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 Computer Engineering

Curriculum Structure FY to B. Tech.

&

First, Second and Third Year Syllabus

Prepared by: Board of Studies for Computer Engineering

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

Effective from :2024-25

Revision: 2024.1

PREAMBLE

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 Board of Studies

Dear Students and Stakeholders,

The Department of Computer Engineering at Fr. C. Rodrigues Institute of Technology, Vashi, was established in 1994 and the current intake capacity is 120.One of the notable achievements is accreditation by the National Board of Accreditation (NBA) in 2006, 2012, 2019 and 2021, which reflects our commitment in maintaining high standards of education and infrastructure. Our mission is to provide a dynamic learning environment where students not only acquire technical expertise but also develop critical thinking, problem-solving skills, and leadership qualities. Through rigorous academic activities, hands-on learning opportunities, and industry collaborations, we aim to prepare our graduates to thrive in today's rapidly evolving technological landscape.

It is with great pleasure and anticipation that the members of Board of Studies, Computer Engineering, at Agnel Charities' Fr. C. Rodrigues Institute of Technology are very happy to introduce the newly designed curriculum for autonomy with effect from AY 24-25.

This curriculum is tailored to shape well-rounded individuals by adopting a comprehensive educational approach. It prioritizes building a solid foundation in science, mathematics, and computer engineering, complemented by a diverse selection of elective courses aimed at honing expertise in specialized areas to gain practical experience through extensive industry or research internships. Collaboration with external entities ensures the integration of pertinent skill-building courses, while honors evaluations offer opportunities for advanced learners. Moreover, in alignment with the principles outlined in the National Education Policy-2020, mission and vision of Institute and Department, our curriculum embraces a multidisciplinary approach, integrating subjects of various disciplines to provide a distinct learning experience to students. Furthermore, the curriculum systematically fosters the development of soft skills and enriches social, physical, mental, and spiritual dimensions of personality through thoughtfully curated liberal and experiential learning. Our curriculum adopts a top-to-down approach, meticulously incorporating all 12 attributes of Program Outcomes mandated by regulatory bodies, with reference to NBA SAR-January 2016.

The salient features of the autonomy curriculum are:

1. Implementation of a credit structure that aims to afford students' more time for extracurricular activities, co-curricularactivities, innovation, internships, and research.

2. Program elective courses within the department, open elective courses and honours/minor courses will offer specialized knowledge in the respective domain to students motivating them to remain updated on emerging trends, actively participate in continuousprofessional development.

3.The inclusion of Skill-Based Labs, Mini Projects, Major projects and Internships as a part of the curriculum provides students with a platform to demonstrate their talents through innovative projects, thereby strengthening their profiles and significantly improving their employability prospects in the product, service and consultancy organizations.

We are sure you will find this curriculum interesting, challenging, fulfilling the needs and expectations of Industry, Research and Academics. We are committed to fostering holistic development and ensuring that our students are well-equipped to succeed in their chosen careers. We take immense pride in serving as a beacon of academic excellence and innovation, fueled by our unwavering commitment.

Join us as we embark on this journey of autonomy, academic excellence and innovation in the field of Computer Engineering.

Sincerely,

Chairman, Board of Studies- Computer Engineering, Fr. C. Rodrigues Institute of Technology

Contents

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 Computer Engineering

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 (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 (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**

† NOTE: The Multidisciplinary Laboratory Course can be moved to the sixth semester if the department prefers.

C Curriculum Structure and Examination Scheme for B. Tech in Computer Engineering

(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 1 to 8 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 8.

NOTE 2: Please note that during semesters 1 to 8 some of the non-technical courses such as Humanities Social Sciences and Management (HSSM), Open Electives (OE), 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 your respective 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 Syllabus 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 Syllabus 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
CEPCC301	Engineering Mathematics-III	3	--	1	3	--	1	4
CEPCC302	Discrete Structures and Graph Theory	3	--	1	3	--	1	4
CEPCC303	Data Structures	3	--	--	3	--	--	3
CEPCC304	Database Management System	3	--	--	3	--	--	3
XXMDM301Y**	----	3	--	--	3	--	--	3
CELBC301	Data Structures Laboratory	--	2	--	--	1	--	1
CELBC302	Database Laboratory	--	2	--	--	1	--	1
CESBL301	Python Programming Laboratory	--	4	--	--	2	--	2
CEMNP301	Mini Project-1A	--	3	--	--	1	--	1
HSS301	Product Design	2	--	--	2	--	--	2
	Total	**17**	**11**	**2**	**17**	**5**	**2**	**24**

**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 Computer Engineering students, to complete the 14-credit requirement of 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	
CEPCC301	Engineering Mathematics-III	20+25@	30	50	1.5	2	125
CEPCC302	Discrete Structures and Graph Theory	20+25@	30	50	1.5	2	125
CEPCC303	Data Structures	20	30	50	1.5	2	100
CEPCC304	Database Management System	20	30	50	1.5	2	100
XXMDM301Y	----	20	30	50	1.5	2	100
CELBC301	Data Structures Laboratory	25	--	25	--	--	50
CELBC302	Database Laboratory	25	--	25	--	--	50
CESBL301	Python Programming Laboratory	50	--	50	--	--	100
CEMNP301	Mini Project-1A	50	--	--	--	--	50
HSS301	Product Design	50	--	--	--	--	50
	Total	**350**	**150**	**350**	--	--	**850**

$ Please refer to the Syllabus 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
CEPCC405	Engineering Mathematics-IV	3	--	1	3	--	1	4
CEPCC406	Analysis of Algorithms	3		--	3	--	--	3
CEPCC407	Operating System	3	--	--	3	--	--	3
CEPCC408	Computer Network	3	--	--	3	--	--	3
XXMDM402Y	----	3	--	--	3	--	--	3
CELBC403	Analysis of Algorithms Laboratory	--	2	--	--	1	--	1
CELBC404	Operating System Laboratory	--	2	--	--	1	--	1
CELBC405	Computer Network Laboratory	--	2	--	--	1	--	1
CESBL402	Web Development Laboratory	--	4	--	--	2	--	2
CEMNP402	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		
CEPCC405	Engineering Mathematics-IV	20+25@	30	50	1.5	2	125
CEPCC406	Analysis of Algorithms	20	30	50	1.5	2	100
CEPCC407	Operating System	20	30	50	1.5	2	100
CEPCC408	Computer Network	20	30	50	1.5	2	100
XXMDM402Y	----	20	30	50	1.5	2	100
CELBC403	Analysis of Algorithms Laboratory	25	--	25	--	--	50
CELBC404	Operating System Laboratory	25	--	25	--	--	50
CELBC405	Computer Network Laboratory	25	--	25	--	--	50
CESBL402	Web Development Laboratory	50	--	50	--	--	100
CEMNP402	Mini Project-1B	50	--	50	--	--	100
VEC402	Environment and Sustainability	50	--	--	--	--	50
	Total	**350**	**150**	**425**	--	--	**925**

$ Please refer to the Syllabus 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
CEPCC509	Theoretical Computer Science	3	--	--	3	--	--	3
CEPCC510	Software Engineering	3	--	--	3	--	--	3
XXMDM503Y	----	3	--	--	3	--	--	3
CEPEC501Y	Program Elective-I	3	--	--	3	--	--	3
CELBC506	Software Engineering Laboratory	--	2	--	--	1	--	1
CELBC507	Application Development Laboratory	--	2	--	--	1	--	1
XXMDL501Y	**----**	--	2	--	--	1	--	1
AEC502	Professional Communication and Ethics-II	1	2	--	1	1	--	2
CEMNP503	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-I:
Every student is required to take Program Elective for Semester V. Students can take this course from the following list of Program Elective-I.

Program Elective-I	
CEPEC5011	Data Mining & Business Intelligence
CEPEC5012	Advanced Database Systems
CEPEC5013	Computer Graphics and Animation
CEPEC5014	Distributed Computing

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	
CEPCC509	Theoretical Computer Science	20	30	50	1.5	2	100
CEPCC510	Software Engineering	20	30	50	1.5	2	100
XXMDM503Y	----	20	30	50	1.5	2	100
CEPEC501Y	Program Elective-I	20	30	50	1.5	2	100
CELBC506	Software Engineering Laboratory	25	--	25	--	--	50
CELBC507	Application Development Laboratory	25	--	25	--	--	50
XXMDL501Y	----	25	--	25	--	--	50
AEC502	Professional Communication and Ethics-II	50	--	--	--	--	50
CEMNP503	Mini Project-2A	50	--	--	--	--	50
HSS502	Entrepreneurship	50	--	--	--	--	50
	Total	**305**	**120**	**275**	--	--	**700**

$ Please refer to the Syllabus 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
CEPCC611	Cryptography and System Security	3		–	3	–	–	3
XXMDM604Y	---	4		–	4	–	–	4
CEPEC602Y	Program Elective-II	3	–	–	3	–	–	3
CELBC608	System Security Laboratory	–	2	–	--	1	–	1
CELBC609	IOT & Cloud Computing Laboratory	–	2	–	--	1	–	1
CESBL603	Full Stack Development Laboratory	–	4	–	--	2	–	2
CEMNP604	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-II:
Every student is required to take Program Elective for Semester VI. Students can take this course from the following list of Program Elective-II.

Program Elective-II	
CEPEC6021	Machine Learning ##
CEPEC6022	Big Data Analytics
CEPEC6023	Advanced Networks
CEPEC6024	High Performance Computing

Students who opted the AIML as Honours/Minor vertical 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	
CEPCC611	Cryptography and System Security	20	30	50	1.5	2	100
XXMDM604Y	---	20	30	50	1.5	2	100
CEPEC602Y	Program Elective-II	20	30	50	1.5	2	100
CELBC608	System Security Laboratory	25	--	25	--	--	50
CELBC609	IOT & Cloud Computing Laboratory	25	--	25	--	--	50
CESBL603	Full Stack Development Laboratory	50	--	50	--	--	100
CEMNP604	Mini Project-2B	50	--	50	--	--	100
ELC601	Research Methodology	50	--	--	--	--	50
LLC601Y	Liberal Learning Course	50	--	--	--	--	50
	Total	**310**	**90**	**300**	--	--	**700**

$ Please refer to the Syllabus 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
CEPCC712	Artificial Intelligence	3	--	--	3	--	--	3
CEPEC703Y	Program Elective-III	3	--	--	3	--	--	3
CEPEC704Y	Program Elective-IV	3	--	--	3	--	--	3
OEC701Y	Open Elective-I	3	--	--	3	--	--	3
CELBC710	Computational Intelligence Laboratory	--	2	--	--	1	--	1
CELBC711	Data Engineering Laboratory	--	2	--	--	1	--	1
CEMJP701	Major Project-A	--	6	--	--	2	--	2
HSS703	Financial Planning	2	--	--	2	--	--	2
	Total	**14**	**10**	**--**	**14**	**4**	**--**	**18**

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

Program Elective-III	
CEPEC7031	Deep Learning ##
CEPEC7032	Natural Language Processing
CEPEC7033	UI/UX
CEPEC7034	Advance Algorithms

Students who opted the AIML as Honours/Minor vertical should not opt Deep Learning as Program Elective-III.

Program Elective-IV	
CEPEC7041	Applied Data Science
CEPEC7042	Blockchain ##
CEPEC7043	Adhoc Networks
CEPEC7044	Compiler Design

Students who opted the Blockchain as Honours/Minor vertical should not opt Blockchain as Program Elective-IV.

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

Course Code	Open Elective-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 who opted for Honours/Minor vertical as Cybersecurity should not opt Cybersecurity and Laws from the Open Elective-I list.

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	
CEPCC712	Artificial Intelligence	20	30	50	1.5	2	100
CEPEC703Y	Program Elective-III	20	30	50	1.5	2	100
CEPEC704Y	Program Elective-IV	20	30	50	1.5	2	100
OEC701Y	Open Elective-I	20	30	50	1.5	2	100
CELBC710	Computational Intelligence Laboratory	25	--	25	--	--	50
CELBC711	Data Engineering Laboratory	25	--	25	--	--	50
CEMJP701	Major Project-A	50	--	--	--	--	50
HSS703	Financial Planning	50	--	--	--	--	50
	Total	**230**	**120**	**250**	--	--	**600**

$ Please refer to the Syllabus 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
CEPEC805Y	Program Elective-V	3	--	--	3	--	--	3
OEC802Y	Open Elective-II	3	--	--	3	--	--	3
CEMJP802	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-V:
Every student is required to take Program Elective for Semester VIII. Students can choose Program Elective - V, from one of the domains listed below. The list of courses within the individual domain will be made available before the course registration.

Program Elective-V	
CEPEC8051	Social Network Data Analytics
CEPEC8052	Software Development
CEPEC8053	Network and Security
CEPEC8054	Machine Intelligence

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

Course Code	Open Elective-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					Total
		In-Semester Assessment$		End Sem Exam (ESE)	Exam Duration for Theory (in Hrs)		
		Continuous Assessment	Mid-Sem Exam		Mid-Sem	End-Sem	
CEPEC805Y	Program Elective-V	20	30	50	1.5	2	100
OEC802Y	Open Elective-II	20	30	50	1.5	2	100
CEMJP802	Major Project-B	50	--	50	--	--	100
INT801	Internship	50	--	50	--	--	100
	Total	**140**	**60**	**200**	--	--	**400**

$ Please refer to the Syllabus for guidelines on in-semester assessments for both theory and laboratory courses.

NOTE: Please note that due to the internship requirement in the 8th semester, theory courses during this semester will be conducted either online synchronously or asynchronously. For more information, please consult the curriculum book of your respective department.

D. Multidisciplinary Minor Courses Offered by the Department 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
CEMDM301	Data Structures and Algorithms	3	--	--	3	--	--	3
CEMDM402	Database Management Systems	3	--	--	3	--	--	3
CEMDM503	Cloud computing	3	--	--	3	--	--	3
CEMDM604	Soft Computing	4	--	--	4	--	--	4
CEMDL601	Machine Learning Laboratory	--	2	--	--	1	--	1
	Total	**13**	**2**	**--**	**13**	**1**	**--**	**14**

Examination Scheme for MDM Courses

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	
CEMDM301	Data Structures and Algorithms	20	30	50	1.5	2	100
CEMDM402	Database Management Systems	20	30	50	1.5	2	100
CEMDM503	Cloud computing	20	30	50	1.5	2	100
CEMDM604	Soft Computing	20	30	50	1.5	2	100
CEMDL601	Machine Learning Laboratory	25	--	25	--	--	50
	Total	**105**	**120**	**225**	--	--	**450**

E. Honours, Minor, and Honours in Research 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.

F. First Year Syllabi

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

<table>
<tr><th colspan="6">Examination Scheme</th></tr>
<tr><th colspan="3">Distribution of Marks</th><th colspan="2" rowspan="2">Exam Duration (Hrs.)</th><th rowspan="3">Total Marks</th></tr>
<tr><th colspan="2">In-semester Assessment</th><th rowspan="2">End Semester Examination (ESE)</th></tr>
<tr><th>Continuous Assessment</th><th>Mid-Semester Exam (MSE)</th><th>MSE</th><th>ESE</th></tr>
<tr><td>20 + 25*</td><td>30</td><td>50</td><td>1.5</td><td>2</td><td>125</td></tr>
</table>

*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.

<table>
<tr><th>Module</th><th>Details</th><th>Hrs.</th></tr>
<tr><td></td><td>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.</td><td>01</td></tr>
<tr><td>01.</td><td>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.</td><td>7-9</td></tr>
</table>

	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.	
	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**	**6-8**
	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.*	
	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**	**7-9**
	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.*	

	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

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

4. 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 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

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.
	Course Introduction	**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)*	
05.	**Semiconductor Devices** ***Learning Objective/s:*** *•To apply the fundamental knowledge of semiconductor in various semiconductor devices.* *•To assess the applicability of semiconductor devices in different societal issues.* *•To identify impact of semiconductor devices in society in terms of sustainability.*	**3-5**
	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:

<u>P.I. No.</u>	**<u>P.I. Statement</u>**
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 Bangalore:- Web link- https://nptel.ac.in/courses/108108122

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.

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.
	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**	**4-6**
	Learning Objectives: ***To state the fundamentals of thermodynamics and apply them in engineering.***	
	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

CO 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	3				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, 17^{th} edition, 2018, Dhanpatrai Publications.
2. Engineering Chemistry by Raghupati Mukhopadhyay, First edition, 2007, New Age

3. Engineering Chemistry by Payal Joshi and Shashank Deep, First edition, 2019, Oxford

Other Resources :

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

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.

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

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.
	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..* **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.*	**5-7**

	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.	
	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	

<table>
<tr><td></td><td>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).</td><td></td></tr>
<tr><td>04.</td><td>Kinematics of Rigid Body
Learning Objectives:
To understand the parameters required to quantify the Kinematics of Particle and Rigid body.

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).</td><td>5-7</td></tr>
<tr><td>05.</td><td>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.

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</td><td>9-11</td></tr>
</table>

	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.*	**3-5**
	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).*	
	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.

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.

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

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 Content	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)*	

<table>
<tr><td rowspan="3">04.</td><td>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.</td><td rowspan="3">4-6</td></tr>
<tr><td>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.</td></tr>
<tr><td>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)</td></tr>
<tr><td rowspan="3">05.</td><td>Introduction to Residential Energy Measurements

Learning Objective/s:
To acquire knowledge on residential energy metering, energy tariff and understanding the residential electricity bill.</td><td rowspan="3">2-4</td></tr>
<tr><td>Contents:
Measurement of Energy, Understanding of electricity bill, energy tariff electricity bill calculation.</td></tr>
<tr><td>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)</td></tr>
</table>

<table>
<tr><td>06.</td><td>Introduction to Electrical Machines

Learning Objective/s:
To identify motors for given application using concepts of construction, working and characteristics of different machines.</td><td rowspan="3">4-6</td></tr>
<tr><td></td><td>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.</td></tr>
<tr><td></td><td>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)</td></tr>
<tr><td></td><td>Course Conclusion</td><td>1</td></tr>
<tr><td colspan="2" align="right">Total</td><td>30</td></tr>
</table>

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 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

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.

