communication services directly to the application processes running on different hosts.*	
	Contents: Transport Layer: Transport Layer Services, Connectionless & Connection-oriented Protocols, Transport Layer protocols: User Datagram Protocol: UDP Services, UDP Applications, Transmission Control Protocol: TCP Services, TCP Features, Segment, A TCP Connection, Windows in TCP, Flow Control, Error Control, TCP Congestion Control, TCP Timers Session Layer: Session layer design issues, Socket Programming, Session Layer protocol - Remote Procedure Call (RPC)	
	Self-Learning Topics: *List real time example of UDP and TCP.* ***Learning Outcomes:*** *The learner will be able to* *LO 5.1:Illustrate error control and flow control mechanism. (P.I.-1.3.1)* *LO 5.2:Summarize Remote Procedure Call (RPC) in session layer. ((P.I.- 1.4.1)* *LO 5.3:Identify connectionless and connection-oriented transport layer protocols. (P.I.- 2.2.4)* *LO 5.4:Implement socket programming using TCP and UDP. (P.I.- 2.4.1)* *LO 5.5:Implement the transport layer protocols like TCP, UDP and select the suitable protocol as per requirement. (P.I.- 3.3.2)* *LO 5.6:Explore design alternatives for client server programming. (P.I.-3.2.1)*	
06.	**Presentation Layer & Application Layer** ***Learning Objectives:*** *To identify the various data compression techniques used by presentation layer and apply it to prepare data for the application layer. Also expected to introduce various application layer protocols used by organizations as per the requirement.*	**08-09**
	Contents:	
	Presentation Layer: Compression: Comparison between Lossy Compression and Lossless Compression, Huffman Coding, Speech Compression, LZW, RLE, Application Layer: Domain Name Space (DNS) Electronic Mail -SMTP, POP, FTP, Telnet, WWW Application: A case study to design a network for an organization meeting the following guidelines: Networking Devices, IP addressing, Routing Protocols to be used, Services to be used (TELNET, FTP server, Web server, File server, etc)	
	Self-Learning Topics: *Difference between HTTP and FTP Protocol.* ***Learning Outcomes:*** *The learner will be able to* *LO 6.1: Illustrate various application layer protocols and design a network as per the requirement of organization by applying engineers' knowledge in the networking field. (P.I.-1.3.1, 6.1.1)* *LO 6.2: Identify the various compression techniques used by presentation layer and identify engineer's contribution to the protection of the public at different level (local, global and international) (P.I.-1.4.1, 6.2.1))* *LO 6.3: Interpret the various data compression techniques suitable for efficient communication. (P.I.-2.2.4)* *LO 6.4: Identify network devices, topology used, layering architecture as per the organization's requirement. (P.I.-2.3.2)* *LO 6.5: Implement Huffman Coding and LZW. (P.I.- 3.3.2)* *LO 6.6: Explore application layer protocols in real time application. (P.I.-3.2.1)*	

	Course Conclusion	**01**
	Total	**45**

Performance Indicators:

P. I. Number	**P. I. Statement**
1.1.2	Apply the concepts of probability, statistics and queuing theory in modeling of computer-based system, data and network protocols.
1.3.1	Apply engineering fundamentals.
1.4.1	Apply theory and principles of computer science engineering to solve an engineering problem.
2.2.4	Compare and contrast alternative solution/methods to select the best methods
2.3.2	Identify design constraints for required performance criteria.
2.4.1	Applies engineering mathematics to implement the solution.
2.4.2	Analyze and interpret the results using contemporary tools.
2.4.4	Arrive at conclusions with respect to the objectives.
3.1.4	Ability to choose appropriate quality attributes as defined by ISO/IEC/IEEE standard.
3.2.1	Ability to explore design alternatives.
3.3.2	Consult with domain experts and stakeholders to select candidate engineering design solution for further development.
6.1.1	Identify and describe various engineering roles; particularly as pertains to protection of the public and public interest at global, regional and local level.
6.2.1	Interpret legislation, regulations, codes, and standards relevant to your discipline and explain its contribution to the protection of the public.
7.1.1	Identify situations of unethical professional conduct and propose ethical alternatives.

Course Outcomes: Learner will be able to

1. Apply the fundamentals of basic network theory and layered communication architectures to design a network for the given application. *(LO 1.1,LO 1.2, LO 1.3,LO 1.4)*
2. Identify the different types of transmission media with real time applications. *(LO 2.1, LO 2.2, LO 2.3, LO 2.4)*
3. Implement algorithms at the appropriate layer, identify and analyze error and flow control mechanisms. *(LO 3.1, LO 3.2, LO 3.3, LO 3.4. LO 4.1, LO 4.2, LO 4.3, LO 4.4, LO 4.5, LO 4.6, LO 3.5, LO 3.6, LO 5.1, LO 5.2, LO 5.3, LO 5.4, LO 5.5, LO 5.6, LO 6.1, LO 6.2, LO 6.3, LO 6.4, LO 6.5, LO 6.6)*
4. Conceptualize and design a network stack using IP addressing and sub netting / super netting schemes. *(LO 3.1, LO 3.2, LO 3.3, LO 3.4,LO 3.5, LO 3.6, LO 4.1, LO 4.2, LO 4.3, LO 4.4.LO 4.5, LO 4.6, LO 6.1, LO 6.2, LO 6.3, LO 6.4, LO 6.5, LO 6.6)*

5. Analyze network service quality performance. *(LO 3.1, LO 3.2, LO 3.3, LO 3.4.LO 3.5, LO 3.6, LO 4.1, LO 4.2, LO 4.3, LO 4.4.LO 4.5, LO 4.6,LO 5.1, LO 5.2, LO 5.3, LO 5.4,LO 5.5, LO 5.6, LO 6.1, LO 6.2, LO 6.3, LO 6.4, LO 6.5, LO 6.6)*

CO-PO Mapping Table with Correlation Level

CO ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
ITPCC406.1	3	3	-	-	-	-	3	-	-	-	-
ITPCC406.2	3	-	3	-	-	-	3	-	-	-	-
ITPCC406.3	3	3	3	-	-	-	-	-	-	-	-
ITPCC406.4	3	3	3	-	-	3	-	-	-	-	-
ITPCC406.5	3	3	3	-	-	3	-	-	-	-	-
Average	**3**	**3**	**3**	**-**	**-**	**3**	**3**	**-**	**-**	**-**	**-**

Text Books:

1. Computer Networks, Andrew S. Tanenbaum, David J. Wetherall, Fifth Edition, 2011, Prentice Hall
2. Data Communication and Networking", Behrouz A. Foruzan, Fifth Edition, 2013, Science Engineering & Math Publications

Reference Books:

1. Data and Computer Communication, W. Stallings, Tenth Edition, 2014, Pearson Education
2. TCP/IP Protocol Suite, B. A. Forouzan, Fourth Edition, 2010,Tata McGraw Hill edition,
3. Information Theory, Coding and Cryptography, Ranjan Bose, Second Edition, 2008, Tata McGraw-Hill
4. Introduction to Data Compression, Khalid Sayood ,Third Edition, 2010, Morgan Kaufman

Other Resources:

1. NPTEL Course: Computer Networks and Internet Protocol by Prof. Soumya Kanti Ghosh, Prof. Sandip Chakraborty, IIT Kharagpur
   Web Link- https://onlinecourses.nptel.ac.in/noc21_cs18/preview
2. NPTEL Course: Computer Networks by Prof. Hema A. Murthy**,** IIT Madras
   Web Link- https://nptel.ac.in/courses/106106091

A. IN-SEMESTER ASSESSMENT (50 MARKS)

1. Continuous Assessment (20 Marks)

Suggested breakup of distribution

a) One MCQ Test as per GATE exam pattern / level: 05 Marks

b) One Class Test:05 Marks

c) One Think Pair Share (TPS) activity: 05 Marks

d) Regularity and active participation :05 Marks

2. Mid Semester Examination (30 Marks)

Mid semester examination will be based on 40% to 50% syllabus.

B. END SEMESTER EXAMINATION (50 MARKS)

End Semester Examination will be based on syllabus coverage up to the Mid Semester Examination (MSE) carrying 20% to 30% weightage, and the syllabus covered from MSE to ESE carrying 70% to 80% weightage.

Course Type	Course Code	Course Name	Credits
PCC	ITPCC407	OPERATING SYSTEM	03

Examination Scheme					
Distribution of Marks			Exam Duration (Hrs.)		Total Marks
In-semester Assessment		End Semester Exam (ESE)			
Continuous Assessment	Mid-Semester Exam (MSE)		MSE	ESE	
20	30	50	1.5	2	100

Pre-requisite:

1. ESL103: Programming Laboratory-I (C)
2. ITPCC303: Data Structures and Analysis

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem analysis

Course Objectives:

1. Facilitate the way students, comprehend the concepts and role of Operating System.
2. Intended to guide learners to understand Process Management and Scheduling Algorithms.
3. Aid learners to learn process coordination and deadlock handling in system.
4. Assist learners in acquiring a strong comprehension of the Memory and I/O Management policies.
5. Facilitate the way to comprehend and use OS as virtual machine and its benefits.

Module	Details	Hrs
00.	**Course Introduction** This course consists of concept of operating system, basic information of computer, Purpose of computer and its various components, Memory hierarchy. This course is used to understand the interaction between various hardware's and software applications.	**01**
01.	**Introduction of Operating System** ***Learning Objective:*** *To know and understand OS and its functions to solve real time-complex issues and maximize computational speed.*	**07-08**
	Contents: Introduction: Types of Computer System, Computer architecture, OS Structure, Operations, Services Interface, System Calls, System Structure, System Design and Implementation, OS Kernel, Types of kernels, Types of special purpose OS.	
	Self-Learning Topics: *Various types of computer and network system architectures.* ***Learning Outcomes:***	

	A learner will be able to *LO 1.1: Illustrate the functions of OS. (P.I.-1.3.1)* *LO 1.2: Correlate OS functions with software and hardware mechanism. (P.I.-1.4.1)* *LO 1.3: Compare various system calls at user and kernel level. (P.I.-2.2.5)* *LO 1.4: Identify various system calls and its constraints with OS functionalities. (P.I.-2.3.2)*	
02.	**Process Management** ***Learning Objective/s:*** *To know process management and apply process and thread scheduling.* **Contents:** Process Management: Process, Scheduling Inter-process Communication, Thread and its execution, CPU Scheduling: CPU Schedulers, scheduling Criteria Scheduling Algorithms. ***Self-Learning Topics:*** *Thread scheduling and system thread functions.* ***Learning Outcomes:*** *A learner will be able to* *LO 2.1: Illustrate various process scheduling algorithms. (P.I.-1.3.1)* *LO 2.2: Apply various process scheduling methods on given set of processes and analyze the obtained result. (P.I.-1.4.1)* *LO 2.3: Compare various system calls at user and kernel level. (P.I.-2.2.5)* *LO 2.4: Optimize process scheduling by changing various parameters of processes. (P.I.-2.3.2)*	**07-09**
03.	**Process Coordination** ***Learning Objective:*** *To know the process coordination and deadlock management policies in OS.* **Contents:** Process Synchronization: Critical Section, remainder section, Process Synchronization Hardware, Semaphores, Classical Problems of Synchronization, Deadlocks: Characterization Methods for Handling Deadlocks, Deadlock Prevention, Avoidance, Detection, Recovery. ***Self-Learning Topics:*** *Study a real time case study for Deadlock detection and recovery.* ***Learning Outcomes :*** *A learner will be able to* *LO 3.1: Summarize various inter-process coordination algorithm. (P.I.-1.3.1)* *LO 3.2: Apply various process scheduling methods on given set of processes and analyze the obtained result. (P.I.-1.4.1)* *LO 3.3: Analyze the deadlock avoidance and prevention mechanism. (P.I.-2.2.5)* *LO 3.4: Identify the suitable method to avoid and detect deadlock. (P.I.-2.3.2)*	**10-11**

04.	**Memory Management**	**06-07**
	Learning Objective: *To primary memory management policies and analyse the various page scheduling algorithms*	
	Contents: Memory Management: Hardware Address, Binding Address, Space Dynamic Loading and Linking, Swapping, Contiguous Allocation, Segmentation, Paging Structure of the Page Table, TLB, Virtual Memory Management: Demand Paging Page Replacement Algorithms, Thrashing and multiprogramming.	
	Self-Learning Topics: *Memory management for any one Operating System, Implementation of Page Replacement Algorithms.* ***Learning Outcomes :*** *A learner will be able to* *LO 4.1: Compare and contrast page scheduling algorithms. (P.I.-1.3.1)* *LO 4.2: Apply various page scheduling methods on given set of references and analyze the obtained result. (P.I.-1.4.1)* *LO 4.3: Compare and analyse page hits and page miss proportions. (P.I.-2.2.5)* *LO 4.4: Identify the effect of thrashing on page scheduling. (P.I.-2.3.2)*	
05.	**Disk and I/O Management** ***Learning Objective:*** *To know and understand File and directory and I/O management and compare various disk scheduling policies.*	**04-06**
	Contents: File system: File concept; Access methods; Directory structure; File system mounting; File sharing; Protection: Implementing File system: File system structure; File system implementation; Directory implementation; Allocation methods; RAID levels. I/O Systems: Overview I/O Hardware Application, I/O Interface, Kernel I/O, Subsystem Transforming, 1/0 Requests to Hardware Operations Performance. System Protection: Goals, Domain Access matrix, System Security: The Security Problem, Threats Encryption, User Authentication.	
	Self-Learning Topics: *File System for Linux and Windows, Features of I/O facility for different OS.* ***Learning Outcomes :***	
	A learner will be able to *LO 5.1: Elaborate allocation methods for disk data. (P.I.-1.3.1)* *LO 5.2: Apply various disk scheduling methods on given set of cylinders and analyze the obtained result. (P.I.-1.4.1)* *LO 5.3: Compare various disk scheduling policies. (P.I.-2.2.5)*	

	LO 5.4: Identify I/O policies and its effect on system performance. (P.I.-2.3.2)	
06.	**Virtual Machines**	**03-04**
	Learning Objective: *To know and understand the demonstration of virtual machine on host and guest OS.*	
	Contents: Type 0, 1, and 2 hypervisors, Advantages of virtual machines, Trap and emulate method, Handling system calls, interrupts, and privileged instructions in VMs, Binary translation and paravirtualization, Type 2 Hypervisors, Shadow and nested page tables, JVMs and application-level hypervisors, Resource allocation in virtual machines, VM migration, Storage virtualization.	
	Self-Learning Topics: *Study and use of cloud based virtual machines.*	
	Learning Outcomes : *A learner will be able to* *LO 6.1: Illustrate various types of hypervisors. (P.I.-1.3.1)* *LO 6.2: Apply virtualization types and compare the performance parameters of VM(P.I.-1.4.1)* *LO 6.3: Compare resource allocation in virtual machines. (P.I.-2.2.5)* *LO 6.4: Identify resource allocation in parallel VM. (P.I.-2.3.2)*	
	Course Conclusion	**01**
	Total	**45**

Performance Indicators:

P.I. No.	P.I. Statement
1.3.1	Apply engineering fundamentals.
1.4.1	Apply theory and principles of computer science engineering to solve an engineering problem.
2.2.5	Compare and contrast alternative solution processes to select the best process.
2.3.2	Identify design constraints for required performance criteria.

Course Outcomes:

Learner will be able to

1. Compare the structure and functions of Operating System. *(LO 1.1, LO 1.2, LO 1.3 ,LO1.4)*
2. Compare the performance of Scheduling Algorithms. *(LO 2.1, LO 2.2, LO 2.3 ,LO 2.4)*
3. Interpret the process coordination and deadlock management. *(LO 3.1, LO 3.2, LO 3.3 ,LO 3.4)*
4. Analyse memory and disk resource management. *(LO 4.1, LO 4.2, LO 4.3 ,LO 4.4)*
5. Identify virtual machine usage and resource allocation. *(LO 5.1, LO 5.2, LO 5.3 ,LO5.4)*

CO-PO Mapping Table with Correlation Level

CO ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
ITPCC407.1	3	3	3	-	-	-	-	-	-	-	-
ITPCC407.2	3	3	3	-	-	-	-	-	-	-	-
ITPCC407.3	3	3	3	-	-	-	-	-	-	-	-
ITPCC407.4	3	3	3	-	-	-	-	-	-	-	-
ITPCC407.5	3	3	3	-	-	-	-	-	-	-	-
Average	**3**	**3**	**3**	-	-	-	-	-	-	-	-

Text Books:

1. Operating System Concepts, Abraham Silberschatz, Peter B Galvin, Greg Gagne, 9th Edition, Wiley India Pvt. Ltd 2018.
2. Operating Systems: Principles and Practice, Thomas Anderson and Michael Dahlin, 2nd Edition, 2014, Recursive Books.

Reference Books:

1. Operating Systems Internals and Design Principles, William Stallings, 9th Edition, 2018, Pearson.
2. Modern Operating Systems, Andrew S. Tanenbaum, Herbert Bos, 4th Edition, 2014, Pearson.

Other Resources:

1. Digital material:
   NPTEL: Introduction to Operating Systems by Prof. Chester Rebiero, IIT Madras
   Web Link-https://nptel.ac.in/courses/106106144
2. Digital material:
   NPTEL: Operating System Fundamental by Prof.Santanu Chattopadhay,IIT Kharagpur
   Web Link-https://archieve.nptel.ac.in/courses/106/105/106105214

A. IN-SEMESTER ASSESSMENT (50 MARKS)

1. Continuous Assessment (20 Marks)

Suggested breakup of distribution

a) One MCQ Test as per GATE exam pattern / level: 05 Marks

b) One Class Test: 05 Marks

c) Mind Map activity: 05 Marks

d) Regularity and active participation :05 Marks

2. Mid Semester Examination (30 Marks)

Mid semester examination will be based on 40% to 50% syllabus.

B. END SEMESTER EXAMINATION (50 MARKS)

End Semester Examination will be based on syllabus coverage up to the Mid Semester Examination (MSE) carrying 20% to 30% weightage, and the syllabus covered from MSE to ESE carrying 70% to 80% weightage

Course Type	Course Code	Course Name	Credits
PCC	ITPCC408	SOFTWARE ENGINEERING	03

Examination Scheme					
Distribution of Marks			Exam Duration (Hrs.)		Total Marks
In-semester Assessment		End Semester Exam (ESE)			
Continuous Assessment	Mid-Semester Exam (MSE)		MSE	ESE	
20	30	50	1.5	2	100

Pre-requisite: NIL

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO3: Development of Solutions
4. PO4: Conduct investigations of complex problems
5. PO5: Engineering tool usage

Course Objectives :

1. To familiarize learner with the basic knowledge in software engineering.
2. To acquaint leaners to identify requirements, analyse and prepare models.
3. To familiarize learner to plan, schedule and track the progress of the projects.
4. To introduce leaners to design & develop the software solutions for the growth of society.
5. To familiarize learner to demonstrate and evaluate real time projects with respect to software engineering principles.
6. To introduce leaners to apply testing and assure quality in software solution.

Module	Detailed Contents	Hrs
00.	**Course Introduction** Software Engineering Course deals with the basic principles of Software Process, with emphasis on the Process models and their usage for different types of Software. This is foundation course which deals with fundamental concepts of Requirement Analysis, Software Estimation and Scheduling, Risk and Configuration Management, Software Testing and Maintenance. The fundamental concepts of this subject are essential for working on Software Projects in Industry.	01
01.	**Introduction to Software Engineering** ***Learning Objective/s:*** *Learner is expected to know the nature of software, software process and the different process models.*	05-06
	Contents:	

	Nature of Software, Software Engineering, Software Process, Capability Maturity Model (CMM) Generic Process Model, Prescriptive Process Models: The Waterfall Model, V-model, Incremental Process Models, Evolutionary Process Models, Concurrent Models, Agile process, Agility Principles, Extreme Programming (XP), Scrum, Kanban model	
	Self-Learning Topics: *Personal and Team Process Models.* ***Learning Outcomes :*** *A learner will be able to* *LO 1.1: Apply concepts of Process models to identify which process model best suits a particular software. (P.I.-1.3.1)* *LO 1.2: Use core principles of Capability Maturity Model to understand the importance of software in applications. (P.I.-1.4.1)* *LO 1.3: Differentiate Process models to identify which process model best suits a particular software. (P.I.-2.1.3)* *LO 1.4: Identify the level of software according to CMM model. (P.I.-2.2.3)*	
02.	**Requirement Analysis** ***Learning Objective/s:*** *Learner is expected to know and understand the concepts of requirement analysis in software engineering.*	**07-09**
	Contents: Software Requirements: Functional & non-functional – user-system requirement engineering process – feasibility studies – elicitation – validation & management – software prototyping – S/W documentation – Analysis and modeling Requirement Elicitation, Software requirement specification (SRS). Unified Modeling Language diagrams.	
	Self-Learning Topics: *Prioritizing requirements (Kano diagram) - real life application case study.* ***Learning Outcomes :*** *A learner will be able to* *LO 2.1: Apply basic concepts of feasibility studies to check if a particular software is feasible for an organization. (P.I.-1.3.1)* *LO 2.2: Use requirement elicitation techniques to know about customer requirements. (P.I.-1.4.1)* *LO 2.3: Use tools to validate and manage requirements of a software. (P.I.-2.1.2)* *LO2.4: Apply fundamentals of software prototyping and create software prototype. .(P.I.-2.2.3)* *LO 2.5: Determine requirements of software and develop SRS. (P.I.-3.1.6)* *LO 2.6: Identify suitable functional requirements for producing a variety of design solutions using UML for software. (PI-3.2.2)*	
03.	**Software Estimation and Scheduling** ***Learning Objective/s:*** *Learner is expected to know and understand the concepts of software estimation and scheduling.*	**07-09**
	Contents:	
	Management Spectrum, 3Ps (people, product and process) Process and Project metrics Software Project Estimation: LOC, FP, Empirical Estimation Models - COCOMO II Model, Specialized Estimation	

	Techniques, Object based estimation, use-case based estimation Project scheduling: Defining a Task Set for the Software Project, Timeline charts, Tracking the Schedule, Earned Value Analysis	
	Self-Learning Topics: *Typical Problems with IT cost estimates.* ***Learning Outcomes :*** *A learner will be able to* *LO 3.1:Identify Process and Project metrics for a software. (P.I.-1.3.1)* *LO 3.2:Use empirical estimation models to estimate cost of software. (P.I.-1.4.1)* *LO 3.3:Identify use cases to estimate cost and resources for a software. (P.I.-2.1.3)* *LO 3.4:Compare scheduling techniques and select best scheduling technique for a software. (P.I.-2.2.4)*	
04.	**Design Engineering** ***Learning Objective/s:*** *Learner is expected to know and understand concepts of design engineering.*	**05-06**
	Contents: Design Process & quality, Design Concepts, The design Model, Pattern-based Software Design. Architectural Design: Design Decisions, Views, Patterns, Application Architectures, Modeling Component level Design: component, Designing class based components, conducting component-level design.	
	Self-Learning Topics: *Refinement aspects, Refactoring* ***Learning Outcomes :*** *A learner will be able to* *LO 4.1: Apply the concepts of Pattern based Software design to use in a software. system(P.I.-1.3.1)* *LO 4.2: Use architectural design (P.I.-1.4.1)* *LO 4.3: Identify the architectural view that best suits a software. (P.I.-2.1.3)* *LO 4.4:Analyze the class based components to be used in component level design. (P.I.-2.2.4)*	
05.	**Software Risk, Configuration Management and Software Testing** ***Learning Objective/s:*** *Learner is expected to know and understand the concepts of software risk and configuration management.*	**09-10**

	Contents: Risk Identification, Risk Assessment, Risk Projection, RMMM Software Configuration management, SCM repositories, SCM process Testing: Software Quality, Testing: Strategic Approach, Strategic Issues- Testing: Strategies for Conventional Software. Dynamic Testing: Black Box Testing: Boundary Value Analysis, Equivalence Class Testing, State Table Based testing, Cause-Effect Graphing Based Testing, Error Guessing. White Box Testing Techniques: need, Logic Coverage Criteria, Basis Path Testing, Graph Matrices, Loop Testing, Static Testing: Formal Technical Review (FTR), Walkthrough.	
	Self-Learning Topics: *Configuration Management for Web Apps.* ***Learning Outcomes :*** *A learner will be able to* *LO 5.1: Use RMMM to identify, assess and project risks in projects. (P.I.-1.3.1)* *LO 5.2: Apply SCM Process to solve an engineering problem associated with software. (P.I.-1.4.1)* *LO 5.3: Identifies processes/algorithms to find errors using testing techniques. (P.I.-2.1.3).* *LO 5.4: Compare the results of testing method used (P.I.-2.2.4).* *LO 5.5: Apply state table based to identify state of bugs. (P.I.-3.2.1)* *LO 5.6: Determine the functionalities and validate the test cases designed. (P.I.-3.4.3)* *LO 5.7: Derive appropriate procedure/algorithm, data set and test cases to find structural errors. (P.I.-4.1.2)* *LO 5.8: Outline structural bugs and logical bugs by running the test cases to refine the process over time. (P.I.-4.3.2)*	
06.	**Software Testing Tools and Quality Assurance**	**04-05**
	Learning Objective/s: *Learner is expected to know and understand concepts of software testing and assure quality of software solution.*	
	Contents: Study of testing tools**.** Dynamic and static testing tools JIRA, Bugzilla. Software Quality Assurance Task and Plan, Metrics, Software Reliability, Software Quality Management and Assurance, McCall's quality factors and criteria, ISO9000:2000, SIX sigma. Basics of Software Maintenance and Reverse Engineering.	

	Self-Learning Topics: *Web based and mobile based Software quality assurance factors and criteria.* ***Learning Outcomes :*** *A learner will be able to* *LO 6.1: Identify quality attributes for software quality assurance (P.I.-1.3.1).* *LO 6.2: Apply Software Quality Management and Assurance for to identify possible solution (P.I.-1.4.1)* *LO 6.3: Categorize automation tools for static and dynamic testing. (P.I.-3.2.2).* *LO 6.4: Use testing tool to design test cases for various modules. (P.I.-3.4.2).* *LO 6.5: Use appropriate testing tools and techniques to collect and analyze test data. (P.I.-4.3.1)* *LO 6.6: Analyze test cases stating possible errors and limitations using automation. (P.I.-4.3.2).* *LO 6.7: Use tools and techniques to design test data and test cases (P.I.-5.1.2)* *LO 6.8: Evaluate the credibility of results from tools used with reference to the accuracy and limitations. (P.I.-5.3.2)*	
	Course Conclusion	**01**
Total		**45**

Performance Indicators:

P.I. No.	P.I. Statement
1.3.1	Apply engineering fundamentals
1.4.1	Apply theory and principles of computer science engineering to solve an engineering problem
2.1.3	Identifies mathematical algorithmic knowledge that applies to a given problem
2.2.4	Compare and contrast alternative solution/methods to select the best methods
3.1.6	Ability to develop software requirement specifications (SRS).
3.2.1	Ability to explore design alternatives.
3.2.2	Ability to produce a variety of potential design solutions suited to meet functional requirements.
3.4.2	Ability to implement and integrate the modules.
3.4.3	Ability to verify the functionalities and validate the design.
4.1.2	Ability to choose appropriate procedure/algorithm, data set and test cases.
4.3.2	Critically analyse data for trends and correlations, stating possible errors and limitations
5.1.2	Create/adapt/modify/extend tools and techniques to solve engineering problems.
5.3.2	Verify the credibility of results from tool use with reference to the accuracy and limitations, and the assumptions inherent in their use.

Course Outcomes:

1. Illustrate use of basic knowledge in software engineering. *(LO 1.1, LO1.2, LO1.3, LO1.4)*
2. Identify requirements, analyze and prepare models. *(LO 2.1, LO 2.2, LO 2.3, LO 2 .4, LO 2.5, LO 2.6)*
3. Plan, schedule and track the progress of the projects.(*LO 3.1, LO 3.2, LO 3.3, LO 3.4)*

4. Design & develop the software solutions for the growth of society. (*LO 4.1, LO 4.2, LO 4.3, LO 4.4)*
5. To demonstrate and evaluate real time projects with respect to software engineering principles. *(LO 5.1, LO 5.2, LO 5.3, LO 5 .4, LO 5.5, LO 5.6,LO 5.7, LO5.8, LO 6.1, LO 6.2, LO 6.3, LO 6 .4, LO 6.5, LO 6.6,LO 6.7, LO6.8)*

CO-PO Mapping Table with Correlation Level

CO ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
ITPCC408.1	3	3	-	-	-	-	-	-	-	-	-
ITPCC408.2	3	3	3	-	-	-	-	-	-	-	-
ITPCC408.3	3	3	-	-	-	-	-	-	-	-	-
ITPCC408.4	3	3	3	-	-	-	-	-	-	-	-
ITPCC408.5	3	3	3	3	3	-	-	-	-	-	-
Average	**3**	**3**	**3**	**3**	**3**	-	-	-	-	-	-

Text Books :

1. Software Engineering: A Practitioner‘s Approach, Roger Pressman, 9th edition , 2019, McGraw-Hill Publications
2. Software Engineering , Ian Sommerville, 9th edition, 2011, Pearson Education
3. Software Engineering Fundamentals , Ali Behfrooz and Fredeick J. Hudson, 9th edition, 1997, Oxford University Press.
4. The unified modeling language user guide, Grady Booch, James Rambaugh, Ivar Jacobson, Second Edition, 2005, Pearson Education

Reference Books :

1. An integrated approach to Software Engineering, Pankaj Jalote, Third edition, 2005, Springer publication.
2. Fundamentals of Software Engineering , Rajib Mall, Fifth Edition, 2014, Prentice Hall India
3. Software Engineering, Jibitesh Mishra and Ashok Mohanty, Third edition, 2011, Pearson Education
4. Software Engineering – Concepts and Practices, Ugrasen Suman, Third edition, 2013, Cengage Learning
5. Software Engineering principles and practice, Roger Pressman, Second edition , 2004, McGraw-Hill Publications

Other Resources:

1. NPTEL Course: Software Engineering By Prof. Rushikesh Joshi, Prof. Umesh Bellur, Prof. N.L. Sarda, Department of Computer Science and Engineering, IIT Bombay :-Web link- https://nptel.ac.in/courses/106/101/106101061/
2. NPTEL Course: Software Engineering By Prof. Rajib Mall, Department of Computer Science and Engineering, IIT Kharagpur :-Web link- https://nptel.ac.in/courses/106105087

A. IN-SEMESTER ASSESSMENT (50 MARKS)

1. Continuous Assessment (20 Marks)

Suggested breakup of distribution

a) One MCQ Test as per GATE exam pattern / level: 05 Marks

b) One Class test:05 Marks

c) One Mind Map activity: 05 Marks

d) Regularity and active participation :05 Marks

2. Mid Semester Examination (30 Marks)

Mid semester examination will be based on 40% to 50% syllabus.

B. END SEMESTER EXAMINATION (50 MARKS)

End Semester Examination will be based on syllabus coverage up to the Mid Semester Examination (MSE) carrying 20% to 30% weightage, and the syllabus covered from MSE to ESE carrying 70% to 80% weightage.

Course Type	Course Code	Course Name	Credits
LBC	ITLBC403	NETWORKS LABORATORY	01

Examination Scheme		
Continuous Assessment	**End Semester Exam(ESE)**	**Total**
25	25	50

Pre-requisite:

1. ESL103: Programming Laboratory-I (C)
2. ESL205: Programming Laboratory-II (Java)
3. ITSBL301: Python Laboratory

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO3: Design/development of solutions
4. PO5: Engineering tool usage
5. PO6: The engineer and the world
6. PO7: Ethics
7. PO10: Project management and finance

Course Objectives:

1. Build an understanding about fundamental concepts of computer network, protocols, architecture and applications.
2. Demonstrate hands-on experience of computer network simulation and modelling techniques using simulation software.
3. Implement client-server socket programming.
4. Demonstrate and interpret the traffic flow and the contents of protocol frames.
5. Design and configure a network for an organization.

Module	Detailed Contents	Hrs
00.	**Course Introduction** The objective of Networks Laboratory course is to get practical knowledge of basic networking commands and working principles of various communication protocols using simulation software. Also analyses the structure and formats of TCP/IP layer protocols using network tools such as wireshark and network simulators.	
01.	**Basic Networking Commands** ***Learning Objective:*** *To impart the knowledge of basic networking commands and execute the networking commands to get network information.* **Task 1:**	**02**

	Understanding and execution of Basic networking Commands: ifconfig ,ip, traceroute, tracepath, ping, netstat, dig, nslookup, route, host, arp, hostname ***Self-Learning Topic:*** *Learn about various types of networks (LAN, WAN, MAN)* ***Learning Outcomes :*** *A learner will be able to* *LO 1.1:Comprehend how to configure network interfaces, assign IP addresses, and manage network interfaces using commands like ifconfig and ip. (P.I.- 1.3.1)* *LO 1.2:Diagnose network connectivity problems by utilizing commands like ping to check connectivity to remote hosts, traceroute and tracepath to trace the route packets take through the network, and netstat to display network statistics and active connections. (P.I.- 1.4.1)* *LO 1.3:Enhance system administration skills required for managing and maintaining computer networks in effective manner. (P.I.- 6.1.1, 6.1.2)*	
02.	**Network equipment** ***Learning Objective:*** *To be aware about network devices and exploit it in network design as per the users/ organization's requirement.* **Task 2:** Hands-on on network equipment. • Switches, Router • Hardware Firewall ***Self-Learning Topic:*** *Learn about other networking devices like repeater, gateway, hub etc.* ***Learning Outcomes :*** *A learner will be able to* *LO 2.1: Gain practical experience in configuring switches, routers, and hardware firewalls. (P.I.- 1.3.1)* *LO 2.2: Implement firewall rules in certain scenario. (P.I.- 1.4.1)* *LO 2.3: Prioritize network traffic, manage bandwidth usage, and improve network performance for critical applications. (P.I.- 2.4.2)* *LO 2.4: Apply security best practices by configuring access control lists on routers and firewalls. (P.I.- 2.2.4)* *LO 2.5: Identify anomalies, troubleshoot performance issues, and optimize network design. (P.I.- 3.2.1)* *LO 2.6: Gain experience in using network monitoring and analysis tools. (P.I.-3.3.2)* *LO 2.7: Analyze the requirements of users or organizations and select appropriate network devices to design efficient network architectures. (P.I.- 6.1.1, 6.1.2)*	**02**
03.	**Basics of Network simulation and simulation of Network Topology with different Protocols** ***Learning Objective/s:*** *To illustrate the basics of Network simulation. Also expected to implement different routing protocols and analyze it to make the best decisions for your network communication, security and management needs.*	**08**
	Task 3: Installation and configuration of NS-2 simulator. Write TCL scripts to create topologies.	

	Task 4: Write TCL scripts for topology with graphical simulation of traffic consideration (TCP, UDP) using NAM and plot the graph. **Task 5**: Implement distance vector routing protocol in NS2.	
	Self-Learning Topic: *Implement link state routing protocols in NS2.* ***Learning Outcomes:*** *The learner will be able to* *LO 3.1: Invoke analytical studies of Computer Networks through network simulation societal impact of network technologies, including considerations related to security, privacy, and accessibility, and propose solutions that align with ethical and societal standards. (P.I.- 1.3.1, 6.1.1,6.2.1)* *LO 3.2: Demonstrate a comprehensive understanding of the fundamentals of network simulation. (P.I.- 1.4.1)* *LO 3.3: Identify modern engineering tools to simulate TCP, UDP, Link state routing protocols to emulate real-world networking scenarios. (P.I.- 5.1.1)* *LO 3.4: Identify the strengths and limitations of modern tools used for simulating and monitoring system performance. (P.I.- 5.2.1)* *LO 3.5: Develop project management skills by planning and executing network simulation projects, including defining project scopes, setting timelines, allocating resources, and evaluating project outcomes in terms of cost-effectiveness and efficiency. (P.I.- 10.1.2,10.3.1)*	
04.	**Socket Programming** ***Learning Objective:*** *To impart the knowledge about socket programming and implement it to create client and server applications in order to exchange information between processes on the same machine or across a network, allow access to centralized data.* **Task 6**: To study and Implement Socket Programming using TCP. **Task 7:** To study and Implement Socket Programming using UDP.	**04**
	Self-Learning Topics: *Learn about Echo Client and Server.* ***Learning Outcomes:*** *The learner will be able to* *LO 4.1: Summarize the underlying principles of networking protocols, communication mechanisms, and socket API functions. (P.I.- 1.3.1)* *LO 4.2: Implement client-server applications using socket programming. (P.I.- 1.4.1)* *LO 4.3: Utilize socket programming libraries and development tools to implement client-server applications and analyze the societal implications of networked systems. (P.I.- 5.1.1,6.1.1,6.1.2)* *LO 4.4: Demonstrate competence in employing modern tools for network application development. (P.I.- 5.2.1)*	
05.	**Protocol analyzer and traffic analysis** ***Learning Objective:*** *To know and illustrate various network protocol analyzer tools and use it to analyze the traffic with the help of different performance measures*. **Task 8:** Study various network protocol analyzer tools and install one of the network protocol analyzer tools. **Task 9:** Analyze the network traffic using one of the network protocol analyzer tools.	**04**

	Self-Learning Topics: *Study tcpdump, Windump, Microsoft Message Analyzer, Ettercap, ISOFT Smart Sniff protocol analyzer tools and check the performance.* ***Learning Outcomes:*** *The learner will be able to* *LO 5.1: Demonstrate the ability to measure and analyze network parameters for high throughput networks. (P.I.- 1.3.1)* *LO 5.2: Apply appropriate measurement techniques to assess network performance. (P.I.- 1.4.1)* *LO 5.3: Identify network protocol analyzer tools analyze the traffic with the help of different performance measures. (P.I.- 5.1.1)* *LO 5.4: Identify the strengths and limitations of protocol analyzer tools used for simulating and monitoring system performance. (P.I.- 5.2.1)*	
06.	**Network Design** ***Learning Objective:*** *To know and summarize IP addressing, networking protocols, layering architecture and implement it to design and configure a network for an organization.* **Task 10:** Perform remote login using Telnet Server. **Task 11:** Perform File Transfer and Access using FTP. **Task 12:** Design a network for an organization using the concepts of Addressing (IP Address Assignment), Naming (DNS) and Routing. Also mention the internetworking devices used.	**10**
	Self-Learning Topics: *Any case study: Design network for any scenario as per users requirement.*	
	Learning Outcomes: *The learner will be able to* *LO 6.1: Evaluate the societal impact of network technologies, including considerations related to security, privacy, and accessibility, and propose solutions that adhere to ethical and societal standards. (P.I.- 1.3.1,6.1.1,7.1.1)* *LO 6.2:Develop effective communication, collaboration, and teamwork skills, demonstrating the ability to contribute positively to group dynamics and achieve common goals in network engineering projects.(P.I.- 1.4.1,6.2.1,7.2.2)*	
	Total	**30**

Performance Indicators:

P. I. Number	**P. I. Statement**
1.3.1	Apply engineering fundamentals.
1.4.1	Apply theory and principles of computer science engineering to solve an engineering problem.
2.2.4	Compare and contrast alternative solution/methods to select the best methods
2.4.2	Analyse and interpret the results using contemporary tools.
3.2.1	Ability to explore design alternatives.

3.3.2	Consult with domain experts and stakeholders to select candidate engineering design solution for further development.
5.1.1	Identify modern engineering tools, techniques and resources for engineering activities
5.2.1	Identify the strengths and limitations of tools for (i) acquiring information, (ii) modelling and simulating, (iii) monitoring system performance, and (iv) creating engineering designs.
6.1.1	Identify and describe various engineering roles; particularly as pertains to protection of the public and public interest at global, regional and local level.
6.2.1	Interpret legislation, regulations, codes, and standards relevant to your discipline and explain its contribution to the protection of the public.
7.1.1	Identify situations of unethical professional conduct and propose ethical alternatives.
7.2.2	Examine and apply moral & ethical principles to known case studies.
10.1.2	Analyse different forms of financial statements to evaluate the financial status of an engineering project
10.3.1	Identify the tasks required to complete an engineering activity, and the resources required to complete the tasks

Course Outcomes:

Learner will be able to

1. Execute and evaluate network administration commands. Also use network equipment to design the network for certain scenario. *(LO 1.1, LO1.2, LO1.3)*
2. Invoke analytical studies of computer networks through network simulation. *(LO 1.1, LO1.2, LO1.3, LO 2.1, LO 2..2, LO2.3,LO 2.4 , LO 2.5 , LO 2.6, LO 2.7)*
3. Implement the socket programming for client server architecture. (*LO 3.1, LO 3..2, LO3.3,LO 3.4 , LO 3.5 ,LO 4.1, LO 4..2, LO 4.3,LO 4.4)*
4. Measure and analyse the network parameters for a high throughput network. *(LO 5.1, LO 5.2, LO 5.3,LO 5.4)*
5. Design a network using NS-3 toolkit and its importance in designing a real network. . *(LO 6.1, LO 6.2)*

CO-PO Mapping Table with Correlation Level

CO ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
ITLBC403.1	3	3	-	-	-	3	-	-	-	-	-
ITLBC403.2	3	3	3	-	3	-	-	-	-	-	-
ITLBC403.3	-	3	3	-	3	-	-	-	-	-	-
ITLBC403.4	3	3	-	-	3	-	-	-	-	-	-
ITLBC403.5	-	3	3	-	3	-	-	-	-	-	-
Average	**3**	**3**	**3**	**-**	**3**	**3**	**-**	**-**	**-**	**-**	**-**

Text Books:

1. Computer Networks, Andrew S. Tanenbaum, David J. Wetherall, Fifth Edition, 2011, Prentice Hall
2. Data Communication and Networking", Behrouz A. Foruzan, Fifth Edition, 2013, Science Engineering & Math Publications

Reference Books:

1. Data and Computer Communication, W. Stallings, Tenth Edition, 2014, Pearson Education
2. TCP/IP Protocol Suite, B. A. Forouzan, Fourth Edition, 2010,Tata McGraw Hill edition,
3. Information Theory, Coding and Cryptography, Ranjan Bose, Second Edition, 2008, Tata McGraw-Hill
4. Introduction to Data Compression, Khalid Sayood ,Third Edition, 2010, Morgan Kaufman

Other Resources:

1. NPTEL Course: Computer Networks and Internet Protocol by Prof. Soumya Kanti Ghosh, Prof. Sandip Chakraborty, IIT Kharagpur
   Web Link- https://onlinecourses.nptel.ac.in/noc21_cs18/preview
2. NPTEL Course: Computer Networks by Prof. Hema A. Murthy**,** IIT Madras
   Web Link- https://nptel.ac.in/courses/106106091

A. IN-SEMESTER ASSESSMENT (25 MARKS)

1. Continuous Assessment (25 Marks)

Suggested breakup of distribution

a) Task Execution :10 Marks

Students will be given 10 tasks based on list as per mentioned in the syllabus. Each task carries 10 Marks. Average will be taken of all tasks. Students are expected to execute the program for given task with network simulator, protocol analyser and java. Students will be evaluated based on logic building for the given task, expected output and analysis of received results.

b) Practical Test: 10 Marks

Students will be given task (different for each student) and they will be evaluated based on the parameters mentioned in continuous assessment.

c) Regularity & Active participation: 05 Marks

B. END SEMESTER EXAMINATION (Practical and Oral Exam) (25 Marks)

Suggested breakup of distribution

a) Task Execution: 10 Marks

Students will be given task (different for each student) and they will be evaluated based on the parameters mentioned in continuous assessment.

b) Results and discussion, Inferences drawn based on above task: 05 Marks
c) Oral based on entire syllabus :10 Marks

Two examiners, one Internal and one External will do the evaluation

Course Type	Course Code	Course Name	Credits
LBC	ITLBC404	LINUX LABORATORY	01

Examination Scheme		
Continuous Assessment	**End Semester Exam(ESE)**	**Total**
25	25	50

Pre-requisite:

1. ESL103: Programming Laboratory-I (C)

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO3: Design/Development of Solution

Course Objectives:

1. To train learners with demonstration and installation of OS guide with basic commands.
2. To instruct learners about demonstration of file and directory management services using Linux commands.
3. To instruct learners about demonstration of user, memory and process management services using Linux commands.
4. To provide hands-on for learners for demonstration of basic shell script.
5. To provide hands-on for learners for demonstration of shell script for advance applications.
6. To prepare students to execute Perl and awk script.

Module	Detailed Contents	Hrs
00.	**Course Introduction** This course discovers the significance of Linux operating System, an open-source operating system that offers security, customization, and cost-effectiveness. The Linux command line is a powerful tool that can be used to save time in a variety of ways. By using the command line, users can quickly navigate through the file system, search for files, create and delete directories, and even run programs. This course is majorly delivers the command line interaction of user with OS.	**01**
01.	**Basic Utility Commands** ***Learning Objective:*** *Demonstration of Linux Installation and Basic Commands.* **Contents:** Utility Commands: echo, clear, exit, date, time, uptime, cal, cat, man, which, history, id, pwd, whoami, pr, lp, lpr, lpstat, lpq, lprm, cancel, mail. cal: The calendar, date: Displaying the system date, echo: Displaying message, printf: An alternative to echo, bc: The calculator, script: Recording your session, Email basics, mailx: The universal mailer passwd: Changing your password, who: Who are the users?, uname: Knowing your machine characteristics, tty: Knowing your terminal, stty: Displaying and setting terminal characteristics.	**03**

	Task 1: Execute various utility commands in Linux.	
	Self-Learning Topics: *Demonstrate the commands line OS installation, memory partitions.* ***Learning Outcomes:*** *A learner will be able to* *LO 1.1: Compile and execute C program on Ubuntu OS using CLI. (P.I.-1.3.1)* *LO 1.2: Code array as 1D and 2D data structure. (P.I.-1.4.1)* *LO 1.3: Identify and use the mail commands for local smtp communication (P.I.-2.2.3)* *LO 1.4: Install Linux OS as single machine or alongside of Windows 10,11. (P.I.-2.3.1)* *LO 1.5: Demonstrate basic utility commands in Linux. (P.I.- 3.4.2)* *LO 1.6: Validate the credentials of system and other users in OS. (P.I.- 3.4.3)*	
02.	**File and Directory Management Commands** ***Learning Objective:*** *To understand and perform file and directory handling in Linux using command line interface.*	**06**
	Contents: The file: Ordinary file, Directory file, Device file, Filename, the parent-child relationship, UNIX file system tree, The Unix file system, the home directory, pwd: Checking your current directory, cd: Changing the current directory, mkdir: Making directories, rmdir: Removing directories, ls: Listing directory contents, Absolute pathnames, Relative pathnames Handling ordinary files, cat: Displaying and creating files, cp: Copying file, rm: Deleting files, mv: Renaming files, more: Paging output The lp subsystem: printing a file, file: knowing the filetypes wc: Counting lines, words and characters, od: Displaying data in octal, cmp: Comparing two files, comm: What is common, diff: Converting one file to other, gzip and gunzip: Compressing and decompressing files and folders. tar: The archival program, zip and unzip: Compressing and archiving together. Basic file attributes, ls -l: Listing file attributes, the -d option: Listing directory attributes. File ownership, File permissions, chmod: Changing file permissions, directory permission, Changing file ownership, chown: Changing file owner, chgrp: Changing group owner **Task 2:** Execute various file permission commands. **Task 3:** Execute file and directory management commands.	
	Self-Learning Topics: *Commands to automate the disk space management and user alert by OS.*	
	Learning Outcomes: *A learner will be able to* *LO 2.1: Associate file access rights to owner, group user and all system users. (P.I.-1.3.1)* *LO 2.2: Identify and change the mode of files and folders. (P.I.-1.4.1)* *LO 2.3: Apply the commands to compress the files and folders. (P.I.-2.2.3)* *LO 2.4: Identify and implement directory management (P.I.-2.3.1)* *LO 2.5: Select various types of files and count total number of files and directories. (P.I.- 3.4.2)* *LO 2.6: Identify issues in file and directory management (P.I.- 3.4.3)*	

03.	**Memory, Process and User Management Commands** ***Learning Objective:*** *To understand the tasks in memory and user management and user management and able execute relevant commands on CLI.*	**06**
	Contents: a) Execution of Memory Management Commands like free, /proc/meminfo, top, htop, df, du, vmstat, demidecode, sar, pagesize, etc. b) Execution of Process Management Commands like ps, pstree, nice, kill, pkill, killall, xkill, fg, bg, pgrep, renice, etc. c)Execution of User Management Commands like who, whoami, su, sudo, login, logout, exit, passwd, useradd/adduser, usermod, userdel, groupadd, groupmod, groupdel, gpasswd, chown, chage, chgrp, chfn, etc. **Task 4:** Execute memory management commands. **Task 5:** Create the process and kill using pid. **Task 6:** Execute user management commands.	
	Self-Learning Topics: *User and group management using shell script.*	
	Learning Outcomes: *A learner will be able to* *LO 3.1: List the process and its features. (P.I.-1.3.1)* *LO 3.2: Fetch the process id by using commands. (P.I.-1.4.1)* *LO 3.3: Execute command for closing the process. (P.I.-2.2.3)* *LO 3.4: Manage the users and their permissions. (P.I.-2.3.1)* *LO 3.5: Use of advance commands for various user and process management activities. (P.I.- 3.4.2)* *LO 3.6: Execute user and memory management from CLI Linux. (P.I.- 3.4.3)*	
04.	**Basic Shell Script** ***Learning Objective:*** *To understand Linux shell processing and syntax associated with it to design batch files.*	**04**
	Contents: Write a basic shell script: with syntax of read, write statements, loop and control statements. **Task 7:** Write shell script for following problems. i. Write a shell script to perform arithmetic operations. ii. Write a shell script to calculate simple interest. iii. Write a shell script to determine largest among three integer numbers. iv. Write a shell script to determine a given year is leap year or not. *v.* Write a shell script to print multiplication table of given number using while statement.	
	Self-Learning Topics: *Execute shell script for array, structures and composite data types.* ***Learning Outcomes:*** *A Learner will be able to* *LO 4.1: Create shell file. (P.I.-1.3.1)*	

	LO 4.2: Change the mode of execution of shell script (P.I.-1.4.1) *LO 4.3: Execute the shell script. (P.I.-2.2.3)* *LO 4.4: Identify the conditions and learn to write the conditional statements in shell script. (P.I.-2.3.1)* *LO 4.5: Implement, for and while loop statement in shell script. (P.I.- 3.4.2)* *LO 4.6: Develop the shell script to handle device and network operations. (P.I.- 3.4.3)*	
05.	**Shell script for File and User Management** ***Learning Objectives:*** *To understand Linux shell processing and syntax associated with it to design batch files which are used for user and file management operations.*	**06**
	Contents: Advance shell script: with file, directory and user management functions. **Task 8:** Write an advanced shell script for file and user management. i. Write shell script to check logged-in user details and number of logged-in user. ii. Write a shell script to read and check if the directory / file exists or not, if not make the directory / file. iii. Write a shell script using grep command to find the number of words, characters, and words and lines in a file. iv. Write shell script to calculate total number of files and folder in specified folder. v. Write a shell script that creates a directory and a file within it. Insert the contents into the file and duplicate the source folder to the specified target location. .	
	Self-Learning Topics: *Code shell script for network and infrastructure security.* ***Learning Outcomes:*** *A learner will be able to* *LO 5.1: Code shell script to create folder. (P.I.-1.3.1)* *LO 5.2: Code shell script to create file and content into it. (P.I.-1.4.1)* *LO 5.3: Manage various tty users using shell script. (P.I.-2.2.3)* *LO 5.4: Fetch user details using shell script. (P.I.-2.3.1)* *LO 5.5: Develop Shell script to process the list. (P.I.- 3.4.2)* *LO 5.6: Develop Shell script to take backup of device on another connected device. (P.I.- 3.4.3)*	
06.	**Execute Perl and Awk Script** ***Learning Objective:*** *To implement complex problems using data structures and algorithms, and analysing data structures inside data management models.*	**04**
	Contents Introduction and use of Perl and Awk script, Syntax in Perl, Syntax in awk, Control and conditional statements in Perl and Awk script. Perform Perl and AWK script for **Task 9:** Study and Execute Perl script. (i) Write a Perl script to sort elements of an array. (ii) Write a Perl script to check a number is prime or not.	

	(iii) Write Perl script to read and write number array. **Task 10:** Study and Execute Perl script. (i) Write an awk script to print all even numbers in a given range. (ii) Write an awk script to develop a Fibonacci series (take user input for number of terms). (iii)Write awk script to find factorial of number.	
	Self-Learning Topics: *Perl script to develop applications in open-source systems.* ***Learning Outcomes*** *A learner will be able to* *LO 6.1: Create Perl and awk file. (P.I.-1.3.1)* *LO 6.2: Associate the path in Perl file. (P.I.-1.4.1)* *LO 6.3: Execute Perl files. (P.I.-2.2.3)* *LO 6.4: Solve various problems using Perl script. (P.I.-2.3.1)* *LO 6.5: Use Perl to develop open-source system. (P.I.- 3.4.2)* *LO 6.6: Develop the shell script to handle device and network operations. (P.I.- 3.4.3)*	
	Total	**30**

Performance Indicators:

P.I. No.	P.I. Statement
1.3.1	Apply engineering fundamentals
1.4.1	Apply theory and principles of computer science engineering to solve an engineering problem.
2.2.3	Identify existing solution/methods to solve the problem, including forming justified approximations and assumptions.
2.3.1	Able to apply computer engineering principles to formulate modules of a system with required applicability and performance.
3.4.2	Ability to implement and integrate the modules.
3.4.3	Ability to verify the functionalities and validate the design.

Course Outcomes:

Learner will be able to

1. Use the basic utilities commands for OS installation. *(LO 1.1,LO 1.2, LO 1.3,LO 1.4, LO 1.5,LO 1.6)*
2. Study and use file and directory management commands in Linux. *(LO 2.1,LO 2.2, LO 2.3,LO 2.4, LO 2.5, LO 2.6, LO 3.1,LO 3.2, LO 3.3,LO 3.4, LO 3.5,LO 3.6)*
3. Study and use advance commands in Linux .*(LO 4.1,LO 4.2, LO 4.3,LO 4.4, LO 4.5,LO 4.6)*
4. Execute basic and advance shell script programs.*(LO 5.1,LO 5.2, LO 5.3,LO 5.4,LO 5.5,LO 5.6)*
5. Execute Perl and awk script. *(LO 6.1,LO 6.2, LO 6.3,LO 6.4, LO 6.5,LO 6.6)*

CO-PO Mapping Table with Correlation Level

CO ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
ITLBC404.1	3	3	3	-	-	-	-	-	-	-	-
ITLBC404.2	3	3	3	-	-	-	-	-	-	-	-
ITLBC404.3	3	3	3	-	-	-	-	-	-	-	-
ITLBC404.4	3	3	3	-	-	-	-	-	-	-	-

ITLBC404.5	3	3	3	-	-	-	-	-	-	-	-
Average	**3**	**3**	**3**	-	-	-	-	-	-	-	-

Text Books:

1. Unix Concepts and Applications, S. Das, 4th edition., 2017, McGraw Hill.
2. Mastering Unix Shell Scripting, R. Michael, 2nd edition, 2008, Wiley.
3. Linux Experiments and Open-Source Technologies, D. Ambawade, D. Shah, 2nd edition, 2014, Dreamtech Press.

Reference Books:

1. Unix Shell Programming, Y. Kanetkar, 3rd edition, 2003, BPB Publications.
2. Unix and Shell Programming, B. Forouzan and R. Gilberg, 4th edition, Cengage Learning, 2003.

Other Resources:

1. Digital material:
   Web Link- Install Ubuntu desktop | Ubuntu
2. Web Link- The Linux Command Handbook – Learn Linux Commands for Beginners (freecodecamp.org)

A. CONTINUOUS ASSESSMENT (25 MARKS)

Suggested breakup of distribution

a) Command based script execution :10 Marks

Students will be given 10 tasks based on list as per mentioned in the syllabus. Each task carries 10 Marks. Average will be taken of all tasks. Students are expected to execute the basic utility and advanced commands of Linux operating system also they have to perform command based shell, Perl, AWK script. Students will be evaluated based on logic building for the given script and expected output.

b) Practical Test: 10 Marks

Students will be given task (different for each student) and they will be evaluated based on the parameters mentioned in continuous assessment.

c) Regularity & Active participation: 05 Marks

B. END SEMESTER EXAMINATION (Practical and Oral Exam) (25 Marks)

Suggested breakup of distribution

a) Command based script **e**xecution: 10 Marks

Students will be given task (different for each student) and they will be evaluated based on the parameters mentioned in continuous assessment.

b) Results and discussion, Inferences drawn: 05 Marks

c) Oral based on entire syllabus :10 Marks

Two examiners, one Internal and one External will do the evaluation.

Course Type	Course Code	Course Name	Credits
LBC	ITLBC405	SOFTWARE DEVELOPMENT LABORATORY	01

Examination Scheme		
Continuous Assessment	**End Semester Exam(ESE)**	**Total**
25	25	50

Pre-requisite:

1. ESL103: Programming Laboratory-I (C)
2. ESL205: Programming Laboratory-II (Java)
3. ITSBL301 : Python Laboratory

Program Outcomes addressed:

1. PO 1: Engineering knowledge
2. PO 2: Problem analysis
3. PO 3: Design/Development of Solutions
4. PO 4: Conduct investigations of complex problems
5. PO 5: Engineering tool usage
6. PO 6: The Engineer and The World
7. PO 8: Individual and collaborative team work
8. PO 9: Communication
9. PO 10: Project management and finance

Course Objectives:

1. To familiarize leaners, the basics of software engineering principles.
2. To make learner understand documentation Requirements, analysis, planning and scheduling.
3. To acquaint leaners with skills to design test case plans for testing software using dynamic testing techniques.
4. To make learner able to apply knowledge of automation testing.
5. To make leaner infer and apply quality assurance and management.

Module	Detailed Contents	Hrs
00.	**Course Introduction** This course deals with basics of software engineering principles, phases of software development life cycle, various process models which will be helpful to follow the process during software development, identify early challenges or cost constraints to know team's development process for the future. Software Testing tools are used in industries for automating the entire testing process. Software QA and testing helps prevent defects from reaching end-users. By detecting issues earlier in software development cycles through extensive testing, problems can be fixed before software gets deployed.	

01.	**Introduction to concepts of software engineering principles and software development process.** ***Learning Objective/s:*** *To infer basics of software engineering principles and software development life cycle and apply it for the project development process.* *Learner is expected to gain knowledge of process models and also expected to determine the right process followed for software development.*	**08**
	Task 1: Select a problem statement and write case study on Software Development Life Cycle for the same. **Task 2:** Implement Waterfall Model and Agile model for the selected problem statement. **Task 3:** Analyze the difference between waterfall model and agile model.	
	Self-Learning Topics: *Personal and Team Process Models.* ***Learning Outcomes :*** *A learner will be able to* *LO 1.1: Use software engineering principles to identify and document phases of software development life cycle. (P.I.-1.3.1,9.1.2)* *LO 1.2: Apply software engineering principles to solve an engineering problem and demonstrate the progress of project development for the selected problem statement. (P.I.-1.4.1,9.3.2)* *LO 1.3: Illustrate design alternatives for the progress of software development. (P.I.-3.2.1)* *LO 1.4: Select optimal process model for further development. (P.I.-3.4.1)* *LO 1.5: Identify the team's development process. (P.I.-2.1.1,10.3.1)* *LO 1.6: Analyze and estimate cost incurred to select best process and also analyze limitations of process models and select the most appropriate process model based on economic and financial considerations. (P.I.-2.2.5, 10.2.1)*	
02.	**Software Requirement Analysis and scheduling** ***Learning Objective/s:*** *To paraphrase and apply knowledge of documentation requirements, analysis, planning and scheduling for software development.*	**04**
	Task 4: Write software requirement specification, Work breakdown structure (WBS). **Task 5:** Prepare Gantt chart for the selected problem statement	
	Self-Learning Topics: *prioritizing requirements, Typical Problems with IT Cost Estimates.* ***Learning Outcomes:*** *A learner will be able to* *LO 2.1: Apply basics of software engineering to prepare SRS document for the selected problem statement. (P.I.-1.3.1)* *LO 2.2: Model WBS to schedule and allocate various task during SDLC. (P.I.-1.4.1)* *LO 2.3: Identify and document system requirements for the software development process. (P.I.-3.1.2)* *LO 2.4: Illustrate Gantt chart to maintain timeline for the software development process. (P.I.-3.1.6)* *LO 2.5: Use tools and techniques to prepare timeline chart P.I.- (5.1.2)*	

	LO 2.6: Identify limitations of the tools used to derive timeline chart. (P.I.-5.3.1)	
03.	**Software Testing Techniques** ***Learning Objective/s:*** *To illustrate and apply black box testing techniques for designing test cases to identify and analyze structural errors.* *Learner is expected to infer knowledge of white box testing techniques and use white box testing techniques to ensure that all the internal components work as expected and are error-free.*	**08**
	Task 6: Design test cases using black box testing techniques for the selected project, execute the test cases and discuss the results. **Task 7:** Design test cases using path testing technique and execute test cases for the same selected problem statement to identify and fix the logical errors.	
	Self-Learning Topics: *Select the test cases (positive and negative scenarios) for the selected system and Design test cases for the system using any two studied testing techniques* ***Learning Outcomes :*** *A learner will be able to* *LO 3.1: Use BVC to test the boundary values of the input. (P.I.-1.3.1)* *LO 3.2: Apply black box and white box testing to solve an engineering problem associated to input classes. (P.I.-1.4.1)* *LO 3.3: Identify processes/algorithms to find errors using testing techniques. (P.I.-2.1.2).* *LO 3.4: Compare the results of testing method used (P.I.-2.2.4).* *LO 3.5: Apply state table based testing to identify state of bugs. (P.I.-3.2.1)* *LO 3.6: Determine the functionalities and validate the test cases designed. (P.I.-3.4.3)* *LO 3.7: Derive appropriate procedure/algorithm, data set and test cases to find structural errors. (P.I.-4.1.2)* *LO 3.8: Outline structural bugs and logical bugs by running the test cases to refine the process over time. (P.I.-4.3.2)*	
04.	**Automation and Testing Tools** ***Learning Objective/s:*** *To infer knowledge of easy approach of testing using automated tools and also expected to select and use automation tools which mainly focuses on reducing manual human activity.* *Learner is expected to summarize effectiveness, and coverage of software testing to save time and effort using automated tools. Also expected to compare the actual output against the expected outcome using testing tool.*	**06**
	Task 8: Study and categorize various testing tools and implement anyone open-source testing tool. **Task 9:** Study and implementation of anyone bug tracking tool.	
	Self-Learning Topics: *Testing tool for agile based model* ***Learning Outcomes:*** *A learner will be able to* *LO 4.1: Infer need of automation in testing. (P.I.-1.3.1).* *LO 4.2: Identify automation tools for testing. (P.I.-1.4.1)* *LO 4.3: Categorize automation tools for static and dynamic testing. (P.I.-3.2.2).*	

	LO 4.4: Use testing tool to design test cases for various modules. (P.I.-3.4.2). *LO 4.5: Use appropriate testing tools and techniques to collect and analyze test data. (P.I.-4.3.1)* *LO 4.6: Analyze test cases stating possible errors and limitations using automation. (P.I.-4.3.2).* *LO 4.7: Use tools and techniques to design test data and test cases (P.I.-5.1.2)* *LO 4.8: Evaluate the credibility of results from tools used with reference to the accuracy and limitations. (P.I.-5.3.2)*	
05	**Software quality Assurance** ***Learning Objective/s:*** *To summarize basics of software quality assurance and management. Also expected to use and analyse various quality factors and criteria which helps to prevent defects from reaching end-users*	**04**
	Task 10: Identify Quality Attributes and Relationships for the various properties used for the selected problem statement. **Task 11:** Implement quality attributes using McCall's quality factors and criteria.	
	Self-Learning Topics: *Web based and Mobile based software quality assurance factors and criteria.* ***Learning Outcomes:*** *A learner will be able to* *LO 5.1: Identify quality attributes for software quality assurance. (P.I.-1.3.1,7.1.1)* *LO 5.2: Apply Software Quality Management and Assurance for to identify possible solution. (P.I.-1.4.1)* *LO 5.3: Apply engineering principles to formulate modules of a system through quality attributes using McCall's quality factors and Criteria. (P.I.-2.3.1,7.2.2,8.2.1,9.2.1)* *LO 5.4: Analyze quality attributes and criteria used for software development using ISO9000:2000, SIX sigma. (P.I.-2.3.2,8.3.1,9.2.2)*	
	Total	**30**

Performance Indicators :

P.I. No.	P.I. Statement
1.3.1	Apply engineering fundamentals
1.4.1	Apply theory and principles of computer science engineering to solve an engineering problem
2.1.1	Evaluate problem statements and identifies objectives
2.1.2	Identifies processes/modules/algorithms of a computer-based system and parameters to solve a problem.
2.2.4	Compare and contrast alternative solution/methods to select the best methods
2.2.5	Compare and contrast alternative solution processes to select the best process.
2.3.1	Able to apply computer engineering principles to formulate modules of a system with required applicability and performance
2.3.2	Identify design constraints for required performance criteria
2.4.3	Identify the limitations of the solution and sources/causes

3.1.2	Able to identify and document system requirements from stake holders
3.1.6	Ability to develop software requirement specifications (SRS).
3.2.1	Ability to explore design alternatives.
3.2.2	Ability to produce a variety of potential design solutions suited to meet functional requirements.
3.4.1	Ability to refine architecture design into a detailed design within the existing constraints.
3.4.2	Ability to implement and integrate the modules.
3.4.3	Ability to verify the functionalities and validate the design.
4.1.2	Ability to choose appropriate procedure/algorithm, data set and test cases.
4.3.1	Use appropriate procedures tools and techniques to collect and analyze data
4.3.2	Critically analyse data for trends and correlations, stating possible errors and limitations
5.1.2	Create/adapt/modify/extend tools and techniques to solve engineering problems.
5.3.2	Verify the credibility of results from tool use with reference to the accuracy and limitations, and the assumptions inherent in their use.
6.1.1	Identify risks/impacts in the life-cycle of an engineering product or activity.
6.2.2	Apply principles of preventive engineering and sustainable development to an engineering activity or product relevant to the discipline
8.2.1	Demonstrate effective communication, problem solving, conflict resolution and leadership skills
8.3.1	Present results as a team, with smooth integration of contributions from all individual efforts.
9.1.2	Produce clear, well-constructed, and well-supported written engineering documents
9.2.1	Listen to and comprehend information, instructions, and viewpoints of others
9.2.2	Deliver effective oral presentations to technical and non-technical audiences
9.3.2	Use a variety of media effectively to convey a message in a document or a presentation
10.2.1	Analyze and select the most appropriate proposal based on economic and financial considerations.
10.3.1	Identify the tasks required to complete an engineering activity, and the resources required to complete the tasks.

Course Outcomes:

Learner will be able to

1. Use concepts of software engineering process models to optimize the flow of project development process. *(LO 1.1,LO 1.2, LO 1.3,LO 1.4, LO 1.5,LO 1.6)*
2. Identify requirements, analyse, plan, schedule and track the progress of the projects. *(LO 2.1,LO 2.2, LO 2.3,LO 2.4, LO 2.5,LO 2.6)*
3. Use various software testing methods and strategies to identify bugs. *(LO 3.1,LO 3.2, LO 3.3,LO 3.4, LO 3.5,LO 3.6,LO 3.7, LO 3.8)*
4. Illustrate use of automation tools. *(LO 4.1,LO 4.2, LO 4.3,LO 4.4, LO 4.5,LO 4.6,LO 4.7, LO 4.8)*
5. Apply the software quality assurance factors to Identify Quality Attributes and their Relationships. *(LO 5.1,LO 5.2, LO 5.3,LO 5.4)*

CO-PO Mapping Table with Correlation Level

CO ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
ITLBC405.1	3	3	3	-	-	-	-	-	-	3	-
ITLBC405.2	3	3	3	-	3	-	-	-	-	3	-
ITLBC405.3	3	3	3	3	-	-	-	-	-	-	-
ITLBC405.4	3	3	-	3	3	-	-	-	-	-	-
ITLBC405.5	3	3	-	-	-	3	-	3	3	-	-
Average	**3**	**3**	**3**	**3**	**3**	**3**	**-**	**3**	**3**	**3**	**-**

Text Books:

1. Software Engineering: A practitioner's approach, Roger S. Pressman, 7 th edition ,2010, McGraw Hill
2. Fundamentals of Software Engineering, Rajib Mall, 7 th edition ,2014, Prentice Hall India
3. Software Testing Principles and Practices, Naresh Chauhan, 2 nd edition, 2016, Oxford Higher Education
4. Software Testing and quality assurance theory and practice, Kshirasagar Naik, Priyadarshi Tripathy, 1st edition 2008,Wiley Publication.

Reference Books:

1. An integrated approach to Software Engineering, Pankaj Jalote, , 3rd edition 2005, Springer/Narosa.
2. Effective Methods for Software Testing, Willam E. Perry, third edition, 2006,Wiley Publication.
3. Software Testing Concepts and Tools, Nageswara Rao Pusuluri, ISE Edition, 2006, Dreamtech press

Other Resources:

1. NPTEL Course: Introduction to software Engineering By Prof. N.L.Sarda, Department of Computer Science and Engineering, IIT Bombay
   Web link- https://archive.nptel.ac.in/courses/106/101/106101061/
2. Course on Software Testing By Prof. Rajib mall, Department of Computer Science and Engineering, IIT Kharagpur
   Web link- https://nptel.ac.in/courses/106105150/.

A. CONTINUOUS ASSESSMENT (25 MARKS)

Suggested breakup of distribution

a) Task Execution :10 Marks

Students will be given 11 tasks based on list as per mentioned in the syllabus. Each task carries 10 Marks. Average will be taken of all tasks. Students are expected to identify and apply software engineering principles also perform manual and automated testing to find the logical and structural errors and also apply quality assurance factors and criteria. Students will be evaluated based on parameters such as identification of process models, testing techniques and quality check.

b) Practical Test: 05 Marks

Students will be given task (different for each student) and they will be evaluated based on the parameters mentioned in continuous assessment.

c) Oral based on entire syllabus: 05 Marks

d) Regularity & Active participation: 05 Marks

B. END SEMESTER EXAMINATION (Practical and Oral Exam) (25 Marks)

Suggested breakup of distribution

a) Task Execution :10 Marks

Students will be given task (different for each student) and they will be evaluated based on the parameters mentioned in continuous assessment.

b) Documentation on Software Development Life Cycle: 05 Marks

c) Oral based on entire syllabus:10 Marks

Two examiners, one Internal and one External will do the evaluation.

Course Type	Course Code	Course Name	Credits
SBL	ITSBL402	FULL STACK DEVELOPMENT LABORATORY	02

Examination Scheme		
Continuous Assessment	**End Semester Exam (ESE)**	**Total**
50	50	100

Pre-requisite :

1. ESL205: Programming Laboratory-II (Java)
2. ITSBL301: Python Laboratory

Program Outcomes addressed :

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO3: Design/Development of solution
4. PO5: Engineering tool usage
5. PO8: Individual and Collaborative team work
6. PO9: Communication
7. PO11: Life-long learning

Course Objectives:

1. To equip students with the skills to design and develop web applications using HTML and multimedia elements.
2. To equip students with the skills to develop and style web applications using HTML and CSS, focusing on creating responsive and interactive user interfaces.
3. To equip students with the skills to analyze and interpret programming results using JavaScript techniques.
4. To equip students with the skills to evaluate and implement modern front-end technologies, focusing on React and AngularJS.
5. To equip students with the skills to install, configure, and develop applications using Node.js, Express, and MongoDB.

Module	Detailed Contents	Hrs
00.	**Course Introduction** In the Full Stack Web Development Lab, students explore modern web development using React and Angular. They gain practical experience building dynamic web applications from frontend to backend.	**01**
01.	**HTML5** ***Learning Objective/s:*** *To demonstrate and apply HTML tags to develop webpages with well-structured HTML. Also expected to create web pages using text formatting, graphics, audio, and video elements.*	**03**

	Contents: Elements, Attributes, Head, Body, Hyperlink, Formatting, Images, Tables, List, Frames, Forms, Multimedia. **Task 1:** Implement using HTML5: Elements, Attributes, Head, Body, Hyperlink, Formatting, Images, Tables, List, Frames, Forms, Multimedia	
	Self-Learning Topics: *Canvas and SVG Graphic, Parallax Scrolling* ***Learning Outcomes :*** *A learner will be able to* *LO 1.1: Apply HTML elements and attributes to structure web pages, utilize head and body tags to organize content, and integrate hyperlinks to connect web resources, ensuring a comprehensive understanding of web page formatting and structure. (P.I.- 1.3.1, 3.4.2, 5.1.1, 8.1.1)* *LO 1.2: Implement multimedia elements such as images, frames, and forms to enhance user interaction, demonstrate proficiency in creating and managing tables and lists for data presentation, and collaborate effectively in teams to develop and debug web applications, ensuring seamless integration of multimedia components. (P.I.- 1.4.1, 3.4.3, 5.2.2, 8.3.1)*	
02.	**CSS3** ***Learning Objective/s:*** *To apply CSS in styling tables and lists, also use advanced selectors to precisely target and style specific elements within a document.*	**04**
	Contents: Syntax, Inclusion, Color, Background, Fonts, Tables, lists, CSS3 selectors, Pseudo classes, Pseudo elements **Task 2:** Implement using CSS3: Syntax, Inclusion, Color, Background, Fonts, Tables, lists, CSS3 selectors, Pseudo classes, Pseudo elements	
	Self-Learning Topics: *CSS Best Practices and Optimization* ***Learning Outcomes :*** *A learner will be able to* *LO 2.1: Apply HTML syntax and inclusion techniques to develop web pages, utilize color and background properties to enhance visual appeal, recognize the strengths and limitations of various font styles, and read, understand, and interpret technical documentation related to HTML and CSS. (P.I.- 1.3.1, 2.1.2, 5.2.1, 9.1.1)* *LO 2.2: Apply CSS3 selectors, pseudo-classes, and pseudo-elements to style web pages, identify and implement tables and lists for data organization, demonstrate proficiency in using CSS for complex styling tasks, and demonstrate effective communication by producing well-structured CSS design documentation. (P.I.- 1.4.1, 2.3.2, 5.2.2, 9.1.2)*	
03.	**Bootstrap** ***Learning Objective/s:*** *To create responsive, mobile-first websites and to ensure all interface elements of a website work optimally on all screen sizes.*	**04**
	Contents: Grid system, Forms, Button, Navbar, Breadcrumb, Jumbotron	

	Task 3: Implement using Bootstrap: Grid system, Forms, Button, Navbar, Breadcrumb, Jumbotron	
	Self-Learning Topics: *Customizing Bootstrap Themes*	
	Learning Outcomes: *A learner will be able to* *LO 3.1: Implement and integrate grid systems and forms within a web application, identify and apply HTML and CSS tools to create responsive and interactive user interfaces, and evaluate the limitations of these tools to validate their effectiveness in real-world applications. (P.I.- 3.4.2, 5.1.1, 5.3.1)* *LO 3.2: Design and develop interactive UI components by integrating buttons, navbars, breadcrumbs, and jumbotrons, and evaluate the limitations of these components, validating their effectiveness in real-world applications. (P.I.- 3.4.3, 5.3.1)*	
04.	**JavaScript** ***Learning Objective/s:*** *To recall and apply JavaScript and its concepts and develop understanding behind JavaScript applications.*	**16**
	Contents: Variables, Operators, Conditions, Loops, Functions, Events, Classes and Objects, Error handling, Validations, Arrays, String, Date **Task 4:** Implement using JavaScript: Variables, Operators, Conditions, Loops, Functions, Events, Classes and Objects. **Task 5:** Implement using JavaScript: Error handling, Validations, Arrays, String, Date.	
	Self-Learning Topics: *Testing and Test-Driven Development, Web APIs and Browser Features* ***Learning Outcomes:*** *A learner will be able to* *LO 4.1: Analyze and interpret programming results using contemporary tools, identify the strengths and limitations of variables, operators, and conditions, and demonstrate proficiency in using discipline-specific tools for handling loops, functions, and events in programming. (P.I.- 2.4.2, 5.2.1, 5.2.2)* *LO 4.2: Identify the limitations of various programming constructs such as classes, objects, and error handling, and demonstrate proficiency in using discipline-specific tools for validations, arrays, strings, and date manipulations. (P.I.- 2.4.3, 5.2.2)*	
05.	**React and Angular** ***Learning Objective/s:*** *To recognize the steps involved in setting up and configuring a React and Angular development environment to ensure a smooth setup. Design and develop an understanding behind React apps and Angular apps.*	**20**
	Contents: Installation and Configuration. JSX, Components, Props, State, Forms, Events, Routers, Refs, Keys. Overview of AngularJS, Need of AngularJS in real web sites, AngularJS modules, AngularJS built-in directives, AngularJS custom directives, AngularJS expressions, Angular JS Data Binding, AngularJS filters, AngularJS controllers, AngularJS scope, AngularJS dependency	

	injection, Angular JS Services, Form Validation, Routing using ng-Route, ng-Repeat, ng-style, ng-view, Built-in Helper Functions, Using Angular JS with Typescript **Task 6:** Implement using React: Installation and Configuration. JSX. Implement using React: Components, Props, State, Forms, Events. Implement using React: Routers, Refs, Keys. **Task 7:** Create a simple HTML "Hello World" Project using AngularJS Framework and apply ng-controller, ng-model and expressions. **Task 8:** Events and Validations in AngularJS. (Create functions and add events, adding HTML validators, using $valid property of Angular, etc.) Create an application for like Students Record using AngularJS	
	Self-Learning Topics: *Context API and Redux, State Management with NgRx (Optional), Testing and Debugging* ***Learning Outcomes:*** *A learner will be able to* *LO 5.1: Evaluate and implement React components, props, and state management in web applications, recognize the importance of lifelong learning in adapting to evolving front-end technologies, and analyze sourced technical information for the feasibility and sustainability of React integration. (P.I.- 3.4.2, 11.1.1, 11.3.2)* *LO 5.2: Verify functionalities and validate the integration of AngularJS services, form validation, and routing, and recognize the importance of lifelong learning in adapting to evolving front-end technologies. (P.I.- 3.4.3, 11.1.1)*	
06.	**Node.js** ***Learning Objective/s:*** *To apply callback functions and event loops, also able to install and configure Express with ease, and build a working Express application on their own to showcase server-side JavaScript coding proficiency. Also expected to build REST API using MongoDB.*	**12**
	Contents: Installation and Configuration, Callbacks, Event loops, creating express app, create Mongodb application **Task 9:** Implement using Node.js: Installation and Configuration, Callbacks, Implement using Node.js: Event loops, Creating express app. Implement Mongodb application. **Task 10:** Implementation of Mini Project on selected case study.	
	Self-Learning Topics: *Template Engines and Views, Indexes and Query Optimization* ***Learning Outcomes:*** *A learner will be able to* *LO 6.1: Identify modern engineering tools for the installation and configuration of Node.js applications, recognize and adapt to diverse working and learning preferences, read, understand, and interpret documentation for callbacks and event loops, and demonstrate proficiency in using discipline-specific tools for creating Express and MongoDB applications. (P.I.- 5.1.1, 5.2.2, 8.1.1, 9.1.1)* *LO 6.2: Present application development results as a team with well-integrated contributions from all members, produce clear, well-constructed, and well-supported documentation for Express and MongoDB applications, and demonstrate proficiency in*	

	using discipline-specific tools for creating and managing these applications. (P.I.- 5.2.2, 8.3.1, 9.1.2, 5.2.2)	
	Total	**60**

Performance Indicators:

P.I. No.	P.I. Statement
1.3.1	Apply engineering fundamentals
1.4.1	Apply theory and principles of computer science engineering to solve an engineering problem
2.1.1	Evaluate problem statements and identifies objectives
2.1.2	Identifies processes/modules/algorithms of a computer based system and parameters to solve a problem
2.2.4	Compare and contrast alternative solution/methods to select the best methods
2.4.2	Analyze and interpret the results using contemporary tools.
2.4.3	Identify the limitations of the solution and sources/causes.
3.4.2	Ability to implement and integrate the modules.
3.4.3	Ability to verify the functionalities and validate the design.
5.1.1	Identify modern engineering tools, techniques and resources for engineering activities
5.2.1	Identify the strengths and limitations of tools for (i) acquiring information, (ii) modeling and simulating, (iii) monitoring system performance, and (iv) creating engineering designs.
5.2.2	Demonstrate proficiency in using discipline specific tools
5.3.1	Discuss limitations and validate tools, techniques and resources
8.1.1	Recognize a variety of working and learning preferences; appreciate the value of diversity on a team
8.3.1	Present results as a team, with smooth integration of contributions from all individual efforts
9.1.1	Read, understand and interpret technical and nontechnical information
9.1.2	Produce clear, well-constructed, and well-supported written engineering documents
11.1.1	Describe the rationale for requirement for continuing professional development
11.3.2	Analyze sourced technical and popular information for feasibility, viability, sustainability, etc.

Course Outcomes:

Learner will be able to

1. To structure web pages, integrate multimedia components, and collaborate effectively in web application development. *(LO 1.1, LO 1.2)*
2. Apply HTML and CSS techniques to build and style web pages, integrate various UI components, and effectively communicate their design through well-structured documentation. *(LO 1.1, LO 1.2, LO 2.1, LO 2.2, LO 3.1, LO 3.2)*
3. Identify the strengths and limitations of JavaScript programming constructs and demonstrate proficiency in using discipline-specific tools for handling loops, functions, events, validations, arrays, strings, and date manipulations. *(LO 4.1, LO 4.2)*

4. Evaluate and implement React components and state management, and verify and validate AngularJS services, form validation, and routing, while recognizing the importance of lifelong learning in adapting to evolving technologies. *(LO 5.1, LO 5.2)*
5. Identify and use modern engineering tools for Node.js applications, collaborate effectively in teams, and produce well-constructed documentation for Express and MongoDB applications. *(LO 5.1, LO 5.2, LO6.1, LO6.2)*

CO-PO Mapping Table with Correlation Level

CO ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
ITSBL402.1	3	-	3	-	3	-	-	3	-	-	-
ITSBL402.2	3	3	3	-	3	-	-	3	3	-	-
ITSBL402.3	-	3		-	3	-	-	-	-	-	-
ITSBL402.4	-	-	3	-		-	-	-	-	-	3
ITSBL402.5	-	-	3	-	3	-	-	3	3	-	3
Average	3	3	3	-	3	-	-	3	3	-	3

Text Books:

1. HTML & CSS: Design and Build Web Sites, Jon Duckett,, First Edition, 2011, Wiley.
2. HTML 5 Black Book (Covers CSS3, JavaScript, XML, XHTML, AJAX, PHP, jQuery) 2Ed., DT Editorial Services, Second Edition, 2016, Dreamtech Press.
3. Learning React Functional Web Development with React and Redux, Alex Banks and Eve Porcello, First Edition, 2017, Shroff/O'Reilly O'Reilly
4. Learning Node.js Development, Andrew Mead, Kindle Edition, 2018, Packet Publishing

Reference Books:

1. JavaScript & jQuery: Interactive Front-End Development, Jon Duckett, First edition, 2014, Wiley .
2. Full Stack Web Development For Beginners, Riaz Ahmed, 2021
3. Beginning Node.js, Express & MongoDB Development, Greg Lim, 2020
4. Full-Stack React Projects: Modern web development using React 16, Node, Express, and MongoDB, Shama Hoque, First edition, 2018, Packt Publication

Other Resources:

1. JavaScript Tutorial
   Web link: https://www.w3schools.com/js/
2. React: The library for web and native user interfaces
   Web link: https://react.dev/
3. Deliver web apps with confidence
   Web link: https://angular.io/
4. Run JavaScript Everywhere
   Web link: https://nodejs.org/en
5. Express4.18.3 Fast, unopinionated, minimalist web framework for Node.js
   Web link: https://expressjs.com/

6. MongoDB

   Web link: https://www.mongodb.com/

A. CONTINUOUS ASSESSMENT (50 MARKS)

1. Task Execution (30 Marks)

Students will be given minimum 10 tasks.

Students are expected to

i. Identify and apply the appropriate HTML tags to develop a webpage.
ii. Identify and apply the appropriate CSS tags to format data on webpage.
iii. Apply JavaScript to add functionality to web pages.
iv. Use React and Angular to develop the front-end user interface, incorporating components, state management, and routing for seamless navigation and interaction with the back-end API.
v. Construct web based Node.js applications using Express.
vi. Identify the components necessary for building a full stack application, including front-end frameworks like React and Angular, and back-end technologies like MongoDB, Express, and Node.js.
vii. Design a relational database schema using MongoDB for storing application data efficiently.
viii. Implement RESTful API endpoints using Express.js to handle CRUD operations for interacting with the MongoDB database.

Students will be evaluated based on following:

i. Logic building for the given task (10 marks)
ii. Rectifying logical errors and syntax errors (06 marks)
iii. Well-structured and organized program (06 marks)
iv. Effective use and integration of the various technologies involved in full stack development, including React, Angular, MongoDB, Express, and Node.js. (08 marks)

Refer the sample task given below.

Example:

Implement JSX code in React

Students are expected to identify.

i. JSX: Students are expected to identify JSX syntax throughout the components, such as , <h2>, <p>, <ul>, <li>, and <a>, which represent HTML elements. JSX allows mixing HTML-like syntax within JavaScript code in React.
ii. Components: Students should recognize that each component is defined as a function that returns JSX elements. This is a fundamental concept in React - components encapsulate the UI logic and structure.
iii. Props and State: Although not explicitly demonstrated in this example, students can understand that props and state can be passed to components to customize their behavior and appearance.
iv. Hooks: In the BlogPost component, students can identify the usage of the useParams hook from React Router to access URL parameters, demonstrating the use of hooks in React functional components.

v. Router: Students can see the usage of React Router's <Route> component to define routes and their corresponding components, allowing for declarative routing in the application.

By analyzing this code, students can gain a deeper understanding of how JSX syntax is used to define the UI of React components and how React Router facilitates navigation between different views in a React application.

Students will be evaluated based on following:

i. Logic building for the given task (10 marks)
ii. Rectifying logical errors and syntax errors (06 marks)
iii. Well-structured and organized program (06 marks)
iv. Effective use and integration of the various technologies involved in full stack development, including React, Angular, MongoDB, Express, and Node.js. (08 marks)

2. Regularity and active Participation (05 Marks)

3. Mini Project Evaluation (15 Marks)

A group of 3-4 students should be assigned a real life problem statement. Evaluation will focus on the project's ability to meet functional requirements, such as CRUD operations, user authentication, and data validation, ensuring that the application behaves as intended.

Attention will be given to the usability and intuitiveness of the application's interface, including navigation, responsiveness, and feedback mechanisms, to ensure a positive user experience.

Assessment will consider the quality of the codebase, including adherence to coding standards, modularity, reusability, and readability, promoting maintainability and scalability of the project.

Projects will be evaluated for performance optimization techniques, such as minimizing load times, reducing server requests, and efficient database queries, to ensure responsiveness and efficiency.

Evaluation will include the completeness and clarity of project documentation, including setup instructions, user guides, API documentation, and code comments, facilitating understanding and collaboration among developers.

B. END SEMESTER EXAMINATION (Practical & Oral Exam) (50 Marks)

a) Task Execution: 30 Marks
Students will be given task (different task for every student) to execute and will be evaluated as per the parameters mentioned in continuous evaluation

b) Mini Project Presentation: 20 Marks
Students will give mini project presentation and will be evaluated as per the parameters mentioned in continuous evaluation

Two examiners, one Internal and one External will do the evaluation.