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

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.
	Course Introduction	**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	
	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.***	**02**

	2. To find the wavelength of the LASER and write valid conclusion	
	Contents: Diffraction through Grating: Measurement of wavelength of He-Ne laser	
	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.	
	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 toapply 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	
	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**	**03**
	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.***	

	Contents: Selection of a project based on physics concepts, Literature survey, and Topic presentation.	
	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 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, 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 link: www.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.
	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**
	Contents: Estimation of Total, temporary and permanent hardness of water by EDTA method.	
	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 ***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.* **Contents:** To synthesize aspirin from salicylic acid ***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.* **Contents:** To determine the enthalpy of dissolution of copper sulphate at room temperature using water as a reaction medium. ***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*** **Contents:** To determine the factors affecting the rate of corrosion. ***Learning Outcomes:***	**02**
	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)*	

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.	
	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, 17^{th} 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

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**.**	
	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. ***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. ***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** ***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.	**07**

	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 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

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

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.
	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*	**07**
	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.	

	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**	**12**
	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.*	
	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*** ***Learning Objectives:*** *Learner is expected to recall one dimensional arrays and understand its usage and apply it to solve problems in C.*	**12**
	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.*	**11**

	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.

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)
   3. Well-structured and organized program (02 marks)
   4. 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 :

There are no specific prerequisites for this course. However, students should have a willingness to learn and a commitment to safety.

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
	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.
	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.*	**6-8**

	2. *Determine the solution of a first order D.E by applying the basic concepts 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**	**5-7**
	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. **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.*** **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).*	**7-9**
05.	**Triple Integration** ***Learning Objective/s:*** *1. Analyze the fundamentals of Triple integration in different coordinate systems and apply it to solve problem.* *2. Apply the concepts of triple integrations to evaluate volume of a solid.* **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)*	**5-7**

	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 and apply 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. Vijaya kumari, Pearson, First Edition, 2017

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.

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.
	Course Introduction	**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** ***Learning Objectives:*** 1. *To identify the properties of magnetic and dielectric materials.*	**6-8**

	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 properties. (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, 1st 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.

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.

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 systemsand green chemistry for sustainable development.

Module	Details	Hrs.
	Course Introduction This course provides the insights into the properties, composition and behavior of materials and enables engineers to understand how different materials 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 numerical. 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 biodegradable polymers 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.	
	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 reinforced materials 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 and applications 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-world problems. (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 electromagnetic radiation, 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 coefficient of 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, 17^{th} 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

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.

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.
	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	**01**

	public speaking, exude confidence in presenting themselves and their work, with hands on training in real time.	
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: *1. Listening skill - Listening to audio and video content of various types like Monologues, dialogues, formal talk and discussion about the same.* *2. Self-Introduction and introducing others - Learning formal self-introduction and introducing colleagues through practice activity.* *3. Group Discussion on various relevant topics - Minimum three rounds to be conducted for facilitating enough practice.* *4. Debates on several relevant issues- Two rounds to be conducted.* *5. Selection of Ethical Case Study, Analysis, discussion and report documentation.* *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.* *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.* *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.* *9. Assignment on Business Correspondence- practice for drafting various business letters* *10. Assignment on writing accurate technical instructions for the end user.*	**4** **2** **6** **4** **2** **2** **2** **4** **2** **2**
	Course Conclusion	**01**
	Total	**60**

Performance Indicators:

<u>P.I. No.P.I. Statement</u>

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 audience
9.3.1 Create technical figures, reports with data to complement reports and presentation
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.
2. Present convincingly before an audience using accurate and appropriate lexis and

enhanced digital content.
3. Read and analyse objectively, summarize graphically and paraphrase effectively.
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.
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.
6. Conduct ably and ethically within the social circles with empathy and confidence, thus exhibiting a well-groomed and balanced personality

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

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.
	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** ***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.*	**6-8**
	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 Logic gates (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.*	**2-4**
	Contents: Transducers, classification of transducers, selection of transducers, Resistance- temperature detector (RTD), inductive transducers, Linear variable differential transformer (LVDT).	
	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)*	
06.	**Introduction to Sensors** ***Learning Objective/s:*** *To demonstrate competence in engineering fundamentals to comprehend the concepts of sensor as per the application.*	**3-5**
	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)*	
	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 and Lab, IIT Madras :-Web link- https://nptel.ac.in/courses/122106025
2. NPTEL Course: Digital Electronic Circuits By Prof. Goutam Saha, NOC:Digital Electronic Circuits, 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.
	Course Introduction	**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.	
	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*	**02**

	Contents: X-ray Diffraction: Simulation of X-ray Diffraction (XRD) pattern of a material. ***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)*	
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. ***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. ***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. ***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)*	**02**
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. ***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 gain experimental skill.
3. To enable the students to utilize the fundamental laboratory techniques for analysis.

Module	Details	Hrs.
	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	
	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).*	
02.	**Experiment 2** *Learning Objective/s:* *To apply the knowledge of condensation polymerization for the synthesis of urea formaldehyde.*	**02**

	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).*	
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.*	**02**
	To Determine molecular weight of a polymer using Ostwald's viscometer.	
	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).	
04.	**Experiment 4** *Learning Objective/s:* *To construct the Daniel cell and calculate its E^0 using Nernst equation.*	**02**
	To determine the emf of galvanic cell-Daniel cell.	
	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).*	
05.	**Experiment 5** *Learning Objective/s:* *To determine the concentration of iron and verify Beer Lambert's law.*	**02**
	To determine iron from the given sample using UV-Visible spectrophotometer.	
	Learning Outcomes : *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.	
	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: Modern 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.
	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.*	**08**
	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.	
	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.	**Name of the Module** ***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 ofa 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.	**Name of the Module** ***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.	**12**

	(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 isometric drawings.	
	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.	**Name of the Module** ***Learning Objectives:*** ***To develop the ability of the students to read the orthographic and sectional orthographic projections to draw the missing views.***	**05**
	Contents: Orthographic Reading: The identification of missing views from the given views. 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 of Orthographic projections.	
	Learning Outcomes: *A learner will be able to* *LO 4.1: Read and interpret technical drawings that use orthographic and sectional orthographic 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 view by 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.	**Name of the Module** ***Learning Objective/s:*** *To develop the ability to imagine the solid geometries and represent the views in a two dimensional space.*	

	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)	**14**
	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, Charotar Publishing 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 House Pvt. 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

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.

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.
	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 (e g. 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 system as a team.* ***2.** To grasp the fundamental concept of input output. Also expected to write program using different input output constructs.*	**08**
	Contents: Classes, objects, data members, member functions, Constructors, method overloading. 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 basic operations. **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 information about any entity (e g. Student, Animal etc.) **Task 6:** Write a Java program that takes input from user with 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) inheriting from 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 of abstraction 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.*	**08**

	2. *Learner is expected to know the concept of multithreading. Also expected to apply it for multitasking.*	
	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 and implements 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 exception using 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 processes in 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 expected to 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. Also expected 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 engineering problem
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 justified approximations and assumptions.
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.
2.4.4	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 to seek 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 current regarding 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.:-Weblink- 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

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

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	ESL 206	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: Modern 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. Evaluate circuit parameters to achieve desired performance characteristics.*	**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 with various 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 and XOR 2. For a given Boolean expression, design and verify the circuit using Universal 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 acquisitions ystem.*	**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 the field 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 in chemical 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 of the 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
ESL 206.1		2		2				2	2		
ESL 206.2		2	2					2	2		
ESL 206.3		2	2					2	2		
ESL 206.4		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 Ray Chaudhuri 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).

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

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		
Term Work	**Practical /Oral**	**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
	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

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

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 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

G. Second Year Syllabi

Course Type	Course Code	Course Name	Credits
PCC	CEPCC301	ENGINEERING MATHEMATICS-III	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

**** 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.
	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 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*	**7-9**
	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* 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)* 2. *Identify the conditions of closure and prove that the given space is a Subspace. (P.I. -2.1.3)* 3. *Applying the condition for linear independency and the span of a Vector Space determine the basis of a vector space. (P.I. 1.1.2)* 4. *Identifying Vector space and its operations to determine the Basis of a Vector Space.(P.I. -2.1.2)*	
02.	**Linear Mappings** ***Learning Objective/s:*** *To apply the concepts of kernel and image of a linear map to compute and analyze rank and nullity.*	**6-8**
	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* 1. *Apply the properties of vector addition and scalar multiplication to examine whether the mapping is a Linear mapping. (P.I. 1.1.1)* 2. *Determine the rank and nullity of the given linear mapping using the matrix method (P.I. 1.1.2)* 3. *Examine whether a mapping is a linear mapping and find its kernel and image. (P.I. 2.1.2)* 4. *Analyze the property of homomorphism and one-one mapping isomorphism between the vector space to prove that the mapping an isomorphism. (P. I. -2.1.3)*	
03.	**Linear Mappings and Matrices** ***Learning Objective/s:*** *To analyze and compute the change of basis matrix for linear map.*	**6-8**
	Contents: Introduction, Matrix Representations of a linear operator, Change of Basis, Similarity, Matrices and general linear mapping.	

	Learning Outcomes : *A learner will be able to* 1. *Express the linear mapping in the matrix form.(P.I. 1.1.1)* 2. *Apply matrix method to prove that the two linear mappings are similar (P.I. 1.1.2)* 3. *Analyse the procedure and determine the change of Basis Matrix from one coordinate system to the alternate coordinate system (P.I. 2.1.3)* 4. *Apply the concept of linear mapping and the change of basis to solve mathematical models (P.I.- 2.4.1)*	
04.	**Inner Product spaces, Orthogonality** ***Learning Objective/s:*** *To analyse and apply Gram-Schmidt Technique to determine an Orthonormal Basis.*	**6-8**
	Contents: Introduction, Inner product spaces, Examples of Inner product spaces, Cauchy-Schwartz Inequality, Orthogonality, orthogonal sets and Basis Gram-Schmidt orthogonalizations process	
	Learning Outcomes : *A learner will be able to* 1 *Prove Cauchy's Schwartz inequality for set of all matrices (P.I. 1.1.1)* 2 *Identify the inner product space to prove that the set of vectors is an orthogonal basis. (P.I. 2.1.2)* 3 *Identify the inner product space to prove that the set of vectors is an orthonormal basis. (P.I. 2.1.3)* 4 *Apply Gram Schmidt Technique to determine the orthonormal basis. (P.I. 1.1.2)*	
05.	**Number Theory** ***Learning Objective/s:*** *To identify and apply the appropriate theorem of Number Theory to solve the simultaneous system of congruences.*	**6-8**
	Contents: Modular Arithmetic, Divisibility and Euclid Algorithm, Primes and Sieve of Eratosthenes, Euler's and Fermat Little Theorem, Congruences, Computing Inverse in Congruences, Legendre and Jacobi Symbol, Chinese Remainder Theorem	
	Self-Learning Topics: *Testing for Primes, Prime Number Theorem*	
	Learning Outcomes : *A learner will be able to* 1. *Apply Euler's or Fermat little theorem to solve congruent modulo equation. (P.I-. 1.1.1)* 2. *Formulate and solve the linear congruent equation for the given problem. (P.I.- 2.2.2)* 3. *Identify appropriate theorem and solve the linear congruent equation. (P.I.- 2.1.3)* 4. *Apply Chinese Remainder theorem to solve the given simultaneous linear congruence.(P. I. - 1.1.2)*	
06.	**Numerical Methods** ***Learning Objective/s:*** *To analyse and apply the appropriate numerical method to solve transcendental equation and system of simultaneous equations.*	**6-8**

	Contents: Solution of Transcendental Equations: Newton Raphson 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* *1. Apply Newton Raphson method and Regula Falsi method to solve the transcendental equation. (P.I.- 1.1.1)* *2. Apply Gauss Jordan or Gauss Siedel Iterative method to solve the system of equations. (P.I.- 1.1.2)* *3. Identify the appropriate numerical method to solve the system of equation. (P.I.- 2.1.3)* *4. Examine the limitation for the convergent solution of system of equation is using iterative method.(P.I.- 2.4.3)*	
	Course Conclusion Engineering Mathematics provides the language and framework through which engineers model, analyze, 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.
1.1.2	Apply the concepts of probability, statistics and queuing theory in modelling of computer-based system, data and network protocols.
2.1.2	Identify processes/modules/algorithms of a computer-based system and parameters to solve a problem
2.1.3	Identify mathematical algorithmic knowledge that applies to a given problem
2.2.2	Identify functionalities and computing resources.
2.4.1	Applies engineering mathematics to implement the solution.
2.4.3	Identify the limitations of the solution and sources/causes.

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
CEPCC301.1	3	2	-	-	-	-	-	-	-	-	-
CEPCC301.2	3	2	-	-	-	-	-	-	-	-	-
CEPCC301.3	3	2	-	-	-	-	-	-	-	-	-
CEPCC301.4	3	2	-	-	-	-	-	-	-	-	-
CEPCC301.5	3	2	-	-	-	-	-	-	-	-	-
Average	**3**	**2**	-	-	-	-	-	-	-	-	-

Text Books :

1. C. L. Liu: Elements of Discrete Mathematics, 2nd edition, TMH.
2. Cryptography 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 2005.
2. Advanced Engineering 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.

IN-SEMESTER ASSESSMENT (75 MARKS)

1. Continuous Assessment-Theory (20 Marks)

Suggested breakup of distribution

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

One Class test: 05 Marks

One Team-Pair-Solo activity: 05 Marks

Regularity and active participation: 05 Marks

2. Continuous Assessment - Tutorial (25 Marks)

Suggested breakup of distribution

Tutorial Assignments and Class tests: 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 active participation: 05 Marks.

3. 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 20%- 30% weightage, and the syllabus covered from MSE to ESE carrying 70%- 80% weightage.

Course Type	Course Code	Course Name	Credits
PCC	CEPCC302	DISCRETE STRUCTURES AND GRAPH THEORY	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

**** Tutorial***

Pre-requisite:

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

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO3: Design/development of solutions

Course Objectives:

1. To inculcate the notion of Logical Thinking.
2. To familiarize with the concepts of Sets, Relations, and Functions.
3. To familiarize with the concepts of Posets and Lattice.
4. To enable to apply the advanced concepts of Counting and Recurrence Relations.
5. To acquaint learners with Algebraic Structures and Coding Theory.

Module	Details	Hrs
	Course Introduction Discrete structures and graph theory enhances problem-solving abilities, vital for algorithm design, network analysis, cryptography, and software engineering, driving professional growth in computer engineering fields.	**01**
01.	**Fundamental of logic:** ***Learning Objective:*** *Students are expected to apply mathematical logic to solve logical problems and mathematical induction.*	**5-7**
	Contents: Basic connectives and truth tables, Logic equivalence- laws of logic Logical Implication-Rules of Inference, Fundamentals of Logic-Use of Quantifier, Mathematical Induction.	

	Self-Learning Topics: *Normal forms*	
	Learning Outcomes: *A learner will be able to* *LO1.1: Verify the correctness of an argument using propositional and predicate logic. (P.I.- 1.1.1)* *LO1.2: Prove that the given statement is factual using mathematical induction (P.I.- 1.3.1)* *LO1.3: Find the logical equivalent of the given statement. (P.I.- 1.4.1)*	
02.	**Relations and Functions:** ***Learning Objective:*** *Students are expected to identify and analyze the operations associated with set theory, functions and relations.*	**7-9**
	Contents: Basic concepts of Set Theory, Relations: Definition, Types of Relations, Representation of Relations, Closures of Relations, Wars hall's algorithm, Equivalence relations and Equivalence Classes, Functions: Definition, Types of functions, Composition of functions, Identity and Inverse function.	
	Self-Learning Topics: *Equivalence Classes.*	
	Learning Outcomes: *A learner will be able to* *LO2.1: Identify if the given relation is an equivalence relation. (P.I.- 1.1.1)* *LO2.2: Solve problems based on set theory, functions. (P.I.- 1.2.1)* *LO2.3: Find the transitive closure using Warshall's algorithm. (P.I.- 1.4.1)* *LO2.4: Find the composition of the function. (P.I.-1.3.1)*	
03.	**Posets and Lattice** ***Learning Objective:*** *Student are expected to construct hasse diagram using poset and analyse chain, anti-chain and Lattice using Hasse diagram*	**5-7**
	Contents: Partial Order Relations, Poset, Hasse Diagram, Chain and Anti chains, Lattice, Types of Lattices, Sub lattice, Application of lattice in real life	
	Self-Learning Topics: *Isomorphism in Lattice.*	
	Learning Outcomes: *A learner will be able to* *LO3.1: Construct Hasse Diagram of the Poset by applying the partial order relation (P.I.- 2.1.3)* *LO3.2:Identify and analyze chain, anti-chain and lattice in Hasse diagram (P.I.-2.4.1)*	
04.	**Fundamental Principle of Counting**	**6-8**
	Learning Objectives:	
	Students are expected to solve recurrence relations and apply advance concepts of counting to provide the solution to associated problems	

	Contents: Basic Counting Principle-Sum Rule, Product Rule, Inclusion Exclusion Principle, Pigeonhole Principal Recurrence relations, Solving recurrence relations	
	Self-Learning Topics: *Permutation and combination* ***Learning Outcomes:*** *A learner will be able to* *LO4.1: Use the sum and product rule to solve counting problems. (P.I.- 1.1.2)* *LO4.2: Use the inclusion exclusion principle to solve counting problem (P.I.- 1.2.1)* *LO4.3: Find the generating sequence of the recurrence relation. (P.I.- 1.4.1)* *LO4.4:Solve recurrence relation using characteristic roots (P.I.- 1.3.1)*	
05.	**Groups** ***Learning Objective/s:*** *To acquaint students with algebraic structure and able to design out lane for real life problems.*	**7-9**
	Contents: Semi group, Monoid, Groups, Subgroups, Abelian Group, Cyclic group, Isomorphism of group, Application of algebraic structure in real life	
	Self-Learning Topics: *Co-sets and Lagrange's theorem* ***Learning Outcomes :*** *A learner will be able to* *LO5.1: Identify if the given operation is algebraic structure (P.I.- 1.3.1)* *LO5.2: Identify Semi-group, monoid, groups, subgroups and abelian based on the binary operation. (P.I.- 1.1.1)* *LO5.3: Identify if the groups are isomorphic. (P.I.- 1.4.1)* *LO5.4: Able to model algebraic structure concept in real life applications (P.I.-2.4.1)* *LO5.5: Able to identify specified groups concept to find the solution real life applications (P.I- 2.1.3)*	
06.	**Graph Theory** ***Learning Objective/s:*** *Student will expect to design and form a solution to real life problems through the concept of graph theory*	**7-9**
	Contents:	
	Types of graphs, Graph Representation, Sub graphs, Operations on Graphs, Walk, Path, Circuit, Connected Graphs, Disconnected Graph, Components, Homomorphism and Isomorphism of Graphs Euler and Hamiltonian Graphs, Planar Graph, Application of Graph Theory in Real life (Computer Network, Social media analytics, etc.)	