Course Type	Course Code	Course Name	Credits
MNP	ITMNP402	MINI PROJECT- 1B	01

Program Outcomes addressed:

1. PO1 : Engineering knowledge
2. PO2 : Problem Analysis
3. PO3 : Design/Development of Solutions
4. PO4 : Conduct investigations of complex problems
5. PO5 : Engineering Tool Usage
6. PO6 : The Engineer & The world
7. PO7 : Ethics
8. PO8 : Individual & Collaborative team work
9. PO9 : Communication
10. PO10: Project Management & Finance
11. PO11: Life-long learning

Course Objectives:

1. To familiarize students about available infrastructure at Department/Institute level, online resources, plagiarism, expectations from MP 1A and 1B, etc.
2. To guide students in identifying societal or research needs and formulating them into problem statements.
3. To facilitate problem-solving in group settings.
4. To apply basic engineering principles to address identified problems.
5. To foster self-learning and research skills.

Course Outcomes:

At the end of the course, students will be able to:

1. Identify problems based on societal or research needs and methodology for solving them.
2. Apply knowledge and skills to solve societal problems collaboratively.
3. Develop interpersonal skills necessary for teamwork.
4. Analyze, verify, and validate results effectively through various methodologies, including, test cases/benchmark data/theoretical/inferences/experiments/simulations, etc.
5. Evaluate the societal and environmental impacts of proposed solutions.
6. Adhere to standard engineering practices.
7. Excel in written and oral communication by technical report writing, oral presentation, and publishing results in
   - Research/white paper/article/blog writing/publication, etc.
   - Business plan for entrepreneurship product creation
   - Patent filing/copyright.
8. Gain technical competencies by participating in competitions, hackathons, etc.
9. Demonstrate lifelong learning capabilities through self-directed group projects.
10. Apply project management principles effectively.

Guidelines for the Mini Project

- At the beginning of semester-III, project guides are required to conduct around 4 hours' orientation sessions including following topics:
  - Familiarizing students about infrastructure available at Department/Institute level and how to use it.

- How to identify societal problems and formulate project problem statement.
- How to carry out literature survey.
- What is plagiarism and what care needs to be taken while writing a report.
- What is project report template and how it should be used.
- What are expectations from mini-projects 1A and 1B.

• Mini project may be carried out in one or more form of following:

Product preparations, prototype development model, fabrication of set-ups, laboratory experiment development, process modification/development, simulation, software development, integration of software (frontend-backend) and hardware, statistical data analysis, creating awareness in society/environment etc.

• Students must form groups of 3 to 4 members either from the same or from different departments.
• Groups should conduct surveys to identify needs and develop problem statements in consultation with faculty.
• An implementation plan in Gantt/PERT/CPM chart format covering weekly activities must be submitted.
• Each group must maintain a logbook to record weekly progress, to be verified by the faculty supervisor.
• Faculty input should emphasize guiding by faculty and self-learning by group members.
• Groups should propose multiple solutions, select the best one in consultation with the supervisor, and develop a working model.
• The solution to be validated with proper justification and report to be compiled in standard format of the Institute. Research papers, competition certificates may be submitted as part of annexure to the report.
• With the focus on self-learning, innovation, addressing societal/research/innovation problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that a single project of appropriate level and quality be carried out in two semesters by all the groups of the students.
• However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Mini Project adhering to the qualitative aspects mentioned above, gets completed in odd semester, then that group can be allowed to work on the extension of the Mini Project with suitable improvements/modifications or a completely new project idea in even semester. This policy can be adopted on a case by case basis.

In-Semester Continuous Assessment and End-Semester Examination Guidelines

- The Head of the Departments will assign a guide to each of the mini-projects and shall form a progress monitoring committee. The guide will carry out weekly monitoring of the project's progress. The committee shall carry out in-semester project evaluation based on presentations with a minimum of two evaluations per semester.
- Assessment will be based on individual contributions, understanding, and responses to questions asked.
- **Continuous Assessment marks distribution in semester III (50 marks):**

- 10 marks for the Topic Approval Presentation in front of the progress monitoring committee
- 15 marks for the Mid-Semester Progress Presentation in front of the progress monitoring committee
- 20 marks for the Final Report & Presentation
- 05 marks for Regularity and active participation

- **Continuous Assessment marks distribution in semester IV (50 marks):**
  - 15 marks for the In-Semester Two Presentations
  - 10 marks for the Participation in Project Competitions, TPP, etc.
  - 20 marks for the Final Report & Presentation
  - 05 marks for Regularity and active participation

The review/progress monitoring committee will assess projects based on the following criteria.

Semester III:

- Theoretical solution completion, including component/system selection/design of software solution and cost analysis.
- Two reviews will occur:
  - The first review will focus on finalizing the problem statement (topic approval).
  - The second review will focus on finalizing the proposed solution.

Semester IV:

- Expected tasks include procuring components/systems, constructing a working prototype, and validating results based on prior semester work.
- Reviews will be conducted as follows:
  - The first review will assess the readiness to build a working prototype.
  - The second review will involve a poster presentation and demonstration of the working model in the last month of the semester.

In addition to the above-mentioned points, the following performance criteria shall be included during the in-semester continuous assessment:

1. Quality of survey and need identification.
2. Clarity and innovativeness in problem definition and solutions.
3. Requirement gathering feasibility study, cost-effectiveness, and societal impact of proposed solutions.
4. Completeness and full functioning of the working model.
5. Effective use of skill sets and engineering norms.
6. Verification & validation of the solutions/test cases.
7. Individual contributions to the group.

8. Clarity in written and oral communication.
9. Participation in technical paper presentations/project competitions/hackathon competitions, etc.

End-Semester Examination in Semester IV (50 marks):

1. Presentation and demonstration to internal and external examiners: 20 marks.
2. Emphasis on problem clarity, innovativeness, societal impact, functioning of the model, skill utilization, and communication clarity: 30 marks.

Course Type	Course Code	Course Name	Credits
VEC	VEC402	ENVIRONMENT & SUSTAINABILITY	02

Program Outcomes addressed:

1. PO2 : Problem Analysis
2. PO6 : The Engineer & The world
3. PO7 : Ethics
4. PO11: Life-long learning

Course Objectives :

1. To provide students with foundational knowledge and understanding of environmental science principles and concepts.
2. To explore the principles of sustainability and their applications in various domains of engineering and technology.
3. To familiarize students with the legal and ethical considerations associated with environmental management and sustainability practices.
4. To equip students with practical skills and strategies for promoting renewable energy, energy efficiency, waste management, and environmental impact assessment.

Module	Details
01.	**Foundations of Environmental Sciences** Introduction to Environmental Science, Earth's Systems: Atmosphere, Hydrosphere, Lithosphere, Biosphere, Ecological Principles: Energy flow, Nutrient cycling, Biodiversity, Environmental Degradation: Pollution, Deforestation, Habitat loss, Environmental Monitoring and Data Analysis.
02.	**Sustainability Basics** Concepts of Sustainability and Sustainable Development, Sustainable Resource Management: Water, Air, Land, Sustainable Agriculture and Food Systems, Sustainable Transportation and Urban Planning, Sustainable Business Practices and Corporate Social Responsibility
03.	**Legal & Ethical Considerations** Environmental Laws and Regulations: National and International Perspectives, Environmental Policies and Governance Frameworks, Ethical Issues in Environmental Decision Making, Environmental Justice and Equity, Corporate Ethics and Environmental Responsibility
04.	**Renewable energy & Energy efficiency** Introduction to Renewable Energy Sources: Solar, Wind, Hydro, Biomass, Geothermal, Energy Conversion Technologies and Systems Energy Efficiency Measures and Strategies, Policy Support for Renewable Energy Deployment, Economic and Environmental Impacts of Renewable Energy

05.	**Waste management & recycling** Solid Waste Management: Collection, Treatment, Disposal, Recycling Processes and Technologies, E-waste Management and Hazardous Waste Handling, Circular Economy Principles, Waste Reduction Strategies: Source Reduction, Reuse, Repair
06.	**Environmental Impact Assessment** Introduction to Environmental Impact Assessment (EIA), EIA Process: Screening, Scoping, Impact Assessment, Mitigation, Monitoring, Methods and Tools for Impact Assessment: GIS, LCA, Risk Assessment, Case Studies of EIA in Various Sectors: Infrastructure, Energy, Mining, Construction, Role of Stakeholders in EIA Process
Total no. of hours: **30**	

Course Outcomes :

1. Gain a comprehensive understanding of key environmental science principles and their relevance to engineering disciplines.
2. Apply principles of sustainability to analyze and address environmental challenges in engineering projects and processes.
3. Demonstrate awareness of legal and ethical considerations in environmental decision-making and management practices.
4. Develop proficiency in implementing renewable energy technologies and energy-efficient practices in engineering designs and operations.
5. Acquire knowledge and skills in waste management, recycling, and circular economy principles for sustainable resource utilization.
6. Apply environmental impact assessment methods to evaluate and mitigate the environmental impacts of engineering projects and activities.

Text Books :

1. Environmental Science: Toward a Sustainable Future by Richard T. Wright and Dorothy F. Boorse (Publisher: Pearson Education)
2. Introduction to Environmental Engineering and Science by Gilbert M. Masters and Wendell P. Ela (Publisher: Pearson Education)
3. Renewable and Efficient Electric Power Systems by Gilbert M. Masters (Publisher: Wiley)

Reference Books :

1. Environmental Law Handbook by Thomas F. P. Sullivan, David R. Buente Jr., and Sally Fairfax, Bernan Press
2. Sustainability Science by Bert J. M. de Vries, Springer
3. Environmental Impact Assessment: Theory and Practice by Peter Wathern, Routledge

Other Resources:

1. NPTEL Course: Introduction to Environmetal Engineering & Science- Fundamental & Sustainability Concepts, Prof.Brajesh Kumar Dubey, Department of Multidisciplinary IIT Kharagpur :-Web link https://archive.nptel.ac.in/courses/127/105/127105018/

2. NPTEL Course: Environment And Development, By Prof. Ngamjahao Kipgen, IIT Guwahati, Web link- https://onlinecourses.nptel.ac.in/noc23_hs133/preview

Course Type	Course Code	Course Name	Credits
PCC	ITPCC509	AUTOMATA THEORY	03

Examination Scheme					
Distribution of Marks			Exam Duration (Hrs.)		Total Marks
In-semester Assessment		End Semester Examination (ESE)			
Continuous Assessment	Mid-Semester Exam (MSE)		MSE	ESE	
20	30	50	1.5	2	100

Pre-requisite:

1. ITPCC301- Engineering Mathematics-III

Program Outcomes addressed:

1. PO 1: Engineering knowledge
2. PO 2: Problem analysis
3. PO 3: Design /Development of Solution
4. PO 4: Conduct investigation of Complex Problem
5. PO 8: Individual and Collaborative Team work
6. PO 9: Communication
7. PO 11: Life-long learning

Course Objectives:

1. To enable students to comprehend and apply the concepts of formal languages, including alphabets, strings, regular expressions, and grammars, and to analyze their properties and closure operations in computational systems.
2. To equip students with the ability to design, analyze, and differentiate between deterministic (DFA) and non-deterministic finite automata (NFA), and to convert regular expressions to finite automata for language recognition and validation.
3. To provide students with the knowledge to construct and simplify context-free grammars (CFG), convert them to Chomsky and Greibach normal forms, and design pushdown automata (PDA) for parsing and recognizing context-free languages.
4. To help students understand the theoretical foundations of Turing Machines (TM), including deterministic and non-deterministic variants, and to analyze the halting problem and its implications on the limits of computability.
5. To enable students to apply automata theory, including finite automata, context-free grammars, pushdown automata, and Turing machines, in practical applications such as lexical analysis, syntax parsing, pattern matching, and compiler design.

Module	Details	Hrs.
00.	**Course Introduction** This course delves into the theory behind computation, formal languages, and abstract models, exploring topics such as finite automata. It has practical applications in algorithmic complexity, compiler construction, and artificial intelligence. By understanding the boundaries and potentials of computational systems, it equips students to design efficient algorithms and advance artificial intelligence development.	01
01.	**Introduction and Regular Languages:** ***Learning Objective:*** *To make learner able to apply fundamental and theoretical engineering principles to analyze and construct alphabets, strings, regular expressions, and grammars. Evaluate and compare closure properties and problem statements involving language recognition and classification.* **Contents:** Languages: Alphabets and Strings. Regular Languages: Regular Expressions, Regular Languages, Regular Grammars, RL and LL grammars, Closure properties ***Self-Learning Topics:*** *Applications of Regular Expressions in Real-World Scenarios (e.g., text processing, search algorithms).* ***Learning Outcomes:*** *A learner will be able to* *LO 1.1: Apply fundamental engineering principles to analyze alphabets, strings, and regular languages, demonstrating their role in formal language theory. (P.I. 1.3.1)* *LO 1.2: Apply theoretical principles of computer science to construct and interpret regular expressions, regular grammars, and different types of regular languages. (P.I. 1.4.1)* *LO 1.3: Evaluate problem statements involving language recognition and define objectives for analyzing regular and context-free grammars, including RL and LL grammars. (P.I. 2.1.1)* *LO 1.4: Compare and contrast various closure properties of regular languages, selecting the most efficient method for solving problems related to language classification. (P.I. 2.2.4)*	06-08
02.	**Finite Automata:** ***Learning Objective:*** *To make learner able to evaluate and analyze problem statements related to Finite Automata (FA), including DFA, NFA, and their equivalence. Compare methods for FA minimization, explore design alternatives for Moore and Mealy Machines, and validate their conversions through testing and analysis.* **Contents:** Finite Automata: FA as language acceptor or verifier, NFA (with and without ε), DFA, RE to NFA, NFA to DFA, Reduced DFA, NFA-DFA equivalence, FA to RE. Finite State Machines with output: Moore and Mealy machines. Moore and Mealy M/C conversion. Limitations of FA. ***Self-Learning Topics:*** *Applications of Finite Automata in Compiler Design (e.g., lexical analysis).* *Comparison of Moore and Mealy Machines in Real-World Systems (e.g., vending machines, traffic light controllers).* ***Learning Outcomes:***	07-09

	A learner will be able to *LO 2.1: Evaluate problem statements related to Finite Automata (FA) and define objectives for analyzing DFA, NFA, and their equivalence in language recognition. (P.I. 2.1.1)* *LO 2.2: Compare and contrast alternative methods for FA minimization and transformation, selecting the most efficient process for converting FA to RE and DFA reduction. (P.I. 2.2.5)* *LO 2.3: Explore various design alternatives for constructing Moore and Mealy Machines and analyze their functional differences in system design. (P.I. 3.2.1)* *LO 2.4: Verify and validate the correctness of Moore-Mealy machine conversion through testing and analysis, ensuring functional consistency in state-based system design. (P.I. 3.4.3)*	
03.	**Context Free Grammars:** ***Learning Objective**:* *To make learner able to apply fundamental engineering and theoretical principles to define, describe, and analyze Context-Free Grammars (CFGs) and their derivations. Evaluate CFG-based problem statements, identify ambiguity, and compare simplification techniques like CNF and GNF for computational efficiency.* **Contents:** Context Free Languages: CFG, Leftmost and Rightmost derivations, Ambiguity, Simplification and Normalization (CNF & GNF) and Chomsky Hierarchy (Types 0 to 3) ***Self-Learning Topics:** Applications of Context-Free Grammars in Programming Languages (e.g., syntax analysis in compilers).* *Comparison of CNF and GNF in Parsing Algorithms (e.g., efficiency and usability).* ***Learning Outcomes:*** *A learner will be able to* *LO 3.1: Apply fundamental engineering knowledge to define and describe the characteristics of Context-Free Grammars (CFGs) and their role in formal language theory. (P.I. 1.3.1)* *LO 3.2: Apply theoretical principles of computation to analyze derivations in CFGs and demonstrate the impact of leftmost and rightmost derivations on parse trees. (P.I. 1.4.1)* *LO 3.3: Evaluate CFG-based problem statements and define clear objectives for identifying ambiguity and grammar simplification methods. (P.I. 2.1.1)* *LO 3.4: Compare and contrast different CFG simplification techniques, including CNF and GNF, to determine the most efficient form for computational applications. (P.I. 2.2.4)*	**06-08**
04.	**Push Down Automata:** ***Learning Objectives:*** *To make learner able to apply engineering and computational principles to define and analyze Context-Free Grammars (CFGs) and their derivations. They will also evaluate CFG-based problems, identify ambiguities, and compare simplification techniques to determine the most efficient forms for computational applications.* **Contents:** Push Down Automata: Deterministic (single stack) PDA, Equivalence between PDA and CFG. Power and Limitations of PDA. ***Self-Learning Topics:** Applications of PDA in Compiler Design (e.g., parsing context-free languages).* *Comparison of PDA with Finite Automata (e.g., expressive power and limitations).* ***Learning Outcomes:***	**06-08**

	A learner will be able to *LO 4.1: Apply computer engineering principles to design and analyze Pushdown Automata (PDA) for recognizing Context-Free Languages (CFL) with required applicability and performance. (P.I. 2.3.1)* *LO 4.2: Apply mathematical foundations to implement PDA transitions and validate their correctness through computational analysis. (P.I. 2.4.1)* *LO 4.3: Explore design alternatives for constructing PDAs and evaluate their efficiency in recognizing various types of languages. (P.I. 3.2.1)* *LO 4.4: Verify and validate PDA functionalities by testing equivalence with Context-Free Grammars (CFG) to ensure correctness in language recognition. (P.I. 3.4.3)*	
05.	**Turing Machine:** ***Learning Objective/s:*** *To make learner able to design and simulate Turing Machine models to solve computational problems, comparing different types of Turing Machines for efficiency. They will also validate state transitions, explore the Universal Turing Machine, and analyze undecidability using the Halting Problem.*	**07-09**
	Contents: Turing Machine: Definition and components of a Deterministic Turing Machine, Transition function, state transitions, and tape movements in a DTM. Non-deterministic Turing Machine (NDTM) and its differences from DTM, Multi-tape Turing Machines: Introduction, design, and comparison with single-tape TMs, Universal Turing Machine (UTM) and its significance in the theory of computation. Statement and formal definition of the Halting Problem, Proof of the undecidability of the Halting Problem using a diagonalization argument, Implications of the Halting Problem on the limits of computability.	
	Self-Learning Topics: *Applications of Turing Machines in Modern Computing (e.g., theoretical models of computation).* *Comparison of Turing Machines with Finite Automata and Pushdown Automata (e.g., expressive power and limitations).*	
	Learning Outcomes :	
	A learner will be able to *LO 5.1: Apply computer engineering principles to design Turing Machine (TM) models for solving computational problems with required performance and applicability. (P.I. 2.3.1)* *LO 5.2: Compare and contrast single-tape, multi-tape, deterministic, and non-deterministic Turing Machines to identify the most efficient computational model for a given problem. (P.I. 2.2.4)* *LO 5.3: Explore design alternatives for constructing and simulating Turing Machines, evaluating their efficiency in solving complex computational problems. (P.I. 3.2.1)* *LO 5.4: Verify and validate the correctness of state transitions and tape movements in a Turing Machine by testing against computational problems. (P.I. 3.4.3)* *LO 5.5: Define the Universal Turing Machine (UTM) and investigate its significance in the theoretical foundations of computation, including its scope and importance. (P.I. 4.1.1)* *LO 5.6: Design and develop methodologies for proving undecidability using the Halting Problem, analyzing its implications on the limits of computability. (P.I. 4.2.1)*	
06.	**Applications of Automata:**	**05-07**

Learning Objective/s:

To make learner able to design and analyze automata-based models for lexical analysis, syntax parsing, and language processing, understanding their applications in compiler design and text processing. They will also collaborate effectively, produce structured technical reports, and stay updated with advancements in computational linguistics and sustainable computing practices.

Contents:

Finite Automata (FA): String Recognition: FA is used for recognizing regular languages, making it applicable in lexical analysis in compilers.

Pattern Matching: FA is employed in searching for specific patterns within strings.

Context-Free Grammars (CFG): Syntax Analysis in Compilers: CFGs are fundamental in defining the syntax of programming languages and are crucial in compiler design for parsing source code.

Natural Language Processing: CFGs are utilized to model the syntax of natural languages, aiding in parsing and understanding sentences.

Pushdown Automata (PDA): Parsing in Compiler Design: PDAs are essential in the design of parsers for context-free grammars during the syntax analysis phase of compilers.

Balanced Parentheses Checking: PDAs can be employed to recognize languages involving balanced parentheses, brackets, or nested structures.

Expression Evaluation: PDAs can be used to evaluate arithmetic expressions by keeping track of the stack.

Turing Machines (TM): Algorithm Analysis: TMs help in understanding the fundamental limits of computation and analyzing the efficiency of algorithms.

Simulating Computations: TMs can simulate any algorithmic process, providing a theoretical foundation for computational studies.

Introduction to Compiler and Its Phases.

Self-Learning Topics: *Applications of Finite Automata in Network Security (e.g., intrusion detection systems).*

Use of Pushdown Automata in Designing Programming Language Interpreters (e.g., Python, Java).

Learning Outcomes:

A learner will be able to

LO 6.1: Define and investigate the role of Finite Automata (FA) in lexical analysis and pattern matching, interpreting its technical applications in compiler design and text processing while analyzing sourced information for feasibility and sustainability. (P.I. 4.1.1, 9.1.1, 11.3.2)

LO 6.2: Design and implement Context-Free Grammars (CFGs) for syntax analysis, programming language parsing, and natural language processing, while understanding the societal relevance of computational linguistics and the importance of staying updated with advancements in the field. (P.I. 4.2.1, 11.2.2)

LO 6.3: Define and investigate the working of Pushdown Automata (PDA) in parsing, balanced parentheses checking, and expression evaluation, collaborating effectively in teams and communicating technical findings through structured documentation. (P.I. 4.1.1, 8.2.1,9.1.2)

LO 6.4: Design and develop automata-based computational models for compiler design and language processing applications, evaluating their broader impact on

	modern software development and sustainable computing practices. (P.I. 4.2.1, 11.3.2) *LO 6.5: Collaborate in teams to analyze and explore the role of Turing Machines (TM) in algorithm analysis and computational theory, discussing their significance in understanding the limits of computation while recognizing the need for continuous learning. (P.I. 4.1.1, 8.3.1, 11.2.2)* *LO 6.6: Produce well-structured technical reports and presentations on case studies related to automata applications, ensuring clarity in communication while analyzing technical information for feasibility and sustainability. (P.I. 4.2.1, 9.1.2, 11.3.2)*	
	Course Conclusion	**01**
	Total	**45**

Performance Indicators:

P.I. No.	**P.I. Statement**
1.3.1	Apply engineering fundamentals
1.4.1	Apply theory and principles of computer science engineering to solve an engineering problem
2.1.1	Evaluate problem statements and identifies objectives
2.2.4	Compare and contrast alternative solution/methods to select the best methods
2.2.5	Compare and contrast alternative solution processes to select the best process.
2.3.1	Able to apply computer engineering principles to formulate modules of a system with required applicability and performance
2.4.1	Applies engineering mathematics to implement the solution.
3.2.1	Ability to explore design alternatives.
3.4.3	Ability to verify the functionalities and validate the design.
4.1.1	Define a problem for purposes of investigation, its scope and importance
4.2.1	Design and develop appropriate procedures/methodologies based on the study objectives
8.2.1	Demonstrate effective communication, problem solving, conflict resolution and leadership skills
8.3.1	Present results as a team, with smooth integration of contributions from all individual efforts
9.1.1	Read, understand and interpret technical and nontechnical information
9.1.2	Produce clear, well-constructed, and well-supported written engineering documents
11.2.2	Recognize the need and be able to clearly explain why it is vitally important to keep current regarding new developments in your field
11.3.2	Analyze sourced technical and popular information for feasibility, viability, sustainability, etc.

Course Outcomes: A learner will be able to -

1. Analyze and construct regular expressions, grammars, and languages, evaluate language recognition problems, and compare closure properties to solve classification problems using theoretical principles of computer science and formal language theory. *(LO 1.1, LO 1.2, LO 1.3, LO 1.4)*
2. Design, analyze, and differentiate between deterministic (DFA) and non-deterministic finite automata (NFA), and convert regular expressions to finite automata for language recognition and validation. *(LO 2.1, LO 2.2, LO 2.3, LO 2.4)*
3. Construct, simplify, and classify context-free grammars (CFG), resolve ambiguity, and apply Chomsky hierarchy concepts to design pushdown automata (PDA) for parsing and

recognizing context-free languages. *(LO 3.1, LO 3.2, LO 3.3, LO 3.4, LO 4.1, LO 4.2, LO 4.3, LO 4.4)*

4. Design and analyze Turing Machines (TM), prove the undecidability of the Halting Problem, and evaluate its implications on the limits of computability and theoretical computer science. *(LO 5.1, LO 5.2, LO 5.3, LO 5.4, LO 5.5, LO 5.6)*
5. Design and analyze Finite Automata (FA), Context-Free Grammars (CFGs), Pushdown Automata (PDA), and Turing Machines (TM) for applications in lexical analysis, syntax parsing, compiler design, and computational theory, while evaluating their societal impact and communicating findings through structured technical reports and collaborative discussions. *(LO 6.1, LO 6.2, LO 6.3, LO 6.4, LO 6.5, LO 6.6)*

CO-PO Mapping Table with Correlation Level

CO ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
ITPCC509.1	3	3	-	-	-	-	-	-	-	-	-
ITPCC509.2	-	3	3	-	-	-	-	-	-	-	-
ITPCC509.3	3	3	3	-	-	-	-	-	-	-	-
ITPCC509.4	-	3	3	3	-	-	-	-	-	-	-
ITPCC509.5	-	-	-	3	-	-	-	3	3	-	3
Average	**3**	**3**	**3**	**3**	-	-	-	**3**	**3**	-	**3**

Text Books :

1. Introduction to languages and the Theory of Computation, J. C. Martin, Fourth edition, 2010, McGraw-Hill Education.
2. Theory of Computation A Problem Solving Approach, Kavi Mahesh, Kindle Edition, 2011, Wiley India.

Reference Books :

1. Theory of Computation, Vivek Kulkarni, Kindle Edition, 2013, Oxford University Press.
2. Theory of Computer Science, Automata Languages & Computations, N. Chandrashekhar, K.L.P. Mishra, Third edition, 2006, PHI publications.

Other Resources :

1. NPTEL Course: Introduction to Automata, Languages and Computation, by Prof. Sourav Mukhopadhyay, Computer Science and Engineering, IIT Kharagpur: -
   Web link - https://onlinecourses.nptel.ac.in/noc21_cs19/preview
2. NPTEL Course: Theory of Automata, Formal Languages and Computation, by Prof. Kamala Krithivasan, Computer Science and Engineering, IIT Madras: -
   Web link - https://archive.nptel.ac.in/courses/106/106/106106049/#

A. IN-SEMESTER ASSESSMENT (50 MARKS)

1. Continuous Assessment - Theory-(20 Marks)

Suggested breakup of distribution

a) One MCQ Test as per GATE exam pattern / level: 05 Marks
b) Article reading with report writing: 05 Marks
c) Class Test: 05 Marks
d) Regularity and active participation:05 Marks

2. Mid Semester Exam (30 Marks)

Mid semester examination will be based on 40% to 50% syllabus.

B.END SEMESTER EXAMINATION (50 MARKS)

End Semester Examination will be based on syllabus coverage up to the Mid Semester Examination (MSE) carrying 20% to 30% weightage, and the syllabus covered from MSE to ESE carrying 70% to 80% weightage.

Course Type	Course Code	Course Name	Credits
PCC	ITPCC510	ARTIFICIAL INTELLIGENCE	03

Examination Scheme					
Distribution of Marks			Exam Duration (Hrs.)		Total Marks
In-semester Assessment		End Semester Exam (ESE)			
Continuous Assessment	Mid-Semester Exam (MSE)		MSE	ESE	
20	30	50	1.5	2	100

Pre-requisite :

1. ITPCC301: Engineering Mathematics-III
2. ITPCC405: Engineering Mathematics-IV
3. ITPCC303: Data Structures & Analysis

Program Outcomes addressed :

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO3: Design/development of solutions
4. PO4: Conduct Investigation of complex problems
5. PO5: Engineering tool usage
6. PO6: The Engineer and The World
7. PO8: Individual and Collaborative Teamwork
8. PO9: Communication
9. PO11: Life-long Learning

Course Objectives:

1. To impart the basic ideas and techniques underlying the design of intelligent systems.
2. To impart the knowledge of mechanism of mind that enables intelligent thought and action.
3. To introduce advanced representation formalism, search techniques, planning and learning techniques to solve problems and to design AI systems.
4. To introduce the methods to analyse and process uncertain and incomplete information.

Module	Detailed Contents	Hrs
00.	**Course Introduction** Artificial Intelligence course deals with techniques to tackle complex real-world problems with various AI techniques and rigorous mathematical tools. This course includes the foundational principles and practice implementing various AI systems.	01
01.	**Introduction to Artificial Intelligence** ***Learning Objective/s:*** *To formulate the problem and apply the concept of various intelligent agents to real time applications.*	04-06

	Contents: **Artificial Intelligence:** Introduction, History of Artificial Intelligence, Intelligent Systems: Categorization of Intelligent System, Components of AI Program, Foundations of AI, Sub-areas of AI, Applications of AI, Current trends in AI **Intelligent Agents:** Agents and Environments, The concept of rationality, The nature of environment, The structure of Agents, Types of Agents, Learning Agent, Agent Environments PEAS representation for an Agent. Solving problem by Searching: Problem Solving Agent, Formulating Problems, Example Problems	
	Self-Learning Topics: *Explore applications and current trends of AI.*	
	Learning Outcomes: *A learner will be able to* *LO 1.1: Formulate the given problem and identify its components. (P.I.-2.2.1)* *LO 1.2: Identify appropriate type of an agent, PEAS parameters and task environment for the given problem. (P.I.-2.1.2)* *LO 1.3: Solve the given problem using different type of agents. (P.I.-3.2.1)* *LO 1.4: Select the optimal solution for the given problem based on the requirement of the problem. (P.I.-3.2.2)*	
02.	**Problem Solving** ***Learning Objective/s:*** *To apply searching techniques to find the optimal solution. Also expected to implement the various adversarial methods for game playing.*	**09-11**
	Contents: **Search Methods:** Uninformed Search Methods: Breadth First Search (BFS), Depth First Search (DFS), Depth Limited Search, Depth First Iterative Deepening (DFID), Informed Search Methods: Greedy best first Search, A* Search **Local Search Algorithms and Optimization Problems:** Hill climbing search, Simulated annealing, Genetic algorithms **Constraint Satisfaction Problem Solving:** Crypto-Arithmetic Problem, Water Jug, Graph Coloring **Adversarial Search:** Game Playing, Min-Max Search, Alpha Beta Pruning **Demonstration of Search Techniques using open source tool**	
	Self-Learning Topics: *IDA*, SMA*.* ***Learning Outcomes:*** *A learner will be able to* *LO 2.1: Apply the constraint satisfaction fundamentals to solve the problem. (P.I.-1.3.1)*	

	LO 2.2: Apply Artificial intelligence methods to solve problem (P.I.-1.4.1) *LO 2.3: Identify the heuristic functions for the given problem to get optimal solution. (P.I.- 2.2.3)* *LO 2.4: Select and apply best searching method to solve a given problem. (P.I.- 2.2.4)*	
03.	**Knowledge and Reasoning** ***Learning Objective/s:*** *To acquaint the knowledge of various types of knowledge representation and apply it to solve problem. Also expected to analyze the inferences drawn using belief network and fuzzy logic.*	**09-11**
	Contents: **Knowledge Representation:** Knowledge based Agents, WUMPUS WORLD Environment, Brief Overview of propositional logic, First Order Logic: Syntax and Semantic, Inference in FOL, forward chaining, backward Chaining. Knowledge Engineering in First-Order Logic, Unification, Resolution **Uncertain Knowledge and Reasoning:** Uncertainty, Representing knowledge in an uncertain domain, The semantics of belief network, Simple Inference in belief network, Markov decision process, Fuzzy Set Theory: Classical Sets and Fuzzy Sets, Classical Relations and Fuzzy Relations, Fuzzy Max-Min and Max-Product Composition, Membership function, Fuzzy extension principle, Fuzzy Systems- fuzzification, defuzzification methods, and design of fuzzy controllers. **Demonstration of knowledge representation and reasoning system using open source tool**	
	Self-Learning Topics: *Explore more inference mechanisms.*	
	Learning Outcomes: *A learner will be able to* *LO 3.1: Apply the knowledge based agent to solve the given problem (P.I.-1.3.1)* *LO 3.2: Apply the predicate and first order logic methods to prove the given fact or to find solution (P.I.-1.4.1)* *LO 3.3: Solve the given problem using the different methods to handle uncertainty. (P.I.-2.2.3)* *LO 3.4: Identify the fuzzy logic solution to solve an uncertain problem. (P.I.-2.1.3)* *LO 3.5: Design the fuzzy controllers to develop a sustainable solution for a given problem. (P.I.-3.1.1, 6.4.2)* *LO 3.6: Verify and validate the design of a fuzzy controller by identifying the risks/impacts of rule base design process. (P.I.-3.4.3, 6.3.1)*	
04.	**Planning** ***Learning Objective/s:*** *To apply the knowledge of planning to solve a problem by decomposing it in to sub problems.*	**03-05**
	Contents: The planning problem, Planning with state space search, Partial order planning, Hierarchical planning, Conditional Planning. **Demonstration of Planning techniques using open source tool**	

	Self-Learning Topics: *Representing real world problems as planning problems.*	
	Learning Outcomes: *A learner will be able to* *LO 4.1: Define a precise problem statement and analyse the impact of causal link constraints. (P.I.-3.1.1, 6.3.1)* *LO 4.2: Design and develop the sustainable planning solution to a real world problem. (P.I.-3.2.2, 6.4.2)*	
05.	**Learning** ***Learning Objective/s:*** *To apply the learning to a network also expected to analyze and interpret the result.*	**04-05**
	Contents: Types of Learning, McCulloch Pitt model, Hebb Network, Linear separability. Supervised Learning algorithms: Perceptron (Single Layer, Multilayer), Delta learning rule, Back Propagation algorithm. Un-Supervised Learning algorithms: Winner take all, Self-Organizing Maps, Learning Vector Quantization, Introduction to reinforcement learning **Demonstration of Learning techniques using open source tool**	
	Self-Learning Topics: *PAC Learning*	
	Learning Outcomes: *A learner will be able to* *LO 5.1: Apply the Artificial neural concept to solve problem. (P.I.-1.1.1)* *LO 5.2: Apply the different learning methods to solve a problem. (P.I.-1.4.1)*	
06.	**AI Applications & Recent trends** ***Learning Objective/s:*** *To apply the concepts of artificial intelligence to design and analyze the real life applications.*	**08-10**
	Contents: **Applications:** Expert System Introduction to NLP- Language models, Grammars, Parsing Robotics - Robots, Robot hardware, Problems Robotics can solve AI applications in Healthcare, Retail, Banking **Recent trends:** Explainable AI, Responsible AI, Generative AI	
	Self-Learning Topics: *Cognitive AI*	

	Learning Outcomes: *The learner will be able to* *LO 6.1: Define a problem statement along with the research gap and identify risk/impact of industrial practice on society and environment., Choose and apply AI technique and tool, to design a solution, and effectively present the solution. (P.I.- 3.1.1,4.1.1,5.1.1, 6.3.1,8.2.1,9.1.1,11.1.2)* *LO 6.2: Identify the recent AI technique alternative to traditional techniques for the selected problem, use it to design a sustainable solution with AI tool and effectively present the solution in a team. (P.I.- 3.2.1,4.2.1,5.2.2, 6.4.2,8.3.1,9.1.2,11.2.1)*	
	Course Conclusion	**01**
	Total	**45**

Performance Indicators:

P.I. No.	P.I. Statement
1.1.1	Apply the knowledge of discrete structures, linear algebra, statistics and numerical techniques to solve problems
1.3.1	Apply engineering fundamentals.
1.4.1	Apply theory and principles of computer science engineering to solve an engineering problem.
2.1.1	Evaluate problem statements and identifies objectives
2.1.2	Identifies processes/modules/algorithms of a computer based system and parameters to solve a problem
2.1.3	Identifies mathematical algorithmic knowledge that applies to a given problem.
2.2.3	Identify existing solution/methods to solve the problem, including forming justified approximations and assumptions
2.2.4	Compare and contrast alternative solution/methods to select the best methods
3.1.1	Able to define a precise problem statement with objectives and scope.
3.2.1	Ability to explore design alternatives.
3.2.2	Ability to produce a variety of potential design solutions suited to meet functional requirements.
3.4.3	Ability to verify the functionalities and validate the design.
4.1.1	Define a problem for purposes of investigation, its scope and importance
4.2.1	Design and develop appropriate procedures/methodologies based on the study objectives
5.1.1	Identify modern engineering tools, techniques and resources for engineering activities.
5.2.2	Demonstrate proficiency in using discipline specific tools.
6.3.1	Identify risks/impacts in the life-cycle of an engineering product or activity.
6.4.2	Apply principles of preventive engineering and sustainable development to an engineering activity or product relevant to the discipline
8.2.1	Demonstrate effective communication, problem solving, conflict resolution and leadership skills.
8.3.1	Present result as a team, with smooth integration of contributions from all individual efforts.

9.1.1 Read, understand and interpret technical and nontechnical information.

9.1.2 Produce clear, well- constructed, and well-supported written engineering documents.

11.2.1 Identify historic points of technological advance in engineering that required practitioners to seek education in order to stay current.

11.1.2 Identify deficiencies or gaps in knowledge and demonstrate an ability to source information to close this gap.

Course Outcomes:

A learner will be able to

1. Formulate and solve the problem using modern tools for development of sustainable solution by analyzing the impact of different types of agent. *(LO 1.1, LO1.2, LO1.3, LO1.4, LO 6.1, LO 6.2)*

2. Select and Apply the appropriate searching method to solve the given problem. *(LO 2.1, LO 2.2, LO 2.3, LO 2.4)*

3. Analyse and Apply an appropriate knowledge-representation and planning models to solve the real world problems by evaluating societal and environmental aspects on the design of models. *(LO 3.1, LO 3.2, LO 3.3, LO 3.4, LO 3.5, LO 3.6, LO 4.1, LO 4.2)*

4. Apply learning techniques to solve a given problem. *(LO 5.1, LO5.2)*

5. Design and develop AI applications in real world scenarios using AI tools and effectively present the solution. *(LO 6.1, LO 6.2)*

CO-PO Mapping Table with Correlation Level

CO ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
ITPCC510.1	-	3	3	3	3	3	--	3	3	-	3
ITPCC510.2	3	3	-	-	-	-	-	-	-	-	-
ITPCC510.3	3	3	3	-	-	3	-	-	-	-	-
ITPCC510.4	3	-	-	-	-	-	-	-	-	-	-
ITPCC510.5	-	-	3	3	3	3	--	3	3	-	3
Average	**3**	**3**	**3**	**3**	**3**	**3**	**--**	**3**	**3**	-	**3**

Text Books :

1. Artificial Intelligence: A Modern Approach ,Stuart J. Russell and Peter Norvig, Fourth Edition" 2020, Pearson Education.
2. Artificial Intelligence ,Saroj Kaushik, First edition, 2011,Cengage Learning,
3. Artificial Intelligence, George F Luger, Fourth edition, 2005, Pearson Education.

Reference Books :

1. Principles of Artificial Intelligence, Nils J. Nilsson, First Edition,1990, Narosa Publication.
2. A First Course in Artificial Intelligence, Deepak Khemani, Sixth Edition.2018, McGraw Hill Publication
3. Artificial Intelligence ,Patrick H. Winston, 3rd edition, 1993,Pearson Education.
4. Artificial Intelligence, Elaine Rich and Kevin Knight, Third Edition,2017, McGraw Hill Education,

Other Resources :

1. NPTEL Course: Artificial Intelligence, Prof. S. Sarkar, Prof. P. Mitra, IIT Kharagpur
   Web Link- https://nptel.ac.in/courses/106105078
2. NPTEL Course: Artificial Intelligence, Prof. P. Dasgupta, IIT Kharagpur
   Web Link- https://nptel.ac.in/courses/106105079

A. IN-SEMESTER ASSESSMENT (50 MARKS)

1. Continuous Assessment (20 Marks)

Suggested breakup of distribution

a) One Assignment on live problems/ case studies: 10 Marks

Students should be assigned a real life problem statement (different for each student). Students are expected to research and collect required resources to solve the problem. They can use the resources and solve the problem on assigned date and time in Institute premises in presence of faculty member. This assignment should be graded for 10 marks depending on the parameters as analysis, design, application of appropriate AI technique and outcome for selected problem statement.

b) One Think Pair Share (TPS) activity: 05 Marks

c) Regularity and active participation :05 Marks

2. Mid Semester Examination (30 Marks)

Mid semester examination will be based on 40% to 50% syllabus.

B. END SEMESTER EXAMINATION (50 MARKS)

End Semester Examination will be based on syllabus coverage up to the Mid Semester Examination (MSE) carrying 20% to 30% weightage, and the syllabus covered from MSE to ESE carrying 70% to 80% weightage.

Course Type	Course Code	Course Name	Credits
PEC	ITPEC5011	ANALYSIS OF ALGORITHMS	03

Examination Scheme					
Distribution of Marks			Exam Duration (Hrs.)		Total Marks
In-semester Assessment		End Semester Examination (ESE)			
Continuous Assessment	Mid-Semester Exam (MSE)		MSE	ESE	
20	30	50	1.5	2	100

Pre-requisite :

1. ITPCC303: Data structure & Analysis
2. ITPCC405: Engineering Mathematics-IV

Program Outcomes addressed :

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO3 : Design/development of solutions
4. PO8: Individual and Collaborative Team work
5. PO9: Communication

Course Objectives :

1. To provide mathematical background for analysis of algorithm
2. To introduce various advanced data structures.
3. To provide comprehensive knowledge about different techniques of problem solving/ algorithm design.
4. To make the students select and apply different algorithm design techniques for problem solving.
5. To familiarize learners with advanced algorithms and the concepts of pattern matching.

Module	Details	Hrs
00.	**Course Introduction** This course includes different techniques of problem solving and their applications for solving problems belonging to multidisciplinary domains. It also involves analysis of algorithms developed using these techniques, selection and application of an optimal technique/algorithm for solving a given problem. The course contents enable software engineers to make decisions on the design and implementation of more efficient algorithms, leading to faster and more scalable software systems in resource constrained diverse industry applications where high performance is a key factor.	**01**
01.	**Fundamentals of the analysis of algorithms and Advanced Data Structures**	**06-08**

	Learning Objective: *To introduce different methods to determine the time and space complexity of different algorithms and to select and apply the most suitable one for a particular problem.* *To introduce advanced data structures and operations on them.*	
	Contents: Fundamentals of the analysis of algorithms: Time and Space complexity, Asymptotic analysis and notation, average and worst-case analysis, Recurrences: The substitution method, Recursive tree method, Masters method. **Advanced Data Structures :** Definition , properties and operations on B tree, B+ tree, Red-Black Trees. Topological Sort –Definition, DFS method, adjacency matrix method.	
	Self-Learning Topics: *Analysis of Time and space complexity of iterative and recursive algorithms.* *Implementation of B tree and Red-Black Tree.*	
	Learning Outcomes : *A learner will be able to* *LO 1.1: Apply different methods to determine topological ordering of a directed acyclic graph. (P.I.-1.3.1)* *LO 1.2: Apply search and insert operations on B/B+ Tree. (P.I.-1.4.1)* *LO 1.3: Differentiate between B Tree and B+ tree and select appropriate data structure between the two for providing indexed sequential access of data. (P.I.-2.2.4)* *LO 1.4: Apply different methods to derive the time complexity of a given recursive algorithm. (P.I.-1.3.1)* *LO 1.5: Apply appropriate method to derive the time complexity of a given Iterative algorithm. (P.I.-1.4.1)* *LO 1.6: Analyze the time complexity of Iterative and recursive algorithms. (P.I.-2.4.1)* *LO 1.7: Identify and Use appropriate method to determine the time complexity of a recurrence relation. (P.I.-2.2.3)* *LO 1.8: Identify and Apply appropriate method to determine the topological ordering of a given graph.. (P.I.-2.2.3)*	
02.	**Divide and conquer technique and Greedy Algorithms** ***Learning Objective/s:*** *To make the learners master Divide and conquer and Greedy technique and make them apply these techniques to solve large scale complex and optimization problems.*	**07-09**
	Contents: **Divide and conquer technique:** Introduction to Divide and conquer technique of problem solving. Advantages, disadvantages. Types of problems that can be solved using D&C. Binary Search, Merge sort and Quick sort, Finding minimum and maximum algorithm. Analysis of all these algorithms. **Greedy Algorithms :** Introduction to Greedy Algorithms. Advantages, disadvantages. Types of problems that can be solved using Greedy Algorithms. Knapsack Problem, Job sequencing using deadlines, Optimal storage on tape, Optimal Merge Pattern. Analysis of all these algorithms.	

	Self-Learning Topics: *Implementation of minimum and maximum algorithm, Knapsack problem, Job sequencing using deadlines.*	
	Learning Outcomes : *A learner will be able to* *LO 2.1: Apply Greedy technique to solve a given problem. (P.I.-1.3.1)* *LO 2.2: Apply Divide and Conquer strategy to design an algorithm to solve a given problem (P.I.-1.4.1)* *LO 2.3: Identify and Use appropriate algorithmic design technique to solve a given problem. (P.I.-2.2.3)* *LO 2.4:Analyze the time complexity of algorithms designed using Divide and Conquer technique. (P.I.- 2.4.2)*	
03.	**Dynamic Algorithms** ***Learning Objective:*** *To acquaint the knowledge of dynamic programming technique to solve and analyze optimization problems in diverse application domains.*	**06-08**
	Contents: **Dynamic Algorithms :** Introduction to Dynamic Algorithms. Advantages, disadvantages. Types of problems that can be solved using Dynamic Algorithms. Comparison of Dynamic algorithms with D&C and Greedy algorithms. All pair shortest path, 0/1 knapsack, travelling salesman problem, Matrix Chain Multiplication, Optimal binary search tree. Analysis of All these algorithms.	
	Self-Learning Topics: *Implementation of All pair shortest path, 0/1 Knapsack and OBST..*	
	Learning Outcomes : *A learner will be able to* *LO 3.1: Determine an optimal order of Multiplication for multiplying a given chain of matrices (P.I.-1.3.1)* *LO 3.2: Use dynamic programming approach to solve a given problem. (P.I.-1.4.1)* *LO 3.3: Identify different methods used for solving knapsack problem. (P.I.-3.2.1)* *LO 3.4: Identify and apply appropriate problem solving technique to determine an optimal solution of a given problem. (P.I.-3.2.2)* *LO 3.5: Select and apply an appropriate technique to solve 0/1 knapsack problem and present the solution effectively in a team. (P.I.-2.2.4, P.I.-8.2.1, P.I.-9.2.2)* *LO 3.6: Select and apply an appropriate technique to solve travelling salesman problem and present the solution effectively in a team.. (P.I.-2.2.3, P.I.-8.3.1, P.I.-9.3.1)*	
04.	**Backtracking and Branch and bound** ***Learning Objective:*** *To acquaint the learners about Backtracking and Branch and bound algorithmic design techniques and make them apply and analyze these techniques to solve a wide range of computational problems including optimization, constraint satisfaction, puzzle solving, graph algorithms etc.*	**06-08**

	Contents: **Backtracking** : Introduction to Backtracking. Types of (decision) problems that can be solved using Backtracking Algorithms. N-queen problem, Sum of subsets or Graph coloring problem. **Branch and Bound :** Introduction to Branch and Bound. Types of (optimization) problems that can be solved using Branch and Bound, Comparison between Backtracking and Branch and Bound. Travelling Salesperson Problem or 15 Puzzle problem. Analysis of All these algorithms.	
	Self-Learning Topics: *Implementation of N-queen problem, 15 Puzzle problem.*	
	Learning Outcomes : *A learner will be able to* *LO 4.1: Use backtracking to solve a given problem (P.I.-1.3.1)* *LO 4.2: Apply Branch and Bound technique to solve a given problem. (P.I.-1.4.1)* *LO 4.3: Identify different algorithmic design techniques to solve a given problem. (P.I.-2.1.2)* *LO 4.4: Differentiate between Backtracking and Branch and Bound technique and select the best technique for solving a given optimization problem (P.I.- 2.2.4)*	
05.	**String matching algorithms** ***Learning Objective/s:*** *To acquaint the learners about the knowledge of string matching algorithms and to make the learners apply and analyze string matching algorithms for identifying patterns in textual data.*	**07-09**
	Contents: Introduction to string matching algorithms. The naïve string-matching algorithm, Rabin Karp algorithm, Knuth Morris-Pratt algorithm, Longest Common Subsequence (LCS). Analysis of All these algorithms.	
	Self-Learning Topics: *Implementation of Robin Karp algorithm, KMP algorithm and LCS.*	
	Learning Outcomes : *A learner will be able to* *LO 5.1: Apply Rabin Karp algorithm for pattern matching. (P.I.-1.3.1)* *LO 5.2: Compute the longest common subsequence for a given set of strings. (P.I.-1.4.1)* *LO 5.3: Apply Knuth Morris-Pratt algorithm to find the given pattern in a given string. (P.I.- 2.4.1)* *LO 5.4: Analyze the time complexity of Naïve Pattern matching algorithm. (P.I.-2.4.2)*	
06.	**Introduction to Advanced Algorithms and NP problems** ***Learning Objective/s:***	**05-07**

	To introduce/identify advance algorithms that are used for solving compute intensive and optimization problems for some of which the exact algorithms are of very low efficiency and the properties of NP hard and NP Complete problems.	
	Contents: **Optimization Algorithms:** Genetic algorithm (GA), **Approximation Algorithms:** Vertex-cover problem, **Parallel Computing Algorithms:** Fast Fourier Transform, Introduction to P, NP, NP-Hard and NP-Complete Problems.	
	Self-Learning Topics: *Implementation of Genetic algorithm and Vertex-cover problem.*	
	Learning Outcomes : *A learner will be able to* *LO 6.1: Solve Fast Fourier Transform problem using Parallel algorithm implementation. (P.I.-1.3.1)* *LO 6.2: Apply approximate algorithm to solve vertex cover problem. (P.I.-1.4.1)* *LO 6.3: Use genetic algorithm approach to solve an optimization problem. (P.I.-2.3.1)* *LO 6.4: Identify the limitations of P, NP, NP- Hard and NP- Complete problems. (P.I.- 2.4.3)*	
	Course Conclusion	**01**
	Total	**45**

Performance Indicators:

P.I. No. P.I. Statement

1.3.1 Apply engineering fundamentals.

1.4.1 Apply theory and principles of computer science engineering to solve an engineering problem.

2.1.2 Identifies processes/modules/algorithms of a computer based system and parameters to solve a problem

2.2.2 Identifies functionalities and computing resources.

2.2.3 Identify existing solution/methods to solve the problem, including forming justified approximations and assumptions

2.2.4 Compare and contrast alternative solution/methods to select the best methods

2.4.1 Applies engineering mathematics to implement the solution.

2.4.2 Analyze and interpret the results using contemporary tools.

2.4.3 Identify the limitations of the solution and sources/causes.

2.4.4 Arrive at conclusions with respect to the objectives.

3.2.1 Ability to explore design alternatives.

3.2.2 Ability to produce a variety of potential design solutions suited to meet functional requirements.

3.3.1 Ability to perform systematic evaluation of the degree to which several design concepts meet the criteria.

8.2.1 Demonstrate effective communication, problem solving, conflict resolution and leadership skills.

8.3.1 Present results as a team, with smooth integration of contributions from all individual efforts

9.2.2 Deliver effective oral presentations to technical and non-technical audiences

9.3.1 Create engineering-standard figures, reports and drawings to complement writing and presentations

Course Outcomes : Learner will be able to

1. Apply mathematical aspects and fundamentals of AOA for analysis of algorithms. *(LO1.4, LO1.5, LO1.7, LO 6.4)*
2. Apply different operations on advanced data structures. *(LO 1.1, LO1.2, LO1.3, LO1.8)*
3. Select and apply appropriate algorithm design technique for solving the given problem. *(LO 2.1, LO 2.2, LO 2.3, LO 3.1, LO 3.2, LO 3.3, LO 3.4, LO 4.1, LO 4.2, LO 4.3, LO 4.4 , LO 5.1, LO 5.2, LO 5.3, LO 6.1, LO 6.2, LO 6.3)*
4. Analyse complexity of different algorithms. *(LO 1.6, LO 2.4, LO 5.4)*
5. Solve a given problem by selecting and applying an appropriate algorithmic design technique and present the solution effectively in a team. *(LO 3.5, LO 3.6)*

CO-PO Mapping Table with Correlation Level

CO ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
ITPEC5011.1	3	3	-	-	-	-	-	-	-	-	-
ITPEC5011.2	3	3		-	-	-	-	-	-	-	-
ITPEC5011.3	3	3	3	-	-	-	-	-	-	-	-
ITPEC5011.4	-	3	-	-	-	-	-	-	-	-	-
ITPEC5011.5	-	3	-	-	-	-	-	3	3	-	-
Average	**3**	**3**	**3**	-	-	-	-	**3**	**3**	-	-

Text Books :

1. Introduction to Algorithms, Cormen, Leiserson, Rivest, Stein, 3rd Edition, 2009, MIT Press.
2. Algorithms: Design and Analysis, Harsh Bhasin, 2015, OXFORD University Press.
3. Fundamentals of Computer Algorithms, Horowitz, Sahani, Rajsekaran, Universities Press.
4. C and Data structures, Deshpande, Kakde, 1st Edition, 2003, Dreamtech Press.

Reference Books :

1. Digital Image Processing using MATLAB , Rafael C. Gonzalez and Richard E. Woods, 2003, Pearson Education.
2. Data Structures and Algorithms in C++, Goodritch, Tamassia, Mount, WILEY India Edition, 2015.
3. Data Structures using C, Reema Thareja , Second Edition, 2014, OXFORD.
4. Data Structures and Algorithm Analysis in C, Mark A. Weiss, Second Edition, 2020, Pearson.

Optimization Algorithms and Applications, By Rajesh Kumar Arora, First Editon, 2015,
5. Chapman and Hall.

Other Resources :

1. NPTEL Course: Design and Analysis of Algorithms By Prof. Madhavan Mukund, Chennai Mathematical Institute. Web link- https://nptel.ac.in/courses/106/106/106106131/

2. NPTEL Course: Image Processing using Python By Prof. Sourav Mukhopadhyay; Department of Computer Science and Engineering, IIT Kharagpur
Web link- https://archive.nptel.ac.in/courses/106/105/106105164/

3. NPTEL Course: Computer Vision and Image Processing - Fundamentals and Applications By Prof. Tim Roughgarden, Department of Computer Science, Stanford University, Stanford.
Web link- https://www.coursera.org/specializations/algorithms

A. IN-SEMESTER ASSESSMENT (50 MARKS)

1. Continuous Assessment (20 Marks)

Suggested breakup of distribution

a) One MCQ test as per GATE exam pattern/level: 05 Marks

b) Class Test : 05 Marks

c) Think-pair-share worksheets: 05 Marks

d) Regularity and active participation in class :05 Marks

2. Mid Semester Exam (30 Marks)

Mid semester examination will be based on 40% to 50% syllabus.

B. END SEMESTER EXAM (50 MARKS)

End Semester Examination will be based on syllabus coverage up to the Mid Semester Examination (MSE) carrying 20% to 30% weightage, and the syllabus covered from MSE to ESE carrying 70% to 80% weightage.

Course Type	Course Code	Course Name	Credits
PEC	ITPEC5012	CLOUD COMPUTING SERVICES	03

Examination Scheme					
Distribution of Marks			Exam Duration (Hrs.)		Total Marks
In-semester Assessment		End Semester Examination (ESE)			
Continuous Assessment	Mid-Semester Exam (MSE)		MSE	ESE	
20	30	50	1.5	2	100

Pre-requisite:

ESL103: Programming Laboratory-I (C)

ITPCC304: Database Management System

Program Outcomes addressed:

1 PO1: Engineering knowledge

2 PO2: Problem analysis

3 PO3: Design/development of solutions

4 PO4: Conduct investigations of complex problems

5 PO8: Individual and Collaborative team work

6 PO9: Communication

7 PO11: Life-long learning

Course Objectives:

1. To make learner to develop a deep understanding of cloud computing and virtualization technologies by analyzing architectures, deployment models, and system performance while fostering problem-solving, teamwork, and continuous learning
2. To make learner analyze and design scalable cloud-based service models by evaluating their essential components, assessing trade-offs, and defining system requirements while ensuring security, efficiency, and resource management.
3. To make learner develop and document structured approaches for selecting, implementing, and managing virtualization technologies, cloud platforms, and security frameworks
4. To familiarize Investigation and assessment of the security, privacy, and compliance challenges in cloud computing, focusing on IAM, Governance, Risk, and Compliance (GRC) standards.
5. To demonstrate communication, teamwork, and problem-solving skills by analyzing and presenting cloud computing concepts, security concerns, and emerging technologies.

Module	Details	Hrs.
00.	**Course Introduction**	**01**

	Cloud computing is a virtualization-based technology that allows us to create, configure, and customize applications via an internet connection. The cloud technology includes a development platform, hard disk, software application, and database.	
	Introduction to cloud computing ***Learning Objective:*** *To impart the concept of cloud computing and different types of service ,deployment model.*	**5-7**
	Contents: Introduction to cloud computing, need for cloud computing and its components, cloud & other similar configurations, cloud types: NIST and Cloud Cube Model, characteristics of cloud computing, deployment models, service models, advantages and disadvantages of Cloud Computing.	
	Self-Learning Topics: *Study the recent trends in cloud computing architectures and related technologies*	
	Learning Outcomes: *A learner will be able to* *LO 1.1: Apply fundamental engineering concepts to analyze cloud computing architectures, including service and deployment models. (PI- 1.3.1)* *LO 1.2: Utilize knowledge of cloud computing fundamentals to compare cloud architectures with traditional computing models.(P-I 1.4.1)* *LO 1.3:Evaluate the given problem statement and identify and categorize different cloud computing models (NIST and Cloud Cube Model) based on their characteristics and functionalities. (PI- 2.1.1)* *LO 1.4:Identify the advantages and disadvantages of cloud computing by assessing different deployment and service models. (PI -2.1.2)*	
01.	**Virtualization** ***Learning Objective:*** *To familarize the concept of Virtualization. Also expected to apply the concept of virtualization to create VM.*	**5-7**
	Contents: Characteristics of virtualized environment, structures of virtualization, implementation levels of virtualization, mechanisms of virtualization, pros and cons of virtualization, virtualization vs cloud computing, Xen and KVM architecture.	
	Self-Learning Topics: *Comparison between different virtualization techniques*	
	Learning Outcomes:	
	A learner will be able to *LO 2.1: Evaluate problem statement **to id**entify and categorize different virtualization technologies based on their architectures and functionalities. (PI - 2..1.1)* *LO 2.2: Analyze the impact of virtualization on system performance and resource management and arrive at conclusion. (PI- 2.4.4)* *LO 2.3: Develop structured approaches for selecting appropriate virtualization solutions based on specific system requirements. (PI- 3.4.1)*	

	LO 2.4: Document system requirements for implementing virtualization technologies effectively. (PI 3.1.2) *LO 2.5: Apply specialized engineering knowledge to analyze virtualization concepts, demonstrate effective communication and teamwork in presenting and discussing their role in modern computing, and recognize the need to stay current with evolving technologies.. (PI-1.4.1, 8.2.1, 9.1.3, 11.2.1)* *LO 2.6: Collaborate effectively in a team to interpret technical documentation, apply engineering fundamentals to understand and implement advancements in virtualization technologies, and recognize the importance of continuous learning to stay updated with evolving technological trends. (PI -1.3.1,8.3.1, 9.1.1, 11.2.2)* *LO 2.7: Apply Specialized Engineering Knowledge for Virtualization Concepts (PI-1.4.1)* *LO 2.8: Study the features, structures, and levels of virtualization using engineering principles. Understand virtualization mechanisms, compare it with cloud computing, and examine the pros and cons of Xen and KVM architectures. (PI-1.3.1)*	
03.	**Cloud Computing Services** ***Learning Objective:*** *To impart the knowledge of cloud computing services. Also expected to use services according to the requirement.* **Contents:** SPI Model of Cloud computing, Everything as a Service (XaaS): Database as a Service, Storage as a Service, Security as a Service, Collaboration as a Service, Monitoring as a Service, Network as a Service, Disaster Recovery as a service, Identity management as a Service, Analytics as a Service and Backup as a Service. ***Self-Learning Topics:*** *Study of different cloud computing platforms providing XaaS services* ***Learning Outcomes:*** *A learner will be able to* *LO 3.1: Understand the SPI (Software, Platform, Infrastructure) model of cloud computing and the fundamentals of Everything as a Service (XaaS). Analyze different cloud-based services, including Database as a Service, Storage as a Service, and Security as a Service. (PI- 1.3.1)* *LO 3.2: Examine the implementation and benefits of cloud service models, including Collaboration, Monitoring, Networking, Disaster Recovery, Identity Management, Analytics, and Backup as a Service. Evaluate their role in modern computing and enterprise solutions. (PI- 1.4.1)* *LO 3.3: Identify and evaluate the essential components of cloud-based service models (SPI) and their functionalities based on selected problem. (PI -2.1.1)* *LO 3.4: Critically assess the advantages, disadvantages, and trade-offs of various XaaS solutions to reach substantiated conclusions. (PI- 2.4.4)* *LO 3.5: Design scalable cloud service-based solutions by defining system requirements aligned with organizational needs. (PI- 3.2.2)* *LO 3.6: Identify **system specifications** for implementing XaaS models with considerations for security, efficiency, and resource management. (PI- 3.1.2)*	**5-7**
04.	**Amazon Web Services and Cloud Platform** ***Learning Objectives:*** *To familiarize amazon web services and also expected to use AWS* **Contents:**	**11-13**

	Introduction to the AWS Cloud, AWS core services by categories. Compute Service: Introduction to EC2, EC2 Instances, EC2 Amazon Machine Images, Instance Types, Instance Lifecycle. Storage Service: Introducing S3, working with Buckets, setting bucket security, S3 event and notification, bucket properties, working with Elastic Block Store Volumes, Object Storage Vs Block Storage, Archives versus backups, Introduction to Glacier. Virtual Private Cloud: Introduction, Subnet, Elastic Network Interfaces, Internet Gateways, Route Tables, Security Groups. CloudWatch:Introduction, CloudWatch Metrics, CloudWatch Alarms. Database as a Service: Introduction to Amazon Relational Database Service (RDS), Database Engines, Database Instance Classes, Backup and Recovery, Non-relational (No-SQL) Databases, Types of Non relational Databases, Introduction to DynamoDB, Features, Partition and Hash Keys	
	Self-Learning Topics: *Comparison of AWS services with other cloud service platforms like Azure and GCP*	
	Learning Outcomes: *A learner will be able to* *LO 4.1: Understand AWS cloud concepts, including compute, storage, networking, and database services. Explore EC2 instances, S3 storage, Virtual Private Cloud (VPC), and CloudWatch for monitoring. Analyze key differences between object and block storage, relational and non-relational databases, and data backup solutions. (PI- 1.3.1)* *LO 4.2: Examine the architecture and functionality of AWS core services, including EC2, S3, VPC, CloudWatch, and DynamoDB. Evaluate security mechanisms, networking configurations, and database management features to enhance cloud-based solutions. (PI- 1.4.1)* *LO 4.3: Design cloud-based solutions and define system requirements using AWS compute, storage, and database services. (PI- 3.1.1)* *LO 4.4: Identify system architecture for implementing AWS cloud services with security, performance, and cost considerations. (PI- 3.1.2)* *LO 4.5: Apply specialized engineering knowledge to analyze technological advancements in AWS cloud services and evaluate their role in modern IT infrastructure, while recognizing the need for continuous learning to keep pace with emerging technologies. (PI- 1.4.1,11.2.1)* *LO 4.6: Apply engineering fundamentals to understand AWS cloud computing and recognize the importance of continuous learning to stay updated with emerging trends and best practices.. (PI-1.3.1, 11.2.2)*	
05.	**Open stack Cloud platform & Severless Computing** ***Learning Objective/s:*** *To make learner understand the open stack architecture and also expected to learn sercerless computing*	**6-8**
	Contents: Open source Cloud Platform: Introduction to Openstack cloud platform, Components and modes of Operations, Architecture of Openstack cloud platform. Mobile Cloud Computing: Definition, architecture, benefits and challenges of mobile cloud computing. Serverless Computing: Introduction, Working with Serverless environment,Basics of severless events and functi ons, AWS Lambda	
	Self-Learning Topics:	

	To study different open source cloud computing platforms and compare them based on different XaaS services provided by them.	
	Learning Outcomes : *A learner will be able to* *LO 5.1:Understand the architecture, components, and operational modes of the OpenStack cloud platform. Analyze the fundamentals of mobile cloud computing, including its architecture, benefits, and challenges. Explore serverless computing concepts, events, and functions.* (PI- 1.3.1) *LO 5.2 Examine the working principles of OpenStack, mobile cloud computing, and serverless environments. Evaluate AWS Lambda functions and serverless event-driven architectures to develop scalable cloud-based applications.* (PI:-1.4.1)*:* *LO 5.3: Design scalable cloud-based solutions and define system requirements using OpenStack, mobile cloud architectures, and AWS Lambda. (PI- 3.1.1)* *LO 5.4: Identify system specifications for implementing OpenStack and mobile cloud computing with security, scalability, and performance considerations. (PI- 3.1.2)* *LO 5.5: Utilize appropriate tools and techniques to collect and analyze data for evaluating cloud performance and efficiency. (PI -4.3.1)* *LO 5.6: Synthesize data and information to draw meaningful conclusions regarding OpenStack performance, mobile cloud computing efficiency, and serverless computing effectiveness. (PI- 4.3.4)*	
06.	**Cloud Security & Privacy**	**5-7**
	Learning Objective/s: *To make learner understand the concept of cloud security and Also expected to provide security to the cloud*	
	Contents: What is security, why is it required in cloud computing, Different types of security in cloud, attacks, and vulnerabilities, IaaS security, PaaS security, SaaS security, trust boundary, Audit and reporting. Introduction to Identity and access Management (IAM), IAM Challenges, IAM Definition, IAM Architecture and Practice, Relevant IAM Standards and Protocols for Cloud Services. Privacy: What Is Privacy? What Are the Key Privacy Concerns in the Cloud?, Legal and Regulatory Implications: Laws and Regulations, Governance, Risk, and Compliance (GRC).	
	Self-Learning Topics: *To assess and analyze how the security and privacy is maintained in different cloud computing platforms*	
	Learning Outcomes: *A learner will be able to* *LO 6.1:Understand the importance of security in cloud computing, including different types of security, attacks, and vulnerabilities. Analyze security measures for IaaS, PaaS, and SaaS, along with trust boundaries, auditing, and reporting. Explore Identity and Access Management (IAM) architecture, challenges, and best practices. (PI- 1.3.1)* *LO 6.2: Examine security frameworks, IAM protocols, and governance models for securing cloud services. Evaluate privacy concerns, legal and regulatory implications, and Governance, Risk, and Compliance (GRC) requirements in cloud computing environments. (PI- 1.4.1)* *LO 6.3: Apply specialized engineering knowledge to analyze cloud security principles, identify and define system requirements, evaluate threats and vulnerabilities in IaaS, PaaS, and SaaS environments, and draw substantiated conclusions to develop effective solutions for complex engineering problems. (PI- ,1.4.1,2.1.1, 3.1.2, 2.4.4)*	

	LO 6.4: Apply engineering fundamentals to evaluate Identity and Access Management (IAM) frameworks, identify system requirements and relevant security protocols, collaborate effectively in teams to design secure cloud solutions, communicate findings through clear documentation and presentations, and recognize the need for continuous learning to ensure compliance with Governance, Risk, and Compliance (GRC) standards. (PI -1.3.1,3.1.1, 2.1.2, 8.2.1, 8.3.1, 9.1.1, 9.1.3, 11.2.1, 11.2.2)	
	Course Conclusion	**01**
	Total	**45**

Performance Indicators:

P.I. No.	**P.I. Statement**
1.3.1	Apply engineering fundamentals
1.4.1	Apply theory and principles of computer science engineering to solve an engineering problem
2.1.1	Evaluate problem statements and identifies objectives
2.1.2	Identifies processes/modules/algorithms of a computer based system and parameters to solve a problem
2.4.4	Arrive at conclusions with respect to the objectives
3.1.1	Able to define a precise problem statement with objectives and scope.
3.1.2	Able to identify and document system requirements from stake holders.
4.3.1	Use appropriate procedures, tools and techniques to collect and analyze data
4.3.4	Synthesize information and knowledge about the problem from the raw data to reach appropriate conclusions
8.2.1	Demonstrate effective communication, problem solving, conflict resolution and leadership skills
8.3.1	Present results as a team, with smooth integration of contributions from all individual efforts
9.1.1	Read, understand and interpret technical and nontechnical information
9.1.3	Create flow in a document or presentation - a logical progression of ideas so that the main point is clear
11.2.1	Identify historic points of technological advance in engineering that required practitioners to seek education in order to stay current
11.2.2	Recognize the need and be able to clearly explain why it is vitally important to keep current regarding new developments in your field

Course Outcomes: A learner will be able to -

1. Analyze and implement cloud computing architectures, virtualization technologies, and cloud service models. *(LO 1.1, 1.2, 1.3, 1.4,2.1, 2.2, 2.7, 2.8, 3.1, 3.2, 3.3, 3.4)*
2. Assess, implement, and optimize cloud solutions using AWS services (EC2, S3, RDS, VPC, CloudWatch) and OpenStack platforms. *(LO 4.1, 4.2, 4.3, 4.4, 5.1, 5.2, 5.3, 5.4)*

3. Apply virtualization technologies ,security measures, IAM protocols, and governance models to ensure secure cloud computing environments and cloud service-based solutions. *(LO 2.3,2.4, 3.5,3.6,6.1, 6.2, 6.3, 6.4)*
4. Evaluate cloud performance, explore mobile cloud computing, and apply serverless architectures like AWS Lambda for scalable solutions. *(LO 5.1, 5.2, 5.5, 5.6)*
5. Work in teams to analyze cloud documentation, present solutions effectively, and stay updated with evolving cloud computing trends. *(LO 2.5, 2.6, 4.5, 4.6, 6.2, 6.3, 6.4)*

CO-PO Mapping Table with Correlation Level

CO ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
ITPEC5012.1	3	3	-	-	-	-	-	-	-	-	-
ITPEC5012.2	3	-	3	-	-	-	-	-	-	-	-
ITPEC5012.3	3	3	3	-	-	-	-	3	3	-	3
ITPEC5012.4	3	-	-	3	-	-	-	-	-	-	-
ITPEC5012.5	3	3	3	-	-	-	-	3	3	-	3
Average	**3**	**3**	**3**	**3**	-	-	-	**3**	**3**	-	**3**

Text Books :

1. Cloud computing Bible, Barrie Sosinsky, Wiley publication
2. Cloud Computing Black Book, Kailash Jayaswal, Jagannath Kallalurchi, Donald J. Houde, Dr. Deven Shah, Dreamtech Press[p;plpkok
3. Mastering Cloud Computing, Rajkumar Buyya, MGH publication
4. AWS certified solution Architect, Joe Baron et.al, Cybex publication
5. Cloud Security and Privacy, Tim Mather, Subra Kumaraswamy, and Shahed Latif, O'Reilly Publication
6. Cloud security: A comprehensive guide to secure cloud computing by ronold L Krutz and Russell Dean Vines, Wiley publication

Reference Books :

1. Distributed and Cloud Computing From Parallel Processing to the Internet of Things, Kai Hwang, Geoffrey C. Fox, Jack Dongarra, Morgan Kaufmann Publication
2. Cloud Computing for Dummies, Judith Hurwitz, Wiley Publication
3. Cloud Application Architectures: Building Applications and Infrastructure in the Cloud, George Reese, O'Reilly Publication
   Cloud computing security: foundation and challenges, John R Vecca, CRC Press

Other Resources :

1. NPTEL Course : Cloud Computing by Prof. Soumya Kanti Ghosh, IIT Kharagpur **Web Link** https://archive.nptel.ac.in/courses/106/105/106105167/
2. NPTEL Course : Google Cloud Computing Foundations by Prof. Soumya Kanti Ghosh, IIT Kharagpur, and experts from Google Cloud **Web Link** https://onlinecourses.nptel.ac.in/noc20_cs55/preview
3. NPTEL Course : Cloud Computing and Distributed Systems by Prof. Sudip Misra, IIT Kharagpur **Web Link**- https://onlinecourses.nptel.ac.in/noc25_cs12/preview

A. IN-SEMESTER ASSESSMENT (50 MARKS)

1. Continuous Assessment (20 Marks)

a) 01 MCQ test strictly as per GATE exam pattern / level) (Please ensure that all quizzes are conducted offline, not online: 05 Marks

b) One Class Test:05 Mark

c) Article reading & summarization: 05 Marks

d) Regularity and active participation :05 Marks

2. Mid Semester Exam (30 Marks)

Mid semester examination will be based on 40% to 50% syllabus.

B. END SEMESTER EXAMINATION (50 MARKS)

End Semester Examination will be based on syllabus coverage up to the Mid Semester Examination (MSE) carrying 20%-30% weightage, and the syllabus covered from MSE to ESE carrying 70%-80% weightage.

Course Type	Course Code	Course Name	Credits
PEC	ITPEC5013	DATA WARE HOUSING & MINING	03

Examination Scheme					
Distribution of Marks			Exam Duration (Hrs.)		Total Marks
In-semester Assessment		End Semester Exam (ESE)			
Continuous Assessment	Mid-Semester Exam (MSE)		MSE	ESE	
20	30	50	1.5	2	100

Pre-requisite:

1. ITPCC304: Database Management System

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO3: Design/development of solutions
4. PO4: Conduct investigation of complex problems
5. PO8: Individual and collaborative team work
6. PO9: Communication

Course Objectives:

Learner is expected to

1. To acquaint with the principles of Data warehousing and Data Mining..
2. To inculcate comprehensive knowledge about the architecture of a Data Mining system.
3. To familiarize the concepts of the various Data preprocessing Methods
4. To gain knowledge of the supervised and unsupervised learning algorithms.

Module	Detailed Contents	Hrs
00.	**Course Introduction:** A data warehouse serves as a robust foundation for data mining activities. It provides a clean, integrated, and historical dataset that makes mining more effective. The integration of these technologies helps organizations in deriving deeper insights, supporting strategic decisions, and maintaining a competitive edge. Data warehouses and data mining (DWM) allow organisations to effectively store, manage, and analyse huge quantities of data, resulting in important insights that fuel corporate success. A data warehouse consolidates data from several sources, making it easier to run complicated queries and generate reports while maintaining data consistency and accuracy. Data mining, on the other hand, employs sophisticated techniques such as clustering, classification, and association analysis to uncover hidden patterns and trends in the data. DWM helps to improve customer relationships, detect fraud, and stay competitive in an increasingly data-driven world.	**01**
01.	**Data Warehousing and Business Analysis:** ***Learning Objective:*** *To gain knowledge of Data Warehouse, design of data warehouse and implement it.*	**07-09**

	Contents: Data Warehouse characteristics, Data Warehouse Architecture, Data Extraction, Transformation and Loading.Online Analytical Processing (OLAP) and Online Transactional Processing (OLTP), Dimensional modeling: Star, Snowflakes OLAP and Multidimensional Data Analysis, OLAP Architecture, OLAP operation	
	Self-Learning Topic: *Data Marts, Major issues in Data Mining*	
	Learning Outcomes: *A learner will be able to* *LO1.1: Apply engineering fundamentals to define data warehouse and data mining. (PI-1.3.1)* *LO1.2: Identifies functionalities of OLTP and OLAP (PI-2.2.2)* *LO1.3: Apply theory and principles of dimensional modelling to real life problem. (P.I.-1.4.1)* *LO1.4: Analyze and interpret star schema and snowflake for real-life problem statement (PI- 3.2.1)* *LO1.5: Implement the data warehouse in terms of OLAP cube (PI- 3.4.2)* *LO1.6: Apply computer engineering principles to attain the inference from result from OLAP operations (PI- 2.4.4)*	
02.	**Data Exploration and Data Preprocessing** ***Learning Objective:*** *To know various steps in pre-processing datasets.*	**05-07**
	Contents: Data Mining as a step in KDD, Data Mining Functionalities, Data Mining applications. Types of Attributes, Statistical Description of Data, Measuring Data Similarity and Dissimilarity, Data visualization techniques. Why Preprocessing? Data Cleaning, Data Integration, Data Reduction: Attribute Subset Selection, Histograms, Clustering, Sampling, Data Cube aggregation, Data transformation and Data Discretization: Binning, Histogram Analysis	
	Self-Learning Topic: *Principal Component Analysis*	
	Learning Outcomes: *The learner will be able to* *LO2.1: Apply concept of datamining attributes to identify types of attributes. (P.I.-1.3.1).* *LO2.2: Apply statistical description to given data (P.I.-1.4.1)* *LO2.3: Apply dissimilarity measures to find the similarity between data objects and give solution for grouping the data samples (P.I.- 2.4.1)* *LO2.4: Apply the preprocessing techniques like cleaning, integration, reduction, transformation on the dataset to obtain the quality data for datamining (PI-2.3.1)* *LO2.5: Use appropriate visualization techniques to analyze data (PI-4.3.1)* *LO2.6: Interpret the data with visualization approach (PI-4.3.3)*	
03.	**Classification and Prediction** ***Learning Objectives:*** *To impart the knowledge of supervised learning algorithm.*	**06-08**
	Contents: Classification methods: Decision Tree Induction: Attribute Selection, Measures, Tree pruning.	

	Bayesian Classification: Naïve Bayes Classifier. k-nearest neighbors Prediction: Structure of regression models; Simple linear regression, Evaluating the Accuracy of a Classifier or Predictor, Holdout, Random Sampling, Cross Validation, Bootstrap Introduction of Ensemble methods: Bagging, Boosting,.	
	Self-Learning Topics: *Random forest, SVM, Multiple linear regression, logistic regression*	
	Learning Outcomes: *The learner will be able to* *LO3.1: Identify and Apply the classification algorithm like decision tree and Bayesian classification algorithm on dataset (P.I.- 2.1.2)* *LO3.2: Analyze and interpret prediction of dependent variable using linear regression. (PI-2.4.2)* *LO3.3: Implement Holdout, Random Sampling, Cross Validation, Ensemble methods to improve the performance of classification. (P.I.- 3.4.2)* *LO3.4: Validate the functionalities of model created using classification by finding Accuracy and Error measures, Precision, Recall. (PI-3.4.3)*	
04.	**Clustering** ***Learning Objectives:*** *To acquaint the knowledge of unsupervised learning algorithm.*	**06-08**
	Contents: Cluster Analysis: Basic Concept A Categorization of Major Clustering Methods: Partitioning Methods: K-means, K-medoid, Hierarchical methods: Agglomerative, Divisive. Density-Based Methods: DBSCAN. Outlier Analysis: What are outliers? Types of outliers. Outlier Detection Methods: Supervised, Semi Supervised, Unsupervised, Proximity based, Clustering Based.	
	Self-Learning Topics: *Hierarchical method: BIRCH, Density based method: OPTICS, Grid based methods: STING, CLIQUE*	
	Learning Outcomes: *The learner will be able to* *LO4.1: Identify different clustering algorithm for user's problem. (P.I.- 2.1.2)* *LO4.2: Identify the functionalities of algorithm selected (P.I.- 2.2.2)* *LO4.3: Apply clustering algorithm to find the group in dataset. (P.I.-3.4.2)* *LO4.4: Validate the created model using error measures. (P.I.-3.4.3)*	
05.	**Frequent Pattern Mining** ***Learning Objective:*** *To impart the knowledge of mining patterns from dataset.*	**05-06**
	Contents: Market Basket Analysis, Support and Confidence Measures, Frequent Itemset, Closed Itemset, and Association Rules; Apriori Algorithm, FP-Growth approach for mining Frequent Itemset, Mining Frequent Itemset using vertical data formats; Introduction to Advance Pattern Mining: Mining Multilevel Association Rules and Multidimensional Association Rules.	
	Self-Learning Topics: *Association Mining to Correlation Analysis, lift, Introduction to Constraint-Based Association Mining*	
	Learning Outcomes: *The learner will be able to* *LO5.1: Apply the concept of market basket analysis (P.I.- 1.3.1)* *LO5.2: Apply the pattern mining methods like Apriori Algorithm and FP growth*	

	algorithm to find association rules among item set. (P.I.- 4.3.3) *LO5.3: Use vertical data format to find patterns (PI- 4.3.1)* *LO5.4: Apply theory of advance pattern mining methods like mining multilevel association rules and multidimensional association rules to analyse the data. (P.I.-1.4.1)*	
06.	**Case study on data mining methodologies:** ***Learning Objectives:*** *To identify the various data mining techniques for mining different datasets*	**08-10**
	Contents: Web Content Mining, Web Structure Mining, Web Usage Mining, Spatial Mining, Text Mining	
	Self-Learning Topics: Multimedia Data Mining	
	Learning Outcomes: *The learner will be able to* *LO6.1: Identify various techniques to solve the real life problem (P.I.- 2.1.2, P.I.-8.2.1)* *LO6.2: Identify functionalities and computing resources to find the solution (PI- 2.2.2)* *LO6.3: Implement data mining stages to find the solution (PI - 3.4.2, P.I.- 9.1.1)* *LO6.4: Interpret and validate the results of data mining case study with different evaluation techniques (P.I.- 3.4.3, P.I.- 8.3.1, P.I.- 9.2.2)*	
	Course Conclusion	**01**
	Total	**45**

Performance Indicators:

P. I. Number	**P. I. Statement**
1.3.1	Apply engineering fundamentals.
1.4.1	Apply theory and principles of computer science engineering to solve an engineering problem
2.1.2	Identifies processes/modules/algorithms of a computer based system and parameters to solve a problem
2.2.2	Identifies functionalities and computing resources.
2.3.1	Able to apply computer engineering principles to formulate modules of a system with required applicability and performance
2.4.1	Applies engineering mathematics to implement the solution.
2.4.2	Analyze and interpret the results using contemporary tools.
2.4.4	Able to apply computer engineering principles to formulate modules of a system with required applicability and performance
3.2.1	Analyze and interpret the results using contemporary tools.
3.4.2	Ability to implement and integrate the modules.
3.4.3	Ability to verify the functionalities and validate the design.
4.3.1	Use appropriate procedures, tools and techniques to collect and analyze data
4.3.3	Represent data (in tabular and/or graphical forms) so as to facilitate analysis and explanation of the data, and drawing of conclusions
8.2.1	Demonstrate effective communication, problem solving, conflict resolution and leadership skills
8.3.1	Present results as a team, with smooth integration of contributions from all individual efforts
9.1. 1	Create flow in a document or presentation - a logical progression of ideas so that the main point is clear
9.2.2	Deliver effective oral presentations to technical and non-technical audiences

Course Outcomes:

Learner will be able to

1. Design data warehouse and apply OLAP operations for analysis of data. (*LO1.1, LO1.2, LO1.3, LO1.4, LO1.5, LO1.6*)
2. Use pre-processing techniques and perform exploratory data analysis. (*LO2.1, LO2.2, LO2.3, LO2.4, LO2.5, LO2.6*)
3. Apply supervised learning algorithms to datasets. (*LO3.1, LO3.2, LO3.3, LO3.4*)
4. Apply unsupervised learning algorithms to datasets. (*LO4.1, LO4.2, LO4.3, LO4.4*)
5. Apply frequent Pattern mining on data sets to find association between item sets (*LO5.1, LO5.2, LO5.3, LO5.4*).
6. Collect the data, preprocess it, select a data mining task, apply it to the preprocessed data, and evaluate the model in relation to the appropriate research article. (*LO6.1, LO6.2, LO6.3, LO6.4*).

CO-PO Mapping Table with Correlation Level

CO ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
ITPEC5013.1	3	3	3	-	-	-	-	-	-	-	-
ITPEC5013.2	3	3	-	3	-	-	-	-	-	-	-
ITPEC5013.3	-	3	3	-	-	-	-	-	-	-	-
ITPEC5013.4	-	3	3	-	-	-	-	-	-	-	-
ITPEC5013.5	3	-	-	3	-	-	-	-	-	-	-
ITPEC5013.6	-	3	3	-	-	-	-	3	3	-	-
Average	3	3	3	3	-	-	-	3	3	-	-

Text Books:

1. Data Mining Concepts and Techniques, Han, Kamber, 3rd Edition.
2. Data Warehousing Fundamentals: A Comprehensive Guide for IT Professionals, Paulraj Ponniah, Wiley Publications

Reference Books:

1. Data Mining, Vikram Pudi & Radha Krishna, Oxford Higher Education.
2. Data Mining Techniques, Michael Berry and Gordon Linoff, 2nd Edition Wiley Publications.,

Other Resources:

1. NPTEL Course: Data Mining by Prof. Pabitra Mitra, IIT Kharagpur **Web Link-** https://onlinecourses.nptel.ac.in/noc22_cs11/course

A. IN-SEMESTER ASSESSMENT (50 MARKS)

Suggested breakup of distribution

1. Continuous Assessment (20 Marks)

a) Numerical Assignment/s (min 20 problems) -05 Marks

b) Class test based on above (a) numerical assignment: 05 Marks

c) Article reading & summarization activity: 05 Marks

d) Regularity and active participation :05 Marks

2. Mid Semester Examination (30 Marks)

Mid semester examination will be based on 40% to 50% syllabus.

B. END SEMESTER EXAMINATION (50 MARKS)

End Semester Examination will be based on syllabus coverage up to the Mid Semester Examination (MSE) carrying 20% to 30% weightage, and the syllabus covered from MSE to ESE carrying 70% to 80% weightage.

Course Type	Course Code	Course Name	Credits
LBC	ITLBC506	CLOUD COMPUTING LABORATORY	01

Examination Scheme		
Continuous Assessment	**End Semester Exam (ESE)**	**Total**
25	25	50

Pre-requisite:

1. ESL103 : Programming Laboratory-I (C)

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO3: Design/development of solutions
4. PO8: Individual and Collaborative team work
5. PO9: Communication
6. PO11: Life-long learning

Course Objectives:

1. To make learner develop fundamental concepts to install, configure, and optimize virtualization environments (hosted and bare-metal) using tools such as VirtualBox, KVM, Xen, Hyper-V, and VMware ESXi, ensuring efficient resource management and compatibility with cloud infrastructures.
2. To make learner to deploy and manage cloud infrastructure and services (IaaS, PaaS, and STaaS) on platforms like AWS, Azure, and Google Cloud, focusing on resource optimization, scalability, and performance
3. To make learner to implement and manage cloud-based services (DBaaS and IAM) with an emphasis on security, compliance, and adaptability to evolving industry standards.
4. To make learner Collaborate effectively in teams to define system requirements, implement cloud-based solutions, and document system specifications and deployment strategies while demonstrating effective communication, leadership, and problem-solving skills.
5. To make learner Cultivate proficiency in container orchestration through the deployment and management of Kubernetes clusters, emphasizing documentation, scalability, orchestration strategies, and awareness of emerging industry trends.