	Self-Learning Topics: *Cut vertex, cut set vertex*	
	Learning Outcomes: *A learner will be able to* *LO6.1: Identify walk, path circuit of the graph (P.I.- 1.1.1)* *LO6.2: Identify if the graph is homomorphic or isomorphic (P.I.- 1.4.1)* *LO6.3: Apply the theorems to identify if the graph is Euler or Hamiltonian graph (P.I.- 1.3.1)* *LO6.4: Design a graphical model solution to different application based on real life scenario (P.I.- 3.1.1)* *LO6.5: Design and validate community detection for real life application (P.I.- 3.4.3)*	
	Course Conclusion In conclusion, proficiency in discrete structures and graph theory is invaluable for problem-solving in computer engineering, facilitating career growth and impactful contributions across diverse domains.	**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.
1.2.1	Apply laws of natural science to an engineering problem.
1.3.1	Apply engineering fundamentals.
1.4.1	Apply theory and principles of computer science and engineering to solve an engineering problem
2.1.3	Identify mathematical algorithmic knowledge that applies to a given problem
2.4.1	Applies engineering mathematics to implement the solution.
3.1.1	Able to define a precise problem statement with objectives and scope.
3.4.3	Able to verify the functionalities and validate the design.

Course Outcomes: A learner will be able to -

1. Solve the basic problems of Logical Thinking. (*LO1.1, LO1.2, LO1.3)*
2. Apply basic principles of Set theory, Relation, and Functions to solve the problem. (*LO2.1, LO2.2, LO2.3, LO2.4)*
3. Apply and analyse the basic concepts of Posets and Lattice to find the solution to computer engineering problem. (*LO3.1, LO3.2)*
4. Apply the concepts of counting and recurrence relations to solve the given problems. (*LO4.1, LO4.2, LO4.3, LO4.4, LO4.5)*
5. Design a solution by using the concepts of Groups and Graph Theory for the problems associated with various domains of Computer Engineering. (*LO5.1, LO5.2, LO5.3, LO5.4, LO5.5, LO6.1, LO6.2, LO6.3, LO6.4, LO6.5)*

CO-PO Mapping Table with Correlation Level

CO ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CEPCC303.1	3	-	-	-	-	-	-	-	-	-	-
CEPCC303.2	3	-	-	-	-	-	-	-	-	-	-
CEPCC303.3	-	3	-	-	-	-	-	-	-	-	-
CEPCC303.4	3	-	-	-	-	-	-	-	-	-	-
CEPCC303.5	3	3	3	-	-	-	-	-	-	-	-
Average	**3**	**3**	**3**	**-**	-	-	-	-	-	-	-

Text Books :

1. Discrete Mathematical Structures, Bernad Kolman, Robert Busby, Sharon Cutler Ross, Nadeem-ur-Rehman, Sixth edition , 2015 Pearson Education.
2. Discrete Mathematics and applications, K. H. Rosen, fifth edition 2003, Tata McGraw Hill Publishing Company.
3. Elements of Discrete Mathematics, C. L. Liu, second edition 1985, Reprinted 2000, McGraw-Hill Book Company.

Reference Books :

1. Discrete Mathematics for Computer Scientists and Mathematicians, J. L. Mott, A. Kandel, T. P. Baker, Second Edition 1986, Prentice Hall of India.
2. Discrete Mathematical Structures with Applications to Computer Science, J. P. Trembley, R. Manohar ,2002,Tata McGraw Hill Publishing Company.
3. Graph Theory with applications to engineering and computer science, Narsing Deo, 1st publication 2016, PHI Publications.
4. Discrete Mathematics, P. K. Bisht, H. S. Dhami, 1st publication 2015, Oxford press.
5. Discrete Mathematical Structures, Y N Singh, 2010,Wiley-India.

Other Resources :

1. NPTEL Course: Discrete Mathematics By Prof. Sudarshan Iyengar, Department of Computer Science Engineering, IIT Ropar :-Web link- https://onlinecourses.nptel.ac.in/noc19_cs49/
2. NPTEL Course: Discrete Mathematics By Prof. Sourav Chakraborty,Department of Computer Science Engineering, IIT Madras :-Web link- https:://nptel.ac.in/courses/111/106/111106086/
3. NPTEL Course: Discrete Mathematics By Prof. Ashish Choudhury, Department of Computer Engineering, IIIT Bangalore:- Web link- https://nptel.ac.in/courses/107/106/107106081/

IN-SEMESTER ASSESSMENT (75 MARKS)

1. Continuous Assessment - Theory-(20 Marks)

Suggested breakup of distribution

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

Class test: 05 Marks

Open book test/ Open notes test: 05 Marks

Regularity and active participation : 05

Marks

2. Continuous Assessment - Tutorial- (25 Marks)

Suggested breakup of distribution

Numerical Assignments: 10 Marks

Class test based on above numerical assignment: 10 Marks

Regularity and active participation : 05 Marks

3. 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 20%-30% weightage, and the syllabus covered from MSE to ESE carrying 70%-80% weightage.

Course Type	Course Code	Course Name	Credits
PCC	CEPCC303	DATA STRUCTURES	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. ESL103- Programming Laboratory-I (C)

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO3: Design/Development of Solutions
4. PO4: Conduct investigations of complex problems

Course Objectives:

1. To impart the fundamental knowledge of data structures.
2. To instruct learners in applying the most suitable data structures to various applications.
3. To instruct learners in comparing various data structures.

Module	Details	Hrs
	Course Introduction Data Structure: This course provides a foundational exploration of data structures, covering concepts such as stacks, queues, and linked lists. Learners will gain proficiency in implementing these structures using programming languages and will develop the analytical skills to choose the appropriate data structure for various applications.	**01**
01.	**Introduction to Data Structures** ***Learning Objective/s:*** *Students are expected to apply engineering knowledge to grasp concepts of various data structure.*	**3-5**
	Contents: 1.1 Introduction to Data Structures – Basic Terminology, Importance of Data Structures 1.2 Types of Data Structures, Operations on Data Structures. 1.3 Abstract Data type (ADT), Advantages of Data structures 1.4 Applications of Data Structures	
	Self-Learning Topics: *Array Data Structure, Elementary Data Structure Organization*	

	Learning Outcomes: *A learner will be able to:* *LO1.1: Apply the concepts of data types and arrays to grasp the concept of data structures. (P.I. - 1.3.1)* *LO1.2: Apply the concept of data structures to write an Abstract Data Type. (P.I. - 1.4.1)* *LO1.3: Compare and contrast various data structures (P.I. - 2.2.4)*	
02.	**Stacks and Queues** ***Learning Objective/s:*** *Expected to write functions to perform operations like insertion, deletion, and traversal operations on-stack and queue data structures.*	**9-11**
	Contents: 2.1 Stacks- Introduction, ADT of Stack, Operations on Stack, Implementation of Stack using array, Applications of Stack- Well form-ness of Parenthesis, Infix to Postfix Conversion and Postfix Evaluation, Reverse String 2.2 Queues - Introduction, ADT of Queue, Operations on Queue, Array Implementation of Queue, Types of Queue-Circular Queue, Priority Queue, Double-Ended Queue, Applications of Queue.	
	Self-Learning Topics: *Use of stack in Recursion, Multiple Queue*	
	Learning Outcomes: *A learner will be able to* *LO2.1: Apply the concepts of data structures to perceive the abstract data types of stack and queue. (P.I. - 1.3.1)* *LO2.2: Compare and contrast array, stack, and queue data structures (P.I. - 2.2.4)* LO2.3: *Write separate functions for each operation of stack and queue data structure and integrate them. (P.I. - 3.4.2)* LO2.4: *Represent data in a predefined format to facilitate explanation of the data (P.I. – 4.3.3)*	
03.	**Linked Lists** ***Learning Objective/s:*** *Expected to write functions to perform operations like insertion, deletion, and traversal operations on linked list data structures.*	**9-11**
	Contents: 3.1 Linked Lists- Basic Terminologies, Representation on Linked List, Linked Lists versus Arrays, Memory Allocation and De-allocation for a Linked List, 3.2 Types of Linked List, Singly Linked List: Traversing a SLL, searching for a value in a SLL, inserting a New Node in a SLL, Deleting a Node from SLL, 3.3 Doubly Linked List: Traversing a DLL, searching for a Value in a DLL, inserting a New Node in a DLL, Deleting a Node from DLL 3.4 Applications of LL: Stack and Queue implementation using LL	
	Self-Learning Topics: *Circular Linked List, Polynomial Representation of equation using LL.*	

	Learning Outcomes: *A learner will be able to* *LO3.1: Use the procedure to perform various operations on linked list data structures. (P.I. - 2.1.2)* *LO3.2: Compare and contrast array, stack, queue, and linked list data structures (P.I. - 2.2.4)* *LO3.3: Write separate functions for each operation of linked list data structure and integrate them. (P.I. - 3.4.2)* *LO3.4: Represent data in predefined form to facilitate explanation of the data, (P.I. – 4.3.3)*	
04.	**Trees** ***Learning Objective/s:*** *Expected to write functions to perform operations like insertion, deletion, and traversal operation on trees data structures.*	**9-11**
	Contents: 4.1 Introduction, Tree Terminologies, Types of Binary trees 4.2 Binary Tree representation, Binary Tree traversals techniques, constructing a Binary Tree from Traversal 4.3 Applications of Binary Tree - Expression Tree, Huffman encoding 4.4 Efficient binary tree: Binary Search Tree and operations on Binary search tree. AVL Trees, Operations on AVL Trees, 4.5 Multi-way Tree - Introduction of multiway tree, Types of multiway tree, B Tree – Operations on B tree, Applications of B tree.	
	Self-Learning Topics: *Threaded Binary Tree, B+ Tree*	
	Learning Outcomes: *A learner will be able to* *LO 4.1: Use algorithms to represent various operations on tree data structures. (P.I. - 2.1.2)* *LO 4.2: Compare and contrast linear and tree data structures (P.I. - 2.2.4)* *LO4.3: Write separate functions for each operation of tree data structure and integrate them. (P.I. - 3.4.2)* *LO4.4: Represent data in predefined form to facilitate explanation of the data (P.I. – 4.3.3)*	
05.	**Graphs** ***Learning Objective/s:*** *Expected to write functions to perform operations like insertion, deletion, and traversal operation on graphs data structures.*	**4-6**
	Contents: 5.1 Introduction, Basic Graph Terminologies, 5.2 Representation of Graph, 5.3 Graph Traversals: Depth First Search (DFS) and Breadth First Search (BFS), 5.4 Topological Sorting. 5.5 Application of Graph	

	Learning Outcomes: *A learner will be able to* *LO 5.1: Use algorithms to represent various operations on graph data structures. (P.I. - 2.1.2)* *LO5.2: Compare and contrast linear and non-linear data structures (P.I. - 2.2.4)* *LO5.3: Write separate functions for each operation of graph data structure and integrate them. (P.I. - 3.4.2)* *LO5.4: Represent data in predefined form to facilitate explanation of the data (P.I. – 4.3.3)*	
06.	**Searching Techniques** ***Learning Objective/s:*** *To develop proficiency in identifying, comparing, listing collision techniques, solving collision-related problems, and implementing various searching techniques.*	**3-5**
	Contents: 6.1 Introduction, Hash table, Hash Function: Different Hash Functions, 6.2 Collision resolution techniques 6.3 Pros and Cons of Hashing, Applications of Hashing 6.4 Searching Techniques: Introduction, Linear Search, Binary Search	
	Self-Learning Topics: *Real world application of hashing*	
	Learning Outcomes: *A learner will be able to* *LO 6.1: Select and apply hashing technique, collision resolution technique, searching technique for a given problem (P.I. – 2.1.2)* *LO 6.2: Apply engineering mathematics to solve the given problem (P.I.- 2.4.1)* *LO 6.3: Compare and contrast various searching techniques (P.I. - 2.2.4)* *LO 6.4: Represent data in predefined form to facilitate explanation of the data, (P.I. – 4.3.3)*	
	Course Conclusion Students will be able to write procedures for different data structures. They will be capable of choosing the appropriate data structure for a specific problem and recognizing various uses of data structures.	**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 and engineering to solve an engineering problem
2.1.2	Identify 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.
2.4.1	Applies engineering mathematics to implement the solution.
3.4.2	Able to write separate functions for each operation of linear data structure and integrate them. (Modified P.I.)
4.3.3	Represent data in predefined form so as to facilitate explanation of the data. (Modified P.I.)

Course Outcomes: A learner will be able to-

1. Represent various operations of data structure as a function and integrate them. *(LO1.1, LO1.2, LO1.3)*
2. Identify and apply a suitable linear data structure for a given problem.*(LO2.1, LO 2.2, LO 2.3, LO 3.1, LO 3.2, LO 3.3,)*
3. Identify and apply a suitable non-linear data structure for a given problem.*(LO 4.1, LO 4.2, LO 4.3, LO 5.1, LO 5.2, LO 5.3)*
4. Apply an appropriate searching technique for a given problem.*(LO 6.1, LO 6.2, LO 6.3)*
5. Analyse various data structures. *(LO 2.4, LO 3.4, LO 4.4, LO 5.4)*

CO-PO Mapping Table with Correlation Level

CO ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CEPCC303.1	3	2	-	-	-	-	-	-	-	-	-
CEPCC303.2	2	3	2	-	-	-	-	-	-	-	-
CEPCC303.3	-	3	2	-	-	-	-	-	-	-	-
CEPCC303.4	-	3	-	2	-	-	-	-	-	-	-
CEPCC303.5	-	-	-	2	-	-	-	-	-	-	-
Average	**3**	**3**	**2**	**2**	-	-	-	-	-	-	-

Text Books:

1. Data Structures Using C, Aaron M Tenenbaum, Yedidyah Langsam, Moshe J Augenstein, 1st Edition, 2019, Pearson Publication.
2. Data Structures using C, Reema Thareja, 2nd Edition, 2014, Oxford Press.
3. Data Structures: A Pseudocode Approach with C, Richard F. Gilberg and Behrouz A. Forouzan, 2nd Edition, 2007, CENGAGE Learning.

Reference Books:

1. Data Structures using C, E Balagurusamy, 1st Edition, 2013, McGraw-Hill Education India
2. Data Structures using C and C++, Rajesh K Shukla, 1st Edition, 2009, Wiley-India.

Other Resources:

1. NPTEL Course: Data Structures and Algorithms, by Prof. Naveen Garg, Department of Computer Science and Engineering Department, IIT Delhi:-Web link- https://nptel.ac.in/courses/106/102/106102064/

IN-SEMESTER ASSESSMENT (50 MARKS)

1.Continuous Assessment (20 Marks)

Suggested breakup of distribution

One MCQ test as per GATE exam pattern/ level: 05 marks.

One Class test: 05 marks

Open book test/ Open notes test: 05 Marks

Observation 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 20%- 30% weightage, and the syllabus covered from MSE to ESE carrying 70% - 80% weightage.

Course Type	Course Code	Course Name	Credits
PCC	CEPCC304	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: *Nil*

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 familiarize fundamental concepts of database management System.
2. To guide in designing ER/EER Models and Relational model for specific applications.
3. To guide in designing relational database model and formulate relational algebra queries.
4. To guide in formulating appropriate query.
5. To impart the concepts of transaction processing, concurrency control, and database recovery techniques by emphasizing their pivotal roles in operational efficiency.

Module	Details	Hrs.
	Course Introduction Database Management System course is vital for computer engineering professionals, equipping them with essential skills in database architecture, optimization, and resilience, crucial for data-centric projects and advancing research, thereby enhancing their professional competence in the field.	**01**
01.	**Introduction Database Concepts** ***Learning Objective:*** *Expected to apply database theory to elucidate core concepts and functionalities, and depict architecture with key components, structure, and dynamics.*	**2-4**

	Contents: 1.1 Basic Concept: -Purpose of Database Systems, Data models, File system v/s Database system. 1.2 Database Architecture: -Views of data, three-schema architecture of DBMS, Data abstraction and data Independence, Database Administrator, Database users, DBMS system architecture.	
	Self-Learning Topics: *Client/Server Architectures for DBMS, Database Storage Structures.*	
	Learning Outcomes: *A learner will be able to* *LO1.1: Use core principles of engineering to understand the importance of database system. (P.I.-1.3.1)* *LO1.2: To apply computer engineering concepts to illustrate the database architecture, providing comprehensive summary of roles and responsibilities of various database users along with operational details. (P.I.-1.4.1)*	
02.	**Entity–Relationship Data Model** ***Learning Objective:*** *Expected to design tailored Entity-Relationship Models for specific applications, and delve into advanced EER Model concepts.*	**5-7**
	Contents:	
	2.1 The Entity-Relationship (ER) Model: - Entity types: Weak and strong entity sets, Entity sets, Types of Attributes, Keys, roles, Relationship, Relationship set, Relationship constraints: Cardinality and Participation, ER diagrams. 2.2 Extended Entity Relationship (EER)Model: Generalization, Specialization and Aggregation, EER Diagrams.	
	Self-Learning Topics: *Constraints and Characteristics of Specialization and Generalization Hierarchies.*	
	Learning Outcomes : *A learner will be able to* *LO2.1: Use the knowledge of discrete structures to define cardinality ratio on ER. (P.I.-1.1.1)* *LO2.2: Apply theory and principles of ER/EER to provide solution to real world problem. (P.I.-1.4.1)* *LO2.3: Evaluate the problem statement and identify various components of ER/EER. (P.I.-2.1.1)* *LO2.4: Identify the participation constraints on ER. (P.I.-2.3.2)* *LO2.5: Design ER/EER data model for the real-world problem. (P.I.-3.2.2)* *LO2.6: Examine ER/EER data model and validate it. (P.I.-3.4.3)*	
03.	**Relational Model and Relational Algebra** ***Learning Objective:*** *Expected to design relational database schema and formulate relational algebra queries.*	**5-7**

	Contents: 3.1 Relational Model: Introduction to the Relational Model, relational database schemas, concept of keys, Mapping the ER and EER Model to the Relational Model, 3.2 Relational Algebra operators: Unary and Binary relational operations, additional relational operations: Aggregate, grouping Examples of Queries in relational algebra.	
	Self-Learning Topics: *The Tuple Relational Calculus, The Domain Relational Calculus*.	
	Learning Outcomes: *Learner should be able to* *LO3.1: Identify process/rules to appropriately map ER model to relational model. (P.I.-2.1.2)* *LO3.2: Identify appropriate mapping of relationships based on the cardinality to ensure performance is not hampered. (P.I.-2.3.2)* *LO3.3: Design Relational model from conceptual model. (P.I.-3.2.2)* *LO3.4: Examine the relational model and validate it. (P.I.-3.4.3)* *LO3.5: Formulate appropriate relational algebraic query statement to retrieve requires data. (P.I.-1.1.1)* *LO3.6: Identify suitable operator useful to retrieve required information. (P.I.-1.4.1)*	
04.	**Structured Query Language (SQL)** ***Learning Objective:*** *Expected to apply adeptly formulate query for retrieving data.*	**9-11**
	Contents: 4.1 SQL Introduction: -SQL Data Definition and Data Types, Integrity constraints: entity integrity constraint, key constraints, Domain Constraints, Referential integrity, check constraints. 4.2 Querying in SQL: -Data Manipulation commands, Basic Retrieval Queries in SQL, set operator, string operator, inner join, outer join, nested and complex queries, aggregate functions, group by and having clause, Views in SQL, triggers, Data Control commands.	
	Self-Learning Topics: *Database Stored Procedures and functions*.	
	Learning Outcomes: *A learner will be able to* LO4.1: *Use the knowledge of query language in formulating appropriate query. (P.I.-1.1.1)* LO4.2: *Apply theory and principles of SQL concepts and constraints to enable database correctness. (P.I.-1.4.1)* LO4.3: *Interpret the statement and identify suitable clauses useful to fetch data. (P.I.-2.1.1)* LO4.4: *Formulate suitable SQL query by ensuring ongoing skill development and adaptation to evolving SQL advancements. (P.I.-2.1.2 & P.I.-11.2.1)*	

05.	**Relational Database Design** ***Learning Objective:*** *Expected to apply normalization to enhance the performance relational database design.* **Contents:** 5.1 Introduction to Relational-Database Design Pitfalls in Relational Database designs, Functional Dependency (Basic concepts, F+, Closure of an Attribute set, Armstrong’s axioms), Concept of Decomposition, Desirable Properties of Decomposition (Lossless join, Lossy join, Dependency Preservation) 5.2 Normalization: -Concept of normalization, Normal Forms: 1NF,2NF and 3NF, Boyce-Codd Normal Form.	**7-9**
	Self-Learning Topics: *Multivalued Dependency and Fourth Normal Form*	
	Learning Outcomes : *A learner will be able to* *LO5.1: Apply the properties of Relational database design to evaluate the relational model. (P.I.-1.1.1)* *LO5.2: Apply properties of decomposition to normalize the relational model to enhance the performance. (P.I.-1.4.1)*	
06.	**Transactions Management, Concurrency Control and Database Recovery**	**9-11**
	Learning Objective: *Expected to apply concepts of transaction processing, concurrency control and Database Recovery techniques and recognize the importance in real world application*	
	Contents: 6.1 Transaction Management: Transaction concept, Transaction states, ACID properties, Transaction Control Commands, Concurrent Executions, characterizing schedules based on Serializability (Serializability-Conflict and View). 6.2 Concurrency Control: Two-phase locking techniques for Concurrency control, Concurrency control based on Timestamp ordering. 6.3 Recovery System: Recovery Concepts, Recovery based on Deferred update, Recovery techniques based on immediate update, Shadow paging, Log based recovery.	
	Self-Learning Topics: *Characterizing schedules based on recoverability, Database backup and recovery from catastrophic failures.*	
	Learning Outcomes: *A learner will be able to* *LO6.1: Apply concepts of serializability, recoverability to ensure integrity and consistency of database. (P.I.-1.3.1)* *LO6.2: 7Apply transaction, concurrency control, and recovery concepts to foster lifelong learning in database management. (P.I.-1.4.1, P.I.-11.2.2)*	
	Course Conclusion A DBMS course equips professionals with crucial skills in database architecture, optimization, and resilience, essential for successful data projects, industry adaptability, and innovative research, enhancing overall competence in data management.	**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 and engineering. (modified PI).

2.1.1 Evaluate problem statements and identifies objectives.

2.3.2 Identify design constraints for required performance criteria.

2.1.2 Identify processes/modules/algorithms of a computer-based system and parameters to solve a problem.

3.2.2 Able to produce potential design solutions suited to meet functional requirements. (modified PI).

3.4.3 Able to verify the functionalities and validate the design.

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. Identify the purpose of database management system and its operational details. (LO1.1, LO1.2)
2. Design ER and EER diagram for real life applications. (LO2.1, LO2.2, LO2.3, LO2.4, LO2.5, LO2.6)
3. Construct relational model and formulate relational algebra queries. (LO3.1, LO3.2, LO3.3, LO3.4, LO3.5, LO3.6)
4. Analyse the query statement and formulate SQL queries.(LO4.1, LO4.2, LO4.3, LO4.4)
5. Apply the concept of normalization to enhance relational database design. (LO5.1,LO5.2)
6. Apply the concept of transaction management, concurrency control and Database recovery. (LO6.1,LO6.2)

CO-PO Mapping Table with Correlation Level

CO ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CEPCC304.1	3	-	-	-	-	-	-	-	-	-	-
CEPCC304.2	3	3	3	-	-	-	-	-	-	-	-
CEPCC304.3	3	3	3	-	-	-	-	-	-	-	-
CEPCC304.4	3	3	-	-	-	-	-	-	-	-	2
CEPCC304.5	3	-	-	-	-	-	-	-	-	-	-
CEPCC304.6	3	-	-	-	-	-	-	-	-	-	2
Average	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**

Text Books:

1. Database System Concepts, Korth, Silberchatz, Sudarshan, 6th Edition, McGraw Hill.
2. Fundamentals of Database Systems, Elmasri and Navathe, 5th Edition, Pearson Education.
3. Database Management Systems, Raghu Ramkrishnan and Johannes Gehrke, TMH.

Reference Books:

1. Database Systems Design, Implementation and Management, Peter Rob and Carlos Coronel, 5th Edition, Thomson Learning
2. SQL and PL/SQL for Oracle 10g, Black Book, Dr. P. S. Deshpande, Dreamtech Press.
3. Database Management Systems, G. K. Gupta, 2012, McGraw Hill.

Other Resources:

1. NPTEL Course: Database Management System, IIT, Kharagpur by Prof. Partha Pratim Das, Prof. Samiran Chattopadhyay, Prof. Kaushi Dutta :-Web Link-https://nptel.ac.in/courses/106105175.
2. NPTEL Course: Database Management System, IIT, Kharagpur by Prof. Partha Pratim Das, Web link- https://onlinecourses.nptel.ac.in/noc19_cs46/preview.
3. MOOC Course: DBMS, Web link- https://www.mooc-list.com/tags/dbms.

IN-SEMESTER ASSESSMENT (50 MARKS)

1. Continuous Assessment (20 Marks)

Suggested breakup of distribution

Assignment on live problems/ case studies, wherein problems are given prior. Students are expected to research and collect required resources. They can use the resources and solve the problem on assigned date and time in Institute premises in presence of faculty member: 10 Marks.

Think Pair share worksheet : 05 Marks.

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 20%-30% weightage, and the syllabus covered from MSE to ESE carrying 70%-80% weightage.

Course Type	Course Code	Course Name	Credits
LBC	CELBC301	DATA STRUCTURES LABORATORY	01

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

Pre-requisite:

1. ESL103- Programming Laboratory -I (C)

Program Outcomes addressed:

1. PO3: Design/development of solutions
2. PO4: Conduct investigations of complex problems
3. PO5: Engineering tool usage
4. PO8: Individual and Collaborative Team work
5. PO9: Communication

Course Objectives:

1. To guide learners to implement various data structures using suitable programming language.
2. To guide learners in distinguishing various data structures.

Module	Detailed Contents	Hrs.
	Course Introduction Introduction to the data structure laboratory encompasses explaining the significance of data structures, tools used and emphasizing hands-on learning.	
01.	***Learning Objective:*** *Expected to implement linear data structure using primitive data types.*	**06**
	Laboratory Exercises: Problem statements based on- 1. Stack implementation 2. Queue implementation 3. Singly-linked list implementation	
	Self-Learning Topics: *Doubly linked list implementation* ***Learning Outcomes:*** *A learner will be able to* *LO1.1: Select the appropriate procedure for the given problem (P.I.-4.1.2)* *LO1.2: Develop functions to carry out various operations of the data structure (P.I.-4.2.1)* *LO1.3: Integrate different functions to carry out various operations related to that data structure. (P.I.-3.4.2)* *LO1.4: Implement data structure using suitable software tools and present the results (P.I.-5.1.2, P.I.- 8.2.1, P.I.-9.1.2)*	

02.	***Learning Objective:*** *Expected to implement data structures using linked list.*	**06**
	Laboratory Exercises: Problem statements based on- 1. Stack using the Linked List Implementation 2. Queue using the Linked List Implementation	
	Self-Learning Topics: *Implement circular queue using circular Linked list.* ***Learning Outcomes:*** *A learner will be able to* *LO2.1: Select the appropriate procedure for the given problem (P.I.-4.1.2)* *LO2.2: Develop functions to carry out various operations of the data structure (P.I.-4.2.1)* *LO2.3: Integrate different functions to carry out various operations related to that data structure. (P.I.-3.4.2)* *LO2.4: Use suitable software tool to implement data structure using linked list and present the results (P.I.-5.1.2, P.I.-8.2.1, P.I.-9.1.2)*	
03.	***Learning Objective:*** *Expected to implement tree data structure*	**06**
	Laboratory Exercises: Problem statements based on- 1. Binary Tree Implementation 2. Binary Search Tree Implementation	
	Learning Outcomes: *A learner will be able to* *LO3.1: Select the appropriate procedure for the given problem (P.I.-4.1.2)* *LO3.2: Develop functions to carry out various operations of the data structure (4.2.1)* *LO3.3: Integrate different functions to carry out various operations related to that data structure. (P.I.-3.4.2)* *LO3.4: Implement data structure using suitable software tools and present the results (P.I.-5.1.2, P.I.-8.2.1, P.I.-9.1.2)*	
04.	***Learning Objective:*** *Expected to implement Graph Traversal Techniques.*	**06**
	Laboratory Exercises: Problem statements based on-	
	1. DFS traversal techniques Implementation 2. BFS traversal techniques Implementation	
	Learning Outcomes: *A learner will be able to* *LO4.1: Select the appropriate procedure for the given problem (P.I.-4.1.2)* *LO4.2: Develop functions to carry out various operations of the data structure (P.I.-4.2.1)* *LO4.3: Integrate different functions to carry out various operations related to that data structure. (P.I.-3.4.2)* *LO4.4: Implement data structure using suitable software tools and present the results (P.I.-5.1.2, P.I.-8.2.1, P.I.-9.1.2)*	
05.	***Learning Objective:*** *Expected to implement hash tables*	**06**
	Laboratory Exercises: Problem statements based on-	
	1. Linear probing Implementation 2. Quadratic probing Implementation	

	Learning Outcomes: *A learner will be able to* *LO5.1: Select the appropriate procedure to perform the operations of hashing (4.1.2)* *LO5.2: Develop functions to carry out various operations. (4.2.1)* *LO5.3: Integrate different functions to carry out various operations. (3.4.2)* *LO5.4: Implement the operations using suitable software tools and present the results (5.1.2, 8.2.1, 9.1.2)*	
	Total	**30**

Performance Indicators:

P.I. No.	**P.I. Statement**
3.4.2	Able to implement and integrate the modules.
4.1.2	Able to choose appropriate procedure/algorithm (modified PI).
4.2.1	Design and develop appropriate procedures/functions based on the programming objectives (modified PI).
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
9.1.2	Produce clear, well-constructed, and well-supported written engineering documents.

Course Outcomes: A learner will be able to-

1. Select an appropriate data structure for the given problem.*(LO1.1, LO2.1, LO3.1, LO4.1)*
2. Develop procedures to carry out various operations of the data structure. *(LO1.2, LO2.2, LO3.2, LO4.2)*
3. Implement procedures and data structures using software tools. *(LO1.3, LO1.4, LO2.3, LO2.4, LO3.3, LO3.4, LO4.3, LO4.4)*

CO-PO Mapping Table with Correlation Level

CO ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CEPCC303.1	-	-	-	2	-	-	-	-	-	-	-
CEPCC303.2	-	-	-	2	-	-	-	-	-	-	-
CEPCC303.3	-	-	-	-	2	-	-	2	2	-	-
Average	**-**	**-**	**-**	**2**	2	-	-	2	2	-	-

Text Books:

1. Data Structures using C, Reema Thareja, 2nd Edition, 2014, Oxford Press.

Reference Books:

1. Data Structures using C and C++, Rajesh K Shukla, 1st Edition, 2009, Wiley-India.

Other Resources:

1. NPTEL Course: Data Structures and Algorithms by Prof. Naveen Garg, Department of Computer Science and Engineering Department, IIT Delhi: -Web link- https://nptel.ac.in/courses/106/102/106102064/

CONTINUOUS ASSESSMENT (25 Marks)

Suggested breakup of distribution

Practical Exercises- 10 Marks

Internal Assessment-

Practical Test – 10 Marks

Evaluation of the conceptual, problem solving and programming skills of each student will be assessed based on their approach towards problem solving, implementation of concepts and execution of the task using a software tool.

Regularity and active participation - 5 Marks.

END SEMESTER EXAMINATION (Practical/Oral Examination) (25 Marks)

Students will be assessed based on three parameters:

- Concept/Algorithmic knowledge
- Practical programming knowledge
- Oral

- Students will be randomly allocated a program from the list of laboratory exercises and will be asked to write appropriate algorithm for the same. The algorithm is checked by the examiners (Internal and External) and weightage for this is 05 Marks.

Then the student will be allowed to start with the implementation of the program.

- Students will be allocated 1 hour to complete the execution. The program is then checked by both the examiners for its correctness. The weightage of the program implementation is 10 Marks.
- Students will then be appearing for Oral in front of both Internal and External examiners. The weightage of Oral will be of 10 Marks.

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

Course Type	Course Code	Course Name	Credits
LBC	CELBC302	DATABASE LABORATORY	01

Examination Scheme		
Continuous Assessment	End Semester Examination	Total
25	25	50

Pre-requisite : *Nil*

Program Outcomes addressed :

1. PO3: Design/Development of Solutions
2. PO4: Conduct investigations of complex problems
3. PO5: Engineering Tool Usage
4. PO7: Ethics
5. PO8: Individual and Collaborative team work
6. PO9: Communication

Course Objectives :

1. To introduce conceptual design and development of relational model.
2. To introduce the basics of SQL and formulate queries.
3. To familiarize learners with the basic functions of transaction processing.