Module	Details	Hrs.
00.	**Course Introduction** This is foundation course which deals with a wide range of benefits, including improved accessibility, flexibility, and cost-effectiveness, making it a central part of modern technology infrastructure.	**00**
01.	**Overview & Virtualization.:** ***Learning Objective:***	**04**

	Learner is expected to gain knowledge types of hypervisor to create virtual machine and expected to implement it	
	Contents: Introduction and overview of cloud computing. Hosted Virtualization using KVM Hypervisor and its types **Task 1:** To implement Hosted Virtualization usingVirtual Box & KVM. **Task 2:** To implement Bare-metal Virtualization using Xen, HyperV or VMware Esxi.	
	Self-Learning Topics:	
	Learning Outcomes: *A learner will be able to* *LO 1.1: Identify various types of hypervisors by applying engineering fundamentals and analyze their architectures to define precise problem statements with clear objectives for selecting the most suitable type for specific applications..* (PI-1.3.1, 3.1.1) *LO 1.2: Set up and manage bare-metal virtualization using hypervisors like Xen, Hyper-V, or VMware ESXi by applying specialized engineering knowledge, identifying system requirements, and analyzing resource usage, scalability, and efficiency..* (PI- 1.4.1, 3.1.2)	
02.	**Types of cloud services** ***Learning Objective:*** *Learner is expected to list and identify cloud computing services to implement real time application* **Task 3:** To implement Infrastructure as a Service usingAWS/Microsoft Azure/Google cloud platform. **Task 4:** To implement Platform as a Service using AWS Elastic Beanstalk/ Microsoft Azure App Service. **Task 5:** To Implement Security as a Service on AWS/Azure **Task 6:** To implement Identity and Access Management (IAM) practices on AWS/Azure cloud.	**08**
	Contents: Infrastructure Services, Platform Services, Cloud Services: IaaS, PaaS, STaaS, DbaaS, IAM andSecurity as a Service on AWS and Azure	
	Self-Learning Topics:	
	Learning Outcomes: *A learner will be able to* *LO 2.1: Work as a team to plan, set up, and manage virtual machines, storage, and networking in an IaaS environment using AWS, Azure, or Google Cloud. Apply engineering fundamentals to define system requirements, ensure high performance and security, use various cloud services (IaaS, PaaS, STaaS, DBaaS, IAM, and Security as a Service), adapt to new cloud technologies, and communicate and solve problems effectively during deployment*. (PI -1.3.1, 1.4.1,3.1.1, 8.2.1, 8.3.1, 11.2.1, 11.2.2)	

	LO 2.2: Work together as a team to specify system requirements and configurations for deploying applications on cloud-based PaaS platforms. Implement Identity and Access Management (IAM) using AWS or Azure to improve security and ensure proper access control. Stay updated with new technologies in PaaS and IAM to understand their impact on modern application development and follow evolving identity management standards (PI-3.1.2, 8.2.1, 8.3.1, 11.2.1, 11.2.2)	
03.	**Storage Services and Containerization** ***Learning Objective:*** *Learner is expected to define and demonstrate storage services to provide access to the required data and implement it for real time application.*	**08**
	Task 7 : To study and Implement Storage as a Service using Own Cloud/ AWS S3, Glaciers/ Azure Storage. **Task 8 :** To implement Database as a Service on SQL/NOSQL databases like AWS RDS, AZURE SQL/MongoDB Lab/ Firebase. **Task 9 :** To implement Containerization using Docker on AWS/Azure/Google cloud platform.	
	Self-Learning Topics:	
	Learning Outcomes: *A learner will be able to* *LO 3.1: Set up Storage as a Service (STaaS) using tools like OwnCloud, AWS S3, Glacier, or Azure Storage to manage data efficiently, securely, and at scale. Document storage configurations, follow best practices, and stay updated with new storage technologies and trends. (PI 3.1.2, PI 11.2.1, PI 11.2.2)* *LO 3.2: Define system requirements to deploy and manage cloud-based Database as a Service (DBaaS) solutions using SQL/NoSQL databases like AWS RDS, Azure SQL, MongoDB, or Firebase. Use engineering knowledge to implement containerization with Docker on AWS, Azure, or Google Cloud to improve application performance and scalability while staying updated with the latest technologies. (PI 3.1.1, PI 11.2.1)*	
04.	**Introduction and overview of Kubernetes:** ***Learning Objectives:*** *Learner is expected to define and demonstrate Kubernetes Configuration and Deployment, Networking in Kubernetes to automate the deployment, scaling, and management of containerized applications. It provides a highly flexible architecture for managing workloads across clusters of machines, whether on-premise or in the cloud.* **Task 10:** **To study and implement container orchestration using Kubernetes on AWS/Azure/Google cloud platform**	**10**
	Contents: Kubernetes Core Concepts, Kubernetes Configuration and Deployment, Networking in Kubernetes	
	Self-Learning Topics:	
	Learning Outcomes:	

	A learner will be able to *LO 4.1: Read, interpret, and develop comprehensive documentation for deploying and managing containerized applications using Kubernetes on AWS, Azure, or Google Cloud, ensuring efficient orchestration, scalability, and security while maintaining a logical flow of deployment processes, adhering to best practices, and identifying existing solutions and methods for effective cloud-based container orchestration.* (Aligned with PI 1.3.1,2.2.3, 9.1.1, 9.1.2) *LO 4.2: document Kubernetes deployment steps and best practices to make cloud-based container orchestration more efficient, scalable, and secure by identifying necessary functions and computing resources.(PI 2.2.2)*	
	Total	**30**

Performance Indicators:

P.I. No.	**P.I. Statement**
1.3.1	Apply engineering fundamentals
1.4.1	Apply theory and principles of computer science engineering to solve an engineering problem
2.2.3	Identify existing solution/methods to solve the problem, including forming justified approximations and assumptions
2.2.2	Identifies functionalities and computing resources.
3.1.1	Able to define a precise problem statement with objectives and scope.
3.1.2	Able to identify and document system requirements from stake holders.
8.2.1	Demonstrate effective communication, problem solving, conflict resolution and leadership skills
8.3.1	Present results as a team, with smooth integration of contributions from all individual efforts
9.1.1	Read, understand and interpret technical and nontechnical information
9.1.2	Produce clear, well-constructed, and well-supported written engineering documents
11.1.1	Describe the rationale for requirement for continuing professional development
11.2.2	Recognize the need and be able to clearly explain why it is vitally important to keep current regarding new developments in your field

Course Outcomes: A learner will be able to –

1. Identify and analyze different types of hypervisors and their architectures to define clear problem statements and select suitable solutions for specific applications. *(LO 1.1, LO 1.2)*
2. Deploy and manage virtual machines, storage, and networks in an IaaS environment while applying engineering fundamentals, defining system requirements, ensuring security, and adapting to evolving cloud technologies. *(LO 2.1, LO 2.2)*
3. Implement and document cloud-based storage (STaaS) and database (DBaaS) solutions to manage data efficiently and securely while staying updated with the latest tools and technologies. *(LO 3.1, LO 3.2)*
4. Deploy, manage, and document containerized applications using Docker and Kubernetes to improve application scalability, performance, and security through efficient orchestration and adherence to best practices. *(LO 4.1 , LO 4.2)*
5. Collaborate effectively in teams to solve complex cloud computing problems, communicate solutions, and adapt to new technologies while ensuring proper documentation and deployment processes. *(LO 2.1, LO 2.2, LO 4.1, LO 4.2)*

CO-PO Mapping Table with Correlation Level

CO ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
ITLBC506.1	3	-	3	-	-	-	-	-	-	-	-
ITLBC506.2	3	-	3	-	-	-	-	3	-	-	-
ITLBC506.3	-	-	-	-	-	-	-	-	-	-	3
ITLBC506.4	-	3		-	-	-	-	-	-	-	-
ITLBC506.5	3	3	3	-	-	-	-	-	3	-	3
Average	**3**	**3**	**3**	-	-	-	-	**3**	**3**	-	**3**

Text Books :

1 Bernard Golden, "Amazon Web Services for Dummies", John Wiley & Sons, Inc.

2 Michael Collier, Robin Shahan, "Fundamentals of Azure, Microsoft Azure Essentials", Microsoft Press

3 RajkumarBuyya, Christian Vecchiola, S ThamaraiSelvi, "Mastering Cloud Computing", Tata McGraw-Hill Education

4 Barrie Sosinsky, "Cloud Computing Bible", Wiley publishing

5 John Paul Mueller, "AWS for Admins for Developers", John Wiley & Sons, Inc.

6 Ken Cochrane, Jeeva S. Chelladhurai, NeependraKhare , "Docker Cookbook - Second Edition", Packt publication

7 Jonathan Baier, "Getting Started with Kubernetes-Second Edition", Packt Publication

Reference Books :

Cloud Application Architectures: Building Applications and Infrastructure in the Cloud, George Reese, O'Reilly Publication

Cloud computing security: foundation and challenges, John R Vecca, CRC Press

Other Resources :

1. NPTEL Course : Cloud Computing by Prof. Soumya Kanti Ghosh, IIT Kharagpur **Web Link** https://archive.nptel.ac.in/courses/106/105/106105167/
2. NPTEL Course : Google Cloud Computing Foundations by Prof. Soumya Kanti Ghosh, IIT Kharagpur, and experts from Google Cloud **Web Link** https://onlinecourses.nptel.ac.in/noc20_cs55/preview
3. NPTEL Course : Cloud Computing and Distributed Systems by Prof. Sudip Misra, IIT Kharagpur **Web Link**- https://onlinecourses.nptel.ac.in/noc25_cs12/preview

A. IN-SEMESTER ASSESSMENT (25 MARKS)

1. CONTINUOUS ASSESSMENT (25 MARKS)

a) Task Execution :10 Marks

Students will be given 10 tasks based on list as per mentioned in the syllabus. Each task carries10 Marks. Average will be taken of all tasks. Students will be evaluated based on logic building for the selected problem and expected output.

b) Deployment of real time application on cloud: 10 Marks

· A group of 3 students should be assigned a real life problem statement.

· Students are expected to collect required resources to create a frontend and backend for the selected problem.

· Students should prepare a presentation of 10-15 minutes.

·c) Regularity & Active participation: 05 Marks

B. END SEMESTER EXAMINATION (Practical and Oral Exam) (25 Marks)

a) Task Execution: 10 Marks

Students will be given task (different task for every student) and will be evaluated as per the parameters mentioned in continuous assessment.

b) Results and discussion, Inferences drawn from the above task: 05 Marks

c) Oral based on entire syllabus :10 Marks

Two examiners, one Internal and one External will do the evaluation

Course Type	Course Code	Course Name	Credits
LBC	ITLBC507	MOBILE APPLICATION DEVELOPMENT LABORATORY	01

Examination Scheme		
Continuous Assessment	**End Semester Exam (ESE)**	**Total**
25	25	50

Pre-requisite :

1. ESL205 :Programming Laboratory-II (Java)
2. ITSBL301 : Python Laboratory
3. ITSBL402 : Full Stack Development Laboratory

Program Outcomes addressed :

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO3: Design/Development of solution
4. PO5: Engineering tool usage
5. PO8: Individual and Collaborative Team work
6. PO9: Communication
7. PO11: Life-Long learning

Course Objectives:

1. To provide hands-on experience in developing cross-platform mobile applications using Flutter and Dart programming.
2. To enable students to design and implement user-friendly and interactive UIs using Flutter widgets, layouts, and animations.
3. To equip students with the skills to integrate Firebase for backend functionality and manage data persistence using file handling and JSON.
4. To train students in testing and deploying Flutter applications on Android and iOS platforms.
5. To foster teamwork, communication, and lifelong learning skills through collaborative projects and technical documentation.

Module	Detailed Contents	Hrs.
00.	**Course Introduction** In the Mobile Application Development Laboratory, where we focus on creating dynamic and user-friendly mobile apps using Flutter. This lab provides hands-on experience in building cross-platform applications, leveraging Dart programming, and mastering UI/UX design principles.	**01**
01.	**Basics of Flutter Programming** ***Learning Objective/s:*** *To make learner able to demonstrate and apply Flutter, covering fundamental Dart basics, understanding widget lifecycle events, constructing widget and element trees, and achieving proficiency in Flutter installation to create a basic "Hello World" app, establishing a foundational understanding of Flutter development.*	**04**
	Content:	

	Introduction of Flutter framework, Understanding Widget Lifecycle Events, Dart Basics, Widget Tree and Element Tree, Basics of Flutter installation, Flutter Hello World App. **Tasks:** 1. To install and configure Flutter Environment. 2. To run basic flutter hello world app.	
	Self-Learning Topics: *State management*	
	Learning Outcomes : *A learner will be able to* *LO 1.1: Apply the Flutter framework to develop simple mobile applications, integrate widget and element trees to create visually appealing apps, utilize modern engineering tools like Flutter SDK and Dart programming language, and recognize diverse learning preferences in mobile application development. (P.I.- 1.3.1, 3.4.2, 5.1.1, 8.1.1)* *LO 1.2: Apply suitable tags according to the given problem, verify the functionality of mobile apps using Dart Basics, demonstrate proficiency in using Flutter and Dart tools to create, debug, and run simple mobile applications, and present basic Flutter application implementations as a team, ensuring smooth integration of contributions. (P.I.- 1.4.1, 3.4.3, 5.2.2, 8.3.1)*	
02.	**Developing Flutter UI: Widgets, Layouts, Gestures** ***Learning Objective/s:*** *To make learner able to apply common widgets and also build high level view of layouts and apply gestures to mobile app.*	**06**
	Content: USING COMMON WIDGETS: SafeArea, Appbar, Column, Row, Container, Buttons, Text, Richtext,Form ,Images and Icon. BUILDING LAYOUTS: high level view of layouts, Creating the layout, Types of layout widgets APPLYING GESTURES: Setting Up GestureDetector, Implementing the Draggable and Dragtarget Widgets,Using the GestureDetector for Moving and Scaling **Tasks:** 3. To design Flutter UI by including common widgets. 4. To create an interactive Form using form widget 5. To design a layout of Flutter App using layout widgets	
	Self-Learning Topics: *Designing responsive layouts, and handling user gestures*	
	Learning Outcomes : *A learner will be able to* *LO 2.1: Apply safearea, appbar, column, row, buttons, text, and icon into mobile apps, identify GestureDetector for moving and scaling, recognize the strengths and limitations of Flutter widgets and layout tools, and read, understand, and interpret technical documentation related to Flutter UI components. (P.I.- 1.3.1, 2.1.2, 5.2.1, 9.1.1)* *LO 2.2 Apply different types of layout widgets, identify Draggable and Dragtarget Widgets, demonstrate proficiency in using Flutter's widget tree and gesture detection tools to implement complex UI designs, and demonstrate effective communication by producing well-structured UI design documentation. (P.I.- 1.4.1, 2.3.2, 5.2.2, 9.1.2)*	

03.	**Developing Flutter UI: Animation and Navigation** ***Learning Objective/s:*** *To make learner able to design effective forms, add buttons, and navigation bars using Bootstrap, facilitating the development and design user-friendly web interfaces.*	**04**
	Content:	
	ADDING ANIMATION TO AN APP: Using Animated Container, Using Animated CrossFade, Using Animated Opacity, Using Animation Controller, Using Staggered Animation CREATING AN APP'S NAVIGATION: Using the Navigator, Using the Named Navigator Route, Using the Bottom NavigationBar, Using the TabBar and TabBarView **Tasks:** 6. To include icons, images, charts in Flutter app 7. To apply navigation, routing and gestures in Flutter App	
	Self-Learning Topics: *Implement seamless app navigation with navigators, bottom navigation bars, and tab bars*	
	Learning Outcomes : *A learner will be able to* *LO 3.1: Implement and integrate animation and navigation modules within a Flutter application, identify and apply Flutter's animation and navigation tools to create dynamic and interactive user interfaces, and evaluate the limitations of these tools to validate their effectiveness in real-world applications. (P.I.- 3.4.2, 5.1.1, 5.3.1)* *LO 3.2: Design and develop interactive UI components by integrating animations and navigation features, and evaluate the limitations of Flutter's animation and navigation tools, validating their effectiveness in real-world applications. (P.I.- 3.4.3, 5.3.1)*	
04.	**Working with files** ***Learning Objective/s:*** *To make learner able to apply libraries and work with files using JSON.*	**04**
	Content: Including libraries in your Flutter app, including a file with your app, Reading/Writing to files, Using JSON. **Tasks:** 8. To include libraries and working with files in Flutter app.	
	Self-Learning Topics: *Manage files, and read/write data using JSON for efficient data handling and storage*	
	Learning Outcomes: *A learner will be able to* *LO 4.1: Analyze and interpret file-handling results using contemporary tools, identify the strengths and limitations of tools used for acquiring and storing file-based data, and demonstrate proficiency in using discipline-specific tools for file handling in Flutter. (P.I.- 2.4.2, 5.2.1, 5.2.2)* *LO 4.2: Identify the limitations of various file storage methods and their sources/causes, and demonstrate proficiency in using discipline-specific tools for file handling in Flutter. (P.I.- 2.4.3, 5.2.2)*	

05.	**Using Firebase with Flutter** ***Learning Objective/s:*** *To familarize the steps involved in setting up and configuring a firebase project and adding a cloud Firestore database and implementing security.*	**06**
	Content: Adding the Firebase and Firestore Backend, Configuring the Firebase Project, adding a Cloud Firestore Database and Implementing Security **Tasks:** 9. To Connect Flutter UI with firebase database.	
	Self-Learning Topics: *Implement robust security measures* ***Learning Outcomes:*** *A learner will be able to* *LO 5.1: Evaluate and implement Firebase as a backend service for Flutter applications, recognize the importance of lifelong learning in adapting to evolving backend technologies, and analyze sourced technical information for the feasibility and sustainability of Firebase integration. (P.I.- 3.4.2, 11.1.1, 11.3.2)* *LO 5.2: Verify functionalities and validate the integration of Firebase services, and recognize the importance of lifelong learning in adapting to evolving backend technologies. (P.I.- 3.4.3, 11.1.1)*	
06.	**Testing and Deploying of Flutter Application** ***Learning Objective/s:*** *To make learner able to apply widget testing and also deploy flutter apps on Android/iOS.*	**05**
	Content: Widget testing, Deploying Flutter Apps on Android / iOS **Tasks:** 10. To test and deploy production ready Flutter App on Android platform. 11. Implementation of Mini Project on selected case study.	
	Self-Learning Topics: *Learn the essentials of widget testing for ensuring app reliability and the steps for deploying Flutter apps on Android and iOS platforms.* ***Learning Outcomes:*** *A learner will be able to* *LO 6.1: Identify modern engineering tools for testing and deployment of mobile applications, recognize and adapt to diverse working and learning preferences, read, understand, and interpret deployment and testing documentation for Flutter applications, and demonstrate proficiency in using discipline-specific testing and deployment tools. (P.I.- 5.1.1,5.2.2, 8.1.1, 9.1.1)* *LO 6.2: Present test results as a team with well-integrated contributions from all members, produce clear, well-constructed, and well-supported test documentation, and demonstrate proficiency in using discipline-specific testing and deployment tools. (P.I.-5.2.2, 8.3.1, 9.1.2)*	
	Total	**30**

Performance Indicators:

P.I. No.	P.I. Statement
1.3.1	Apply engineering fundamentals
1.4.1	Apply theory and principles of computer science engineering to solve an engineering problem
2.1.1	Evaluate problem statements and identifies objectives
2.1.2	Identifies processes/modules/algorithms of a computer based system and parameters to solve a problem
2.2.4	Compare and contrast alternative solution/methods to select the best methods
2.4.2	Analyze and interpret the results using contemporary tools.
2.4.3	Identify the limitations of the solution and sources/causes.
3.4.2	Ability to implement and integrate the modules.
3.4.3	Ability to verify the functionalities and validate the design.
5.1.1	Identify modern engineering tools, techniques and resources for engineering activities
5.2.1	Identify the strengths and limitations of tools for (i) acquiring information, (ii) modeling and simulating, (iii) monitoring system performance, and (iv) creating engineering designs.
5.2.2	Demonstrate proficiency in using discipline specific tools
5.3.1	Discuss limitations and validate tools, techniques and resources
8.1.1	Recognize a variety of working and learning preferences; appreciate the value of diversity on a team
8.3.1	Present results as a team, with smooth integration of contributions from all individual efforts
9.1.1	Read, understand and interpret technical and nontechnical information
9.1.2	Produce clear, well-constructed, and well-supported written engineering documents
11.1.1	Describe the rationale for requirement for continuing professional development
11.3.2	Analyze sourced technical and popular information for feasibility, viability, sustainability, etc.

Course Outcomes:

Learner will be able to

1. Apply Flutter framework and Dart programming to develop cross-platform mobile applications, demonstrating proficiency in engineering fundamentals and tools. (*LO1.1, LO1.2)*
2. Design and implement user interfaces using Flutter widgets, layouts, and animations, ensuring responsiveness and interactivity. *(LO2.1, LO2.2, LO3.1, LO 3.2)*
3. Integrate Firebase services and manage data persistence using file handling and JSON, demonstrating the ability to work with backend technologies. *(LO 3.2, LO 4.1, LO 4.2, LO 5.1)*
4. Evaluate and execute testing and deployment processes for Flutter applications, ensuring functionality and performance on Android and iOS platforms. *(LO5.1,LO 5.2, LO6.1,LO 6.2)*
5. Collaborate effectively in teams to develop, test, and present mobile applications, while producing clear and well-structured technical documentation. *(LO2.1, LO2.2, LO3.1, LO3.2, LO 5.1, LO 5.2,LO6.1, LO6.2)*

CO-PO Mapping Table with Correlation Level

CO ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
ITLBC507.1	3	-	3	-	3	-	-	3	-	-	-
ITLBC507.2	3	3	3	-	3	-	-	-	3	-	-
ITLBC507.3	-	3	3	-	3	-	-	-	-	-	3
ITLBC507.4	-	-	3	-	3	-	-	3	3	-	3
ITLBC507.5	3	3	3	-	3	-	-	3	3	-	3
Average	**3**	**3**	**3**	**-**	**3**	**-**	**-**	**3**	**3**	**-**	**3**

Text Books:

1. Beginning App Development with Flutter: Create Cross-Platform Mobile Apps, By Rap Payne, 2019
2. Beginning Flutter a Hands-on Guide to App Development, Marco L. Napoli, 2020, Wiley.

Reference Books:

1. Flutter in Action by Eric Windmill, MANING, 2019.
2. Google Flutter Mobile Development Quick Start Guide.Packt,2019.

Other Resources:

1. Flutter

   Web link: https://archive.nptel.ac.in/courses/106/106/106106156/
2. NPTEL Course: Android Mobile Application Development , Dr. Himanshu N. Patel , Dr. Babasaheb Ambedkar Open University, Ahmedabad
   Web Link- https://onlinecourses.swayam2.ac.in/nou25_ma01/preview

A. IN-SEMESTER ASSESSMENT (25 MARKS)

1. Continuous Assessment (25 Marks)

a) Task Execution : 10 Marks
b) Mini Project (Presentation with Q&A): 10 marks
c) Regularity and active participation in class :05 Marks

B. END SEMESTER ASSESSMENT (Practical & Oral Exam) (25 MARKS)

a) Execution of Task: 10 Marks
b) Presentation on Mini Project with Q&A: 10 Marks
c) Oral Test:05 Marks

Two examiners, one Internal and one External will do the evaluation.

Course Type	Course Code	Course Name	Credits
AEC	AEC 502	PROFESSIONAL COMMUNICATION & ETHICS-2	02

Examination Scheme					
Distribution of Marks			**Exam Duration (Hrs.)**		**Total Marks**
In-semester Assessment		**End Semester Examination (ESE)**			
Continuous Assessment	**Mid-Semester Exam (MSE)**		**MSE**	**ESE**	
50	--	--	--	--	50

Program Outcomes addressed:

1. PO7 : Ethics
2. PO8 : Individual and Teamwork
3. PO9 : Communication
4. PO11: Life-long learning

Course Objectives:

1. To inculcate in students, professional and ethical attitude, effective communication skills, team work and a multidisciplinary approach.
2. To provide students with an academic environment where they will be aware of the need for excellence, leadership and lifelong learning to build a successful academic & professional career.
3. To create awareness about professional ethics and codes of professional practices.
4. To prepare students for a successful academic and/or professional career that meets the global academic and/or corporate requirement by providing students to work on multidisciplinary projects as part of different teams to enhance their team building capabilities like leadership, motivation, teamwork, and other interpersonal skills.

Module	**Details**	**Hrs.**
00.	**Course Introduction** The curriculum of Professional Communication and Ethics-2 is designed to provide students with an academic environment that promotes a professional and ethical attitude as they participate in individual and team activities. The practical sessions will supplement the learner's interactive competence and confidence to respond appropriately and creatively to the implied challenges of the global industrial and corporate requirements. The curriculum will create an awareness of professional ethics and the standard code of conduct. It will further inculcate within the budding engineer the social commitment as responsible technical citizens. It will enhance the learner's team building capacities,	**01**

	interpersonal skills and leadership skills so as to become a well-rounded professional in their field of expertise.	
01.	**EMPLOYABILITY SKILLS** ***Learning Objectives:*** *1. Customised writing skills and Content Development: To develop effective writing skills to craft a clear, concise, and compelling Statement of purpose, formal letters and resumes for a specific purpose.* *2. To instil productive and efficient skills to participate confidently and constructively in group discussions and interviews for employability* *3. To inculcate Ethical Communication & Empathetic Listening*	
	Contents: **1.1 Business Correspondence** o Letter Writing (Principles, Format, Structure, Content, Types) o Job Application Letter o Joining Letter o Resignation Letter o Resume Writing **1.2 Statement of Purpose/ Letter of Intent or Interest** o Purpose o Elements of SOP/LOI o Structure o Tips for writing effective and ethical SOP/LOI **1.3 Verbal Aptitude Tests** modeled on CAT,GRE,GMAT,IELTS **1.4 Group Discussions**: Purpose, parameters of evaluating, Types of GDs (Traditional, Case-based & Role Plays), GD Etiquettes, and Importance of inclusivity, respectful listening and expression of diverse ideas for a common goal. **1.5 Personal Interviews:** Preparation, Types of questions, Types of interviews and modes of interviews. Types: Structured, Stress, Behavioural, Problem Solving & Case-based, Modes of Interviews: Face-to-face (One-to one and Panel) Telephonic, Virtual **1.6 Significance of Ethical approach during Group Discussions and Interviews** o Respectful listening o Speaking Assertively o Inclusivity of diverse individuals o Mindfulness and openness to different ideas o Common Goal of Consensus	**03**
	Self-Learning Topics: ***Watch recordings of professional interviews from online resources.(ex: Civil Service interviews), IIM and UPSC GDs***	

	Activities: *1. Prepare an SOP for admission procedure in a reputed university.* *2. Participate in GDs on a given topic followed by Mock Interview.* *3. Attempt Verbal Aptitude and Comprehension Tests.* *4. Write a Job Application/Resignation/Request/Enquiry letter in the learned format* *5. Write a Resume as a fresh graduate trainee for a specific post.*	
	Learning Outcomes: *A learner will be able to* *LO 1.1: Write clear, concise and professional letters of various types that effectively convey information, build relationships and achieve professional objectives.(9.1.3, 9.2.3, 9.3.2, 11.1.1)* *LO 1.2: Rationally apply gained knowledge of group discussions and aptitude tests for continuous improvement and professional growth in academia and industry. (8.1.2, 8.2.1, 11.1.1.)* *LO 1.3: Exhibit the ethical code of conduct by treating all team mates with respect and dignity, by listening attentively to each member, and encouraging diversity of ideas during a GD. (7.3.1, 8.1.1, 8.2.2,8.2.3, 8.2.4, 9.2.3)* *LO 1.4: Demonstrate through group discussions and mock interviews, the ability to effectively identify unethical conduct and arrive at ethical decisions through strong leadership skills and respectfully lead a team or oneself to the desired goal. (7.1.1,8.1.2,8.2.1,8.2.3, 8.2.4, 8.3.1,9.2.2, 9.2.3)* *LO 1.5: Exhibit a calm demeanor by effectively preparing for competitive exams through mock tests which contain comprehending logical instructions, analysis, problem solving and verbal aptitude assessment (8.2.4, 9.1.1,11.1.1)*	
02.	**INTERPERSONAL SKILLS & ETHICS** ***Learning Objectives:*** 1. *Develop Problem Solving & Critical Thinking: To help budding engineers understand the importance of interpersonal skills and demonstrate creativity, resourcefulness, along with enhanced communication in personal and professional settings.* 2. *Self-Management & Ethical Awareness: To create awareness of Ethical and Social Responsibility towards individual and society by fostering self and team management leading to increased productivity and job readiness.*	**03**
	Contents: **2.1 Interpersonal Skills (implementation in all AE activities)** o Emotional intelligence o Effective Leadership o Team Building o Conflict Management o Negotiation & Ethical Conflict Resolution o Time management, o Assertiveness **2.2 Importance of Ethics in Interpersonal Relations** o Ethical and Inclusive Decision making. o Ethics in relation to Emotional Quotient	

	Self-Learning Topics: Follow industry leaders and experts on social media or read articles on topics related to corporate ethics and social responsibility. ***Activity:*** 1. *Listen to podcasts that discuss ethics, communication and interpersonal skills, such as "The TED Radio Hour" or "How I Built This" and conduct a GD on its learnings.*	
	Learning Outcomes: *A learner will be able to* *LO 2.1: Apply the learned interpersonal skills in various A.E. activities such as Report presentations, drafting business plans and SOP in an accepting, respectful and inclusive manner. (7.3.1,8.1.1, 8.1.2, 8.2.1, 8.2.2, 9.2.1, 9.2.3)* *LO 2.2: Apply the awareness of ethics while participating in a well-organized, time bound and constructive GD on topics raising ethical and moral concerns. (7.2.2, 7.3.1,8.2.1, 8.3.1, 9.2.3)* *LO 2.3: Apply empathetic and effective speaking skills utilizing ethical values and principles to resolve any social problem while working in a diverse team for group activities. (7.2.2, 7.3.18.1.1, 8.2.1, 8.2.2, 8.2.3, 9.2.1, 9.2.2.)* .	
03.	**ADVANCED TECHNICAL WRITING:PROJECT/PROBLEM BASED LEARNING** ***Learning Objective:*** *1. Structure & Organisation: To enable the learner to craft a well-structured technical report, utilizing a logical flow with clear introduction, body and flow, ensuring clarity and coherence in their writing.* *2. Effective Communication: To enhance the ability to communicate complex information clearly and concisely, using relevant visual aids and making the information accessible to technical and non-technical audience.*	**03**
	Contents: **3.1 Technical/Academic Report** o **Classification of reports on the basis of**: Subject Matter, Time Interval, Function, Physical Factors. o **Parts of a long formal report**: Front Matter, Main Body and Back Matter. o **Language and style of Reports:** Grammar, Tone, Style, Vocabulary, Format of the report from title page to appendices. **3.2 Definition, purpose and types of Proposal** o Parts of a Proposal**:** Elements, Scope and Limitations, Conclusion o Technical Proposal/Synopsis **3.3 Technical Paper Formats (APA/IEEE)** **Parts of a Research paper**: o Title Page o Abstract, o Introduction o Problem Statement/Hypothesis o Research methods, o Data Search (Primary/Secondary) o Quantitative/ Qualitative Analysis o Discussion, o Delimitations, o future scope and	

	o References. o Appendix o Acknowledgement **3.4 Significance of Presenting and Publishing a Research Paper** o Reading Secondary Data o Looking for research gaps o Understanding Need to fill research gap o Creating a Problem Statement o Writing a Synopsis o Writing an academic paper in the APA/IEEE format	
	Self-Learning Topics: ***Read academic research papers and look for gaps in the research area.*** ***Activity*:** *1. Prepare an Academic Research Paper on any technical problem of your choice with solutions for the same and present it using ICT. [Team of 6/ Research Paper + Presentation & Group Dynamics]*	
	Learning Outcomes: *The learner will be able to* *LO3.1: Write, individually or as a team, a research paper, with logical & rational progression of ideas, effectively, in a time bound manner to everyone's understanding (8.3.1, 9.1.3, 9.2.3)* *LO3.2: Read, comprehend, and interpret previous research/ secondary source data and clearly state the purpose of research using the IEEE format. (9.1.1,9.1.3,11.3.1)* *LO3.3: Demonstrate the ability to use critical thinking to find gaps in research, interpret the technical and non-technical data and present it with clarity. (9.1.1, 9.1.3, 11.1.2, 11.3.1)* *LO3.4: Apply gained knowledge of technical writing for continuous improvement in academia and professional growth. (11.1.1)*	
04.	**TECHNICAL/BUSINESS PESENTATIONS** ***Learning Objectives:*** *1. The development of effective presentation structure and content for academic and technical presentation with the help of ICT* *2.Capacity building for delivering confident and persuasive presentation to both technical and non-technical audience individually or in a team.*	**02**
	Contents: **4.1 Effective Presentation Strategies:** o Purpose of a presentation, o Understanding the audience, location and the event, o Arranging the material, structuring the presentation, o Making effective slides and platform skills. **4.2 Group Presentations:** o Working with a mixed team (Diversity) o Sharing responsibility in a team (Delegation) o Creating the content together (Uniformity) o Transition phases and Coordination. (Teamwork) o Time Management (Individual and Team)	

	4.3 Individual Presentations: o Introduction of Self and Topic o Understanding the audience, building rapport o Time Management o End with Q n A, Feedback	
	Self-Learning Topics: *Watch YouTube videos of presentations like TED TALKS on motivational topics* ***Activity*:** *1. Prepare an academic research paper on any one Technical problem of your choice with solutions for the same and present it using ICT. [Team of 6/ Research Paper + Presentation & Group Dynamics]*	
	Learning Outcomes: *A learner will be able to* *LO4.1: Demonstrate efficacious and seamless presentation skills to all audiences as an individual and a team with impeccable leadership qualities through proper delegation, problem solving and management (8.1.2, 8.2.1,8.3.1, 9.1.3, 9.2.2, 9.3.2)* *LO4.2: Engage with a diverse team and a mixed audience, during presentations, keeping in mind their uniqueness and differences. (7.3.1.,8.1.1,8.1.2,8.3.1,9.2.2, 9.2.3)*	
05.	***CORPORATE ETHICS*** ***Learning Objective/s:*** 1. *Ethical Principles & Frameworks: To aid the learner to differentiate between various codes of conduct and ethics in the social and professional world.* 2. *Analyse & Resolve Ethical Dilemmas: To enforce the significance of ethical citizenry & generate awareness on the importance of IPR and its consequences*	**02**
	Contents: **5.1. Intellectual Property Rights : Significance, Duration, Laws** o Copyrights o Trademarks o Patents o Geographical Indication o Industrial Designs o Trade Secrets **5.2. Start- Up Skills:** o Financial Literacy o Risk Assessment o Data Analysis. **5.3. Gender Equity & Inclusivity at the Work Place** o Study on Cases related to Gender Equity in India & Global o Corporate Social Responsibility o Inclusivity at the work place o Corporate Code of Conduct	
	Self-Learning Topics: Read a biography on a Business Leader/Philanthropist, Collect information on some failed startups. Assess and analyse the reasons for their failure.	

	Activity: 1. *Find and analyse a Case Study on the topic on Gender Equity & Inclusivity; Generate a solution based article in APA format and present before an audience (10M)* 2. *Assess and analyse a failed start up. Find gaps leading to failure. Give viable solutions; Generate an article in APA format; present before an audience. (10M)*	
	Learning Outcomes : *A learner will be able to* *LO 5.1: Utilise professional, moral and ethical principles to identify wrong conduct and suggest ethical solutions through IPR, Gender Equity and Corporate ethics (7.1.1, 7.2.2, 7.3.1)* *LO 5.2: Critically evaluate various socioeconomic, gender issues of discriminatory nature, while emulating equality and open mindedness in all teams, sectors and activities. (7.1.1, 7.2.2,7.3.1, 8.1.1, 8.1.2, 9.2.3)* *LO 5.3: Employ the awareness of IPR to avoid or solve unethical practices in professional life by following standard rules and practices and emerge as a productive team member and a progressive leader. (7.1.1,7.2.2, 8.2.1, 8.2.2, 11.1.1)* *LO 5.4: Assess a failed business plan, analyse reasons for failure and suggest viable solutions as a team keeping in consideration both the individual and team effort. (8.2.1, 8.3.1,9.1.3, 11.1.2)*	
	Activities for Ability Enhancement (Practical Sessions):	**30**
	Contents: 1. *Write a job application letter, a joining letter, a letter of apology, a request letter. Attach a Resume to the Job Application letter. Follow Standard formats and protocols for each document. (5M)* 2. *Prepare an Academic Research Paper on any one Technical problem of your choice with solutions for the same and present it using ICT. [Team of 6/ Research Paper (5M) + Presentation & Group Dynamics (5M)]* 3. *Prepare an SOP for admission procedure in a reputed university. (5M)* 4. *Participate in GDs on given topic followed by Mock Interview ((10 M)* 5. *Attempt Verbal Aptitude and Comprehension Tests(5M)* 6. *Find and analyse a Case Study on the topic on Gender Equity & Inclusivity; Generate a solution based article in APA format and present before an audience (10M)* ***OR*** *Assess and analyse a failed start up. Find gaps leading to failure. Give viable solutions; Generate an article in APA format; present before an audience. (10M)* 7. *Active Participation & Regularity (5M)*	
	Activities will start in the inverted pyramid, viz., with group activities first so as to build confidence and ending with solo presentations in the form of research paper presentation or Gender Equity presentation. *Group Discussion, Interview Skills, Presentation skills will have at least three mock drills before the final assessment of the same.* *Rigorous development of the English language, social and professional etiquette will be the praxis*	
	Course Conclusion	**01**
	Total	**45**

Performance Indicators:

P.I. No.	P.I. Statement
7.1.1	Identify situations of unethical professional conduct and propose ethical alternatives
7.2.2	Examine and apply moral & ethical principles to known case studies
7.3.1	Apply and exhibit universal human values and a diverse and inclusive mind-set, free of discrimination
8.1.1	Recognize a variety of working and learning preferences; appreciate the value of diversity on a team
8.1.2	Implement the norms of practice (e.g. rules, roles, charters, agendas, etc.) of effective team work, to accomplish a goal.
8.2.1	Demonstrate effective communication, problem-solving, conflict resolution andleadership skills
8.2.2	Treat other team members respectfully
8.2.3	Listen to other members
8.2.4	Maintain composure in difficult situations
8.3.1	Present results as a team, with smooth integration of contributions from all individual efforts
9.1.1	Read, understand and interpret technical and non-technical information
9.1.3	Create flow in a document or presentation - a logical progression of ideas so that themain point is clear
9.2.1	Listen to and comprehend information, instructions, and viewpoints of others
9.2.2	Deliver effective oral presentations to technical and non-technical audiences
9.2.3	Apply efficient and effective communication, keeping in mind the diversity and uniqueness in the team.
9.3.2	Use a variety of media effectively to convey a message in a document or a presentation
11.1.1	State the rationale for the requirement for continuing professional development
11.1.2	Identify deficiencies or gaps in knowledge and demonstrate an ability to source information to close this gap
11.3.1	Source and comprehend technical literature and other credible sources of information

Course Outcomes: A learner will be able to -

1. Communicate and present effectively and ethically with mixed media in both oral and written forms business reports and documents which will in turn provide a solid foundation for their future managerial roles. (*LOs 1.1, 1.2, 1.4, 2.1, 2.2, 3.1, 3.2, 4.1, 4.2, 5.1)*
2. Exhibit the skill set required for successful employability while expressing ethical, assertive and inclusive leadership skills. (*LOs 2.1, 2.2, 2.3, 3.2, 4.2, 4.3, 5.2)*
3. Develop a critical thinking acumen to prepare for and give various competitive exams, emerge successful in group discussions and conduct healthy debates. (*LOs 1.3, 2.1, 2.2, 2.3, 3.1, 4.2)*
4. Develop creative and mindful thinking while demonstrating the knowledge of professional and personal etiquettes & ethics, such as diversity and inclusivity, in the global environment. (*Los 1.2, 2.2, 2.4,1.3, 3.2, 4.3, 5.1, 5.2, 5.3, 5.4)*

CO-PO Mapping Table with Correlation Level

CO ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
AEC502.1	-	-	-	-	-	-	3	3	3	-	3
AEC502.2	-	-	-	-	-	-	3	3	3	-	3
AEC502.3	-	-	-	-	-	-	2	3	3	-	3
AEC502.4	-	-	-	-	-	-	3	3	3	-	3
Average	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**3**	**-**	**3**

Reference Books:

1. Arms, V. M. (2005). *Humanities for the engineering curriculum: With selected chapters from Olsen/Huckin:*
2. *Technical writing and professional communication, second edition*. Boston, MA: McGraw-Hill.
2. Bovée, C. L., &Thill, J. V. (2021).
3. *Business communication today*. Upper Saddle River, NJ: Pearson.
4. Butterfield, J. (2017). *Verbal communication: Soft skills for a digital workplace*. Boston, MA: Cengage Learning.
5. Masters, L. A., Wallace, H. R., & Harwood, L. (2011).*Personal development for life and work*. Mason: South Western Cengage Learning.
6. Robbins, S. P., Judge, T. A., & Campbell, T. T. (2017). *Organizational behaviour*. Harlow, England: Pearson.
7. Meenakshi Raman, Sangeeta Sharma (2004) Technical Communication, Principles and

Practice. Oxford University Press

8. Archana Ram (2018) Place Mentor, Tests of Aptitude For Placement Readiness. Oxford University Press
9. Sanjay Kumar &PushpLata (2018). Communication Skills a workbook, New Delhi: Oxford University Press.

Other Resources :

1. NPTEL Course: https://archive.nptel.ac.in/courses/109/104/109104030
   Dept. of Humanities and Social Sciences, IIT Kanpur, A Course on Communication Skills

CONTINUOUS INTERNAL ASSESSMENT (50 Marks)

1. Assignments on Resume Writing and Business Correspondence (5M)
2. Prepare an Academic Research Paper (3500-4000 words) on any one socio-technical problem of your choice with solutions for the same and present it using ICT. [Team of 6/ Research Paper/ IEEE (5 M) + Presentation & Group Dynamics. (5M)]
3. Prepare an SOP for admission procedure in a reputed university. (5M)
4. Participation in Final GD on concrete/abstract topic followed by Mock Interview. (10M)
5. Verbal Aptitude Tests (5M)
6. Analyse a Case Study on the topic of Gender Equity & Inclusivity and present (APA) OR

   Analyse a failed start up present your case to a mixed audience (APA) (10M)
7. Regularity and Active participation (5M)

Course Type	Course Code	Course Name	Credits
MNP	ITMNP503	MINI PROJECT- 2A	01

Program Outcomes addressed:

1. PO1 : Engineering knowledge
2. PO2 : Problem Analysis
3. PO3 : Design/Development of Solutions
4. PO4 : Conduct investigations of complex problems
5. PO5 : Engineering Tool Usage
6. PO6 : The Engineer & the world
7. PO7 : Ethics
8. PO8 : Individual & Collaborative Team work
9. PO9 : Communication
10. PO10: Project Management & Finance
11. PO11: Life-long learning

Course Objectives:

1. To guide students in identifying societal or research needs and formulating them into problem statements.
2. To facilitate problem-solving in group settings.
3. To apply basic engineering principles to address identified problems.
4. To foster self-learning and research skills.

Course Outcomes:

At the end of the course, students will be able to:

1. Identify problems based on societal or research needs and methodology for solving them.
2. Apply knowledge and skills to solve societal problems collaboratively.
3. Develop interpersonal skills necessary for teamwork.
4. Analyze, verify, and validate results effectively through various methodologies, including, test cases/benchmark data/theoretical/inferences/experiments/simulations, etc.
5. Evaluate the societal and environmental impacts of proposed solutions.
6. Adhere to standard engineering practices.
7. Excel in written and oral communication by technical report writing, oral presentation, and publishing results in
   - Research/white paper/article/blog writing/publication, etc.
   - Business plan for entrepreneurship product creation
   - Patent filing/copyright.
8. Gain technical competencies by participating in competitions, hackathons, etc.
9. Demonstrate lifelong learning capabilities through self-directed group projects.
10. Apply project management principles effectively.

Guidelines for the Mini Project

- Mini project may be carried out in one or more form of following:
  Product preparations, prototype development model, fabrication of set-ups, laboratory experiment development, process modification/development, simulation, software development, integration of software (frontend-backend) and hardware, statistical data analysis, creating awareness in society/environment etc.
- Students must form groups of 3 to 4 members either from the same or from different departments.
- Groups should conduct surveys to identify needs and develop problem statements in consultation with faculty.
- An implementation plan in Gantt/PERT/CPM chart format covering weekly activities must be submitted.
- Each group must maintain a logbook to record weekly progress, to be verified by the faculty supervisor.
- Faculty input should emphasize guiding by faculty and self-learning by group members.
- Groups should propose multiple solutions, select the best one in consultation with the supervisor, and develop a working model.
- The solution to be validated with proper justification and report to be compiled in standard format of the Institute. Software requirement specification (SRS) documents, research papers, competition certificates may be submitted as part of annexure to the report.
- With the focus on self-learning, innovation, addressing societal/research/innovation problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that a single project of appropriate level and quality be carried out in two semesters by all the groups of the students.
- However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Mini Project adhering to the qualitative aspects mentioned above, gets completed in odd semester, then that group can be allowed to work on the extension of the Mini Project with suitable improvements/modifications or a completely new project idea in even semester. This policy can be adopted on a case by case basis.

In-Semester Continuous Assessment and End-Semester Examination Guidelines

- The Head of the Departments will assign a guide to each of the mini-projects and shall form a progress monitoring committee. The guide will carry out weekly monitoring of the project's progress. The committee shall carry out in-semester project evaluation based on presentations with a minimum of two evaluations per semester.
- Assessment will be based on individual contributions, understanding, and responses to questions asked.
- Continuous Assessment marks distribution in semester V (50 marks):
  - 05 marks for the Topic Approval Presentation in front of the progress monitoring committee
  - 15 marks for the Mid-Semester Progress Presentation in front of the progress monitoring committee
  - 25 marks for the Final Report & Presentation
  - 05 marks for Regularity and active participation
- Continuous Assessment marks distribution in semester VI (50 marks):
  - 15 marks for the In-Semester Two Presentations
  - 05 marks for Participation in Project Competitions, TPP, etc.
  - 25 marks for the Final Report & Presentation

- 05 marks for Regularity and active participation

The review/progress monitoring committee will assess projects based on the following criteria.

Semester V:

- Theoretical solution completion, including component/system selection/design of software solution and cost analysis.
- Two reviews will occur:
  - The first review will focus on finalizing the problem statement (topic approval).
  - The second review will centre on finalizing the proposed solution.

Semester VI:

- Expected tasks include procuring components/systems, constructing a working prototype, and validating results based on prior semester work.
- Reviews will be conducted as follows:
  - The first review will assess the readiness to build a working prototype.
  - The second review will involve a poster presentation and demonstration of the working model in the last month of the semester.

In addition to above mentioned points, the following performance criteria shall be included during in-semester continuous assessment:

1. Quality of survey and need identification.
2. Clarity and innovativeness in problem definition and solutions.
3. Requirement gathering via SRS/feasibility study, cost-effectiveness, and societal impact of proposed solutions.
4. Completeness and full functioning of the working model.
5. Effective use of skill sets and engineering norms.
6. Verification & validation of the solutions/test cases.
7. Individual contributions to the group.
8. Clarity in written and oral communication.
9. Participation in technical paper presentation/project competitions/hackathon competitions, etc.

End-Semester Examination in Semester VI (50 marks):

1. Presentation and demonstration to internal and external examiners: 20 marks.
2. Emphasis on problem clarity, innovativeness, societal impact, functioning of the model, skill utilization, and communication clarity: 30 marks.

Course Type	Course Code	Course Name	Credits
HSS	HSS502	ENTREPRENEURSHIP	02

Examination Scheme		
Continuous Assessment	**End Semester Exam (ESE)**	**Total Marks**
50	--	50

Pre-requisite: NIL

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO3: Design/ Development of Solutions
4. PO6: The Engineer & The world
5. PO7: Ethics
6. PO10: Project Management & Finance
7. PO11: Life-Long learning

Course Objectives:

1. To develop Entrepreneurial mindset amongst the learners.
2. To promote Entrepreneurship as life-skills to improve quality of life, skills of creation and management of entrepreneurial pursuits.
3. To explore paths of the innovation through the creative problem-solving skills
4. To familiarize with the steps involved in 'idea to product' development.
5. To get acquainted with the preparation of pitch at ideation, business idea presentation and funding stages

Module	Details	Hrs
00.	**Course Introduction:** This course aims to equip individuals with the knowledge, skills, and mindset needed to identify and pursue new business opportunities. It aims to foster an entrepreneurial culture and mindset to help develop the next generation of entrepreneurs who can create jobs, drive economic growth, and contribute to the society. Entrepreneurship is a life skill that will help an individual succeed in a variety of scenarios, both personal and professional. By its very nature, entrepreneurship is an interdisciplinary field that draws from a range of disciplines, including business, economics, engineering, and social sciences. Some of the key topics covered in Entrepreneurship Course include opportunity recognition, market research, business planning, financing, marketing, and management while emphasizing the development of critical thinking, creativity, risk-taking, and problem- solving skills.	**01**
01.	**Fundamentals of Entrepreneurship**	**5-6**
	Learning Objectives:	

	• To gain knowledge about the concepts and principles of entrepreneurship, including opportunity recognition and value creation. • To develop an entrepreneurial mindset and skills that will enable them to identify, evaluate, and pursue viable business opportunities with confidence.	
	Contents: Introduction to Entrepreneurship, Entrepreneurial Mindset, Opportunity Identification, Market Analysis & Customer Research, Business Models & Go-to-Market, Funding and Financial Management, Marketing Aspects, Scaling the Venture and Growth Strategies: *Note:* A real life case study covering key elements of the module shall be covered.	
	Learning Outcome: The learner would be able to: • Understand the concept of Entrepreneurship • State the myths, advantages and limitations of Entrepreneurship • Interpret and analyze market research data and customer analysis to make informed business decisions. • Discuss the steps in the process of Entrepreneurship	
02.	**Technological Innovation and Entrepreneurship**	**4-5**
	Learning Objectives: • To enhance creative problem-solving skills and to examine the importance of innovation in business success. • To identify the types of Innovation • To gain knowledge for taking an idea to product development stage while protecting the idea with IPR.	
	Content: Foundations of Creativity and Innovations, Creative thinking process, Types of Innovation: Incremental, Disruptive, and Radical, Innovation Process: from idea to execution; Protecting ideas - Patents and IPR. Exploring Technological Innovation through Case Studies.	
	Learning Outcome: The learner would be able to • Use their understanding of the role Technological innovation plays in driving business success. • To formulate steps for taking an idea to product stage with necessary patents	
03.	**Ideation, Prototyping, Testing, Validation and Commercialisation**	**5-6**
	Learning Objectives:	

	• Experiment to test Minimum Viable Products (MVPs) and validate business ideas. • To formulate a Build-Measure-Learn feedback loop for continuous improvement.	
	Contents: Identifying customer needs and problems to solve, Ideation, Concept Development, Design Thinking, Prototyping, Minimum Viable Product (MVP), Testing, and Iterations. Understanding the Market, customer feedback and refinement of business idea based on feedback. *Note:* A real life case study covering key elements of the module shall be covered.	
	Learning Outcome: The learner would be able to • Select specific measures to design, test, and validate Minimum Viable Products (MVPs) to assess business ideas. • Interpret the learnings from the build-measure-learn feedback loop to facilitate continuous improvement and learning.	
04.	**Financial Resources**	**3-4**
	Learning Objectives: • Describe the key concepts, and strategies related to fundraising for entrepreneurial ventures. • Compare various funding sources, including angel investors, venture capitalists, grants, and crowdfunding platforms. • Devise and create compelling investor pitches, develop financial projections.	
	Contents: Funding new ventures – bootstrapping, crowd sourcing, Angel investors, VCs, debt financing, and due diligence; Raising fund during life-cycle of a new ventures. *Note:* A real life case study covering key elements of the module shall be covered.	
	Learning Outcome: The learner would be able to • Recognize various fundraising strategies and techniques, enabling s to choose the most appropriate funding sources for their entrepreneurial ventures. • Sketch effective pitches and fundraising campaigns tailored to different types of investors and funding sources, ensuring successful capital-raising efforts.	
05.	**National Entrepreneurial Culture**	**4-5**

	Learning Objectives: • To gain knowledge of legal and regulatory requirements for startups, including compliance with relevant regulations. • To identify the various government initiatives to develop the start-up ecosystem.	
	Contents: Entrepreneurial Ecosystem in India, Key regulations and legal aspects, Forms of Business Ownership, MSMED Act 2006 and its implications, schemes and policies of the Ministry of MSME, role and responsibilities of various government organisations, departments, banks etc. Government incentives for entrepreneurship, Incubation, & Acceleration.	
	Learning Outcome: • Describe the current scenario of Entrepreneurial activity in India. • To state legal and regulatory requirements and compliances for start-ups. • To state the various government initiatives to support the entrepreneurs.	
06.	**Start-up Case Studies**	**3-4**
	Learning Objectives: To relate the real life case studies and analyse them for acquiring the clarity on various aspects of entrepreneurship covered in the first 5 modules	
	Contents: Case Studies of various start-ups (with Indian Context): Start-ups from Tech, Edtech, Fintech, and Agriculture domain; Study of successful start-ups and failed start-ups.	
	Learning Outcome: To evaluate the real-world examples and case studies that will help them understand the practical aspects of idea to product, fundraising and financial management in the context of entrepreneurship.	
Course Conclusion		**01**

In-semester Assessment - Continuous Assessment: Suggested

1 Teams of 3-4 students shall present a One-Minute business idea pitch– ideation phase-10 marks
2 Teams of 3-4 students shall present a Three-Minute Business Pitch –Validation phase-10 marks
3 Teams of 3-4 students shall present a Five-Minute Business Pitch for Funding- 15 marks
4 Teams of 3-4 students shall present analysis of one case study of successful or failed start-up- (15 Marks)

Course Outcome:

1. State the concept of Entrepreneurship and Indian Start-up ecosystem
2. Identify the business ideas and to analyse the environment for potential business opportunity.
3. Identify the specific measures to design, test, and validate Minimum Viable Product.
4. State the key concepts, and strategies related to fundraising for entrepreneurial ventures.
5. Identify the legal and regulatory framework for entrepreneurs in Indian context.
6. Analyse and correlate the reasons for the success or the failure of entrepreneurial firms.

Text Books:

1. Poornima Charantimath, Entrepreneurship Development- Small Business Enterprise, Pearson
2. Education Robert D Hisrich, Michael P Peters, Dean A Shapherd, Entrepreneurship, The McGrawHill Company
3. Dr TN Chhabra, Entrepreneurship Development, Sun India Publications, New Delhi
4. Vasant Desai, Entrepreneurial Development and Management, Himalaya Publishing House
5. Maddhurima Lall, Shikah Sahai, Entrepreneurship, Excel Books
6. Rashmi Bansal, STAY hungry STAY foolish, CIIE, IIM Ahmedabad
7. Law and Practice relating to Micro, Small and Medium enterprises, Taxmann Publication Ltd.

Reference Books:

1. Zero to One: Notes on Startups, or How the Build the Future by Peter Thiel
2. The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses by Eric Ries
3. India as Global Start-up Hub: Mission with Passion by C B Rao
4. Innovation and Entrepreneurship: Practice and Principles by Peter F Drucker
5. Effective Entrepreneurial Management: Strategy, Planning, Risk Management, and Organization - Robert D. Hisrich, Veland Ramadani, Springer (2017)
6. Entrepreneurship- Theory, Process Practice –by Kuratko &Hodgetts, Thompson South-Western Publication

Relevant Websites:

1. www.msme.gov.in
2. www.dcmesme.gov.in
3. www.msmetraining.gov.in

Other Resources:

1. NPTEL Course: Entrepreneurship By Prof. C Bhaktavatsala Rao, IIT Madrao
   Weblink https://onlinecourses.nptel.ac.in/noc20_mg35/preview
2. NPTEL Course: Entrepreneurship Essentials By Prof. Manoj Kumar Mondal, IIT Kharagpur
   Weblink https://onlinecourses.nptel.ac.in/noc21_ge06/preview

Course Type	Course Code	Course Name	Credits
PCC	ITPCC611	CRYPTOGRAPHY & NETWORK SECURITY	03

Examination Scheme					
Distribution of Marks			Exam Duration (Hrs.)		Total Marks
Continuous Internal Evaluation		End Semester Exam			
Continuous Assessment	Mid-Sem Exam		MSE	ESE	
20	30	50	1.5	2	100

Pre-requisite:

1. ITPCC401: Engineering Mathematics-IV
2. ITPCC406: Computer Network

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO3: Design/Development of solutions
4. PO6: The Engineer and The World
5. PO7: Ethics
6. PO11: Life-Long Learning

Course Objectives:

1. To impart the basic concepts of security services and cryptographic techniques.
2. To acquaint the knowledge of different symmetric key cryptographic techniques.
3. To introduce the various asymmetric key cryptographic techniques.
4. To inculcate the cryptographic hash functions , authentication protocols and malicious software.
5. To learn the basics of Web security, Transport layer security, IP security, Email security and various types of system security.

Module	Detailed Contents	Hrs
00.	**Course Introduction:** Cryptography and Network Security is a fundamental aspect of modern data security, serving as a shield to protect sensitive information from unauthorized access and potential breaches. It is important for organizations to have a good cryptography system in place in today's digital landscape.	01
01.	**Introduction to Security Concepts and Basic Cryptography** ***Learning Objective:*** *To impart the knowledge of the basic concepts of security services and classical cryptographic techniques used in real time applications.*	10-12

	Contents: The need for security, Security approaches, Principles of security, Basic Security services: confidentiality, integrity, availability, non-repudiation, privacy, Types of security attacks: Active attacks and Passive Attacks, Security Mechanisms, The OSI security architecture, Network security model, Concept of Cryptography, Classical Encryption techniques: mono-alphabetic and poly-alphabetic, substitution techniques: Caesar Cipher, Multiplicative Cipher, Affine Cipher, Autokey Cipher, Vigenère cipher, Playfair cipher, Hill Cipher ,Transposition techniques: keyed and keyless transposition ciphers, Introduction to steganography.	
	Self-Learning Topic: *Study some basics of Quantum Cryptography.*	
	Learning Outcomes: *A learner will be able to* *LO 1.1: Apply the knowledge of fundamental concepts of security services and its mechanisms in various applications (P.I.-1.3.1)* *LO 1.2 : Apply various types of classical encryption techniques for security purpose. (P.I.-1.4.1)* *LO 1.3: Identify and assess impact of different types of substitution, transposition techniques on secure used in real-time cryptographic applications . (P.I.-2.1.3, 6.1.1)* *LO 1.4: Compare and analyse the effectiveness of various encryption techniques in addressing modern digital world cybersecurity challenges.. (P.I.- 2.2.4,6.3.1)*	
02.	**Symmetric Key Cryptography** ***Learning Objective:*** *To acquaint the knowledge of various block cipher modes, symmetric key cryptographic techniques in real time applications.*	**06-08**
	Contents: Euclidean algorithm, Modular Arithmetic, Prime numbers, Fermat's and Eulers theorem, Congruence relation, Chienese Remainder Theorem, Block cipher modes of operation: Electronic Code Book (ECB) mode, Cipher Block Chaining (CBC) mode, Cipher Feedback (CFB) mode, Output Feedback (OFB) mode, Counter mode (CTR), Data Encryption Standard (DES), Advanced Encryption Standard (AES), Stream Ciphers: Rivest Cipher 4 (RC4), Rivest Cipher 5 (RC5) algorithm.	
	Self-Learning Topics: *Study some more types of ciphers like Feistel Cipher, XOR Cipher, Keyword Cipher, Null Cipher.*	
	Learning Outcomes: *A learner will be able to* *LO 2.1: Apply the knowledge of fundamental mathematical concepts in the field of security. (P.I.-1.1.1)* *LO 2.2: Apply various block cipher modes of operation in various encryption standards. (P.I.-1.3.1)* *LO 2.3: Identify various Symmetric Key Cryptographic techniques. (P.I.- 2.1.3)* *LO 2.4: Compare and contrast different types of the stream ciphers and select the optimal strategy. (P.I.- 2.2.4)*	
03.	**Asymmetric Key Cryptography** ***Learning Objective:***	**06-08**

	To impart the knowledge of different asymmetric key cryptographic techniques in real time applications.	
	Contents: Public key cryptography, Principles of public key cryptosystems, The RSA algorithm, Elgamal Cryptography, Elliptic Curve Cryptography, Key distribution and Key exchange protocols, Diffie-Hellman Key Exchange, Man in the middle attack.	
	Self-Learning Topics: *Study some other types of attacks like denial-of-service attack, DDOS, SYN Flood attack.*	
	Learning Outcomes: *A learner will be able to* *LO 3.1: Apply principles of public key cryptosystems. (P.I.-1.3.1)* *LO 3.2: Apply RSA asymmetric key cryptographic algorithm in real time application. (P.I.-1.1.1)* *LO 3.3: Compare and evaluate the effectiveness of Elgamal Cryptography and Elliptic Curve Cryptography technique in real-world security systems (P.I.-2.2.4)* *LO 3.4: Apply the concept of key distribution in the Diffie-Hellman Key Exchange Algorithm to develop secure communication protocols.(P.I.-2.1.3)*	
04.	**Cryptographic Hash Functions and Authentication Protocols** ***Learning Objective:*** *To identify different hash functions , hashing techniques and authentication protocols.*	**06-08**
	Contents: Concept of cryptographic hash function, properties of secure hash function, Hashing Techniques: Secure Hash Algorithm-256 (SHA-256), Secure Hash Algorithm-512 (SHA-512), Message Digest (MD5), Hash based Message Authentication Code (HMAC) and Cipher based Message Authentication Code (CMAC), Digital Signature Schemes: RSA, DSS, Attacks on Digital Signature, Remote user Authentication Protocols, Kerberos, Digital Certificate:X.509, Public Key Infrastructure (PKI).	
	Self-Learning Topics: *Study Zero-knowledge protocols, Lightweight Directory Access Protocol (LDAP), Cryptographic hash Functions in blockchain.*	
	Learning Outcomes: *A learner will be able to* *LO 4.1: Apply the concept of Cryptographic Hash Functions in cybersecurity and cryptography. (P.I.-1.3.1)* *LO 4.2: Apply the concept of hashing techniques to ensure data integrity and analyze the societal impact of cryptographic hashing techniques in securing sensitive data, ensuring privacy, and preventing malicious activities .P.I.-1.4.1, 6.2.1)* *LO 4.3: Compare and contrast remote user authentication protocols. (P.I.-2.2.4)* *LO 4.4: Identify and analyze various Digital Signature Schemes used in real-time applications, evaluating their significance in engineering & societal contexts . (P.I.-2.1.3, 6.3.1)*	
05.	**Malicious Programs** ***Learning Objective:*** *To familiarize various malicious programs and countermeasures required to protect system against malicious code.*	**01-03**
	Contents: SPAM, Trojan horse, Viruses, Worms, System Corruption, Attack Agents, Information Theft, Trapdoor, Keyloggers, Backdoors, Rootkits, Zombie, SQL injection, Phishing, Countermeasures.	

	Self-Learning Topics: *Study the recent malicious software and their effects.*	
	Learning Outcomes: *A learner will be able to* *LO 5.1: Apply knowledge of different types of malicious software to protect the system from virus. (P.I.-1.3.1)* *LO 5.2: Implement countermeasures to protect system from malicious programs. (P.I.-1.4.1)*	
06.	**Network Security and Applications** ***Learning Objective:*** *To introduce the basics of web security, transport layer security, IP security, Email security and various types of system security in the network.*	**08-10**
	Contents: Web security considerations, Secure Electronic Transaction Protocol, Secure Sockets Layer (SSL)Architecture, Transport Layer Security (TLS), IP level Security: Introduction to IPSec, IPSec Architecture, Protection Mechanism (Authentication Header and Encapsulating Security Payload), Email security : Pretty Good Privacy (PGP), S/MIME, Intruders, Intrusion detection System (IDS), Firewall design principles, types of firewalls, Case Studies on Cryptography and security: Secure Inter-branch Payment Transactions, Cross site Scripting Vulnerability, Virtual Elections.	
	Self-Learning Topics: *Study advanced Security Applications like Cryptology in Contact Tracing Applications, Issues related to Quantum Cryptanalysis.*	
	Learning Outcomes: *A learner will be able to* *LO6.1: Apply and analyze web security ,Transport Layer Security (TLS),IP security to identify potential threats and designing effective solutions to enhance cybersecurity (P.I.-1.3.1,2.2.3,3.2.2)* *LO6.2: Apply and analyze email security protocols, such as SMTP, POP,S/MIME , PGP, for protecting email communication against cyber threats and evaluate its ethical and societal implications to address evolving threats. (P.I.-1.4.1,2.2.2,3.2.1,6.1.1, 7.1.1,11.2.1)* *LO 6.3: Analyze real-world security challenges by using various network security and evaluate the ethical, societal, and technological implications of cryptographic security measures in modern applications, emphasizing continuous learning and professional responsibility (P.I.-2.3.1, 6.2.1,7.2.2,11.2.2)*	
	Course Conclusion	**01**
	Total	**45**

Performance Indicators:

P. I. Number	**P. I. Statement**
1.1.1	Apply the knowledge of discrete structures, linear algebra, statistics, and numerical techniques to solve problems.
1.3.1	Apply engineering fundamentals.
1.4.1	Apply theory and principles of computer science engineering to solve an engineering problem.
2.1.3	Identifies mathematical algorithmic knowledge that applies to a given problem
2.2.2	Identifies functionalities and computing resource.

2.2.3	Identify existing solution/methods to solve the problem, including forming justified approximations and assumptions.
2.2.4	Compare and contrast alternative solution/methods to select the best methods
3.2.1	Ability to explore design alternatives.
3.2.2	Ability to produce a variety of potential design solutions suited to meet functional requirements.
6.1.1	Identify and describe various engineering roles; particularly as pertains to protection of the public and public interest at global, regional, and local level.
6.2.1	Interpret legislation, regulations, codes, and standards relevant to your discipline and explain its contribution to the protection of the public.
6.3.1	Identify risks/impacts in the life-cycle of an engineering product or activity.
7.1.1	Identify situations of unethical professional conduct and propose ethical alternatives
7.2.2	Examine and apply moral & ethical principles to known case studies.
11.2.1	Identify historic points of technological advance in engineering that required practitioners to seek education in order to stay current developments.
11.2.2	Recognize the need and be able to clearly explain why it is vitally important to keep current regarding new developments in your field.

Course Outcomes:

Learner will be able to

1. Apply fundamental security concepts and various encryption techniques to enhance secure communication and evaluate their role in data security, privacy, and societal implications. *(LO 1.1,LO1.2,LO1.3,LO1.4)*
2. Apply different symmetric key cryptographic techniques to enhance data security in real-world application. *(LO 2.1,LO 2.2,LO 2.3,LO 2.4)*
3. Apply various asymmetric key cryptographic techniques to ensure data security in real time application. *(LO 3.1, LO3.2, LO3.3, LO3.4)*
4. Identify hashing techniques, various authentication protocols to enhance security and apply the knowledge of malicious software to implement countermeasures to protect system. *(LO 4.1,LO 4.2,LO 4.3,LO 4.4,LO5.1,LO5.2)*
5. Analyse web, TLS, IP-level, and email security mechanisms to protect digital communication. Also evaluate their societal, ethical, and technological impact while emphasizing continuous learning in cybersecurity. *(LO 6.1,LO 6.2,LO 6.3)*

CO-PO Mapping Table with Correlation Level

CO ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
ITPCC611.1	3	3	-	-	-	3	-	-	-	-	-
ITPCC611.2	3	3	-	-	-	-	-	-	-	-	-
ITPCC611.3	3	3	-	-	-	-	-	-	-	-	-
ITPCC611.4	3	3	-	-	-	3	-	-	-	-	-
ITPCC611.5	3	3	3	-	-	3	3	-	-	-	3
Average	**3**	**3**	**3**	-	-	**3**	**3**	-	-	-	**3**

Text Books:

1. Cryptography and Network Security, Principles and Practice, William Stallings, Sixth Edition, March 2013, Pearson Education.
2. Cryptography & Network Security, Behrouz A. Ferouzan, First Edition, 16 March 2007, Tata McGraw Hill.
3. Cryptography and Network Security, Behrouz A. Forouzan & Debdeep Mukhopadhyay, Second Edition, 2010, Tata McGraw Hill Education.
4. Cryptography & Network Security, Bernard Menezes, Sixth Edition ,2010, Cengage Learning.

Reference Books:

1. Cryptography and Network Security, Atul Kahate, Third Edition, 2013, Mc Graw Hill.
2. Applied Cryptography, Protocols Algorithms and Source Code in C, Bruce Schneier, Second Edition,2001, John Wiley and Sons Inc.
3. Network Security Bible, Eric Cole, Second Edition, 2011.Wiley.

Other Resources:

1. NPTEL Course: Cryptography and Network Security by Dr. Debdeep Mukhopadhyay, IIT Kharagpur
   Web Link- https://nptel.ac.in/courses/106105031
2. NPTEL Course: Foundation of Cryptography by Prof. Ashish Choudhary, IIT Bengaluru
   Web Link- http://www.digimat.in/nptel/courses/video/106106221/L46.html
3. NPTEL Course: Cryptography and Network Security by Prof. Sourav Mukhopadhyay , IIT Kharagpur.
   Web Link- https://archive.nptel.ac.in/noc/courses/noc19/SEM1/noc19-cs28/

A. IN-SEMESTER ASSESSMENT (50 MARKS)

1. Continuous Assessment (20 Marks)

Suggested breakup of distribution

a) One MCQ Test as per GATE exam pattern / level: 05 Marks

b) One Class Test:05 Marks

c) One Think Pair Share (TPS) activity: 05 Marks

d) Regularity and active participation :05 Marks

2. Mid Semester Examination (30 Marks)

Mid semester examination will be based on 40% to 50% syllabus.

B. END SEMESTER EXAMINATION (50 MARKS)

End Semester Examination will be based on syllabus coverage up to the Mid Semester Examination (MSE) carrying 20% to 30% weightage, and the syllabus covered from MSE to ESE carrying 70% to 80% weightage.

Course Type	Course Code	Course Name	Credits
PEC	ITPEC6021	INFRASTRUCTURE MANAGEMENT	03

Examination Scheme					
Distribution of Marks			Exam Duration (Hrs.)		Total Marks
In-semester Assessment		End Semester Examination (ESE)			
Continuous Assessment	Mid-Semester Exam (MSE)		MSE	ESE	
20	30	50	1.5	2	100

Pre-requisite:

1. ITPCC406: Computer Network
2. ITPCC407: Operating System
3. ITLBC506: Cloud Computing Laboratory
4.

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO3: Design/development of solutions
4. PO4: Conduct investigations of complex problems
5. PO10: Project management and finance
6. PO11: Life-Long Learning

Course Objectives:

1. To introduce the perspective of Infrastructure Management.
2. To make learner learn concepts of Network Infrastructure Management.
3. To make learner demonstrate System and Storage Management skills
4. To impart the knowledge of fundamentals of Cloud computing and Cybersecurity in IT Infrastructure management
5. To acquaint learner with Emerging Technologies in IT Infrastructure management

Module	Details	Hrs.
00.	**Course Introduction** The Infrastructure Management course includes a combination of technical, managerial, and practical aspects related to planning, designing, implementing, and managing IT infrastructure. It is the process of keeping an organization's IT infrastructure - hardware, data storage, operating systems, networks and communications, enterprise software, and internet platforms - running smoothly.	**01**
01.	**Introduction to IT Infrastructure management** ***Learning Objective:***	**05-07**

	To make learner identify and summarize basics of infrastructure management, Role of Infrastructure Managers and challenges faced.	
	Contents: Definition, Scope and Importance of IT Infrastructure. Evolution, Goals and types for Infrastructure Management. Role of Infrastructure Managers. Challenges in IT infrastructure management.	
	Self-Learning Topics: *Identify current trends in IT infrastructure management.*	
	Learning Outcomes: *A learner will be able to* *LO 1.1: Apply concepts of Infrastructure management to Information System (P.I.-1.3.1)* *LO 1.2: Apply the knowledge of infrastructure managements to find challenges of Infrastructure management (P.I.-1.4.1)* *LO 1.3: Identify processes for manager role in Infrastructure management (P.I.-2.1.2)* *LO 1.4: Identify the functionalities of components of IT infrastructure (P.I.-2.2.2)*	
02.	**Network Infrastructure management** ***Learning Objective:*** *To familiarize with the different components, protocols, standards, topologies and challenges of network infrastructure management*	**08-10**
	Contents: Definition, scope, and importance of network infrastructure management. Current trends and challenges in network management. Network architecture, models, protocols and standards. Network devices and their functions. Network performance optimization and QoS, Network topologies and design principles. **Demonstration of Network Infrastructure Management techniques using open source tool.**	
	Self-Learning Topics: *Identify Career paths and opportunities in network infrastructure management.*	
	Learning Outcomes: *A learner will be able to* *LO 2.1: Identify objectives of network infrastructure management (P.I.-2.1.1)* *LO 2.2: Identify current trends and challenges in network management. Network architecture, models, protocols and standards (P.I.-2.1.2)* *LO 2.3: Apply fundamentals for network performance optimization (P.I.-1.3.1)* *LO 2.4: Apply different network topologies and design principals to network infrastructure management (P.I.-1.4.1)*	
03.	**System Management** ***Learning Objective:*** *To make learner analyze different server requirements for managing the resources.*	**06-08**
	Contents: Server hardware and architecture, Server operating systems (Windows Server, Linux Server), Server management and configuration, High	

	availability and disaster recovery planning. Containerization (Docker, Kubernetes) and its role in IT infrastructure. **Demonstration of System/Server Management techniques using open source tool.**	
	Self-Learning Topics: *Identify current trends in server configuration available in the market.* ***Learning Outcomes:*** *A learner will be able to* *LO 3.1: Apply concepts to achieve high availability and disaster recovery (P.I.-1.3.1)* *LO 3.2: Apply different NLP approaches to mining information from clinical text (P.I.-1.4.1)* *LO 3.3: Identify role of containerization in IT infrastructure (P.I.-2.2.3)* *LO 3.4: Identify server operating system and configuration required for IT infrastructure management. (P.I.-2.1.2)*	
04.	**Storage Management** ***Learning Objective:*** *To familiarize with storage technologies like SAN, NAS, CAS etc. and understand storage management challenges for business continuity.*	**06-08**
	Contents: Storage technologies (SAN, NAS, CAS), RAID configurations and data redundancy, Monitoring the storage Infrastructure, Storage management activities and provisioning, Backup and recovery strategies, Replication strategies, Storage Infrastructure Management challenges. **Demonstration of Storage Management techniques using open source tool**	
	Self-Learning Topics: *Identify current trends in storage technologies available in the market* ***Learning Outcomes:*** *A learner will be able to* *LO 4.1: Apply concepts to achieve data redundancy in storage technologies(P.I.-1.3.1)* *LO 4.2: Apply fundamentals to find challenges in Storage Infrastructure Management (P.I.-1.4.1)* *LO 4.3: Identify different techniques to monitor storage infrastructure (P.I.-2.2.3)* *LO 4.4: Identify Backup/recovery and Replication processes for Storage Infrastructure Management (P.I.-2.1.2)*	
05.	**Cloud computing and Cybersecurity in IT Infrastructure** ***Learning Objective:*** *To make learner aware of the different cloud computing models, security audit, monitoring and compliance.*	**06-08**
	Contents: Introduction to cloud computing models, deployment models. Cloud security and compliance. Security principles and best practices. Network security (firewalls, VPNs, IDS/IPS). Identity and access management, Security auditing and monitoring. Ethical considerations in IT infrastructure management. **Demonstration of Cloud and Cybersecurity Management techniques using open source tool**	
	Self-Learning Topics:	

	Case study of any cyber security based IT infrastructure managing industry. ***Learning Outcomes:*** *A learner will be able to* *LO 5.1: Use appropriate techniques to collect data required for cloud security and compliance (P.I.-4.3.1)* *LO 5.2: Define problems encounter during application of Security principles and best practices used in investigation of IT infrastructure (P.I.- 4.1.1)* *LO 5.3: Identify access management, Security auditing and monitoring in IT infrastructure (P.I.- 2.2.3)* *LO 5.4: Identify processes used for Ethical considerations in IT infrastructure management (P.I.-2.1.2)*	
06.	**Emerging Technologies in IT Infrastructure** ***Learning Objective:*** *To make learner aware of emerging technologies in IT infrastructure management domain and should be able to provide to mitigate the risk associated with business continuity.* **Contents:** Internet of Things (IoT) and its impact on IT infrastructure. Edge computing and its relevance. Artificial Intelligence (AI) and machine learning in infrastructure management. Project planning and scheduling, Budgeting and resource management, Risk assessment and mitigation in infrastructure projects. **Demonstration of IoT and Edge Computing techniques using open source tool** ***Self-Learning Topics:*** *Case studies and future trends IT infrastructure Management of different Industries* ***Learning Outcomes:*** *A learner will be able to* *LO 6.1: Synthesize requirements for risk assessment and mitigation in infrastructure projects and select most appropriate proposal (P.I.- 3.1.5, 10.2.1)* *LO 6.2: Design Project planning and scheduling alternatives for IT infrastructure management and identify tasks required to complete the tasks (P.I.- 3.2.1, 10.3.1)* *LO 6.3: Identify technological advances in edge computing relevance on IT infrastructure (P.I.- 2.1.2, 11.2.1)* *LO 6.4: Identify and analyze impact of IoT on performance and sustainability of IT infrastructure (P.I.- 2.3.1, 11.3.2)*	**06-08**
	Course Conclusion	**01**
	Total	**45**

Performance Indicators:

P.I. No.	**P.I. Statement**
1.3.1	Apply engineering fundamentals
1.4.1	Apply theory and principles of computer science engineering to solve an engineering problem
2.1.1	Evaluate problem statements and identifies objectives
2.1.2	Identifies processes/modules/algorithms of a computer-based system and parameters to solve a problem
2.2.2	Identifies functionalities and computing resources.

2.2.3 Identify existing solution/methods to solve the problem, including forming justified approximations and assumptions
2.3.1 Able to apply computer engineering principles to formulate modules of a system with required applicability and performance
3.1.5 Explore and synthesize system requirements from larger social and professional concerns
3.2.1 Ability to explore design alternatives
4.1.1 Define a problem for purposes of investigation, its scope and importance
4.3.1 Use appropriate procedures, tools and techniques to collect and analyze data
10.2.1 Analyse and select the most appropriate proposal based on economic and financial considerations.

10.3.1 Identify the tasks required to complete an engineering activity, and the resources required to complete the tasks
11.2.1 Identify historic points of technological advance in engineering that required practitioners to seek education in order to stay current
11.3.2 Analyse sourced technical and popular information for feasibility, viability, sustainability, etc.

Course Outcomes: A learner will be able to -

1. Identify and apply appropriate IT infrastructure techniques to Information System. *(LO 1.1, LO 1.2, LO 1.3, LO 1.4)*
2. Analyse different techniques of Network Infrastructure Management and apply appropriate techniques for the same. *(LO 2.1, LO 2.2,LO 2.3, LO 2.4)*
3. Identify and apply Server and Storage management techniques for IT infrastructure Management. *(LO 3.1, LO 3.2, LO 3.3, LO 3.4, LO 4.1, LO 4.2, LO 4.3, LO 4.4)*
4. Analyse Cloud computing and Cybersecurity in IT Infrastructure Management. *(LO 5.1, LO 5.2, LO 5.3, LO 5.4)*
5. Design cost effective solution using recent IoT and Edge Computing techniques for IT Infrastructure Management. *(LO 6.1, LO 6.2, LO 6.3, LO 6.4)*

CO-PO Mapping Table with Correlation Level

CO ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
ITPEC6021.1	3	3	-	-	-	-	-	-	-	-	-
ITPEC6021.2	3	3	-	-	-	-	-	-	-	-	-
ITPEC6021.3	3	3	-	-	-	-	-	-	-	-	-
ITPEC6021.4	-	3	-	3	-	-	-	-	-	-	-
ITPEC6021.5	-	3	3	-	-	-	-	-	-	3	3
Average	**3**	**3**	**3**	**3**	-	-	-	-	-	**3**	**3**

Text Books:

1. Mishra, Nikhilesh. Mastering IT Infrastructure Management: Concepts, Techniques, and Applications., Amazon Digital Services LLC - Kdp, 2023
2. Infrastructure Planning Handbook by Prof Makarand Hastak, ASCE Press
3. Strategic Management of Large Engineering Projects by Miller and Lessard
4. Keshari, Surendra., Kumar, Narendra. IT Infrastructure and Management. India: I.K. International Publishing House Pvt. Limited, 2013.

Reference Books:

1. Kramp, Luna. Beginner'S Guide to IT Infrastructure Management- Managing Technology and Technology Teams, it Budgets, Risk, Assets, Large It Projects: Infrastructure Manager Guide Book. N.p., Independently Published, 2020.
2. Schiesser, Rich. IT Systems Management. United Kingdom, Prentice Hall PTR, 2002.
3. Choubey, Manoj Kumar. IT Infrastructure and Management: For the GBTU and MMTU. India: Pearson India, 2011.
4. Infrastructure Planning and Management in India: Opportunities and Challenges. Singapore: Springer Nature Singapore, 2022.

Other Resources :

1. NPTEL Course: Infrastructure Planning and Management by Prof. Ashwin Mahalingam, IIT Madras. Web link- https://onlinecourses.nptel.ac.in/noc21_mg81/preview
2. NPTEL Course: Infrastructure Economics by Prof. Nalin Bharti, IIT Patna. Web link- https://nptel.ac.in/courses/109106089

A. IN-SEMESTER ASSESSMENT (50 MARKS)

1. Continuous Assessment - Theory-(20 Marks)

a) Assignment on live problems/ case studies: 10 Marks

Students should be assigned a real life problem statement related to IT infrastructure management domain. Students are expected to research and collect required data to design a system for the selected problem. Students should apply infrastructure management knowledge to design a system for IT resources including memory, network, server and storage requirements. Students should present their work in the form of presentation and demonstration in 10-15 minutes. This assignment should be graded for 10 marks like a design assignment based on the parameters such as data acquisition, requirement analysis, designing a system for selected problem statement.

b) One Think Pair Share (TPS) activity: 05 Marks

c) Regularity and active participation: 05 Marks

2. Mid Semester Exam (30 Marks)

Mid semester examination will be based on 40% to 50% syllabus.

B. END SEMESTER EXAMINATION (50 MARKS)

End Semester Examination will be based on syllabus coverage up to the Mid Semester Examination (MSE) carrying 20% to 30% weightage, and the syllabus covered from MSE to ESE carrying 70% to 80% weightage.

Course Type	Course Code	Course Name	Credits
PEC	ITPEC6022	MACHINE LEARNING	03

Examination Scheme					
Distribution of Marks			Exam Duration (Hrs.)		Total Marks
In-semester Assessment		End Semester Exam (ESE)			
Continuous Assessment	Mid-Semester Exam (MSE)		MSE	ESE	
20	30	50	1.5	2	100

Pre-requisite :

1. ITPCC301: Engineering Mathematics-III
2. ITPCC405: Engineering Mathematics-IV
3. ITPCC510: Artificial Intelligence

Program Outcomes addressed :

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO3: Design/development of solutions
4. PO4: Conduct Investigation of complex problems
5. PO5: Engineering tool usage
6. PO8: Individual and Collaborative Teamwork
7. PO9: Communication
8. PO11: Life-Long Learning

Course Objectives:

1. To impart the knowledge about basic difference among the techniques of Machine Learning.
2. To introduce regression, classification and clustering methods to solve problem.
3. To introduce various ensemble techniques for combining ML models
4. To impart the knowledge about design an application using Machine learning and Deep learning methods

Module	Detailed Contents	Hrs
00.	**Course Introduction** Machine Learning course deals with techniques to develop algorithms that improve automatically through experience and by the use of data. This course includes the foundational principles and practice implementing various ML systems.	01
01.	**Introduction to Machine Learning** ***Learning Objective/s:*** *To acquaint learner with interpretation of various types of machine learning and implementation of it in real time applications.*	04-06

	Contents: Machine Learning, Types of Machine Learning, Issues in Machine Learning, Application of Machine Learning, Steps in developing a Machine Learning Application, Training Error, Generalization error, Overfitting, Under fitting, Bias-Variance trade-off	
	Self-Learning Topics: *Explore applications of ML.*	
	Learning Outcomes: *The learner will be able to* *LO 1.1: Identify the appropriate ML method applicable to a given problem (P.I.-2.2.3)* *LO 1.2: Solve a given problem using ML technique. (P.I.-2.1.3)* *LO 1.3: Apply engineering fundamentals to identify the type of machine learning applicable to a given problem (P.I-1.3.1)* *LO 1.4: Apply the appropriate ML method applicable to a given problem. (P.I- 1.4.1)*	
02.	**Supervised Learning Methods** ***Learning Objective/s:*** *To make learner apply regression and decision tree techniques for prediction. Also expected to evaluate the performance of the method.*	**12-14**
	Contents: **Learning with Regression:** Linear Regression, Multivariate Linear Regression, Logistic Regression **Learning with Trees:** Decision Trees, Constructing Decision Trees using Gini Index, Classification and Regression Trees (CART) Performance Metrics: Confusion Matrix, Kappa Statistics, Sensitivity, Specificity, Precision, Recall, F-measure, ROC curve **Learning with Support Vector Machine:** Support Vector Machine Constrained Optimization, Optimal decision boundary, Margins and support vectors, SVM as constrained optimization problem, Quadratic Programming, SVM for linear and nonlinear classification, Basics of Kernel trick, Support Vector Regression, Multiclass Classification. **Ensemble Learning:** Understanding Ensembles, K-fold cross validation, Boosting, Stumping, XGBoost Bagging, Subagging, Random Forest, Comparison with Boosting, Different ways to combine classifiers **Demonstration of Regression, Decision Tree and SVM Techniques using open source tool**	
	Self-Learning Topics: *ID3 Method for Decision Tree*	
	Learning Outcomes: *The learner will be able to* *LO 2.1: Apply the regression techniques for prediction of output based on the input. (P.I.-1.3.1)* *LO 2.2: Apply Logistic regression, Decision tree and support vector machine to classify the data. (P.I.-1.4.1)* *LO 2.3: Evaluate the performance of the ML Model. (P.I.-3.3.1)* *LO 2.4: Apply ensemble learning to combine different ML classifiers. (P.I. 3.4.2)*	

03.	**Unsupervised Learning Methods** ***Learning Objective/s:*** *To make leaner apply clustering and association rule mining techniques for discovering clusters/rules.*	**06-08**
	Contents: **Learning with Clustering:** Introduction to clustering with overview of distance metrics, K means Clustering, Hierarchical Clustering. K-NN Clustering, Clustering with minimal spanning tree, Expectation Maximization Algorithm, DBSCAN **Learning with Association Rule Mining:** Discovering association rules **Demonstration of Clustering techniques using open source tool**	
	Self-Learning Topics: *K medoid clustering*	
	Learning Outcomes: *The learner will be able to* *LO 3.1: Apply different distance metrics to find clusters. (P.I.-1.3.1)* *LO 3.2: Apply the clustering algorithms to group the data in to clusters. (P.I.-1.4.1)* *LO 3.3: Select the value of K based on the given data. (P.I.-2.1.3)* *LO 3.4: Select the best linkage method used in hierarchical clustering by comparing different linkage methods. (P.I.-2.2.4)*	
04.	**Reinforcement Learning Methods** ***Learning Objective/s:*** *To make learner apply the knowledge of reinforcement learning to solve a problem.*	**03-05**
	Contents: Introduction, Elements of Reinforcement Learning, Model based learning, Temporal Difference Learning, Generalization, Partially Observable States.	
	Self-Learning Topics: *Robot Navigation as reinforcement learning problem.*	
	Learning Outcomes: *The learner will be able to* *LO 4.1: Apply the concept of reinforcement to solve a problem. (P.I.-1.3.1)* *LO 4.2: Apply different reinforcement learning methods to solve a real life problem. (P.I.-1.4.1)*	
05.	**Introduction to Deep Learning** ***Learning Objective/s:*** *To make leaner apply the deep learning networks to design application also expected to analyze and interpret the result.*	
	Contents: Introduction to Deep Learning, ANN, Machine Learning Vs Deep Learning, Working of Deep Learning; **Convolutional Neural Network:** Introduction, Components of CNN Architecture, Properties of CNN, Architectures of CNN, Applications of CNN **Recurrent Neural Network:** Introduction, Simple RNN, LSTM Implementation, Deep RNN	**08-10**

	Autoencoder: Introduction, Features, Types, **Demonstration of Deep Learning applications using open source tool**	
	Self-Learning Topics: *GAN* ***Learning Outcomes:*** *The learner will be able to* *LO 5.1: Apply the convolution operation to extract the features of Image (P.I.-1.1.1)* *LO 5.2: Apply Convolutional Neural Network to solve a problem. (P.I.-1.4.1)* *LO 5.3: Identify the components and parameters of CNN to solve a problem. (P.I.-2.1.2)* *LO 5.4: Solve the given problem by identifying the appropriate deep learning network.(P.I.-2.2.3)*	
06.	**Applications and Recent trends of Machine Learning** ***Learning Objective/s:*** *To make learner apply the concepts of machine learning to design and analyze the real life applications.*	**04-06**
	Contents: **Applications:** Recommender Systems, Machine Learning for Image Recognition, Sentiment Analysis, Machine Learning for video surveillance **Recent trends:** TinyML , MLOps	
	Self-Learning Topics: *Interpretable ML*	
	Learning Outcomes: *The learner will be able to* *LO 6.1: Define a problem statement along with the research gap, Choose ML technique and tool, use it to design a solution and effectively present the solution. (P.I.-3.1.1,4.1.1,5.1.1, 8.2.1,9.1.1,11.1.2)* *LO 6.2: Identify the recent ML technique alternative to traditional techniques for the selected problem, use it to design a solution with the help of ML tools and effectively present the solution in a team (P.I.- 3.2.1,4.2.1,5.2.2,8.3.1,9.1.2,11.2.1)*	
	Course Conclusion	**01**
Total		**45**

Performance Indicators:

P.I. No.	P.I. Statement
1.3.1	Apply engineering fundamentals.
1.4.1	Apply theory and principles of computer science engineering to solve an engineering problem.
2.1.2	Identifies processes/modules/algorithms of a computer based system and parameters to solve a problem
2.1.3	Identifies mathematical algorithmic knowledge that applies to a given problem.
2.2.3	Identify existing solution/methods to solve the problem, including forming justified approximations and assumptions
2.2.4	Compare and contrast alternative solution/methods to select the best methods
3.1.1	Able to define a precise problem statement with objectives and scope.