Module	Detailed Contents	Hrs
	Course Introduction Database Lab course aims to provide students with hands-on experience in designing, implementing, and managing databases. The course usually covers fundamental concepts of database management systems (DBMS) along with practical exercises. This lab enables the students to practice the concepts learnt in the subject DBMS by developing a database. The topics that will be covered throughout the semester are: Introduction to SQL, Relational Database Design, Normalization, Database Querying and Manipulation, Transaction Management, Controlled access to database.	
01.	***Learning Objective:*** *Expected to identify design tool for modeling an application's data requirements and designing database schemas as a team.*	**06**
	Laboratory Exercises: Design of ER /EER model	
	Use conceptual tool to sketch an application's data requirements and design database schema. Laboratory Exercises list 1. Identify the real-world problem, draft the problem statement and derive entities, attributes and their associations. 2. Design ER /EER diagrams for the identified problem statement.	

	3. Construct Relation model of the ER/EER.	
	Learning Outcomes : *A learner will be able to* *LO1.1:Formulate problem statements for real life applications. (P.I.- 3.1.1)* *LO1.2:Design conceptual model for the identified problem statement. (P.I.- 3.4.1)* *LO1.3:Select appropriate mapping rules. (P.I.- 4.1.2)* *LO1.4:Construct Relational model from ER and EER diagram. (P.I.- 4.3.3)* *LO1.5:Use a tool to sketch the designed schema. (P.I.- 5.1.1)* *LO1.6::Test correctness of designed schema (P.I.- 5.2.2)*	
02.	***Learning Objective:*** *Expected to develop database and tables with reference to the designed schema for the selected real life application and apply different constraints on database.*	**08**
	Laboratory Exercises : DDL & DML With reference to the database schema, use structured query language to create database & tables with different constraints and populate them. Laboratory Exercises list 1. Implementation of DDL commands of SQL • Create table • Alter table • Drop Table 2. Implementation of DML commands of SQL • Insert • Update • Delete 3. Implementation of different types of constraints	
	Learning Outcomes : *A learner will be able to* *LO2.1:Identify software tool/language to create database. (P.I.- 5.1.1)* *LO2.2Choose appropriate DDL and DML commands to create database and tables and populate them. (P.I.- 4.1.2)* *LO2.3: Represent database to check its correctness (P.I.- 4.3.3)* *LO2.4Demonstrate the use of selected tools to represent the output of DDL and DML(P.I.- 5.2.2)*	
03.	***Learning Objective:*** *Expected to formulate appropriate SQL statements for querying a database to retrieve useful information from the database.*	**08**

	Laboratory Exercises: Formulate queries for information retrieval Apply different filters (using where clause and nested queries), built-in functions to retrieve data from the database and use views on relational database, access control privileges for database correctness. Laboratory Exercises list 1. Implementation of different types of function ▪ Number function ▪ Aggregate Function ▪ Character Function ▪ Date Function 2. Implementation of different types of operators ▪ Arithmetic Operators ▪ Logical Operators ▪ Comparison Operator ▪ Special Operator (LIKE, IN, EXISTS, BETWEEN ▪ ROWNUM/ROW_NUMBER()) 3. Implementation of Set Operation 4. Implementation of different types of Joins ▪ Inner Join ▪ Outer Join ▪ Natural Join, etc. 5. Implementation of ▪ Group By & having clause ▪ Order by clause 6. Implementation of Sub queries. 7. Implementation of Views. 8. Apply DCL commands ▪ GRANT ▪ REVOKE 9. Apply TCL commands ▪ Rollback ▪ Commit ▪ Savepoint ***Learning Outcomes :*** *A learner will be able to* *LO3.1 Use a software tool to retrieve required information from the database (P.I.- 5.1.1)* *LO3.2Select and apply different filters to fetch appropriate data from the database (P.I.-4.1.2)* *LO3.3Represent the filtered output. (P.I-.4.3.3)* *LO3.4Check the correctness of fetched information. (P.I.- 5.2.2)*	
04.	***Learning Objective:*** *To identify the requisite SQL statements for implementing stored procedures and functions as well as triggers, to manage events within a relational database.*	**08**
	Laboratory Exercises: Procedure, Functions & Triggers Implement stored procedures and functions within a relational database, alongside triggers designed to automate the execution of predefined actions or tasks in response to specific events or conditions Laboratory Exercises list 1. Implementation of procedures 2. Implementation of functions 3. Implementation of triggers	

	Learning Outcomes: *A learner will be able to* *LO4.1Use a software tool to write procedural code (such as loops, conditions, and variables) within the SQL commands. (P.I.- 5.1.1)* *LO4.2Use and implement procedures and functions and triggers to perform database operations. (P.I.- 4.1.2)* *Represent the output of database operations in tabular format. (P.I-4.3.3)* *LO4.3Verify the correctness and functionality of procedures, functions, and triggers within the database system. (P.I.- 5.2.2)* *LO4.4Demonstrate foundational data analysis tasks, incorporating fundamental database design ethics, producing clear, well-constructed written documents, and applying acquired knowledge of database concepts for creating mini project. (P.I- 5.1.2,5.2.2, 7.1.1, 8.2.1, 8.3.1, 9.1.2, 9.1.3)*	
	Minimum 2 or 3 Laboratory Exercises from each module, and total at least 10 Laboratory Exercises and a mini project	
	Total	**30**

Performance Indicators:

P.I. No.	**P.I. Statement**
3.1.1	Able to define a precise problem statement with objectives and scope.
3.4.1	Able to refine architecture design into a detailed design within the existing constraints.
4.1.2	Able to choose appropriate procedure/algorithm, dataset and test cases.
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
5.1.1	Identify modern engineering tools such as computer aided drafting, modeling and analysis; techniques and resources for engineering activities.
5.2.2	Demonstrate proficiency in using discipline-specific tools.
7.1.1	Identify situations of unethical professional conduct and propose ethical alternatives.
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.
9.1.3	Create flow in a document or presentation - a logical progression of ideas so that the main point is clear.

Course Outcomes : A learner will be able to -

1. Design conceptual schema for a given real world problem. (LO1.1,LO1.2, LO1.3,LO1.4, LO1.5,LO1.6)
2. Create conceptual database schema using software tool/language. (LO2.1,LO2.2, LO2.3,LO2.4)
3. Formulate and implement simple queries to demonstrate database operations using software tool/language(LO2.1,LO2.2, LO2.3,LO2.4)
4. Implement various procedures, functions and triggers for a specific task in a database. (LO2.1,LO2.2, LO2.3,LO2.4)

CO-PO Mapping Table with Correlation Level

CO ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CELBC302.1	-	-	3	3	3	-	-	-	-	-	-
CELBC302.2	-	-	-	3	3	-	-	-	-	-	-
CELBC302.3	-	-	-	3	3	-	-	-	-	-	-
CELBC302.4	-	-	-	3	3	-	2	3	3	-	-
Average	**-**	**-**	**-**	**3**	**3**	**-**	**2**	**3**	**3**	**-**	**-**

Text Books :

1. Korth, Slberchatz, Sudarshan, Database System Concepts, 6th Edition, McGraw Hill.
2. Elmasri and Navathe, Fundamentals of Database Systems, 6th Edition, Pearson education.
3. Raghu Ramkrishnan and Johannes Gehrke, Database Management Systems, TMH.

Reference Books :

1. SQL & PL / SQL for Oracle 11g Black Book, Dreamtech Press.
2. G. K. Gupta : "Database Management Systems", McGraw – Hill.
3. Peter Rob and Carlos Coronel, ― Database Systems Design, Implementation and Management‖, Thomson Learning, 9th Edition.

Other Resources :

1. SQL : https://www.tutorialspoint.com/sql/index.html.
2. SQL : https://www.w3schools.com/sql/
3. Microsoft SQL Server Document: https://learn.microsoft.com/en-us/sql/?view=sql-server-ver16.

CONTINUOUS ASSESSMENT (25 Marks)

Laboratory Exercises: 10 Marks

Internal Assessment: 10 marks

As a part of Internal Assessment, students will do course mini project. It is will be group activity. Students will be tasked to develop a small-scale database application with front end (optional) using database concepts, query language and programming language. This project-based assessment will require students to apply their knowledge and skills gained throughout the course to design and implement a functional system using database concepts, query language and programming language.

Course Project Rules:

1. **Group Size:** Groups of 3 to 4 members allowed.
2. **Project Proposal**: Detailed proposal with scope, objectives.
3. **Project Requirements:**
   - Develop using database concepts, query language and programming language.
   - Encouraged to use open-source database design tool, query language.
4. **Presentation:**
   - Present project features, challenges faced, and solutions.
   - Q&A session for evaluation.
5. **Evaluation Criteria:**
   - Adherence to requirements and objectives.
   - Design quality and organization.
   - Functionality, UI/UX (if applicable), and error handling.
   - Effective presentation and Q&A skills.

6. Documentation

Clear and comprehensive documentation is essential. This includes a project report detailing the design decisions, implementation details, challenges faced, and how they were addressed.

Regularity and Active Participation : 5 marks.

END SEMESTER EXAMINATION (Practical /Oral Exam) -25 Marks

Students will be assessed based on three parameters:

- Concept/SQL knowledge
- Practically design and implementation of queries
- Oral

1. Students will be allocated a set of questions or task with a problem statement. This involves scenarios where students need to design a database schema, implement queries to extract specific information, or perform data manipulation operations.

2. Students will be allocated 1 hour to complete the design part of question. The weightage for design part is 10 marks.

3. The design part will be checked by the examiners (Internal and External) following which student will be allowed to start with the implementation using database management systems (DBMS) such as MySQL or SQL Server or/and design tools.
4. Students will be allocated 1 hour to complete the implementation. Then output of queries will be checked by both the examiners for its correctness. The weightage of the queries implementation is 10 marks.
5. Students will then be appearing for Oral in front of both Internal and External examiners. The weightage of Oral will be of 5 Marks.

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

Course Type	Course Code	Course Name	Credits
SBL	CESBL301	PYTHON PROGRAMMING LABORATORY	02

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

Pre-requisite:

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

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO4: Conduct investigations of complex problems
4. PO5: Engineering tool usage
5. PO7: Ethics
6. PO8: Individual and Collaborative team work
7. PO9: Communication
8. PO11: Life Long Learning

Course Objectives:

1. To establish a strong foundation in Python programming.
2. To guide in achieving mastery of Object-Oriented Programming (OOP) concepts using Python programming.
3. To assist in applying advanced Python concepts effectively in real-world scenarios.
4. To encourage in exploring and engaging with practical applications of Python libraries and frameworks, fostering a dynamic learning environment.

Module	Detailed Contents	Hrs
	Course Introduction Python has emerged as one of the most popular programming languages globally, and its relevance continues to grow across various industries. Understanding and mastering Python not only enhances students' academic pursuits but also equips them with sought-after skills in the job market. It opens doors to diverse career paths and enables professionals to contribute meaningfully to innovative technological advancements across industries. Python Importance- Versatility and Simplicity, Rich Ecosystem, Industry Adoption and Community Support. History and evolution, Use cases and applications.	
01.	**Introduction to Python** *Learning Objective/s:* *Learners are expected to build on prior programming knowledge, adapt Python's unique features, and develop problem-solving skills.*	**10**

	Content: 1.1 Basic Syntax and Data Types - Variables and data types, Operators, Input and output, 1.2 Data Structures- list, tuple, set and dictionary 1.3 Understanding the Syntax Transition: From C and Java to Python	
	Laboratory Exercise/s 1. **Personalized Greeting Generator *-** Write a python code to generate Personalized Greeting. 2. **Calculating Areas of Geometric Figures *-** Write a python program to calculate areas of different geometric figures like circle, rectangle and triangle. 3. **Developing Conversion Utilities *:** Develop Converter such as Rupees to dollar, temperature convertor, inch to feet etc. 4. **Handling new Data Structure of Python *:** Write a python code for creating and manipulating data structures like list, tuple, set and dictionary	
	Learning Outcomes : *A learner will be able to* *LO1.1: Grasp Python programming concepts and develop program logic independently by leveraging their proficiency in languages such as C and Java from previous semesters in engineering. (P.I -1.4.1, 8.2.1)* *LO1.2: Learners will demonstrate a proficient understanding of basic Python concepts through practical code implementation to solve fundamental programming problems. They will also adhere to fundamental programming ethics, produce clear and well-constructed written documents of their results, and apply their knowledge of logic development to write Python program effectively (P.I- 5.1.2, 7.1.1, 9.1.2, 11.1.1.)*	
02.	**Control Flow and Functions** ***Learning Objective/s:*** *To reinforce understanding and application, learners will recall the syntax and usage of conditional statements (if, else, elif) and loops (for and while), adopt these structures in Python programming to control program execution based on conditions and iterations, and comprehend the concept and syntax of functions in Python to develop efficient and reusable code.*	**10**
	Content: 2.1 Conditional Statements: if, else, elif 2.2 Loops: for and while loop 2.3 Functions- Defining functions, Parameters and return values, Scope and lifetime of variables	

	Laboratory Exercise/s 1. **Generating multiplication table*:** Create a Python program that takes a numerical input from the user and generates its multiplication table. 2. **Generate a number analyzer (Menu driven)** *: Develop a Python program to analyze an input number, determining whether it is even or odd and checking for primality 3. **To-Do List Application (Lists and Functions):** Write a python code to create a to-do list application that allows users to add, delete, and view tasks. Utilize lists and functions for task management 4. **Number Guessing Game (Control Flow and Loops**) *: Develop a number guessing game where the program generates a random number, and the user has to guess it. Implement loops and conditional statements for user interaction. 5. **Interactive Calculator (Basic Arithmetic Operations using Functions) *:** Implement a simple calculator that takes user input and performs basic arithmetic operations (addition, subtraction, multiplication, division) 6. **Contact Book (Dictionaries and Functions):** Create a simple contact book application where users can add, edit, and delete contacts. Utilize dictionaries to store contact information and functions for management.	
	Learning Outcomes: *A learner will be able to* *LO2.1 Grasp Python programming concepts and develop program logic independently by leveraging their proficiency in languages such as C and Java from previous semesters in engineering. (P.I -1.4.1, 8.2.1)* *LO2.2 Identify and implement modular processes, modules, algorithms, and parameters in Python programming. Independently, they will comprehend the syntax and usage of conditional statements, loops, and functions to break down complex tasks into manageable modules, enhancing code organization and reusability. (P.I- 2.1.2, 8.2.1)* *LO2.3 Demonstrate a strong understanding of basic Python concepts through coding to solve fundamental programming problems, adhere to fundamental programming ethics during development, produce clear and well-constructed written documents of their results, and apply their knowledge of control structures and modular programming to write Python programs effectively. (P.I- 5.1.2,7.1.1,9.1.2,11.1.1)*	
03.	**File I/O and High Order Functions** ***Learning Objective/s:*** *Learners are expected to grasp fundamental concepts such as file handling in Python, understand the significance of proper file management encompassing error handling and resource cleanup, and comprehend high-order functions in Python, including lambda expressions, filter, map, and reduce functions.*	**10**
	Content: 3.1 File Handling- Reading and writing files, Exception handling 3.2 High Order Functions: lambda, filter, map reduce	

	Laboratory Exercise/s 1. **Extracting Words from Text File ***: Develop a Python program that reads a text file and prints words of specified lengths (e.g., three, four, five, etc.) found within the file. 2. **Finding Closest Points in 3D Coordinates from CSV**: Write a python code to take a csv file as input with coordinates of points in three dimensions. Find out the two closest points. 3. **Sorting City Names from File:** Write a python code to take a file which contains city names on each line. Alphabetically sort the city names and write it in another file. 4. **Fortune Forecaster (using lambda function)*:** Create a list of quotes. Using lambda function return a random string from a list of string. 5. **Co-ordinates Converter:** Write a python code using lambda function to perform the Cartesian to polar coordinates conversion. 6. **Neuron Simulator*:** Create a function Neuron that performs linear combination of two Vectors. Modify function Neuron using Map, Reduce and filter function. (For e.g. filters only positive values after the map operation before passing it to reduce operation). ***Learning Outcomes :*** *A learner will be able to* *LO3.1 Identify and implement modular processes, modules, algorithms, and parameters in Python programming. Independently, they will comprehend the syntax and usage of high ordered functions to break down complex tasks into manageable modules, enhancing code organization and reusability. (P.I- 2.1.2, 8.2.1)* *LO3.2 Learners will demonstrate proficiency in advanced Python concepts through coding to solve fundamental programming problems, adhere to fundamental programming ethics during development, produce clear and well-constructed written documents of their results, and apply acquired knowledge of File I/O and High-order Functions in advanced subjects like AI, ML, and NLP. (P.I- 5.1.2, 7.1.1, 9.1.2, 11.1.1)*	
04.	**Object-Oriented Programming (OOP) in Python** ***Learning Objective/s:*** *Learners are expected to recall foundational OOP concepts, understand class and object syntax, and apply this knowledge to create Python classes and objects, integrating attributes, methods, constructors, and destructors to depict real-world scenarios.*	**10**
	Content: 4.1 Introduction to OOP: Classes and objects, Encapsulation, inheritance, and polymorphism 4.2 Creating Classes and Objects: Class attributes and methods Constructor and destructor.	

	Laboratory Exercise/s 1. **College Festival Representation using OOPs**: Develop a python code to depict the ETAMAX/ FACES/or any other a College festival using OOPs Concept /or any real world scenario. 2. **Autonomous College Administrative Hierarchy *:** Develop a python code to depict an autonomous college administrative hierarchy using OOPs Concept or any other real world scenario. 3. **Quiz Game (Object-Oriented Programming):** Implement a quiz game where questions are objects of a class. Include features like scoring and multiple-choice questions. 4. **Text-based Adventure Game (Classes and Inheritance):** Design a text-based adventure game with different scenarios and outcomes. Use classes and inheritance for character types and game elements. ***Learning Outcomes :*** *A learner will be able to* *LO 4.1: Define hierarchical systems and complex scenario for open ended problem using OOPs principles. (P.I 4.1.1)* *LO 4.2: Demonstrate the ability to select and apply suitable OOPs concepts, classes, and structures individually to effectively model and solve open-ended problems (P.I 4.2.1, 8.2.1)* *LO 4.3: Apply Python programming's OOPS concepts effectively to solve open-ended problems, while adhering to fundamental programming ethics, documenting results clearly, and preparing for future project development (P.I-5.1.2,7.1.1,9.1.2,11.1.1)*	
05	**Advanced Python Concepts** *Learning Objective/s:* *Learners are expected to master regular expressions for text manipulation and both frontend and backend development techniques in Python* **Content** 5.1 Regular Expressions: Pattern matching, Regex functions in Python 5.2 GUI Development using Tkinter 5.3 Database connectivity and networking **Laboratory Exercise/s** 1. **Data Extraction using Regular Expressions***: Build a program that will read text/csv file and extracts using expressions. 2. **Real-World Entity CRUD Operations***: Frontend-Backend Development- Developing a frontend and backend system to represent real-world entities (such as students, teachers, sportspersons, or scientists) and execute basic CRUD (Create, Read, Update, Delete) operations through the frontend interface.	**10**

	Learning Outcomes: *A learner will be able to* *LO5.1: Specify the system's scope and requirements necessitating seamless connectivity between the frontend and backend components. (P.I -4.1.1)* *LO5.2: Select suitable GUI components and implement database operations tailored to a specific application's requirements, aiding, in application design and development. (P.I-4.1.2)* *LO5.3: Design and develop a frontend-backend systems using Tkinter for GUI development, enabling CRUD operations for real-world entities. The gain proficiency in advanced concept can be used for future Mini or Major project in higher classes. (P.I 4.2.1, 11.1.1)* *LO5.4: Apply advanced Python programming concepts to develop frontend, backend, and database connectivity for a small-scale system, while adhering to fundamental programming ethics and individually producing clear, well-constructed written documents. (P.I- 5.1.2, 5.2.2, 7.1.1,8.2.1,9.1,2)*	
06	**Python Libraries** *Learning Objective/s:* *Learners should explore various Python libraries to master Python programming, such as NumPy for efficient numerical computing and managing large datasets, Matplotlib for visualizing data with graphs, charts, and histograms, and Pandas for advanced data manipulation and analysis using Series and DataFrame structures.*	**10**
	Content 6.1 Introduction to Popular Libraries 6.2 NumPy for numerical computing, 6.3 Matplotlib for data manipulation 6.4 Pandas for data visualization **Laboratory Exercise/s** 1. **Performing Basic Data Exploration (Using NumPy, Pandas and Matplotlib) ***: Analyze a dataset (CSV file) using NumPy and Pandas. Calculate statistics, visualize data using Matplotlib, and draw insights from the analysis. 2. **Currency Converter (API Integration):** Build a currency converter that fetches the latest exchange rates from an API. Use requests library for API integration 3. **Password Generator (Random Module) *:** Develop a password generator that creates strong, random passwords. Use the `random` module to generate different combinations. ***Learning Outcomes:*** *A learner will be able to* *LO6.1 :Gain the ability to utilize appropriate libraries such as NumPy, Matplotlib, and Pandas for effective data collection, analysis, and visualization. (P.I-4.3.I)* *LO6.2: Develop skills to represent data in tabular and graphical forms using Python libraries such as Matplotlib and Pandas, aiding in data analysis, interpretation, and drawing conclusions. (P.I- 4.3.3)* *LO6.3: Identify modern engineering tools, techniques, and resources such as NumPy, Matplotlib, and Pandas for data analysis and visualization in Python programming. (P.I-5.1.1)* *LO6.4:The learner will demonstrate foundational data analysis tasks using Python programming, incorporating fundamental programming ethics, producing clear, well-*	

	constructed written documents, and applying acquired knowledge of popular libraries for mini or major projects in subsequent classes. (P.I- 5.1.2,5.2.2, 7.1.1,8.2.1,9.1.2,11.1.1)	
	The Laboratory Exercises marked with an asterisk (*) are mandatory for each module and are designed to help students, to build a foundational understanding of Python programming. The Laboratory Exercises not marked with an asterisk are optional and intended to provide additional hands-on experience.	
	Total	**60**

Performance Indicators:

P.I. No.	P.I. Statement
1.4.1	Apply theory and principles of computer science and engineering to solve an engineering problem.
2.1.2	Identify processes/modules/algorithms of a computer-based system and parameters to solve a problem.
4.1.1	Define a problem for purposes of investigation, its scope and importance.
4.1.2	Able to choose appropriate procedure/algorithm, dataset and test cases.
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.
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.
5.1.1	Identify modern engineering tools, techniques and resources for engineering activities.
5.1.2	Adapt the tools and techniques to solve engineering problems.
5.2.2	Demonstrate proficiency in using discipline-specific tools.
7.1.1	Identify situations of unethical professional conduct and propose ethical alternatives.
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.
11.1.1	Describe the rationale for the requirement for continuing professional development.

Course Outcomes: A Learner will able to-

1. Demonstrate the proficiency in python programming (LO 1.1, LO1.2, LO2.1,LO2.2,LO2.3, LO3.1,LO3.2)
2. Demonstrate the ability to apply OOPs concepts in Python programming to develop solutions for real-world problems (LO4.1,LO4.2,LO4.3)
3. Design and develop GUI with backend connectivity for specific applications using advanced Python programming skills.(LO 5.1,LO5.2,LO5.3,LO5.4)
4. Investigate and apply popular Python libraries to conduct efficient data handling tasks. (LO 6.1, 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
CESBL301.1	2	2	-	-	2	-	2	2	2	-	2
CESBL301.2	-	-	-	2	2	-	2	2	2	-	2
CESBL301.3	-	-	-	3	3	-	2	2	2	-	2
CESBL301.4	-	-	-	3	3	-	2	2	2	-	2
Average	**3**	**2**	**-**	**3**	**3**	**-**	**2**	**2**	**2**	**-**	**2**

Books :

1. Core Python Programming, Dr. R. Nageswara Rao, Second Edition, Dreamtech Press.
2. Beginning Python: Using Python 2.6 and Python 3.1. James Payne, Wrox Publication.
3. Python Programming, Anurag Gupta and G. P. Biswas, First Edition,McGraw-Hill Education.
4. Introduction to computing and problem-solving using python, Balagurusamy, First Edition, McGraw Hill Education.

Reference Books :

1. Learn Python the Hard Way, , Zed Shaw, Third Edition, Addison-Wesley.
2. Python Projects, Laura Cassell,Alan Gauld, First Edition, Wrox Publication.

Other Resources :

1. Python Tutorial: http://docs.python.org/release/3.0.1/tutorial/
2. Python for everybody specialization: https://www.coursera.org/specializations/python.

CONTINUOUS ASSESSMENT (50 Marks)

Suggested breakup of distribution

A. Laboratory Exercises**: 10 Marks**

B. Internal Assessment**: 15 Marks**

As a part of Internal Assessment, students will do course mini project as a team to inculcate teamwork [P. I. – 8.3.1]. Students will be tasked with developing a small-scale system using Python. This project-based assessment will require students to apply their knowledge and skills gained throughout the course to design and implement a functional system using Python programming language.

Course Project Rules in Python:

1. Group Size: Groups of 2 to 4 members allowed.

2. Project Proposal: Detailed proposal with scope, objectives.

3. Project Requirements:

   - Develop using Python.
   - Encouraged to use relevant libraries and show core concepts understanding.

4. Presentation:

   - Present project features, challenges faced, and solutions.
   - Q&A session for evaluation.

5. Evaluation Criteria:

   - Adherence to requirements and objectives.
   - Code quality, readability, and organization.
   - Functionality, UI/UX (if applicable), and error handling.
   - Effective presentation and Q&A skills.

C. Practical Tests**: 20 Marks**

Two practical tests will be conducted based on laboratory exercises.

1. The allocation of laboratory exercises for testing programming and problem-solving skills, with each student receiving two or more laboratory exercises.

2. Students will have a designated 2-hour timeframe for code development. After the first hour, an internal examiner will review the progress and evaluate the above skills.

3. During the practical assessment or at its conclusion, students will be queried to evaluate their conceptual understanding, ensuring comprehension.

D. Regularity and active participation**: 05 Marks**

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

For the End semester exams, practical examination will be conducted. The details of the end-semester evaluation are as follows. It will consist of three sections:

Section 1: Practical Examination (20 Marks)

This section will have practical exam based on the laboratory exercises conducted during the term. The assessment criteria will be similar to Internal Practical Test.

Section 2: Debugging and Output Prediction Exercise (20 Marks)

This section involves questions problems such as providing partial code segments with bugs and asking students to identify and correct the errors, predict the output of the corrected code, complete the code, identify the appropriate library etc. This option is designed to prepare students for placements or industry roles by testing their ability to debug and understand code in real-world scenarios.

Section 3: Oral (10 Marks)

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

Course Type	Course Code	Course Name	Credits
MNP	CEMNP301	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 and 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, learner 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):
  - 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

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.

Course Type	Course Code	Course Name	Credits
HSSM	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. PO10: Project Management & Finance
7. 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
01.	**Introduction to Product Design** 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)
02.	**Design Principles and Fundamentals** 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
03.	**Concept Generation and Ideation** Techniques for brainstorming and idea generation, Sketching andvisualization techniques, Developing design briefs and specifications, Evaluating and selecting design concepts, Rapid prototyping methods(e.g., 3D printing, CNC machining)

04.	**Renewable energy & Energy efficiency** Detailed overview of the product development lifecycle, Design for manufacturability (DFM) considerations, Cost estimation and budgeting, Collaborative design tools and project management Regulatory and compliance requirements (e.g., safety standards)
05.	**User Experience (UX) Design** Understanding user needs and behaviour, Usability testing and feedback gathering, Wireframing and prototyping for digital products Iterative design process, Accessibility and inclusive design principles.
06.	**Sustainability in Product Design** 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
Total No. of Hours: 30	

Course Outcomes: A learner will be able to-

1. Apply design thinking methodologies effectively to solve design problems.
2. Demonstrate proficiency in utilizing design tools and techniques for product development.
3. Communicate and collaborate effectively for interdisciplinary teamwork.
4. Create functional and aesthetically pleasing product designs.
5. Integrate sustainable and user-centric design principles into product development processes.

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 MikeAshby 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; Revised and expanded edition (November 5, 2013).

Other Resources:

1. NPTEL Course: Product Design and Development, Prof. Inderdeep Singh, IIT Roorkee 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

Course Type	Course Code	Course Name	Credits
PCC	CEPCC405	ENGINEERING MATHEMATICS -IV	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

**** Tutorial***

Pre-requisite : Nil

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.
	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.	**01**
01.	**Probability Theory and Random Variable** ***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.*	**6-8**
	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* 1. *Identify independent sets and disjoint sets and use its knowledge in the context of conditional probability. (P.I.-2.1.3)* 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.-1.1.1)* 3. *Identify if a given Random variable is Discrete or continuous in nature using existing definitions and formulas from Probability. (P.I.-2.1.2)* 4. *Apply mathematical techniques of integration and summation for finding Expectation, Variance, Probability density function and Probability distribution function. (P.I.-1.1.2)*	
02.	**Probability Distribution** ***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.*	**6-8**
	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* 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)* 2. *Apply the advance mathematical techniques of statistics to find the probabilities the random variable (P.I. -1.1.2)* 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)* 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.-2.1.1)*	
03.	**Sampling Theory-I** ***Learning Objective/s:*** *Learner will be able to formulate the null hypothesis and apply parametric testing to test the hypothesis.*	**5-7**
	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,	

<table>
<tr><td rowspan="2"></td><td>Self-Learning Topics:
sampling distribution of proportions</td><td rowspan="2"></td></tr>
<tr><td>Learning Outcomes:
A learner will be able to
1. Identify and test the hypothesis of significance difference between the parameter and the statistics (P.I.-2.2.2)
2. Identify and test the hypothesis of significance difference between the two means (P.I.-2.2.4)
3. Identify and apply appropriate test to be used to test the given hypothesis.(P.I.-2.1.1)
4. Determine the test statistics using the appropriate formula (P.I.-1.1.1)
5. Determine frequencies fitting a particular probability distribution(P.I.-1.1.2)</td></tr>
<tr><td rowspan="4">04.</td><td>Sampling Theory-II
Learning Objective/s:
Learner will be able to formulate the hypothesis and apply non-parametric testing to test the it.</td><td rowspan="4">5-7</td></tr>
<tr><td>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.</td></tr>
<tr><td>Self-Learning Topics:
Yate’s Correction, ANOVA</td></tr>
<tr><td>Learning Outcomes :
A learner will be able to
1. Identify and test the hypothesis of test the independence of attributes (P.I.-2.2.2)
2. Identify and test the hypothesis of significance difference between the two variances (P.I.-2.2.4)
3. Determine the expected frequencies of the assumption. (P.I.-1.1.1)
4. Determine the expected frequencies of the contingency table(P.I.-1.1.2)</td></tr>
<tr><td rowspan="4">05.</td><td>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.</td><td rowspan="4">7-9</td></tr>
<tr><td>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.</td></tr>
<tr><td>Self-Learning Topics:
Fitting of an exponential Curve</td></tr>
<tr><td>Learning Outcomes :
A learner will be able to
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)
2. Apply basic mathematical techniques from algebra in finding the lines of regression and regression coefficients. (P.I.-1.1.1)
3. Apply Least Square Method to fit a particular to the given data (P.I.-1.1.2)
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.-2.2.2)</td></tr>
</table>

06.	**Algebraic Structure** ***Learning Objective/s:*** *The learner will be able analyze the Algebraic Structure using the basic properties.*	**7-9**
	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* *1. Apply mathematical operations defined on algebraic structures like Rings, Integral domain and Field and demonstrating closure under these operations. (P.I.-1.1.1)* *2. Identify substructures within algebraic systems and the concept of homomorphism between them. (P.I.-2.1.2)* *3. Apply the properties of homomorphism and one-one proves that the homomorphism is an isomorphism(P.I. 1.1.2)* *4. Identify and characterize various algebraic structures based on their properties.(P.I.-2.2.2)*	
	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 mathematical techniques such as calculus, linear algebra, and statistics to solve problems.
1.1.3	Apply advanced mathematical techniques such as integral and differential equations to describe/solve/construct a mathematical model of a system.
2.1.1	Articulate problem statements and identify primary objectives and key constraints.
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.
2.2.2	Identify, assemble and evaluate information and resources.
2.2.4	Compare and contrast alternative solution processes to select the best process.

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)*
5. Apply the properties and Identify the Algebraic Structure. *(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
CEPCC405.1	3	2									
CEPCC405.2	3	2									
CEPCC405.3	3	2									
CEPCC405.4	3	2									
CEPCC405.5	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.

IN-SEMESTER ASSESSMENT (75 MARKS)

1. Continuous Assessment-Theory (20 Marks)

Suggested breakup of distribution

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

One Class test: 05 Marks.

One Team-Pair-Solo activity: 05 Marks.

Regularity and active participation: 05 Marks.

2. Continuous Assessment - Tutorial (25 Marks)

Suggested breakup of distribution

Tutorial Assignments and Class tests 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 active participation: 05 Marks.

3. Mid Semester Exam (30 Marks)

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

END SEMERSTER 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	CEPCC406	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. ESL103- Programming Laboratory- I (C)
2. BSC101- Engineering Mathematics - I

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO4: Conduct investigations of complex problems
4. PO11: Life-long learning:

Course Objectives:

1. To familiarize mathematical approaches to analyse the algorithms.
2. To familiarize the applications of algorithmic strategies to solve various problems.
3. To introduce the concept of time and space complexity for analysis.
4. To facilitate to compare different algorithmic approaches.