3.2.1 Ability to explore design alternatives.

3.3.1 Ability to perform systematic evaluation of the degree to which several design concepts meet the criteria.

3.4.2 Ability to implement and integrate the modules.

4.1.1 Define a problem for purposes of investigation, its scope and importance

4.2.1 Design and develop appropriate procedures/methodologies based on the study objectives

5.1.1 Identify modern engineering tools, techniques and resources for engineering activities.

5.2.2 Demonstrate proficiency in using discipline specific tools.

8.2.1 Demonstrate effective communication, problem solving, conflict resolution and leadership skills.

8.3.1 Present result as a team, with smooth integration of contributions from all individual efforts.

9.1.1 Read, understand and interpret technical and nontechnical information.

9.1.2 Produce clear, well- constructed, and well-supported written engineering documents.

11.2.1 Identify historic points of technological advance in engineering that required practitioners to seek education in order to stay current.

11.1.2 Identify deficiencies or gaps in knowledge and demonstrate an ability to source information to close this gap.

Course Outcomes:

Learner will be able to

1. Select and apply appropriate machine learning model for the given application. *(LO 1.1, LO 1.2, LO 1.3, LO 1.4)*
2. Select and apply various supervised, unsupervised and ensemble machine learning techniques and evaluate the performance of the model. *(LO 2.1, LO 2.2., LO 2.3, LO 2.4, LO 3.1, LO 3.2, LO 3.3, LO 3.4)*
3. Apply the Reinforcement learning to solve a given problem. *(LO 4.1, LO 4.2)*
4. Analyse and apply Deep learning methods to solve the given problem.*(LO 5.1, LO 5.2, LO 5.3, LO5.4)*
5. Design application using machine learning techniques. *(LO 6.1, LO 6.2)*

CO-PO Mapping Table with Correlation Level

CO ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
ITPEC6022.1	3	3	-	-	-	-	-	-	-	-	-
ITPEC6022.2	3	3	3	-	-	-	-	-	-	-	-
ITPEC6022.3	3	-	-	-	-	-	-	-	-	-	-
ITPEC6022.4	3	3	-	-	-	-	-	-	-	-	-

ITPEC6022.5	-	-	3	3	3	3	-	3	3	-	3
Average	**3**	**3**	**3**	**3**	**3**	**3**	**-**	**3**	**3**	**-**	**3**

Text Books :

1. Machine Learning in Action, Peter Harrington, Fourth Edition" 2020, DreamTech Press.
2. Introduction to Machine Learning, Ethem Alpaydın, First edition, 2011, MIT Press.
3. Machine Learning, Tom M. Mitchell, Fourth edition, 2005, McGraw Hill.

Reference Books :

1. Data Mining Concepts and Techniques, Han Kamber, First Edition,1990, Morgan Kaufmann Publishers.
2. Data Mining Introductory and Advanced Topics, Margaret. H. Dunham, Sixth Edition.2018, Pearson Education.
3. Machine Learning — A Probabilistic Perspective, Kevin P. Murphy, 3rd edition, 1993,Pearson Education.

Other Resources :

1. NPTEL Course: Introduction to Machine Learning, Prof. S. Sarkar, IIT Kharagpur
   Web Link- https://onlinecourses.nptel.ac.in/noc21_cs85
2. NPTEL Course: Introduction to Machine Learning, Prof. Balaraman Ravindran, IIT Madras
   Web Link- https://onlinecourses.nptel.ac.in/cnoc21_cs24

A. IN-SEMESTER ASSESSMENT (50 MARKS)

1. Continuous Assessment (20 Marks)

Suggested breakup of distribution

a) One Assignment on live problems/ case studies: 10 Marks

Students should be assigned a real life problem statement (different for each student). Students are expected to research and collect required resources to solve the problem. They can use the resources and solve the problem on assigned date and time in Institute premises in presence of faculty member. This assignment should be graded for 10 marks depending on the parameters as analysis, design, application of appropriate ML technique and outcome for selected problem statement.

b) One Think Pair Share (TPS) activity: 05 Marks

c) Regularity and active participation :05 Marks

2. Mid Semester Examination (30 Marks)

Mid semester examination will be based on 40% to 50% syllabus.

B. END SEMESTER EXAMINATION (50 MARKS)

End Semester Examination will be based on syllabus coverage up to the Mid Semester Examination (MSE) carrying 20% to 30% weightage, and the syllabus covered from MSE to ESE carrying 70% to 80% weightage.

Course Type	Course Code	Course Name	Credits
PEC	ITPEC6023	WIRELESS TECHNOLOGY	03

Examination Scheme					
Distribution of Marks			Exam Duration (Hrs.)		Total Marks
In-semester Assessment		End Semester Examination (ESE)			
Continuous Assessment	Mid-Semester Exam (MSE)		MSE	ESE	
20	30	50	1.5	2	100

Pre-requisite:

1. ITPCC302: Computer Organization and Architecture
2. ITPCC406 : Computer Network

Course Objectives:

1. To familiarize with the concepts of Wireless communication system
2. To impart knowledge of various Wireless technologies and analyse their Architectures.
3. To introduce leaners with the need of Wireless Sensor& Ad hoc Networks along with Mobile IP
4. To acquaint the learner with the security challenges in wireless systems and Analyse Different Wireless Network Security Standards
5. To make them Analyse the Design Considerations for Wireless Networks and recent trends in wireless technologies.

Module	Details	Hrs.
00.	**Course Introduction** Wireless Technology deals with the need and basic concepts of Wireless communication, with emphasis on the 4G and 5G wireless technologies along with WSN and Ad hoc networks. The fundamental concepts of this subject are essential for the Internet of Things.	**01**
01.	**Introduction to Wireless Communications** ***Learning Objective:*** *To make learner understand the technical challenges of wireless communications and the concepts to address these challenges in practical applications*	**5-6**
	Contents: **History:** Types of *Communication*, Requirements for the Wireless *Communication*, Economic and social aspects, Limitations **Technical Challenges of wireless communications:** Multipath propagation, Spectrum limitations, Limited energy, User mobility, **Modulation Techniques**-ASK, FSK, PSK, **Multiple Access Techniques** - FDMA, TDMA, CDMA, OFDMA **Spread Spectrum Techniques** –DSSS, FHSS.	
	Self-Learning Topics: *Comparison with Wired System*	

	Learning Outcomes: *A learner will be able to* *LO 1.1: Apply different concepts of communication to study the challenges in wireless communication. (P.I.-1.3.1)* *LO 1.2: Use basics of Wireless communications (Modulation, MA and Spread Spectrum Techniques) in different applications. (P.I.-1.1.1)* *LO 1.3: Differentiate between different multiple access and spread spectrum Techniques and select the best method in various applications. (P.I.-2.2.4)* *LO 1.4: Identify major performance criteria for the design of wireless communication systems. (P.I.- 2.2.3)*	
02.	**Wide Area Wireless Networks** ***Learning Objective:*** *To acquaint the learner with the importance of mobile telecommunications technology in terms of different Cellular Generations, advancements and improvements over their predecessors.*	**7-9**
	Contents: 1G to 5G based on technological differences and advancements; Principle of Cellular Communication – Frequency Reuse concept, cluster size and system capacity, Co channel Interference, GSM –System Architecture, GSM Radio Subsystem, Frame Structure; – Network Architecture of GPRS,UMTS; **LTE, 5G:** Key requirements and drivers of 5G systems, Use cases, Massive MIMO	
	Self-Learning Topics: *CDMA2000*	
	Learning Outcomes: *A learner will be able to* *LO 2.1: Identify the cellular concept for analysis of different generation architectures. (P.I.- 2.2.3)* *LO 2.2: Analyze requirements of different Generation Architectures (GSM, UMTS, GPRS LTE) based on applications (P.I.-3.2.1)* *LO 2.3: Explore and synthesize system requirements from larger social and professional concerns of different Generation Architectures (GSM, UMTS, GPRS LTE) (P.I.-3.1.5)* *LO 2.4: Differentiate between different Cellular Generations like 2G,3G,4G and 5G* and select the best method. *(PI-2.2.4)*	
03.	**WLAN,WPAN and WMAN Standards** ***Learning Objective:*** *To make learner understand the technology and concepts of 5G along with WMAN*	**6-8**
	Contents: **Wireless MAN Technology:** WiMAX Physical layer, Media Access Control, Mobility and Networking, and 802.16 broadband wireless access standards **Wireless LAN Technology:** IEEE 802.11(Wi-Fi) – Architecture, Protocol Stack, Enhancements (802.11a, 802.11g, 802.11n, 802.11ac) and Applications	

	Wireless PAN Technology: IEEE 802.15.1 (Bluetooth) – Piconet, Scatter net, Protocol Stack; IEEE 802.15.4 (ZigBee) – LRWPAN Device Architecture, Protocol Stack	
	Self-Learning Topics: *Wi-Fi 6*	
	Learning Outcomes: *A learner will be able to* *LO 3.1: Identify the limitations of Wi-Fi along with the enhancements. (P.I.-2.4.3)* *LO 3.2: Distinguish among various wireless protocols stacks such as IEEE 802.11, IEEE 802.15, IEEE 802.16 and select the best method in various applications (P.I.-2.2.4)* *LO 3.3: Choose appropriate wireless protocol stack such as IEEE 802.11, IEEE 802.15, IEEE 802.16 for different applications. (P.I.-3.1.4)* *LO 3.4: Ability to implement and integrate different layers in IEEE 802.11, IEEE 802.15, IEEE 802.16 Protocol Stack(P.I.-3.4.2).*	
04.	**Advanced Wireless Systems Standards -WSN & Ad hoc Network, Mobile IP** ***Learning Objectives:*** *To make learner understand concepts of WSN, Adhoc network and Mobile IP architecture.*	**6-8**
	Contents: **Wireless Sensor Network-** WSN Architecture, Applications, Issues and Challenges **Introduction of Ad hoc Networks –**MANET and VANET – Characteristics, Advantages and Limitations, Applications. **Mobile IP and Wireless Application Protocol:** Fundamentals of Mobile IP, data forwarding procedures in mobile IP	
	Self-Learning Topics: E-VANET	
	Learning Outcomes: *A learner will be able to* *LO 4.1: Apply the concepts of WSN architecture and to use in ad hoc network. (P.I.-1.3.1)* *LO 4.2: Apply concepts of MANET and VANET based on the characteristic to understand about their applications. (P.I.-1.4.1)* *LO 4.3: Identify the need along with design challenges associated with Mobile IP (P.I.-2.1.3)* *LO 4.4: Identify process of encapsulation and de-capsulation in Mobile IP. (P.I.-2.2.3)* *LO 4.5: Explore and synthesize system requirements of VANET. (P.I.-3.1.5)* *LO 4.6: Ability to explore a variety of designs to meet functional requirements for different Ad-Hoc networks for various applications. (P.I.-3.2.1)*	
05.	**Wireless Network Security & Network Design** ***Learning Objective/s:***	**6-7**

	To make learner identify need of Wireless network security for preventing unauthorized access, against cyber threats, and Designing Wireless Networks for providing connectivity, mobility, scalability, and quality of service in modern telecommunications and IT environments	
	Contents: **Wireless Security:** GSM Security; UMTS and LTE Security; Bluetooth Security; WEP; WPA2. **Wireless Network Design Considerations:** Cisco Unified Wireless Network; Designing, Wireless Networks with Lightweight Access Points and Wireless LAN Controllers.	
	Self-Learning Topics: *Study of Wireless Security Tools*	
	Learning Outcomes : *A learner will be able to* *LO 5.1: Identify the algorithms used in Cellular System Security. (P.I.-2.1.3)* *LO 5.2: Analyse the security mechanisms of Bluetooth, WEP, and WPA2 for different applications. (P.I.-2.2.3)* *LO 5.3: Analyze designing of wireless networks by reading and interpreting technical papers and collaborating effectively in teams to demonstrate problem-solving and leadership skills to recognize key technological advancements in wireless networking, and to stay updated with emerging trends. (P.I -2.1.3, 8.2.1,9.1.1 and 11.2.1)* *LO 5.4: Identify existing methodologies for optimizing wireless network performance, collaborate effectively in a team to present findings and solutions for wireless network design, by delivering effective oral presentation by recognizing the importance of staying updated with emerging wireless technologies to ensure continuous professional growth and adaptability (PI 2.2.3, 8.3.1 ,9.2.2 and 11.2.2).*	
06.	**Emerging trends in Wireless Technology** ***Learning Objective/s:*** *To apply the knowledge and skills required to navigate and analyze the rapidly evolving landscape of Wireless Technologies and its applications.*	**5-7**
	Contents: Wireless Beyond 5G, Security issues in 5G, 6G: Introduction,6G Vision and Requirement, Cognitive Radio, SDR, WRAN.	
	Self-Learning Topics: *Low-Power Wide-Area (LPWA) Networks*	
	Learning Outcomes: *A learner will be able to* *LO 6.1: Identify the security issues of 5G for any application. (P.I.-2.2.2)* *LO 6.2: Identify the requirement of 6G. (P.I.-1.3.1)* *LO 6.3: Illustrate Cognitive Radio SDR and WRAN concepts to optimize the performance of wireless communication. (P.I.-1.4.1)* *LO6.4: Compare 5G & 6G to select best cellular Technique (P.I.-2. 2..4)*	
	Course Conclusion	**01**
	Total	**45**

Performance Indicators:

P.I. No.	P.I. Statement
1.1.1	Apply the knowledge of discrete structures, linear algebra, statistics and numerical techniques to solve problems
1.3.1	Apply engineering fundamentals
1.4.1	Apply theory and principles of computer science engineering to solve an engineering problem
2.1.3	Identifies mathematical algorithmic knowledge that applies to a given problem
2.2.2	Identifies functionalities and computing resources.
2.2.3	Identify existing solution/methods to solve the problem, including forming justified approximations and assumptions
2.2.4	Compare and contrast alternative solution/methods to select the best methods
2.4.3	Identify the limitations of the solution and sources/causes.
3.1.4	Ability to choose appropriate quality attributes as defined by ISO/IEC/IEEE standard.
3.1.5	Explore and synthesize system requirements from larger social and professional concerns
3.2.1	Ability to explore design alternatives.
3.4.2	Ability to implement and integrate the modules
8.2.1	Demonstrate effective communication, problem solving, conflict resolution and leadership skills
8.3.1	Present results as a team, with smooth integration of contributions from all individual efforts
9.1.1	Read, understand and interpret technical and nontechnical information
9.2.2	Deliver effective oral presentations to technical and non-technical audiences
11.2.1	Identify historic points of technological advance in engineering that required practitioners to seek education in order to stay current
11.2.2	Recognize the need and be able to clearly explain why it is vitally important to keep current regarding new developments in your field

Course Outcomes: A learner will be able to -

1. Apply concepts of communication to understanding Wireless Fundamentals and analyse challenges in wireless **c**ommunication techniques. *(LO 1.1, LO 1.2, LO 1.3, LO 1.4))*
2. Analyse and synthesize system requirements of cellular network advancements from 1G to 5G and apply IEEE wireless standards (802.11, 802.15, 802.16) along with security mechanisms in real-world scenarios. *(LO 2.1, LO 2.2, LO 2.3, LO 2.4, LO 3.1, LO 3.2, LO 3.3, LO 3.4, LO5.1, LO5.2)*
3. Analyse Wireless Sensor Networks (WSN), Ad hoc Networks, and Mobile IP, evaluating their architectures, applications, and associated challenges *(LO 4.1, LO 4.2, LO 4.3, LO 4.4, LO 4.5,LO 4.6)*
4. Identify the design challenges and constraints associated with wireless networks by collaborating effectively in teams to analyse and design wireless networks while demonstrating problem-solving, leadership skills, and staying updated with advancements in wireless networking while presenting solutions *(LO 5.3, LO 5.4)*

5. Analyse and compare next-generation wireless technologies, including 6G, Cognitive Radio, SDR, and WRAN. *(LO 6.1, LO 6.2, LO 6.3, LO 6.4)*

CO-PO Mapping Table with Correlation Level

CO ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
ITPEC6023.1	3	3	-	-	-	-	-	-	-	-	-
ITPEC6023.2	-	3	3	-	-	-	-	-	-	-	-
ITPEC6023.3	-	3	3	-	-	-	-	-	-	-	-
ITPEC6023.4	-	3	-	-	-	-	-	3	3	-	3
ITPEC6023.5	3	3	-	-	-	-	-	-	-	-	-
Average	**3**	**3**	**3**	-	-	-	-	**3**	**3**	-	**3**

Text Books :

1. Wireless Communications and Networks", William Stallings, Pearson / Prentice Hall., Third Edition.
2. Wireless Communications, T.L. Singal, McGraw Hill Education
3. Designing for Cisco Internetwork Solutions, 2nd Edition, CCDA, Diane Teare, Cisco Press
4. Wireless Mobile Internet Security, 2nd Edition, Man Young Rhee, A John Wiley & Sons, Ltd. Publication

Reference Books :

1. Cellular Communications: A Comprehensive and Practical Guide, Nishith Tripathi, Jeffery H Reed, Wiley.
2. Mobile Communications Engineering: Theory and Applications, 2nd Edition, William C. Y. Lee, McGraw-Hill Publications
3. Adhoc & Sensor Networks Theory and Applications, Carlos de Morais Cordeiro,Dharma Prakash Agrawal, World Scientific,2nd Edition.

Other Resources :

1. NPTEL Course on Introduction to Wireless and Cellular Communications by Prof., IIT Madras.
   Web link- https://nptel.ac.in/courses/106106167
2. NPTEL Course on Wireless Ad hoc and sensor networks by Prof. Sudip Mishra, Department of Computer Science and Engineering, IIT Kharagpur
   Web link- https://archive.nptel.ac.in/courses/106/105/106105160/

A. IN-SEMESTER ASSESSMENT (50 MARKS)

1. Continuous Assessment (20 Marks)

Suggested breakup of distribution

a. MCQ test based on GATE exam pattern: 05 Marks
b. One Class Test:05 Marks
c. Technical Report writing: 05 Marks
d. Regularity and active participation :05 Marks

2. **Mid Semester Exam (30 Marks)**

Mid semester examination will be based on 40% to 50% syllabus.

B. END SEMESTER EXAMINATION (50 MARKS)

End Semester Examination will be based on syllabus coverage up to the Mid Semester Examination (MSE) carrying 20%-30% weightage, and the syllabus covered from MSE to ESE carrying 70%-80% weightage.

Course Type	Course Code	Course Name	Credits
LBC	ITLBC608	CRYPTOGRAPHY & NETWORK SECURITY LABORATORY	01

Examination Scheme		
Continuous Assessment	**End Semester Exam (ESE)**	**Total**
25	25	50

Pre-requisite:

1. ESL103 : Programming Laboratory-I (C)
2. ITSBL301 : Python Laboratory

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO3: Design/development of solutions
4. PO5: Engineering tool usage
5. PO6: The Engineer and The World
6. PO7: Ethics
7. PO11: Life-Long Learning

Course Objectives:

1. To impart the knowledge of various encryption/decryption techniques.
2. To introduce the different symmetric key and asymmetric key cryptographic techniques.
3. To impart the basics of cryptographic hash functions and digital signature scheme.
4. To use network security tools and vulnerability assessment tools.

Module	Detailed Contents	Hrs
00.	**Course Introduction** Cryptography & Network Security Laboratory course plays a vital role in safeguarding data confidentiality, integrity, and availability in today's digital landscape. With the increasing prevalence of cyber threats and attacks, organizations prioritize the security of their systems and data. The main objective of this course is to build the ability to implement various encryption/decryption techniques, digital signature scheme, generate hash code and demonstrate network security tools & vulnerability assessment tools**.**	--
01.	**Classical encryption/decryption techniques (mono-alphabetic and polyalphabetic substitution techniques: Caesar Cipher, Playfair cipher, Vigenere cipher, Hill Cipher, multiplicative cipher etc.)** ***Learning Objective:*** *To apply various encryption /decryption techniques.*	**10**

	Task 1: Perform encryption, decryption using the following substitution techniques: Caesar (Additive/ Shift) cipher, Vigenere Cipher, Hill Cipher **Task 2**: Implement Playfair cipher using substitution cipher. **Task 3**: Perform encryption and decryption using following transposition techniques: Rail fence cipher and Row & Column Transformation.	
	Self-Learning Topics: *Learn about Quantum Cryptographic Shor's algorithm and quantum key distribution (QKD).*	
	Learning Outcomes: *A learner will be able to* *LO 1.1:Apply various types of classical encryption/decryption techniques in real world applications. (P.I.-1.3.1)* *LO 1.2Apply monoalphabetic and polyalphabetic substitution ciphers to encrypt and decrypt the given plaintext. (P.I.-1.4.1)* *LO 1.3: Identify the different types of substitution, transposition techniques used in real-time cryptographic applications and assess their impact on secure communication and societal implications in the modern digital world. (P.I.-2.1.3, 6.1.1)* *LO 1.4: Compare and analyze the results of various encryption/decryption techniques. Also identify their impact on data security, privacy, and societal implications in the modern digital landscape. (P.I.- 2.2.4,6.3.1)*	
02.	**Symmetric Key Cryptography** ***Learning Objective:*** *To know and apply symmetric key cryptographic techniques in real time applications.*	**06**
	Task 4: Apply DES algorithm for practical applications. **Task 5:** Apply AES algorithm for practical applications.	
	Self-Learning Topics: *Study and analyse various block cipher modes.*	
	Learning Outcomes: *A learner will be able to* *LO 2.1: Apply the knowledge of fundamental mathematical concepts in the field of security. (P.I.-1.1.1)* *LO 2.2: Apply various Symmetric Key Cryptographic techniques in real world applications. (P.I.-1.3.1)* *LO 2.3: Identify and analyze various Symmetric Key Cryptographic techniques.(P.I.- 2.1.3)* *LO 2.4: Compare and contrast DES and AES(P.I.- 2.2.4)*	
03.	**Asymmetric Key Cryptography** ***Learning Objective:*** *To know and apply different asymmetric key cryptographic technique and key exchange technique in real time applications.*	**04**
	Task 6: Implement RSA Algorithm. **Task 7:** Implement the Diffie-Hellman Key Exchange algorithm for a given problem. **Task 8:** Implement Elgamal Cryptography and Elliptic Curve Cryptography.	
	Self-Learning Topics: *Study some other types of attacks like denial-of-service attack, DDOS, SYN Flood attack.*	
	Learning Outcomes: *A learner will be able to*	

	LO 3.1: Apply principles of public key cryptosystems. (P.I.-1.3.1) *LO 3.2: Apply RSA asymmetric key cryptographic algorithm. (P.I.-1.1.1)* *LO 3.3: Apply the concept of key distribution to implement Diffie-Hellman Key Exchange algorithm (P.I.-2.1.3)* *LO 3.4: Compare and evaluate effectiveness of Elgamal Cryptography and Elliptic Curve Cryptography technique in real-world security systems. (P.I.-2.2.4)*	
04.	**Cryptographic Hash Functions and Digital Signature** ***Learning Objective:*** *To identify different hash functions and digital signature scheme.*	**04**
	Task 9: Calculate the message digest of a text using the SHA algorithm **Task 10:** Implement the Signature Scheme - Digital Signature Standard	
	Self-Learning Topics: *Study Zero-knowledge protocols, Lightweight Directory Access Protocol (LDAP), Cryptographic hash Functions in blockchain.*	
	Learning Outcomes: *A learner will be able to* *LO 4.1: Apply the concept of Cryptographic Hash Functions in cybersecurity and cryptography. (P.I.-1.3.1)* *LO 4.2: Apply SHA algorithm to calculate the message digest of a text and analyze the societal impact of cryptographic hashing techniques in securing sensitive data, ensuring privacy, and preventing malicious activities .(P.I.-1.4.1, 6.2.1)* *LO 4.3: Identify the properties of cryptographic hash functions, such as collision resistance, preimage resistance, and avalanche effect. (P.I.-2.2.3)* *LO 4.4 : Identify and analyze various Digital Signature Schemes used in real-time applications, evaluating their significance in engineering & societal contexts.(P.I.-2.1.3, 6.3.1)*	
05.	**Malicious Programs** ***Learning Objective:*** *To familiarize various malicious programs and countermeasures required to protect system against malicious code.*	**02**
	Task 11: Defeating Malware - Rootkit Hunter	
	Self-Learning Topics: *Study the recent malicious software and their effects.*	
	Learning Outcomes: *A learner will be able to* *LO 5.1: Apply knowledge of different types of malicious software to protect the system from virus using command line tool. (P.I.-1.3.1,5.1.1)* *LO 5.2: Use various tools to implement countermeasures to protect system from malicious programs. (P.I.-1.4.1,5.2.2)*	
06.	**Network Security and Applications** ***Learning Objective:*** *To summarize and demonstrate the network security tools and vulnerability assessment tools .*	**04**
	Task 12: Demonstrate Intrusion Detection System (IDS) using any tool eg. Snort , Security Onion, Zeek, Kismet or any other software. **Task 13:** Implementation and analysis of Email Security Protocols (SMTP, SSL/TLS, and PGP) **Task 14:** Cryptographic Analysis of Secure Inter-Branch Payment Transactions, Virtual Elections etc .	

	Self-Learning Topics: *Study advanced Security Applications like Cryptology in Contact Tracing Applications, issues related to Quantum Cryptanalysis.*	
	Learning Outcomes: *A learner will be able to* *LO 6.1: Identify network security tools & vulnerability assessment tools to demonstrate IDS. (P.I.-5.1.1)* *LO 6.2: Identify the strengths and limitations of modern tools used to demonstrate IDS. (P.I.-5.2.1)* *LO 6.3: Apply and analyze email security protocol, for protecting email communication against cyber threats and evaluate its ethical and societal implications to address evolving threats (P.I.-1.3.1,2.2.3, 6.1.1, 7.1.1,11.2.1)* *LO 6.4: Evaluate and analyze cryptographic mechanisms in secure inter-branch transactions in terms of effectiveness, ethics, societal impact, and lifelong learning in financial cybersecurity(P.I.-2.4.2, 6.2.1, 7.2.2,11.2.2)*	
	Total	**30**

Performance Indicators:

P. I. Number	**P. I. Statement**
1.1.1	Apply the knowledge of discrete structures, linear algebra, statistics, and numerical techniques to solve problems.
1.3.1	Apply engineering fundamentals.
1.4.1	Apply theory and principles of computer science engineering to solve an engineering problem.
2.1.3	Identifies mathematical algorithmic knowledge that applies to a given problem
2.2.3	Identify existing solution/methods to solve the problem, including forming justified approximations and assumptions.
2.2.4	Compare and contrast alternative solution/methods to select the best methods
2.4.2	Analyze and interpret the results using contemporary tools.
5.1.1	Identify modern engineering tools, techniques and resources for engineering activities
5.2.2	Demonstrate proficiency in using discipline specific tools
6.1.1	Identify and describe various engineering roles; particularly as pertains to protection of the public and public interest at global, regional, and local level.
6.2.1	Interpret legislation, regulations, codes, and standards relevant to your discipline and explain its contribution to the protection of the public.
6.3.1	Identify risks/impacts in the life-cycle of an engineering product or activity.
7.1.1	Identify situations of unethical professional conduct and propose ethical alternatives
7.2.2	Examine and apply moral & ethical principles to known case studies.
11.2.1	Identify historic points of technological advance in engineering that required practitioners to seek education in order to stay current developments.

11.2.2 Recognize the need and be able to clearly explain why it is vitally important to keep current regarding new developments in your field.

Course Outcomes:

Learner will be able to

1. Implement classical encryption/decryption techniques to solve real time the problems. *(LO 1.1, LO1.2, LO1.3, LO1.4)*

2. Build cryptosystems by applying symmetric key cryptographic algorithms. *(LO 2.1, LO 2.2, LO 2.3, LO 2.4)*

3. Implement various asymmetric key cryptographic techniques. *(LO 3.1, LO3.2, LO3.3, LO3.4)*

4. Use message digest concept in hashing algorithm and analyse its societal impact. Also apply the knowledge of various malicious programs to implement countermeasures to protect system from malicious programs. *(LO 4.1, LO 4.2, LO 4.3, LO 4.4, LO5.1, LO5.2)*

5. Use and demonstrate network security tools and vulnerability assessment tools . *(LO 6.1, LO 6.2, LO 6.3, LO 6.4)*

CO-PO Mapping Table with Correlation Level

CO ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
ITLBC608.1	3	3	-	-	-	3	-	-	-	-	-
ITLBC608.2	3	3	-	-	-	-	-	-	-	-	-
ITLBC608.3	3	3	-	-	-	-	-	-	-	-	-
ITLBC608.4	3	3	-	-	3	3	-	-	-	-	-
ITLBC608.5	3	3	-	-	3	3	3	-	-	-	3
Average	**3**	**3**	-	-	**3**	**3**	**3**	-	-	-	**3**

Text Books:

1. Cryptography and Network Security, Principles and Practice, William Stallings, Sixth Edition, March 2013, Pearson Education.
2. Cryptography & Network Security, Behrouz A. Ferouzan, First Edition, 16 March 2007, Tata McGraw Hill.
3. Cryptography and Network Security, Behrouz A. Forouzan & Debdeep Mukhopadhyay, Second Edition, 2010, Tata McGraw Hill Education.
4. Cryptography & Network Security, Bernard Menezes, Sixth Edition ,2010, Cengage Learning.

Reference Books:

1. Cryptography and Network Security, Atul Kahate, Third Edition, 2013, Mc Graw Hill.

2. Applied Cryptography, Protocols Algorithms and Source Code in C, Bruce Schneier, Second Edition,2001, John Wiley and Sons Inc.

3. Network Security Bible, Eric Cole, Second Edition, 2011.Wiley

Other Resources:

1. NPTEL Course: Cryptography and Network Security by Dr. Debdeep Mukhopadhyay, IIT Kharagpur
   Web Link- https://nptel.ac.in/courses/106105031

2. NPTEL Course: Foundation of Cryptography by Prof. Ashish Choudhary, IIT Bengaluru.
   Web Link- http://www.digimat.in/nptel/courses/video/106106221/L46.html

3. NPTEL Course: Cryptography and Network Security by Prof. Sourav Mukhopadhyay, IIT Kharagpur.
   Web Link- https://archive.nptel.ac.in/noc/courses/noc19/SEM1/noc19-cs28/

A. IN-SEMESTER ASSESSMENT (25 MARKS)

1. Continuous Assessment (25 Marks)

Suggested breakup of distribution

a) Task Execution :10 Marks

Students will be given 10 tasks based on list as per mentioned in the syllabus. Each task carries 10 Marks. Average will be taken of all tasks. Students are expected to execute the program for given task with network simulator, protocol analyser and java. Students will be evaluated based on logic building for the given task, expected output and analysis of received results.

b) Practical Test: 10 Marks

Students will be given task (different for each student) and they will be evaluated based on the parameters mentioned in continuous assessment.

c) Regularity & Active participation: 05 Marks

B. END SEMESTER EXAMINATION (Practical and Oral Exam) (25 Marks)

Suggested breakup of distribution

a) Task Execution: 10 Marks

Students will be given task (different for each student) and they will be evaluated based on the parameters mentioned in continuous assessment.

b) Results and discussion, Inferences drawn based on above task: 05 Marks
c) Oral based on entire syllabus :10 Marks

Two examiners, one Internal and one External will do the evaluation

Course Type	Course Code	Course Name	Credits
LBC	ITLBC609	DATA SCIENCE LABORATORY	01

Examination Scheme		
Continuous Assessment	**End Semester Exam (ESE)**	**Total**
25	25	50

Pre-requisite:

1. ITSBL301: Python Laboratory

Program Outcomes addressed :

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO3:Design/development of solutions
4. PO4: Conduct investigations of complex problems
5. PO5: Engineering tool usage
6. PO8: Individual and collaborative team work
7. PO9: Communication
8. PO11: Life-long learning

Course Objectives:

1. To inculcate comprehensive knowledge of data science using Python.
2. To learn the essential concepts of data analytics and data visualization.
3. To acquire the knowledge of machine learning and deep learning techniques.

Module	Detailed Contents	Hrs
00.	**Course Introduction** Data Science is an interdisciplinary field that combines statistics, computer science, and domain knowledge to extract insights and knowledge from data. Data Science enables organizations to utilize their data to support informed decision-making, optimize operations, and explore. Data science gives businesses a competitive advantage by allowing them to make faster, data-driven choices, stimulate innovation, and ensure long-term growth. This lab course introduces students to fundamental and advanced data science concepts through hands-on, project-based learning. Students will work on real-world datasets, implement machine learning algorithms, and build data-driven applications. The course emphasizes problem-solving, teamwork, and practical implementation of data science tools.	--
01.	**Overview of Data Science :** ***Learning Objective:*** *To impart the knowledge of numpy and pandas library*	**06**

	Contents: • Overview of Data Science • Introduction to Python and Jupyter Notebooks • NumPy and Pandas for Data Manipulation • Data Cleaning and Handling Missing Values **Task 1:** Select dataset and apply data cleaning on a Real-World Dataset	
	Learning Outcomes : *A learner will be able to* *LO1.1: Apply the knowledge of data selection to define the problem and Evaluate problem statement by identifying objectives (**Problem Statement**). (P.I. - 1.1.1, P.I. - 2.1.1)* LO1.2: *Apply data science concepts like pandas and numpy libraries to identify key features, attributes, target variable and preprocessing steps (**Data Description**) (P.I. - 1.3.1, , P.I. - 2.1.2*)	
02.	**Exploratory Data Analysis (EDA) & Data Visualization:** ***Learning Objective:*** *To inculcate EDA concept and learn different visualization techniques*	**06**
	Contents • Descriptive Statistics and Data Distributions • Data Visualization using Matplotlib and Seaborn • Statistical Hypothesis Testing • Feature Engineering Technique **Task 2:** Exploratory Data Analysis of a Public Dataset (e.g., Titanic, Iris)	
	Learning Outcomes: *The learner will be able to* *LO2.1: Perform statistical analysis and adapt appropriate visualization techniques to represent data insights with appropriate engineering tool. (**Data Analysis**) (P.I. - 2.1.2, P.I. - 2.4.2, P.I.- 5.1.1, P.I. - 5.1.2)* *LO2.2: Implement feature engineering to select relevant features to enhance data quality (**Preprocessed data**) (P.I. -3.3.1, P.I. - 3.4.2)*	
03.	**Machine Learning (ML) - Deep Learning (DL) Fundamentals:** ***Learning Objective:*** *To inculcate EDA concept and learn different visualization techniques*	**18**
	Contents • Supervised Learning: Linear Regression, Decision Trees, SVM, ensemble learning techniques. • Unsupervised Learning: Partition approach, Hierarchical clustering techniques • Introduction to Neural Networks and TensorFlow/Keras • Convolution neural networks for Image Processing • Model Evaluation and Hyperparameter Tuning **Task 3:** Apply machine learning or deep learning techniques on a real dataset prepared in previous tasks	

	Learning Outcomes: *The learner will be able to* *LO3.1: Identify and use appropriate algorithms to solve a problem with ML/DL approaches (**Approach and reason**). (P.I.- 2.1.2, P.I.-4.3.1)* *LO3.2: Design and train the ML/DL model for set objectives, tune hyperparameters to optimize model performance (**Methodology**).(P.I. -2.4.1, P.I.- 4.2.1, P.I. -3.4.2, P.I. -8.1.1, P.I.-9.2.2, P.I. - 11.1.1)* *LO3.3: Assess model accuracy using appropriate metrics and present results with appropriate visualization in document and presentation (**Results**) (P.I. -3.3.1, P.I.-5.1.1, P.I.-5.1.2, P.I.-8.3.1, P.I. -9.3.2, P.I. - 11.3.1)*	
	Total	**30**

Performance Indicators:

P. I. Number	**P. I. Statement**
1.1.1	Apply the knowledge of discrete structures, linear algebra, statistics and numerical techniques to solve problems
1.3.1	Apply engineering fundamentals.
2.1.1	Evaluate problem statements and identifies objectives
2.1.2	Identifies processes/modules/algorithms of a computer based system and parameters to solve a problem
2.4.1	Applies engineering mathematics to implement the solution.
2.4.2	Analyze and interpret the results using contemporary tools.
3.3.1	Ability to perform systematic evaluation of the degree to which several design concepts meet the criteria.
3.4.2	Ability to implement and integrate the modules.
4.2.1	Design and develop appropriate procedures/methodologies based on the study objectives
4.3.1	Use appropriate procedures, tools and techniques to collect and analyze data
5.1.1	Identify modern engineering tools, techniques and resources for engineering activities
5.1.2	Create/adapt/modify/extend tools and techniques to solve engineering problems
8.2.1	Demonstrate effective communication, problem solving, conflict resolution and leadership skills
8.3.1	Present results as a team, with smooth integration of contributions from all individual efforts
9.2.2	Deliver effective oral presentations to technical and non-technical audiences
9.3.2	Use a variety of media effectively to convey a message in a document or a presentation
11.1.1	Describe the rationale for requirement for continuing professional development
11.3.1	Source and comprehend technical literature and other credible sources of information

Course Outcomes:

Learner will be able to

1. Apply principles of NumPy and Pandas to analyse the data (*LO 1.1, LO 1.2*).
2. Perform exploratory data analysis (EDA) using statistical and visualization techniques to derive meaningful insights (*LO 2.1, LO 2.2*).
3. Implement machine learning models and deep learning models. (*LO3.1, LO3.2)*.
4. Evaluate the ML/DL models and optimize their performance. (*LO 3.3)*.

5. Design and develop a data science application that can have data acquisition, processing, visualization and statistical analysis methods with supported machine learning and deep learning technique to solve the real-world problem (*LO 1.1, LO 1.2, LO2.1, LO2.2, LO 3.1, LO 3.2, LO 3.3)*

CO-PO Mapping Table with Correlation Level

CO ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
ITLBC609.1	3	3	-	-	-	-	-	-	-	-	-
ITLBC609.2	-	3	3	-	3	-	-	-	-	-	-
ITLBC609.3	-	3	3	-	-	-	-	-	3	-	3
ITLBC609.4	-	-	3	3	-	-	-	3	3	-	3
ITLBC609.5	-	3	3	3	3	-	-	3	3	-	3
Average	**3**	**3**	**3**	**3**	**3**	**-**	**-**	**3**	**3**	**-**	**3**

Text Books:

1. Wes McKinney, "Python for Data Analysis",O'REILLY, ISBN:978-1-449-31979-3, 1st edition, October 2012.
2. Rachel Schutt & O'neil, "Doing Data Science", O'REILLY, ISBN:978-1-449-35865-5, 1st edition, October 2013.

Reference Books:

1. Joel Grus, "Data Science from Scratch: First Principles with Python", O'Reilly Media, 2015
2. Matt Harrison, "Learning the Pandas Library: Python Tools for Data Munging, Analysis, and Visualization , O'Reilly, 2016.

Other Resources:

1. NPTEL Course: Data Science for Engineers by Prof. Prof. Ragunathan Rengasamy, IIT Madras
   Web Link- https://onlinecourses.nptel.ac.in/noc22_cs28/course

2. Data science Tutorial
   Web Link- https://www.w3schools.com/datascience/

3. Web Link- https://www.computernetworkingnotes.com/networking-tutorials/

A. IN-SEMESTER ASSESSMENT (25 MARKS)

Suggested breakup of distribution

a) Task/Project Evaluation: 20 Marks

- A group of 3 students should be assigned a real life problem statement.

- Students are expected to research and collect required resources to create a frontend and backend for the selected problem.
- Students should prepare a presentation of 10-15 minutes.
- This project should be graded for 20 marks depending on the parameters as Data Collection and data preparation (**Task1 – 6 marks**) , data analysis (**Task 2 - 4 marks**), design and model creation, implementation and model evaluation (**Task 3 - 10 marks**) for selected problem statement.

b) Regularity & Active participation: 05 Marks

B. END SEMESTER EXAMINATION (Practical and Oral Exam) (25 MARKS)

Suggested breakup of distribution

a) Task Execution: 10 Marks

Students will be given task (different task for every student) and will be evaluated as per the parameters mentioned in continuous assessment.

b) Results and discussion, Inferences drawn from the above task: 05 Marks

c) Oral based on entire syllabus: 10 Marks
Two examiners, one Internal and one External will do the evaluation

Course Type	Course Code	Course Name	Credits
SBL	ITSBL603	DEVOPS LABORATORY	02

Examination Scheme		
Continuous Assessment	**End Semester Exam (ESE)**	**Total**
50	50	100

Pre-requisite :

1. ITPCC407: Operating System
2. ITPCC408: Software Engineering
3. ITLBC404: Linux Laboratory
4. ESL205: Programming Laboratory-II (Java)
5. ITLBC506: Cloud Computing Laboratory

Program Outcomes addressed:

1. PO1: Engineering Knowledge
2. PO2: Problem analysis
3. PO4: Conduct Investigation of Complex Problems
4. PO5: Engineering Tool Usage
5. PO6: The Engineer and The World
6. PO11: Life Long Learning

Course Objectives:

1. To introduce learners to the DevOps methodology and its principles, focusing on the collaboration, automation, and continuous integration/continuous delivery (CI/CD) model.
2. To instruct learners on version control using Git, including branching, merging, and collaborative workflows in GitHub or similar platforms.
3. To train learners on automating the build, test, and deployment processes through continuous integration and deployment (CI/CD) using Jenkins and Maven
4. To guide learners in implementing automated software testing using Selenium.
5. To provide hands-on experience with continuous deployment using Docker containers.
6. To provide learners with knowledge of using DevOps in the cloud (AWS) for code development and application deployment using AWS CodeBuild and CodeDeploy.
7. To prepare students to manage and orchestrate containerized applications using Docker Swarm, focusing on deployment, scaling, and managing clusters.
8. To introduce learners to serverless computing concepts and platforms (e.g., AWS Lambda) and the importance of continuous monitoring using tools like Nagios.
9. To upskill learners in creating Infrastructure as Code (IaC) using tools like Terraform or AWS CloudFormation.
10. To train learners in performing Static Application Security Testing (SAST) using tools like SonarQube.