Module	Details	Hrs.
	Course Introduction Analysis of Algorithm: This course provides the foundation for analyzing time and space complexity for various algorithmic approaches. The course focuses on developing skills to assess the efficiency and performance of algorithms in problem-solving.	**01**
01.	**Introduction to Analysis of Algorithm** ***Learning Objective/s:*** *To familiarize the concept of time and space complexity of the algorithm.*	**4-6**
	Contents: 1.1 Performance Analysis, Asymptotic notations, Time and space complexity, Mathematical background for algorithm analysis, Definitions of P, NP, NP-Hard, NP-Complete 1.2 Analyzing time and space complexity of Iterative Algorithm- Insertion Sort, Selection Sort 1.3 Analyzing time complexity of Recursive Algorithm	
	Self-Learning Topics: *Randomized Algorithms*	

	Learning Outcomes: *A learner will be able to* *LO1.1 Apply algorithmic fundamentals and get familiarized with asymptotic notations to find the time and space complexity of an algorithm (P.I. - 1.3.1)* *LO1.2 Apply the various methods to find the complexity of iterative and recursive algorithm approaches (1.4.1)* *LO1.3 Compare iterative and recursive algorithmic approaches. (P.I. - 2.2.4)* *LO1.4 Analyze the time and space complexity of iterative and recursive algorithms (P.I. - 2.4.2)*	
02.	**Divide and Conquer Approach** ***Learning Objective/s:*** *To familiarize the time and space complexity of divide & conquer* **Contents:** 2.1 Divide and Conquer: General Method 2.2 Merge Sort, Quick sort, Performance analysis of sorting using iterative approach and divide and conquer approach. 2.3 Finding Minimum and Maximum, Performance analysis of iterative approach and divide and conquer approach to find minimum and maximum. 2.4 Binary Search, Performance analysis of Linear search and binary search. ***Self-Learning Topics:*** *Strassen's Matrix Multiplication* ***Learning Outcomes:*** *A learner will be able to* *LO2.1 Apply algorithmic fundamentals to perceive divide & conquer approach (P.I. -1.3.1)* *LO2.2Apply divide & conquer approach to solve various problems (P.I. -1.4.1)* *LO2.3Compare the divide & conquer and iterative algorithm approaches. (P.I. -2.2.4)* *LO2.4Analyze the time and space complexity divide & conquer approach (P.I. -2.4.2)* *LO2.5Choose appropriate procedure/algorithms with respect to the divide & conquer algorithmic approach in the current field of Computer Engineering. (P.I. -4.1.2, P.I. -11.2.2)*	**6-8**
03.	**Greedy Approach** ***Learning Objective/s:*** *Students are expected to apply greedy approaches to solve various problems and analyze the time and space complexity of these approaches* **Contents:** 3.1 Greedy Algorithms – General Method 3.2 Single Source shortest path: Dijkstra's Algorithm 3.3 Knapsack Problem 3.4 Job sequencing with deadline 3.5 Minimum cost spanning tree algorithms: Prims and Kruskal's algorithm ***Self-Learning Topics:*** *Optimal Randomized Algorithm*	**8-10**

	Learning Outcomes: *A learner will be able to* *LO3.1Apply algorithmic fundamentals to perceive greedy approach (P.I. -1.3.1)* *LO3.2Apply the greedy approach to solve various problems (P.I. -1.4.1)* *LO3.3Compare greedy strategies for spanning tree (P.I. -2.2.4)* *LO3.4Analyze the time and space complexity of Greedy approach (P.I. -2.4.2)* *LO3.5Choose appropriate procedure/algorithms with respect to the greedy algorithmic approach in the current field of Computer Engineering. (P.I. -4.1.2, P.I. -11.2.2)*	
04.	**Dynamic Programming Approach** ***Learning Objective/s:*** *Students are expected to analyze the time and space complexity of dynamic programming approaches.*	**8-10**
	Contents: 3.1 Dynamic Programming- General Method 3.2 Multistage graphs 3.3 Single source shortest path: Bellman Ford Algorithm 3.4 All pair shortest path: Floyd Warshall Algorithm 3.5 Longest common subsequence 3.6 Travelling Salesman Problem 3.7 Knapsack problem: Comparison between greedy knapsack and dynamic programming knapsack 3.8 Comparison of Greedy approach and Dynamic approach	
	Self-Learning Topics: *Travelling salesperson problem, Assembly line scheduling*	
	Learning Outcomes: *LO4.1Apply algorithmic fundamentals to perceive dynamic programming approach (P.I. -1.3.1)* *LO4.2Apply dynamic programming approach to solve various problems (P.I. -1.4.1)* *LO4.3Compare the greedy, and dynamic programming strategies. (P.I. -2.2.4)* *LO4.4Analyze the time and space complexity dynamic programming approach (P.I. -2.4.2)* *LO4.5Choose appropriate procedure/algorithms with respect to the dynamic algorithmic approach in the current field of Computer Engineering. (P.I. -4.1.2, P.I. -11.2.2)*	
05.	**Backtracking approach** ***Learning Objective/s:*** *Students are expected to apply the backtracking to solve various problems and analyze the time and space complexity of these approach.*	**6-8**
	Contents: 5.1 Backtracking- General Method 5.2 N-queen problem 5.3 Sum of Subset 5.4 Graph Coloring 5.5 Knapsack Problem: Comparison between greedy, dynamic programming and backtracking approach	

	Self-Learning Topics: *Hamilton Cycle*	
	Learning Outcomes: *LO5.1Apply algorithmic fundamentals to perceive backtracking approach (P.I. -1.3.1)* *LO5.2Apply the backtracking approach to solve various problems (P.I. -1.4.1)* *LO5.3Compare the dynamic programming, greedy, and backtracking approaches (P.I. -2.2.4)* *LO5.4Analyze the time and space complexity backtracking approach (P.I. -2.4.2)* *LO5.5Choose appropriate procedure/algorithms with respect to the backtracking algorithmic approach in the current field of Computer Engineering. (P.I. -4.1.2, P.I. -11.2.2)*	
06.	**Branch & Bound Approach** ***Learning Objective/s:*** *Apply the branch & bound to solve various problems and analyze the time and space complexity of these approaches*	**5-7**
	Contents: 6.1 Branch & Bound: LC and FIFO branch & bound 6.2 15- puzzle Problem 6.3 Knapsack Problem: Comparison between greedy, dynamic programming, backtracking and branch and bound approach 6.4 Comparison of backtracking, and branch & bound	
	Self-Learning Topics: *Travelling Salesperson Problem* ***Learning Outcomes:*** *LO6.1Apply algorithmic fundamentals to perceive branch & bound approach (P.I. -1.3.1)* *LO6.2Apply the branch & bound approach to solve various problems (P.I. -1.4.1)* *LO6.3Compare the, greedy, dynamic programming, backtracking, and branch and bound approaches of algorithm. (P.I. -2.2.4)* *LO6.4Analyze the time and space complexity branch & bound approach (P.I. -2.4.2)* *LO6.5Choose appropriate procedure/algorithms with respect to the branch and bound algorithmic approach in the current field of Computer Engineering. (P.I. -4.1.2, P.I. -11.2.2)*	
	Course Conclusion It emphasizes the importance of applying efficient algorithms to solve problems and analyzing their performance in terms of time and space.	**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 and engineering to solve an engineering problem.
2.2.4	Compare and contrast alternative solutions/methods to select the best methods.
2.4.2	Analyze and interpret the results. (modified PI)
4.1.2	Able to choose appropriate procedure/algorithm.(modified PI)
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 algorithmic fundamentals and asymptotic notations to analyze and compare the time and space complexity of iterative and recursive algorithms. (LO1.1, LO1.2, LO1.3, LO1.4)
2. Apply divide and conquer algorithms to solve sorting and searching, analyze their complexities, and compare them with iterative approaches. (LO1.1, LO1.2, LO1.3, LO1.4)
3. Apply greedy and dynamic programming approaches to solve classical problems, analyze their complexities, and compare them. (LO2.1, LO2.2, LO2.3, LO2.4, LO2.5)
4. Apply backtracking and branch and bound strategies to solve complex problems, analyze their performance, and compare them with other algorithmic methods. (LO3.1, LO3.2, LO3.3, L31.4, LO3.5) (LO4.1, LO4.2, LO4.3, LO4.4, LO4.5)
5. Compare and contrast various algorithmic approaches to select the most appropriate method for a given problem. (LO1.1, LO1.2, LO1.3, LO1.4) (LO2.1, LO2.2, LO2.3, LO2.4, LO2.5) (LO3.1, LO3.2, LO3.3, L31.4, LO3.5) (LO4.1, LO4.2, LO4.3, LO4.4, LO4.5) . (LO5.1, LO5.2, LO5.3, LO5.4, LO5.5) (LO6.1, LO6.2, LO6.3, LO6.4, LO6.5)

CO-PO Mapping Table with Correlation Level

CO ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CEPCC406.1	3	3	-	-	-	-	-	-	-	-	-
CEPCC406.2	3	3	-	2	-	-	-	-	-	-	2
CEPCC406.3	3	3	-	2	-	-	-	-	-	-	2
CEPCC406.4	3	3	-	2	-	-	-	-	-	-	2
CEPCC406.5	3	3	-	2	-	-	-	-	-	-	2
Average	**3**	**3**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**

Text Books:

1. Introduction to algorithms, T. H. Cormen, C.E. Leiserson, R.L. Rivest, and C. Stein, 3rd Edition, 2009, The MIT Press.
2. Fundamentals of computer algorithms, Ellis Horowitz, Sartaj Sahni, S. Rajsekaran, 2nd Edition, 2008, Universities Press.

Reference Books:

1. Algorithms, Sanjoy Dasgupta, Christos Papadimitriou, Umesh Vazirani, 1st Edition, 2006, McGraw- Hill India.
2. Design Methods and Analysis of Algorithm, S. K. Basu, 2nd Edition, 2005, PHI.

Other Resources:

1. NPTEL Course: Data Structures and Algorithms by Prof. Naveen Garg, Department of Computer Science and Engineering Department, IIT Delhi :-Web link- https://nptel.ac.in/courses/106/102/106102064/
2. NPTEL Course: Design and Analysis of Algorithms By Prof. Madhavan Mukund, Department of computer science at Chennai Mathematical Institute, Web link- https://nptel.ac.in/courses/106106131.

IN-SEMESTER ASSESSMENT (50 MARKS)

1. Continuous Assessment (20 Marks)

Suggested breakup of distribution

Numerical Assignment/s (min 20 problems): 05 Marks.

Class test based on above numerical assignment: 05 Marks.

Open book test/ Open notes test: 05 Marks

Regularity & Active Participation: 05 Marks

2. Mid Semester Examination (30 MARKS)

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

END SEMESTER EXAMINATION (50 MARKS)

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

Course Type	Course Code	Course Name	Credits
PCC	CEPCC407	OPERATING SYSTEM	03

<table>
<tr><th colspan="6">Examination Scheme</th></tr>
<tr><th colspan="3">Distribution of Marks</th><th colspan="2" rowspan="2">Exam Duration (Hrs.)</th><th rowspan="3">Total Marks</th></tr>
<tr><th colspan="2">In-semester Assessment</th><th rowspan="2">End Semester Examination (ESE)</th></tr>
<tr><th>Continuous Assessment</th><th>Mid-Semester Exam (MSE)</th><th>MSE</th><th>ESE</th></tr>
<tr><td>20</td><td>30</td><td>50</td><td>1.5</td><td>2</td><td>100</td></tr>
</table>

Pre-requisite :

Nil

Program Outcomes addressed:

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

Course Objectives:

1. To impart comprehensive understanding of fundamental concepts and functions of operating systems.
2. To instruct how to use the concept of process, thread and resource management.
3. To impart learners to use the concepts of process synchronization and deadlock.
4. To familiarise various Memory, I/O and File management techniques.

<table>
<tr><th>Module</th><th>Details</th><th>Hrs</th></tr>
<tr><td></td><td>Course Introduction
This is the basic course of computer engineering which explore various functions of Operating Systems and how it used as an interface between the user and the computer hardware, and controls the execution of all kinds of programs. This course will provide basic to advanced concepts like process scheduling, concurrency control, Memory, File and IO management</td><td>01</td></tr>
<tr><td rowspan="3">01.</td><td>Introduction of operating system
Learning Objective/s:
Learners are expected to use computer engineering knowledge /principles for learning the Objectives, Functions, architectures of Operating System and recognize it’s need in the field of computer engineering.</td><td rowspan="3">4-6</td></tr>
<tr><td>Contents:
Concept of Operating Systems (OS), Generations of OS, Types of OS, OS Services, Interrupt handling and System Calls, Basic architectural concepts of an OS, Concept of Virtual Machine.</td></tr>
<tr><td>Self-Learning Topics:
Resource Manager view, process view and hierarchical view of an OS</td></tr>
</table>

	Learning Outcomes: *A learner will be able to* *LO1.1: Use principles of computer organization to identify the importance of Operating system. (P.I.-1.3.1)* *LO1.2: Apply principles of operating system to interpret its objectives and functions. (P.I.-1.4.1)*	
02.	**Process Management** ***Learning Objective/s:*** *Learners are expected to Apply computer engineering principles and mathematical knowledge to learn about process and how they are scheduled.*	**8-10**
	Contents: 2.1 Process Definition, Different states of a Process, Process State transitions, Process Control block (PCB), Context switching. 2.2 Thread: Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads. 2.3 Process Scheduling: Scheduling objectives, Types of Schedulers, Scheduling criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time. Scheduling algorithms: Pre-emptive and non-pre-emptive, FCFS, SJF, RR, Real time scheduling	
	Self-Learning Topics: *rate monotonic scheduling, earliest deadline first scheduling, and deadline monotonic scheduling.*	
	Learning Outcomes: *A learner will be able to* *LO2.1: Use principles of Operating System to illustrate the importance of Process Scheduling. (P.I.-1.3.1)* *LO2.2: Interpret the concepts of a Process, Process States, Process Description and Process Control Block, importance of threads(P.I.-1.4.1)* *LO2.3: Compare the scheduling algorithm and justify which is more effective with respect to CPU utilization and response time. (P.I.-2.2.4)* *LO2.4: Identify scheduling algorithm that applies to a given problem. (P.I.-2.1.3)*	
03.	**Process Concurrency control and Deadlock** ***Learning Objective/s:*** *Learners are expected to Conceptualize how OS handles concurrency control and deadlock mechanism, and conclude on suitability of solution.*	**8-10**
	Contents: 3.1 Concurrent processes, precedence graphs, Critical Section, Critical region Race Conditions, Mutual Exclusion, Hardware Solution, Semaphores: binary and counting, Peterson's Solution, The Producer / Consumer Problem, Monitors, Inter Process Communication: Message Passing, Classical IPC Problems: Reader's & Writer Problem, Dinning Philosopher Problem 3.2 Deadlocks: Definition, Necessary and sufficient conditions for Deadlock, Dead lock Prevention, Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery.	
	Self-Learning Topics: *Barber's shop problem*	

	Learning Outcomes: *A learner will be able to* *LO3.1: Use Operating system fundamentals to perceive concurrency control mechanisms. (P.I.-1.3.1)* *LO3.2: Apply OS concepts to solve Concurrency control and Deadlock problems. (P.I.-1.4.1)* *LO3.3: Select the appropriate concurrency control mechanism to solve the classical synchronization problems with approximations and assumptions. (P.I.-2.2.3)* *LO3.4: Select a suitable semaphore solution for a given concurrency control problem and conclude. (P.I.-2.4.4)*	
04.	**Memory Management**	**9-11**
	Learning Objective/s: *Learners are expected to apply principles of mathematics to comprehend the optimal memory management solution and use it to analyse the system behaviour.*	
	Contents: 4.1 Basic concept of memory, Logical and Physical address maps, Memory allocation: Contiguous Memory allocation – Fixed and variable partition–Internal and External fragmentation and Compaction. 4.2 Virtual Memory: Basics of Virtual Memory – Hardware and control structures – Locality of reference, Page allocation, Partitioning, Paging, Page fault, Working Set, Segmentation, Demand paging, Page Replacement algorithms: Optimal, first in first out (FIFO), Least Recently used (LRU), Second Chance (SC)	
	Self-Learning Topics: *Not recently used (NRU)*	
	Learning Outcomes: *A learner will be able to* *LO 4.1: Apply computer architecture fundamentals to perceive the need of memory management. (P.I.-1.3.1)* *LO 4.2: Apply memory management techniques in solving problems related to various partitioning and virtual memory management methods. (P.I.- 1.4.1)* *LO 4.3: Compare and contrast memory partitioning techniques to select best one.. (P.I.-2.2.4)* *LO 4.4: Analyse and Conclude on the best memory allocation strategies. (P.I.-2.4.4)*	
05.	**I/O management** ***Learning Objective/s:*** *Learners are expected to analyse the disk organisation techniques*	**4-6**
	Contents: Principles of I/O and Disk structure, Disk scheduling - FCFS, SSTF, SCAN, C-SCAN, Disk reliability, Disk formatting.	
	Self-Learning Topics: *Boot-block, Bad blocks.*	

	Learning Outcomes: *A learner will be able to* *LO 5.1: Apply concepts of I/O functions and Disk Organization using engineering knowledge.* ***(****P.I.-1.4.1)* *LO 5.2: Illustrate the working of I/O management by applying OS concepts. (P.I.-1.3.1)* *LO 5.3: Identify suitable page replacement algorithms to solve the problem of demand paging. (P.I.-2.2.3)* *LO 5.4: Use and analyze the performance of various disk scheduling techniques and conclude. (P.I.-2.4.4)*	
06.	**File management** ***Learning Objective/s:*** *Learners are expected to Apply computer engineering principles and choose suitable file allocation method and justify suitability of file allocation method to optimize system performance.*	**4-6**
	Contents: Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods (contiguous, linked, indexed).	
	Self-Learning Topics: *Free-space management (bit vector, linked list, grouping).*	
	Learning Outcomes: *A learner will be able to* *LO 6.1: Apply OS fundamentals to illustrate the working of file management. (P.I.-1.3.1)* *LO 6.2: Use OS principles to summarize Various File organization and Access methods. (P.I.-1.4.1)* *LO 6.3: Compare various file allocation methods and choose optimal solution on file management. (P.I.-2.2.4)* *LO 6.4: Conclude on suitability of allocation based on given system design constraints. (P.I.-2.4.4)*	
	Course Conclusion Operating System course provides fundamental understanding of system software and its role in managing computer resources efficiently, crucial for computer science and engineering students. Through theoretical concepts and practical implementations, students grasp essential skills in designing, implementing, and optimizing operating systems.	**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 and engineering to solve an engineering problem.
2.1.3	Identify mathematical algorithmic knowledge that applies to a given problem.
2.2.4	Compare and contrast alternative solution/methods to select the best methods.
2.2.3	Identify existing solution/mechanism to solve the problem, including forming justified approximations and assumptions.
2.4.4	Arrive at conclusions with respect to the objectives.