Module	Detailed Contents	Hrs
00.	**Course Introduction** This course is intended to teach the advanced software development industrial strategy which is the DevOps environment. The course will delve in to the Continuous Integration and Continuous Deployment/Delivery using certain software tools which enhances the software product release schedule. It will emphasize on the standalone environment as well as the cloud environment**.**	**--**
01.	**Introduction to DevOps and Version Control** ***Learning Objective/s:*** *To study the Devops practices and implement the version control on the code using git.* **Contents:** Definition of DevOps: Challenges of traditional IT systems & processes, History and emergence of DevOps, DevOps definition and principles governing DevOps, DevOps Lifecycle. Basic Operations in a VCS. Features and benefits of GIT. **Demonstration:** • Illustrate the Devops history, Lifecycle • Install git, Learn git and git commands • Create a github account **Task 1:** Install Git and create a GitHub account. Perform basic Git operations (commit, push, pull). ***Self-Learning Topics:*** *AWS Codecommit, Mercurial, Subversion, Bitbucket, CVS, Scrum, Kanban, Agile* ***Learning Outcomes:*** *A learner will be able to* *LO 1.1: Demonstrate proficiency in GIT Installation, Version Control, Working with remote repository 5.2.2, P.I-11.1.1)* *LO 1.2: Create and fork repositories in GitHub and Adapt branching, merging and rebasing concepts. (P.I-5.1.2, P.I.11.2.1)*	**08**
02.	**Continuous Integration using Jenkins** ***Learning Objective:*** *To integrate and deploy tools like Jenkins and Maven, which is used to build, test and deploy applications in DevOps environment* **Contents:** Introducing Continuous Integration and Jenkins, Installing and Configuring Jenkins, Creating and configuring a job in Jenkins, Pipelining in Jenkins, Master-slave Architecture, Jenkins standalone implementation. **Demonstration:** • Install and Configure Jenkins • Creating a Pipeline in Jenkins • Implement a Master-Slave architecture	**09**

	Task 2: To understand Continuous Integration, install and configure Jenkins with Maven/Ant/Gradle to setup a build Job. **Task 3:** To Build the pipeline of jobs using Maven / Gradle / Ant in Jenkins, create a pipeline script to Test and deploy an application over the tomcat server. ***Self-Learning Topics:*** *Travis CI, Bamboo, GitLab, AWS CodePipeline* ***Learning Outcomes:*** *A learner will be able to* *LO 2.1: Apply the theory and principles of Jenkins (With Architecture) to build a job (P.I-1.4.1, P.I.6.1.1, PI.5.1.1)* *LO 2.2: Apply the continuous integration continuous deployment process ((P.I-1.3.1, 4.1.3, P.I.11.1.2, PI.6.4.1)* *LO 2.3: Create the pipeline of jobs using Maven / Gradle / Ant in Jenkins, create a pipeline script to deploy an application over the tomcat server(P.I-5.1.2,PI.4.2.1,P.I.11.2.1)*	
03.	**Continuous Testing with Selenium and Continuous Deployment: Containerization with Docker** ***Learning Objective:*** *To understand the importance of Jenkins to Build and deploy Software Applications on server environment and the infer importance of Selenium to test Software Applications* **Contents:** Introducing Continuous Testing and Selenium Installing and Configuring Selenium, Docker Architecture and Container Life Cycle, Docker commands, Dockerfile instructions. **Demonstration:** • Installing and Configuring Selenium • Installing Docker and implementing the Docker Commands • Study on Docker Architecture **Task 4:** To Setup and Run Selenium Tests in Jenkins Using Maven. **Task 5*:*** To install Docker and execute docker commands to manage images and interact with containers. ***Self-Learning Topics:*** *Junit, Cucumber, Docker Compose.* ***Learning Outcomes:*** *A learner will be able to* *LO 3.1: Identify the purpose of Selenium as a tool and Install Selenium (P.I-5.1.1, P.I 11.1.2)* *LO 3.2: Demonstrate proficiency in Creating Test Cases in Selenium WebDriver (P.I-5.2.2, P.I 11.1.1)* *LO 3.3: Demonstrate proficiency to Create and Implement docker images using Dockerfile(P.I-5.2.2, P.I-11.1.2)* *LO 3.4: Create, deploy and manage web or software application on Docker Engine. (P.I-5.1.2, P.I.11.2.1)*	**09**
04.	**Introduction to Devops on Cloud, Orchestration using Docker Swarm** ***Learning Objective:*** *To understand the procedure to setup the IDE on the Cloud environment and deploy the Docker Swarms for container orchestration.*	**14**

	Contents: Cloud Computing, Types of Clouds, Types of Cloud Services, Integrated Development Environment, CodePipeline: Code Build, Code Deploy, Containerization, Container Orchestration with Docker Swarm. **Demonstration:** • Case Study: Cloud Computing, Types of Clouds, Cloud Services • Create an AWS account/Cloud Service Provider Account • Create an IDE in the AWS/cloud environment to collaborate • Demonstrate the CodePipeline • Demonstrate the Docker Swarm **Task 6:** To Setup AWS Cloud9 IDE, Launch AWS Cloud9 IDE and Perform Collaboration Demonstration **Task 7:** To Build Your Application using AWS CodeBuild and Deploy on S3 / SEBS using AWS CodePipeline, deploy Sample Application on EC2 instance using AWS CodeDeploy **Task 8:** To set Up a Docker Swarm Cluster and Deploying a Multi-Container Application	
	Self-Learning Topics: *AWS Codestar, Using Services and Ingresses to Expose Deployments in KubernetesPerform logging, monitoring, services, and volumes in Kubernetes.*	
	Learning Outcomes: *A Learner will be able to* *LO 4.1: Create the DevOps infrastructure on the cloud (P.I-5.1.1, P.I:11.2.1)* *LO 4.2: Demonstrate proficiency to set up IDE on Cloud9 (P.I-5.2.2)* *LO 4.3: Create projects on AWS using Code Build, CodeDeploy, and CodePipeline (P.I-5.1.2, P.I:11.1.2)* *LO 4.4: Install and manage Docker Swarm clusters and deploying multi-container applications. (P.I-5.2.2, P.I:11.2.2)*	
05.	**Infrastructure Automation with Terraform and DevSecOps: Static Application Security Testing (SAST)** ***Learning Objectives:*** *To be upskilled in creating, building, destroying an Infrastructure by writing a Software code, as well as be well versed with application security testing by integrating Jenkins to SonarQube/Gitlab*	**10**
	Contents: Infrastructure Automation with Infrastructure as a code (IaaC), Terraform, Static application software testing, Dynamic Application Software Testing, SonarQube. **Demonstration:** • Write a code for Infrastructure • Deploy,Change and Destroy the infrastructure in AWS/Docker using code • Install Jenkins and Sonarqube and Integrate Jenkins and Sonarqube for CICD and detect bugs, code smells and security vulnerabilities. **Task 9:** To Build, change, and destroy AWS / GCP /Microsoft Azure/ DigitalOcean infrastructure Using Terraform.	

	Task 10: Create a Jenkins CICD Pipeline with SonarQube / GitLab Integration to perform a static analysis of the code to detect bugs, code smells, and security vulnerabilities on a sample Web / Java / Python application.	
	Self-Learning Topics: *Terraform: Create Resource Dependencies, Provision Infrastructure, Define Input Variables, Query Data with output and store remote state,SAST: Snyk, OWASP ZAP, Analysis Core Plugin*	
	Learning Outcomes: *A learner will be able to* *LO 5.1: Identify the Infrastructure as Code with Terraform. (P.I-5.1.1, PI 11.2.1)* *LO 5.2: Demonstrate proficiency to Install, Build, change and Destroy Infrastructure using Terraform. (P.I-5.2.2)* *LO 5.3: Identify the potential vulnerabilities before deployment. Analysis of java / web-based project. (P.I-2.4.3,2.4.2)* *LO 5.4: Demonstrate proficiency to Perform Jenkins SonarQube / Gitlab Integration. (P.I-5.2.2, P.I.11.1.2)*	
06.	**NoOps: Serverless Computing and DevSecOps: Continuous Monitoring** ***Learning Objective:*** *Learner is expected to learn serverless computing platform like AWS Lambda which helps to code and deploy without needing to configure or manage underlying server.* *Learner also needs to be able to detect ,report, respond to attack and issues in infrastructure through continuous monitoring*	**10**
	Contents: Serverless Computing, AWS Serverless ArchitectureAWS Serverless Authentication,AWS Serverless Functions,AWS Serverless Services AWS Serverless Applications, Nagios, Nagios Core,Nagios Plugin, NRPE, Port monitoring, Service Monitoring **Demonstration:** • Create a Lamda service for serverless computing • Deploy a project on the server • Analyze the usage and performance statistics • Create a server in AWS/linux/Windows • Install nagios,nrpe in the server • Analyze the Nagios log to check for alerts. **Task 11:** To create a Lambda function which will log "An Image has been added" once you add an object to a specific bucket in S3. **Task 12:** To install and configure Nagios for monitoring	
	Self-Learning Topics: *AWS Lambda:Create a REST API with the Serverless Framework, Splunk, Snort, Tenable*	
	Learning Outcomes: *A learner will be able to* *LO 6.1: Build and Configure the Lambda function (NODEJS/PYTHON/JAVA)(P.I-5.1.2,P.I:11.2.1)* *LO 6.2: Install Nagios, Nagios Plugins (NRPE) and Objects Nagios Commands and Notification (P.I-5.2.1., PI:4.3.1,PI.11.1.2)* *LO 6.3: Monitor different servers using Nagios(Pi-5.2.2, PI:4.3.2)*	
	Total	**60**

Performance Indicators:

P.I. No	P.I. Statement
1.3.1	Apply engineering fundamentals
1.4.1	Apply theory and principles of computer science engineering to solve an engineering problem.
2.4.2	Identify the limitations of the solution and sources/causes.
2.4.3	Analyze and interpret the results using contemporary tools.
4.1.3	Ability to choose appropriate hardware/software tools to conduct the experiment.
4.3.1	Use appropriate procedures, tools and techniques to collect and analyze data
4.3.2	Critically analyze data for trends and correlations, stating possible errors and limitations
5.1.1	Identify modern engineering tools, techniques and resources for engineering activities
5.1.2	Create/adapt/modify/extend tools and techniques to solve engineering problems
5.2.2	Demonstrate proficiency in using discipline specific tools
6.1.1	Identify and describe various engineering roles; particularly as pertains to protection of the public and public interest at global, regional and local level
6.4.1	Describe management techniques for sustainable development
11.1.1	Describe the rationale for requirement for continuing professional development
11.1.2	Identify deficiencies or gaps in knowledge and demonstrate an ability to source information to close this gap
11.2.1	Identify historic points of technological advance in engineering that required practitioners to seek education in order to stay current
11.2.2	Recognize the need and be able to clearly explain why it is vitally important to keep current regarding new developments in your field

Course Outcomes:

Learner will be able to

1. Design code-sharing environments for standalone and cloud systems, applying engineering knowledge and tools, while fostering lifelong learning and social responsibility. (*LO 1.1, LO 1.2, LO 4.1, LO 4.2, LO 4.3, LO 4.4)*

2. Implement continuous integration with Jenkins and containerization using Docker and Docker Swarm, applying engineering knowledge and tools to solve complex problems by assessing the global impact of their solutions and foster lifelong learning in software engineering. *(LO 2.1, LO 2.2, LO 2.3, LO 3.1, LO 3.2, LO 3.3, LO 3.4, LO 4.1, LO 4.2, LO 4.3, LO 4.4)*

3. Apply continuous software testing using SAST and Selenium, utilizing engineering tools to ensure code quality thereby foster lifelong learning to stay updated with evolving testing methodologies. (*LO 3.1, LO 3.2, LO 3.3, LO 3.4*)

4. Build and Deploy Infrastructure as Code using Terraform, applying problem analysis and engineering tools to create effective solutions thereby cultivate lifelong learning to stay current with evolving infrastructure practices. (*LO 4.1, LO 4.2, LO 4.3, LO 4.4*)

5. Build and deploy serverless environment using AWS Lambda and monitor it with Nagios, applying engineering tools to solve complex problems and fostering lifelong learning in evolving cloud technologies. (*LO 5.1, LO 5.2, LO 5.3, LO 5.4, LO 6.1,LO 6.2,LO 6.3*)

CO-PO Mapping Table with Correlation Level

CO ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
ITSBL603.1	-	-	-	-	3	3	-	-	-	-	3
ITSBL603.2	3	-	-	3	3	3	-	-	-	-	3
ITSBL603.3	-	-	-	-	3	-	-	-	-	-	3
ITSBL603.4	-	3	-	-	3	-	-	-	-	-	3
ITSBL603.5	-	-	-	3	3	-	-	-	-	-	3
Average	**3**	**3**	**-**	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**3**

Text Books :

1. DevOps Bootcamp, Sybgen Learning
2. Karl Matthias & Sean P. Kane, Docker: Up and Running, O'Reilly Publication.
3. Len Bass,Ingo Weber,Liming Zhu,"DevOps, A Software Architects Perspective", AddisonWesleyPearson Publication
4. AWS Certified SysOps Administrator Official Study Guide: Associate Exam by Stephen Cole (Author), Gareth Digby (Author), Chris Fitch (Author), Steve Friedberg (Author), Shaun Qual
5. Terraform: Up & Running - Writing Infrastructure as Code, Second Edition by Yevgeniy Brikman , O'Reilly
6. Kubernetes: Up and Running - Dive into the Future of Infrastructure, Second Editionby Brendan Burns,O'Reilly
7. Going Serverless with AWS Lambda: Leveraging the latest services from the AWS cloud by Ajay Pherwani , Shroff/X-Team

Reference Books:

1. Sanjeev Sharma and Bernie Coyne," DevOps for Dummies", Wiley Publication.
2. Learning Aws - Second Edition: Design, build, and deploy responsive applications using AWS by Amit Shah Aurobindo Sarkar
3. Httermann, Michael, "DevOps for Developers", Apress Publication.

Other Resources:

1. Notes : https://topperworld.in/the-ultimate-guide-to-devops-free-pdf-notes-for-success/

A. IN-SEMESTER ASSESSMENT (50 MARKS)

1. Task Execution (30 Marks)

Students are expected to

i. Identify the purpose of the given Task
ii. Execute the task as per the methodology explained
iii. Identify and troubleshoot the errors and installation issues that arise
iv. Demonstrate the expected task as per the specification given in the Tasks.
v. Preferable to utilize the tools specified, can choose any cloud environment.

Students will be evaluated based on following:

i. Purpose-driven objective for the given task (10 marks)
ii. Rectifying errors or introducing new methods to implement the solution (06 marks)
iii. Proper documentation of the step by step process (06 marks)
iv. Verification of Task output for the given experiment task (08 marks)

Refer the sample task given below.

Example:

To Build, change, and destroy AWS / GCP /Microsoft Azure/ DigitalOcean infrastructure Using Terraform.

Students are expected to.

i. Identify the purpose of the platform Terraform and its objective
ii. Execute given task for the procedure explained (eg.AWS) in another platform GCP/Digital Ocean/Microsoft Azure
iii. Identify errors and rectify the errors.
iv. Prepare a proper detailed document regarding the steps
v. Demonstrate the proper output

Students will be evaluated based on following:

i. Identification and Explanation of the objective of Terraform (10 marks)
ii. Rectifying errors during Installation/Build/Change/Destroy (06 marks)
iii. Well-structured and organized documentation of the Task performed (06 marks)
iv. Verification of experiment output for different inputs (08 marks)

2. Regularity and active Participation (05 Marks)

3. Practical Test (15 Marks)

a) Task Execution: 10 Marks

Students will be given task (different task for every student) to execute and will be evaluated as per the parameters mentioned in continuous evaluation

Students will be evaluated based on following:

i. Purpose-driven objective for the given task (04 marks)
ii. Rectifying errors or introducing new methods to implement the solution (02 marks)
iii. Proper documentation of the step-by-step process (02 marks)

iv. Verification of task output for the given problem statement (02 marks)

b) Oral based on covered syllabus: 05 Marks

B. END SEMESTER EXAMINATION (Practical & Oral Exam) (50 Marks)

a) Task Execution: 30 Marks
Students will be given task (different task for every student) to execute and will be evaluated as per the parameters mentioned below
   i. Purpose-driven objective for the given task (10 marks)
   ii. Rectifying errors or introducing new methods to implement the solution (06 marks)
   iii. Proper documentation of the step-by-step process (06 marks)
   iv. Verification of Task output for the given problem statement (08 marks)

b) Presentation of Results and conclusion, Inferences drawn: 05 Marks

c) Oral based on entire syllabus: 15 Marks

Two examiners, one Internal and one External will do the evaluation.

Course Type	Course Code	Course Name	Credits
MNP	ITMNP604	MINI PROJECT- 2B	01

Program Outcomes addressed:

1. PO1 : Engineering knowledge
2. PO2 : Problem Analysis
3. PO3 : Design/Development of Solutions
4. PO4 : Conduct investigations of complex problems
5. PO5 : Engineering Tool Usage
6. PO6 : The Engineer & the world
7. PO7 : Ethics
8. PO8 : Individual & Collaborative Team work
9. PO9 : Communication
10. PO10: Project Management & Finance
11. PO11: Life-long learning

Course Objectives:

1. To guide students in identifying societal or research needs and formulating them into problem statements.
2. To facilitate problem-solving in group settings.
3. To apply basic engineering principles to address identified problems.
4. To foster self-learning and research skills.

Course Outcomes:

At the end of the course, students will be able to:

1. Identify problems based on societal or research needs and methodology for solving them.
2. Apply knowledge and skills to solve societal problems collaboratively.
3. Develop interpersonal skills necessary for teamwork.
4. Analyze, verify, and validate results effectively through various methodologies, including, test cases/benchmark data/theoretical/inferences/experiments/simulations, etc.
5. Evaluate the societal and environmental impacts of proposed solutions.
6. Adhere to standard engineering practices.
7. Excel in written and oral communication by technical report writing, oral presentation, and publishing results in
   - Research/white paper/article/blog writing/publication, etc.
   - Business plan for entrepreneurship product creation
   - Patent filing/copyright.
8. Gain technical competencies by participating in competitions, hackathons, etc.
9. Demonstrate lifelong learning capabilities through self-directed group projects.
10. Apply project management principles effectively.

Guidelines for the Mini Project

- Mini project may be carried out in one or more form of following:
  Product preparations, prototype development model, fabrication of set-ups, laboratory experiment development, process modification/development, simulation, software development, integration of software (frontend-backend) and hardware, statistical data analysis, creating awareness in society/environment etc.
- Students must form groups of 3 to 4 members either from the same or from different departments.
- Groups should conduct surveys to identify needs and develop problem statements in consultation with faculty.
- An implementation plan in Gantt/PERT/CPM chart format covering weekly activities must be submitted.
- Each group must maintain a logbook to record weekly progress, to be verified by the faculty supervisor.
- Faculty input should emphasize guiding by faculty and self-learning by group members.
- Groups should propose multiple solutions, select the best one in consultation with the supervisor, and develop a working model.
- The solution to be validated with proper justification and report to be compiled in standard format of the Institute. Software requirement specification (SRS) documents, research papers, competition certificates may be submitted as part of annexure to the report.
- With the focus on self-learning, innovation, addressing societal/research/innovation problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that a single project of appropriate level and quality be carried out in two semesters by all the groups of the students.
- However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Mini Project adhering to the qualitative aspects mentioned above, gets completed in odd semester, then that group can be allowed to work on the extension of the Mini Project with suitable improvements/modifications or a completely new project idea in even semester. This policy can be adopted on a case by case basis.

In-Semester Continuous Assessment and End-Semester Examination Guidelines

- The Head of the Departments will assign a guide to each of the mini-projects and shall form a progress monitoring committee. The guide will carry out weekly monitoring of the project's progress. The committee shall carry out in-semester project evaluation based on presentations with a minimum of two evaluations per semester.
- Assessment will be based on individual contributions, understanding, and responses to questions asked.
- Continuous Assessment marks distribution in semester V (50 marks):
  - 05 marks for the Topic Approval Presentation in front of the progress monitoring committee
  - 15 marks for the Mid-Semester Progress Presentation in front of the progress monitoring committee
  - 25 marks for the Final Report & Presentation
  - 05 marks for Regularity and active participation
- Continuous Assessment marks distribution in semester VI (50 marks):
  - 15 marks for the In-Semester Two Presentations
  - 05 marks for Participation in Project Competitions, TPP, etc.
  - 25 marks for the Final Report & Presentation

- 05 marks for Regularity and active participation

The review/progress monitoring committee will assess projects based on the following criteria.

Semester V:

- Theoretical solution completion, including component/system selection/design of software solution and cost analysis.
- Two reviews will occur:
  - The first review will focus on finalizing the problem statement (topic approval).
  - The second review will centre on finalizing the proposed solution.

Semester VI:

- Expected tasks include procuring components/systems, constructing a working prototype, and validating results based on prior semester work.
- Reviews will be conducted as follows:
  - The first review will assess the readiness to build a working prototype.
  - The second review will involve a poster presentation and demonstration of the working model in the last month of the semester.

In addition to above mentioned points, the following performance criteria shall be included during in-semester continuous assessment:

1. Quality of survey and need identification.
2. Clarity and innovativeness in problem definition and solutions.
3. Requirement gathering via SRS/feasibility study, cost-effectiveness, and societal impact of proposed solutions.
4. Completeness and full functioning of the working model.
5. Effective use of skill sets and engineering norms.
6. Verification & validation of the solutions/test cases.
7. Individual contributions to the group.
8. Clarity in written and oral communication.
9. Participation in technical paper presentation/project competitions/hackathon competitions, etc.

End-Semester Examination in Semester VI (50 marks):

1. Presentation and demonstration to internal and external examiners: 20 marks.
2. Emphasis on problem clarity, innovativeness, societal impact, functioning of the model, skill utilization, and communication clarity: 30 marks.

Course Type	Course Code	Course Name	Credits
ELC	ELC601	RESEARCH METHODOLOGY	02

Examination Scheme					
Distribution of Marks			Exam Duration (Hrs.)		Total Marks
In-semester Assessment		End Semester Exam (ESE)			
Continuous Assessment	Mid-Semester Exam (MSE)		MSE	ESE	
50	--	--	--	--	50

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO6: The Engineer & The World
4. PO7: Ethics
5. PO8: Individual & Collaborative team work
6. PO9: Communication
7. PO11: Life-Long learning

Course Objectives:

1. To gain the knowledge of use research tools and techniques to design research projects and form the hypothesis.
2. To familiarize students about the literature review practice for identifying the research gap.
3. To gain the knowledge about collection of data and qualitative/ quantitative analysis of data and results
4. To understand the key practices in preparation of a research report / paper.
5. To foster ethical practices in research and publications

Module	Details	Hrs
00.	**Course Introduction:** This course aims to introduce students to the important aspects of research. The course is intended to make students aware of formal research and to overcome common misconceptions in research that may be present in their minds. At the end of this course, students shall be able to take up research activities in a more systematic and formal manner right from the beginning. This course on Research Methodology learned through experiential learning mechanism can play a significant and holistic role in contributing to the personal and professional development of students.	**1**
01.	**Fundamentals of Research Methodology** Types of Research, Research approaches, Empirical research methods, Significance of research, Research design, Case study method, Sampling technique, Sources of data, Selection of research problem, Research Ethics and Empiricism	**4-5**

	Exercise: A group discussion on what is research and ethics in research with related case studies shall be conducted.	
02.	**Formulation of a Research Problem & Hypothesis formulation**	**4-5**
	Content: Selection and formulation of a research problem, Objectives of formulation, Criteria of a good research problem, Literature Review Process and Formulation of Research Questions Hypothesis-Characteristics and Hypothesis Testing –Logic and Importance *Exercise: Groups of students shall make Technical Presentations on Selection of a research problem and Hypothesis formulations based on topics given.*	
03.	**Research Design**	**4-5**
	The Research framework, Research design: Need, Characteristics & Components; Experimental and non-experimental designs, Experimental and non-experimental hypothesis testing. Classification schemes for research design, Principles of experimental designs, Writing rationale for a research *Exercise: Students shall prepare the framework of research methods and techniques to conduct a study on a given real life case study covering key elements of the module.*	
04.	**Sampling Method**	**3-4**
	Probability or random sampling, Cluster sampling, Area sampling, Multi-stage sub-sampling, Random sampling with probability proportional to size, Non-probability sampling. *Exercise: A real life case study shall be demonstrated to students covering key elements of the module shall be covered.*	
05.	**Data Collection & Data Analysis**	**4-5**
	Sources of data, Collection of data, Measurement and scaling technique, Collection of data from appropriate sources (primary and secondary), Correlation and causation, Classification of quantitative analysis. Selection and analysis of multi-variate methods, Performing data analysis and presentation of results, Case study method. *Exercise: Group of students shall carry out exercise of real life data collection on a given research problem and data analysis and submit the report*	
06.	**Report Writing and Journal Publication**	**3-4**

	Preparation of a research report, Formats and Contents of report: Literature review, Presentation of research work, Research Design & Analysis, Results, Findings, and Contribution, Significance of research, and Conclusion. Mechanics of writing papers in Peer-reviewed Journals / Reputed Conferences. Ethics in Publication. *Exercise: Students shall prepare & submit a paper (4-5 pages) in a standard format (suitable universally accepted journal publication format) based on the exercises / research case study carried out in this course.*	
7	***Course Conclusion***	**1**

Course Outcome:

1: Identify and demonstrate the importance of research process in science and technology domains
2: Perform literature reviews using print and online databases.
3: Analyse the data using qualitative and quantitative methods
4: Identify and prepare the key elements of a research report/ paper
5: Illustrate the rationale for research and publication ethics

Text Books:

1. C. R. Kothari and Gaurav Garg, Research Methodology: Methods and Techniques, New Age International Publisher, 2014.
2. Ranjit Kumar, Research Methodology: A Step-by-Step Guide for Beginners, Sage Publication, 2018
3. R. Pannershelvam, Research Methodology, Prentice Hall, India, 2014

Reference Books:

1. John W. Creswel, Research Design: Qualitative, Quantitative, and Mixed Methods Approaches, 4th Ed., SAGE, 2018.Geoffrey R. Marczyk, David DeMatteo & David Festinger, Essentials of Research Design and Methodology, John Wiley & Sons, 2005.
2. Suresh C. Sinha and Anil K. Dhiman, Research Methodology (2 Vols-Set), Vedam Books, 2006.
3. Manfred Max Bergman, Mixed Methods Research, SAGE Books, 2006.
4. Paul S. Gray, John B. Williamson, David A. Karp, John R. Dalphin, The Research Imagination, Cambridge University press, 2007.
5. Cochrain & Cox, Experimental Designs, II Edn. Wiley Publishers, 2006

Other Resources:

NPTEL Course: Research Methodology By Prof. Edamana Prasad, Prof. Prathap Haridoss (IIT Madras) Weblink https://onlinecourses.nptel.ac.in/noc25_ge28/preview

Course Type	Course Code	Course Name	Credits
LLC	LLC6011	ART OF LIVING	02

Program Outcomes addressed:

1. PO6 : The Engineer & The World
2. PO7 : Ethics
3. PO8 : Individual and Collaborative Team Work
4. PO9: Communication
5. PO11: Life-Long learning

Course Objectives :

1. To provide a comprehensive understanding of the principles of the Art of Living and their relevance to holistic well-being.
2. To equip participants with practical techniques like Sudarshan Kriya, yoga, and mindfulness for stress management and emotional balance
3. To enable participants to apply the Art of Living principles to enhance relationships, productivity, and life purpose.

Module	Details
01.	**Introduction to the Art of Living** Understanding the Mind and Stress, Breath and Life Energy, Basics of Yoga and Guided Meditation
02.	**Sudarshan Kriya and Breathing Techniques** Introduction to Sudarshan Kriya, Practicing Rhythmic Breathing Techniques
03.	**Emotional Well-being** Understanding and Balancing Emotions, Forgiveness and Gratitude Practices, Guided Meditation for Emotional Healing
04.	**Relationships and Social Connections** Compassion and Effective Communication, Stress-free Relationships, Group Activities for Trust and Collaboration
05.	**Living with Purpose and Awareness** Discovering Life Purpose, Mindfulness Practices, Time Management and Productivity
06.	**Sustaining the Practices** Developing a Daily Routine, Advanced Breathing Techniques, Reflections, and Closing Meditation
Total no. of hours: **30**	

Course Outcomes :

1. Gain insights into managing stress and emotions through breathwork and meditation
2. Develop skills for building harmonious relationships and enhancing emotional intelligence.
3. Cultivate mindfulness, compassion, and clarity in daily life.
4. Sustain the Art of Living practices for long-term well-being and self-discovery.

Text Books :

1. "Celebrating Silence" by Sri Sri Ravi Shankar (1999, Sri Sri Publications Trust)
2. "The Heart of Yoga: Developing a Personal Practice" by T.K.V. Desikachar (1995, Inner Traditions International)
3. "The Miracle of Mindfulness" by Thich Nhat Hanh (1975, Beacon Press)

Reference Books :

1. "Wisdom for the New Millennium" by Sri Sri Ravi Shankar (2000, Sri Sri Publications Trust)
2. "The Healing Power of the Breath" by Richard P. Brown and Patricia L. Gerbarg (2012, Shambhala Publications)

Course Type	Course Code	Course Name	Credits
LLC	LLC6012	YOGA AND MEDITATION	02

Program Outcomes addressed:

1. PO6: The Engineer and The World
2. PO7: Ethics
3. PO11: Life-Long Learning

Course Objectives:

1. To raise awareness of the therapeutic and preventive benefits of Yoga and Meditation
2. To nurture Holistic wellness through the harmony of body, mind and self
3. To advocate for the application of Yogic science in the treatment and prevention of psychosomatic and Lifestyle disorders.
4. To inspire the practice of Yogic Science tools for fostering health and well-being in daily life.
5. To promote the art of purposeful and mindful living by cultivating a deep sense of oneness with the self, nature and the world.

MODULE	DETAILS
1.	**Introduction to Yoga and Meditation** Definition of Yoga, Importance of Yoga for Human life, Literature of Yoga: Yoga Sutra, Bhagavat Gita – Synthesis of Yoga, Hathapradipika etc. Challenges of health in students & youth - Studies, Yogic concept of Health and Meditation, Concept of Body and Disease in Yoga, Dimensions of Health- Physical, Mental, Social and Spiritual, Different types of yoga (Karma, Gyaan, Ashtanga, Bhakti), Eight limbs of ashtanga yoga.

2.	**Yoga and Wellness** Yoga and Medical perspectives – Health related fitness, Yoga for common ailments, Scientific Researches in Yoga, Yogic anatomy of Human body, Asanas – Definitions and classifications, Scientific reasoning behind the asanas, Yoga for Stress, Technostress and Lifestyle management. Mental Disturbances and Preventive, Curative Aspect of Yoga for Mental wellness.

3.	**Essentials of Yoga Practices** Difference between Yoga and Exercise, Obstacles in the path of Yogic Practices, Disciplines in Yogic practices – Prayers, Yama, Niyama, Place, Time, Diet, Schedule, Sequence for Yogic Practices. Yogasanas: Surya Namaskara, Standing asanas and Sitting asanas, Different groups of Yogasanas – Relaxation, Meditative, Digestive etc. Psycho-physiological effects and health benefits of Yogasana, Function and effect of Asanas - Digestive system, Respiratory system, Excretory system, Circulatory system, Nervous system etc.
4.	**Meditation – Role of Breath and Pranayama** Yogic anatomy, Wellness and Triguna system, Science of Pranayama – 'Prana', the vital principle, Prana and air element, Awareness - Breath Awareness, Different types of Breathing, Breath Control, Breath and Postures, Rhythmic Breathing, Pranic body in the five-fold body (Panchakosha), Power of breath, Difference between Pranayama and breathing, Prana and nervous system, Fivefold function of prana, Benefits of pranayama

5.	**Fundamental aspects of Meditation** Pranayama and deep breathing - Concept of Inhalation (Puraka), Retention (Kumbhaka), & Exhalation (Rechaka); Important Pranayamas; Pranayama and Meditation; Mind and Meditation; Inner Instrument – Mind, Constituents of Mind - Mana, Buddhi, Ahankar and Chitta(Consciousness), Magnitude of Mind, Buddhi – the determinative faculty; Body-Mind complex; Mind Cleansing; Yogic Meditation and Mindfulness meditations; Yogic Process and Outcome of Meditation – Pratyahara, Dharana and Dhyana; Scientific studies on Meditation and Healing.
6.	**Meditation Tools and Techniques** Why Meditate - States of Mind, Mind over Body – Processing Thoughts, Preparing for Meditation – Posture, Shanti prayers, Pranayama, Training the Mind: Practicing tools- Bhramari Pranayama, Sacred Pranav (Om) mantra, Mantra Japa/ajapa, Types of Mindfulness Meditations, Yoga Nidra, Body scan meditation, etc. Benefits of Meditation

Course Outcomes:

1. Gain comprehensive insights about the necessity of yoga for daily life.
2. Obtain a simplified understanding of the impact of mindful breathing on health wellbeing.
3. Acquire knowledge of 'practice and principles' of simple awareness meditation for Mental wellness
4. Gain required knowledge to improve overall health and immune system
5. Practice simple asanas and meditation techniques to improve concentration, self-confidence and inner peace

Text Books:

1. Light on the Yoga Sutras of Patanjali by B.K. Iyengar (Publisher: Orient Longman Pvt. Ltd. Mumbai)
2. Pranayama - The Art & Science by Dr. Nagendra H R (Publisher: Swami Vivekananda Yoga Prakashan, Bangalore)
3. Yog – Its Philosophy and Practice by Swami Ramdev (Publisher: Divya Prakashan, Haridwar)

Recommended Books

1. Pranayama-Science of Breath by Gharote, M. (Publisher: The Lonavla Yoga Institute, India)
2. Svatmarama's HathaYogaPradeepika by Gyan Shankar Sahay (Publisher: Yogic Heritage, India)
3. Yoga for Health and Peace by Padamshree Sadashiv Nimbalkar (Publisher: Yoga Vidya Niketan, Mumbai)

Other Resources:

1. NPTEL Course: Yoga and Positive Psychology for Managing career and life by Prof. Ashish Pandey, IIT Bombay.
Weblink https://archive.nptel.ac.in/courses/110/101/110101165/

2. SWAYAM Course: Yoga for Concentration by By Dr H R Nagendra, Dr Manjunath N K and Dr Apar Avinash Saoji from Swami Vivekananda Yoga Anusandhana Samsthana, Bangalore.
Weblink: https://onlinecourses.swayam2.ac.in/aic23_ge05/preview

Course Type	Course Code	Course Name	Credits
LLC	LLC6013	HEALTH AND WELLNESS	02

Program Outcomes addressed:

1. PO6: The Engineer and The World
2. PO7: Ethics
3. PO11: Life-Long Learning

Course Objectives:

1. To advocate for the significance of Holistic wellness
2. To enhance all dimensions of wellness through the lens of scientific temper.
3. To foster integrative medicine through mindful lifestyle choices and guided practices
4. To promote the integration of scientific research with ancient wellness practices & techniques.

MODULE	DETAILS
1.	**Foundations of Health Well-being** Defining Health and Wellness, Dimensions of wellness Determinants of Health behavior, Health in everyday life Constitution of your body, Medical Anatomy of physical body Layers of your Body: Physical, Physiological, Psyche Yogic anatomy of Physiological and Psyche layers, Triguna system
2.	**Physical Wellbeing** Management of Ailments: Common, Acute, chronic Integrative medicines: Ayurveda, Naturopathy, Yoga etc. Preventive care for illness, Lifestyle, Dietary habits, Repair and Rejuvenation

3.	**Emotional Wellness** Types of Emotions, Symptoms of emotional wellness Studies on challenges of emotional wellness: Sleep, Stress, Resilience, eating habits, attention deficit, Digital fatigue, Communications etc. Emotions and physical wellness Understanding the trinity of senses, sense objects and emotions, Studies on breath regulation, Role of breath in emotions, Yogic methods to emotional wellness

4.	**Mental Wellness** What is Mental Wellness, Dimensions of mental Wellness Scientific studies on Mental disorder issues: Depression, anxiety, behavioural disorder, addiction, self-disconnection, suicidal thoughts etc. Mind-Body issues: Mental Wellness, Mental illness and Physical illness, Constitution of Mind – Manas, Buddhi, ahankara, Chitta, Consciousness Intelligence and Mental Wellness, Modifications of Mind Paths to Mental Wellness: Regulating Thoughts, Meditation tools and process - Pranayama, Pratyahara, Dharna, Dhyana, Mindfulness meditation, Chakra meditation, Sabdh(mantra) Meditation, spiritual engagements
5.	**Intellectual Wellness** Mind, Intelligence and Intellectual Wellness Aspects of Intellect, incapacitate Intellect, Examining Intellectual Wellness, Nurturing Intellectual Wellness
6.	**Spiritual Wellness** Yogic understanding of term 'spiritual' Relationship: Physical, Physiological, Psyche, Consciousness (Spiritual) Symptoms of spiritual wellness Studies on Spiritual wellness and Body Healing Practices for spiritual wellness: Prayers, Yoga and Meditation, spiritual engagements

Course Outcome: Learner will be able to

1. Gain a comprehensive understanding of Holistic Health
2. Acquire essential knowledge to regulate thoughts and behavior.
3. Apply holistic health tools for emotional stability and healthy mind
4. Develop proficiency in applying cognitive faculty for intellectual pursuits
5. Acquire holistic wisdom for attaining inner peace in daily life

Text Books

1. Nature Cure for All: Natural Remedies for Health Disorders (Publisher:

Nisargopachar Gramsudhar Trust, Pune)

2. Towards the Wellness of Body, Mind and Self – Conference Proceedings Editor - Dr. Jayanti Chavan (Publisher: Institute of Science and Religion, Navi Mumbai)

3. Ayurveda & Panchakarma – The Science of Healing and Rejuvenation by Dr. Sunil V. Joshi (Publisher: Motilal Banarsidass Publishing House, Delhi)

Reference books

1. Dr R Nagarathna and Dr H R Nagendra: Yoga for Promotion of Positive Health (Publisher: SVYP, Bangalore)

2. Text book of Kriya Yoga – The Cosmic Engineering of Life in the light of Medical Science by Yogacharyya Dr. Chanchal Roy Devsharmman
(Publisher: Motilal Banarsidass Publishing House, Delhi)

3. Yog – Its Philosophy and Practice by Swami Ramdev
(Publisher: Divya Prakashan, Haridwar)

Other Resources:

1. NPTEL Course: Adolescent Health And Well-Being: A Holistic Approach by Dr. Sumana Samanta, Dr. Parmeshwar Satpathy, IIT Kharagpur.
Weblink https://nptel.ac.in/courses/127105236

2. NPTEL Course: The Science of Happiness and Wellbeing by By Prof. Priyadarshi Patnaik, Prof. Manas K. Mandal from IIT Kharagpur.
Weblink https://onlinecourses.nptel.ac.in/noc23_hs06/preview

Course Type	Course Code	Course Name	Credits
LLC	LLC6014	DIET AND NUTRITION	02

Program Outcomes addressed:

1. PO6 : The Engineer & The World
2. PO7 : Ethics
3. PO11: Life-Long learning

Course Objectives :

1. To provide students with a comprehensive understanding of nutrition principles and their application in promoting optimal health.
2. To develop critical thinking skills to evaluate nutritional information and make informed decisions.
3. To apply knowledge of nutrition education and counselling to promote healthy nutrition practices in individuals and group.
4. To demonstrate an understanding of role of nutrition in disease prevention and management.

Module	Details
01.	**Nutrition for wellness -1** Introduction to nutrition, food pyramid, Macros: Carbohydrates, Protein and fats, Micros: Vitamins A C E K and D, Minerals-Calcium, Iron and Zinc Importance of hydration, signs and symptoms, stages of dehydration.
02.	**Nutrition wellness -2** Introduction to mindful eating, plate concept, understanding physical and emotional hunger, eating disorder-Anorexia nervosa, bulimia nervosa and binge eating.
03.	**Exercise and fitness** Introduction to exercise and its importance, types of exercise its classification, side effects of over exercising, Impact of sedentary lifestyle on body composition.
04.	**Sleep and relaxation** Flow of circadian rhythm, sleep cycle, stages of sleep, sides effects, sleeping disorder-sleep apnea, insomnia, sleep hygiene routine and foods inducing sleep
05.	**Managing stress** Introduction to stress, causes, effects of stress, management of stress, foods and adaptogenic foods for stress management.
06.	**The lifestyle flow** Morning/ wake up rituals, meal flow i.e in which order to eat, post meal flow, bedtime rituals – how should your last hour of the day look like
Total no. of hours: **30**	

Course Outcomes :

1. Understand the fundamentals of nutrition and its role in promoting wellness.
2. Apply mindful eating practices to manage physical and emotional hunger.
3. Assess the importance of exercise and its impact on health and fitness
4. Gain insights into sleep hygiene and manage sleep-related disorders.

5. Develop strategies for stress management using nutrition and adaptogenic foods.
6. Assess the importance of exercise and its impact on health and fitness

Text Books :

1. Nutrition and dietetics by C.S. shah: covers various aspects of nutrition, including nutrient metabolism, dietary planning and diet therapy.
2. Dietetics by B. Srilakshmi- covers aspects of dietetics including nutrition, food science and diet therapy.

Reference Books :

1. Nutrition science by B. Shrilakshmi: provides an overview of nutrition, nutrient metabolism and dietary patterns
2. Food science by B. Shrilakshmi covers food, including food composition, food processing and food safety.

Course Type	Course Code	Course Name	Credits
LLC	LLC6015	PERSONALITY DEVELOPMENT	02

Program Outcomes addressed:

1. PO6 : The Engineer & The World
2. PO7 : Ethics
3. PO11: Life-Long learning

Course Objectives :

1. To enhance self-awareness and self-confidence in the students.
2. To develop effective communication, leadership, and interpersonal skills.
3. To equip students with stress management and time management techniques.
4. To foster teamwork, problem-solving, and decision-making abilities.
5. To prepare students for professional life through resume building, interview skills, and networking.
6. To instill a growth mindset and adaptability in personal and professional contexts.

Module	Details
01.	**Self-Awareness and Emotional Intelligence** Understanding personality traits and self-assessment, Importance of emotional intelligence (EI) in personal and professional success, Strategies to enhance EI and self-awareness.
02.	**Communication Skills** Fundamentals of verbal and non-verbal communication, Public speaking, presentation skills, and storytelling, Listening skills and constructive feedback.
03.	**Leadership and Teamwork** Understanding importance of self-confidence, leadership styles, and their applications, Building effective teams and managing conflicts, Developing collaboration and networking skills.
04.	**Stress and Time Management** Recognizing stressors and managing stress effectively, Prioritization and goal-setting techniques, Tools for efficient time management and productivity.
05.	**Professional Development** Importance of presentation skills, resume writing, cover letter, and LinkedIn optimization, Interview preparation: Mock interviews and common questions, Networking skills and professional etiquette
06.	**Personal Growth and Adaptability** Developing a growth mindset and embracing lifelong learning, Cultivating resilience and adaptability to change, Setting long-term personal and professional goals
Total no. of hours: **30**	

Course Outcomes : By the end of this course, students will be able to:

1. demonstrate increased self-awareness and emotional intelligence.
2. communicate effectively in professional and personal contexts.
3. exhibit leadership and teamwork skills in various scenarios.
4. manage time and stress efficiently to enhance productivity.
5. prepare a professional resume, excel in interviews, and network effectively.
6. develop resilience, adaptability, and a growth-oriented mind-set.

Text Books :

1. Daniel Goleman, Emotional Intelligence: Why It Can Matter More Than IQ / What Makes a Leader: Why Emotional Intelligence Matters
2. Stephen R. Covey, The 7 Habits of Highly Effective People: Powerful Lessons in Personal Change

Reference Books :

1. Dale Carnegie, How to Win Friends and Influence People.
2. Anthony Robbins, Awaken the Giant Within: How to Take Immediate Control of Your Mental, Emotional, Physical, and Financial Destiny!
3. David J. Schwartz, The Magic of Thinking Big.
4. Robin Sharma, The Monk who sold his Ferrari.
5. Dorie Clark, Reinventing You: Define Your Brand, Imagine Your Future.
6. Gangadhar Joshi, Campus to Corporate: Your Roadmap to Employability.

Other Resources :

1. Videos and TED Talks by Simon Sinek, Brené Brown, Malcolm Gladwell and other motivational speakers
2. Online courses on communication and leadership (e.g., Coursera, LinkedIn Learning, EdX).