Course Outcomes: A learner will be able to-

1. Apply the concepts of Operating System to interpret its objectives and functions. *(LO1.1, LO1.2)*
2. Apply the concepts of process scheduling on a given scheduling scenario and justify its applicability to increase CPU utilization. *(LO2.1, LO 2.2, LO 2.3, LO 2.4)*
3. Apply concurrency control mechanism and select suitable solution for problems of deadlock and concurrency control. *(LO 3.1, LO 3.2, LO 3.3, LO 3.4)*
4. Analyse and select optimal memory management solutions. .*(LO 4.1, LO 4.2, LO 4.3, LO 4.4)*
5. Analyse various disk organization, I/O methods.(*LO 5.1, LO 5.2, LO 5.3, LO 5.4)*
6. Analyse different file access and file allocation methods in terms of efficiency.(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**
CEPCC407.1	3	-	-	-	-	-	-	-	-	-	-
CEPCC407.2	3	3	-	-	-	-	-	-	-	-	-
CEPCC407.3	3	3	-	-	-	-	-	-	-	-	-
CEPCC407.4	3	3	-	-	-	-	-	-	-	-	-
CEPCC407.5	3	3	-	-	-	-	-	-	-	-	-
Average	**3**	**3**	-	-	-	-	-	-	-	-	-

Text Books:

1. Operating Systems: Internals and Design Principles by William Stallings, 9th edition (Global edition), Pearson, 2018.
2. Operating System Concepts by Abraham Silberschatz, Peter Baer Galvin, and Greg Gagne, 10th edition (Global edition), Wiley, 2018 (2023).

Reference Books :

1. Operating Systems by Achyut Godbole and Atul Kahate, 3rd Edition, McGraw Hill Education.
2. Modern Operating Systems by Tanenbaum and Herbert Bos, 5th edition, Pearson, 2023.
3. UNIX: Concepts and Applications by Sumitabha Das, 4th Edition, McGraw Hill.2020

Other Resources :

1. NPTEL Course: OS fundamentals by Prof. Santanu Chattopadhyay IIT Kharagpur Web link- https://nptel.ac.in/courses/106105214

IN-SEMESTER ASSESSMENT (50 MARKS)

1. Continuous Assessment (20 Marks)

Suggested breakup of distribution

One MCQ test as per GATE exam pattern/ level: 05 marks.

One Class test: 05 marks

Think Pair share worksheet: 05 Marks

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 20%-30% weightage, and the syllabus covered from MSE to ESE carrying 70%-80% weightage.

Course Type	Course Code	Course Name	Credits
PCC	CEPCC408	COMPUTER NETWORK	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. CEPCC303 - Data Structures

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. PO11: Life-long learning.

Course Objectives:

1. To impart the fundamental knowledge of computer networks.
2. To introduce the concept of IP addresses and various protocols used at network layer.
3. To familiarize the strengths and weaknesses of various routing algorithms.
4. To introduce the protocols of various transport layer and application layer.

Module	Details	Hrs.
	Course Introduction A computer network theory course offers foundational understanding in data transmission, protocols, and security, empowering students for research, project development, higher education pursuits, and industry roles like network engineering and cybersecurity analysis.	**01**
01.	**Introduction to Networking** ***Learning Objective/s:*** *To apply fundamentals of computer engineering to learn the concepts of computer networks and network requirements for real life applications.*	**6-8**

	Contents: 1.1 Basic concepts and fundamentals of data communication and computer network, Basic Networking Devices: Repeater, Hub, Switch, Router, NIC, Modem, Network Topologies, Type of networks (LAN, WAN, MAN) 1.2 Layers of OSI and TCP/IP Design Issues of Layers. Guided and Unguided media. Switching– Circuit-switched Networks – Packet Switching, Message switching	
	Self-Learning Topics: *Study of Network Tools (NS2 and Cisco Packet tracer)*	
	Learning Outcomes: *A learner will be able to:* *LO1.1: Use the computer engineering concept to identify required software and hardware components for each layer of network.(PI-1.4.1)* *LO1.2: Compare and contrast different switching techniques and Transmission Media. (P.I.-1.4.2)* *LO1.3: Identify the functionalities and computing resources of all layers of OSI and TCP/IP models.(PI-2.2.2)* *LO1.4: Compare different network topologies and conclude which topology performs better(PI-2.4.4)* *LO1.5: Use the principles of engineering to understand the basic concepts and fundamentals of computer network useful in the future(PI-1.3.1,11.2.2)*	
02.	**Data Link Layer** ***Learning Objective/s:*** *To use fundamentals of computer engineering to learn the various issues and the available solution of Data Link Layer and Medium access control layer.*	**7-9**
	Contents: 2.1 Overview of DLL, Issues of DLL: Framing, Error Detection and Correction: Parity, CRC, Checksum, Hamming Code 2.2 Elementary Data Link protocols, Stop and Wait, Sliding Window (Go Back N, Selective Repeat) 2.3 Medium Access Control Sublayer Channel Allocation problem, Multiple access Protocol (Aloha, Carrier Sense Multiple Access (CSMA/CD)	
	Self-Learning Topics: *HDLC protocol, CSMA/CA*	
	Learning Outcomes : *A learner will be able to* *LO2.1: Apply engineering fundamentals to solve channel allocation problem in Medium Access Control sublayer (P.I-1.3.1)* *LO2.2: Apply computer engineering fundamentals to find various issues of DLL. (P.I.-1.4.1)* *LO2.3: Compare various Elementary Data Link protocols based on functionalities. (P.I.-2.2.2)* *LO2.4: Apply engineering mathematics to solve numerical problems based on Error Detection and Correction techniques. (P.I.-2.4.1)*	
03.	**Network Layer** ***Learning Objective/s:*** *To apply fundamentals of IP addressing to design network using the concepts of subnet / supernet.*	**7-9**

	Contents: 3.1 Network layer issues, Communication Primitives, IPV4 datagram format, IPv4 address, classful address, Design network using the concept of subnetting and supernetting, classless addressing, IPV6 datagram format, Transition from IPV4 to IPV6 3.2 Protocols - ARP, RARP, ICMP, IGMP	
	Self-Learning Topics: *NAT*	
	Learning Outcomes: *A learner will be able to:* *LO3.1: Use the principles of engineering to restate the concepts of Communication primitives used in computer network. (P.I.-1.3.1)* *LO3.2: Use the concepts of* computer engineering *to summarize various issues of Network layer. (P.I.-1.4.1)* *LO3.3: Summarize the functionalities and computing resources of various network layer protocols. (P.I.-2.2.2)* *LO3.4: Compare IPv4 and IPv6 protocols based on functionalities. (P.I.-2.4.4)* *LO3.5: Apply Classful and classless addressing to explore design alternatives. (P.I.-3.2.1)* *LO3.6: Apply the concepts of IP addressing to develop networks and verify the functionalities. (P.I.-3.4.3)*	
04.	**Routing in Network Layer** ***Learning Objective/s:*** *To use the fundamentals of various routing algorithms and protocols at network layer to find the optimal path.*	**5-7**
	Contents: Introduction to Routing in computer network, Routing algorithms- Shortest Path (Dijkastra's), Link state routing, Distance Vector Routing, RIP, BGP.	
	Self-Learning Topics: *Routing Protocol (OSPF)*	
	Learning Outcomes: *A learner will be able to* *LO4.1: Apply the concepts of queueing theory to summarize the different routing protocols. (P.I.-1.1.2)* *LO4.2: To use computer engineering concepts to restate the purpose and use of intra/internetwork layer protocols. (P.I.-1.4.1)* *LO4.3: Apply various routing algorithms to find the optimal path between the source and the destination nodes to the given situation/problem. (P.I.-4.1.2).* *LO4.4: Identify the appropriate routing protocols for the given problem/data/situation. (P.I.-4.3.1).*	
05.	**Transport Layer** ***Learning Objective/s:*** *To know the functionalities of transport layer and analyze various protocol works at transport layer.*	**7-9**

	Contents: 5.1 Introduction to Transport layer services: User Datagram Protocol (UDP), Transmission Control Protocols (TCP) 5.2 Congestion control algorithms: Open loop congestion control, Closed loop congestion control, QoS parameters, Token & Leaky bucket algorithms 5.3 TCP Flow control (sliding Window), TCP Congestion Control: Slow Start	
	Self-Learning Topics: *Fast Transmit /Fast Recovery protocols*	
	Learning Outcomes: *A learner will be able to:* *LO5.1: Use the engineering fundamentals to summarize the main objectives, service primitives of transport layer. (P.I.-1.3.1)* *LO5.2: Apply the concepts of Transmission control protocol and summarize flow control and congestion control. (P.I.-1.4.1)* *LO5.3: Identify the functionalities and computing resources to compare the transport layer protocols: TCP and UDP. (P.I.-2.2.2)* *LO5.4: Compare Token & Leaky bucket algorithms and conclude with respect to the given objectives. (P.I.- 2.4.4)*	
06.	**Application Layer** ***Learning Objective/s:*** *To recognize the different protocols their functionalities used at application layer which are useful in real life applications.*	**6-8**
	Contents: DNS, Telnet, HTTP, FTP, SMTP, Streaming audio and video RTSP, SRTP.	
	Self-Learning Topics: *SSH*	
	Learning Outcomes: *A learner will be able to:* *LO 6.1: Use the basic concepts of computer engineering to summarize the DNS and various types of name server. (P.I.-1.3.1)* *LO 6.2: Analyze the structure of HTTP request and response. (P.I.-.2.2.2)* *LO 6.3: Analyze different intermediaries used in mail delivery. (P.I.-.2.2.3)* *LO 6.4: Identify the purpose of various protocols used in the application layer for different real- life applications (P.I- 1.4.1,11.2.2)* *LO6.5: Explore advanced protocols of Application Layer used in recent trend (P.I-1.3.1,11.3.1)*	
	Course Conclusion: In this course, students will be able to apply theoretical knowledge of computer networks to practical scenarios.	**01**
	Total	**45**

Performance Indicators:

P.I. No.	P.I. Statement
1.1.2	Apply the concepts of probability, statistics and queuing theory in modelling of computer-based system, data and network protocols.
1.3.1	Apply engineering fundamentals
1.4.1	Apply fundamental engineering concepts to solve computer engineering problems
2.2.2	Identifies functionalities and computing resources
2.4.1	Applies engineering mathematics to implement the solution.
2.4.4	Arrive at conclusions with respect to the objectives (as per network requirements)
3.2.1.	Able to explore design alternatives.
3.4.3	Able to verify the functionalities and validate the design.
4.1.2	Ability to choose appropriate procedure/algorithm/protocol depends on the situation (M)
4.3.1	Use appropriate procedures, tools, and techniques to collect and analyse data
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.

Course Outcomes: A learner will be able to-

1. Use the basic concepts of computer networks to compare different network topologies and network models.(LO1.1, LO1.2, LO1.3, LO1.4, LO1.5)
2. Apply the functionalities (Framing, Error detection, flow control, error control and collision detection) of data link layer to solve the given problems.(LO2.1, LO2.2, LO2.3,LO2.4)
3. Design a network using subnetting / supernetting schemes.(LO3.1, LO3.2, LO3.3, LO3.4,LO3.5, LO3.6)
4. Apply the appropriate routing algorithm / protocol to find the optimal path.(LO4.1, LO4.2, LO4.3, LO4.4)
5. Compare the transport layer protocols with reference to their functionalities.(LO5.1, LO5.2, LO5.3, LO5.4)
6. Identify the features and operations of various application layer protocols such as DNS, HTTP, SMTP, Telnet, FTP and DHCP.(LO6.1, LO6.2, LO6.3,LO6.4, LO6.5)

CO-PO Mapping Table with Correlation Level

CO ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CEPCC408.1	3	3	-	-	-	-	-	-	-	-	2
CEPCC408.2	3	3	-	-	-	-	-	-	-	-	-
CEPCC408.3	3	3	3	-	-	-	-	-	-	-	-
CEPCC408.4	3	-	-	3	-	-	-	-	-	-	-
CEPCC408.5	3	3	-	-	-	-	-	-	-	-	-
CEPCC408.6	3	2	-	-	-	-	-	-	-	-	3
Average	**3**	**3**	**3**	**3**	-	-	-	-	-	-	**3**

Text Books:

1. Computer Networks, A.S. Tanenbaum,4th edition, 2018 Pearson Education.
2. Data Communications and Networking, B.A. Forouzan, 5th edition, 2017, TMH.
3. A Top-Down Approach Featuring the Internet, James F. Kurose, Keith W. Ross, Computer .Networking, 6th edition, 2017, Addison Wesley.

Reference Books:

1. An Engineering Approach to Computer Networking, S. Keshav,1 Edition, 2007, Pearson.
2. Computer Networks: Principles, Technologies & Protocols for Network Design, Natalia Olifer & Victor Olifer, 1 Edition, 2006 Wiley India.
3. Computer Networks: A Systems Approach, Larry L.Peterson, Bruce S.Davie, , Second Edition, 2011, The Morgan Kaufmann Series in Networking.

Other Resources:

1. NPTEL Course: Computer Networks by Prof. Sujoy Ghosh, Department of Computer Science and Engineering IIT Kharagpur: -Web link- https://nptel.ac.in/courses/106105081
2. CISCO Network academy course: https://www.netacad.com/courses/networking/networking-essentials
3. The Bits and Bytes of Computer Networking : https://www.coursera.org/learn/computer-networking

IN-SEMERSTER ASSESSMENT (50 MARKS)

1. Continuous Assessment (20 Marks)

Suggested breakup of distribution

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

One Class test: 05Marks

Think Pair Share (TPS) activity: 05 Marks

Regularity and Active Participation: 05 Marks

2. Mid Semester Exam (30 Marks)

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

END SEMERSTER 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	CELBC403	ANALYSIS OF ALGORITHMS LABORATORY	01

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

Pre-requisite:

1. ESL103- Programming Laboratory- I (C)

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. PO8: Individual and Collaborative team work
6. PO9: Communication

Course Objectives:

1. To guide students in implementing various algorithms.
2. To guide students in analysing the performance of algorithms.

Module	Detailed Contents	Hrs
	Course Introduction This course emphasizes the practical implementation of algorithms, as well as delving into their performance analysis.	**01**
01.	***Learning Objective/s:*** *Expected to implement iterative sorting approach.*	**04**
	Laboratory Exercises: Implement iterative approach for the given problems and analyze their performance (Time and Space Complexity).	
	Learning Outcomes: *A learner will be able to* *LO1.1Develop appropriate algorithms based on the programming objectives (P.I.-4.2.1)* *LO1.2 Implement various iterative sorting methods. (P.I.-3.4.2)* *LO1.3 Use software tool to implement iterative approach (P.I.-5.1.2)* *LO1.4 Analyze iterative approach for the given problems based on their time and space complexity (P.I.-2.4.2)* *LO1.5 Facilitate the analysis by drawing conclusions and present in report form (P.I.-2.4.4, P.I.-8.2.1, P.I.-9.1.2)*	
02.	***Learning Objective/s:*** *Expected to implement divide & conquer algorithmic approach.*	**04**

	Laboratory Exercises: Implement divide & conquer approach for the given problems and analyze their performance (Time and Space Complexity).	
	Learning Outcomes: *A learner will be able to* *LO2.1 Develop appropriate procedures/algorithms based on the programming objectives (P.I.-4.2.1)* *LO2.2 Implement divide & conquer approach for given problems. (P.I.-3.4.2)* *LO2.3 Use software tool to implement divide & conquer approach. (P.I.-5.1.2)* *LO2.4 Analyze divide & conquer approach for the given problems based on their time and space complexity (P.I.-2.4.2)* *LO2.5 Facilitate the analysis by drawing conclusions and present in report form (P.I.-2.4.4, P.I.-8.2.1, P.I.-9.1.2)*	
03.	***Learning Objective/s:*** *Expected to implement greedy algorithmic approach.*	**06**
	Laboratory Exercises: Implement greedy approach for the given problems and analyze their performance (Time and Space Complexity).	
	Learning Outcomes: *A learner will be able to* *LO3.1 Design and develop appropriate procedures/algorithms based on the programming objectives (P.I.-4.2.1)* *LO3.2 Implement various greedy algorithms. (P.I.-3.4.2)* *LO3.3 Use software tool to implement various greedy approach. (P.I.-5.1.2)* *LO3.4 Analyse greedy approach for the given problems based on their time and space complexity (P.I.-2.4.2)* *LO3.5 Facilitate the analysis by drawing conclusions and present in report form (P.I.-2.4.4, P.I.-8.2.1, P.I.-9.1.2)*	
04	***Learning Objective/s:*** *Expected to implement dynamic programming algorithmic approach*	**06**
	Laboratory Exercises: Implement dynamic programming approach for the given problems and analyze their performance (Time and Space Complexity).	
	Learning Outcomes: *A learner will be able to* *LO4.1 Develop appropriate procedures/algorithms based on the programming objectives (P.I.-4.2.1)* *LO4.2 Implement various dynamic programming algorithms. (P.I.-3.4.2)* *LO4.3 Use software tool to implement various dynamic programming approach(P.I.-5.1.2)* *LO4.4 Analyse dynamic programming approach for the given problems based on their time and space complexity (P.I.-2.4.2)* *LO4.5 Facilitate the analysis by drawing conclusions and present in report form (P.I.-2.4.4, P.I.-8.2.1, P.I.-9.1.2)*	
05.	***Learning Objective/s:*** *Expected to implement backtracking algorithmic approach*	**05**

	Laboratory Exercises: Implement backtracking approach for the given problems and analyze their performance (Time and Space Complexity).	
	Learning Outcomes: *A learner will be able to* *LO5.1 Develop appropriate procedures/algorithms based on the programming objectives (P.I.-4.2.1)* *LO5.2 Implement various backtracking algorithms. (P.I.-3.4.2)* *LO5.3 Use software tool to implement various backtracking approach. (P.I.-5.1.2)* *LO5.4 Analyze backtracking approach for the given problems based on their time and space complexity (P.I.-2.4.2)* *LO5.5 Facilitate the analysis by drawing conclusions and present in report form (P.I.-2.4.4, P.I.-8.2.1, P.I.-9.1.2)*	
06.	***Learning Objective/s:*** *Expected to implement branch & bound algorithmic approach*	**04**
	Laboratory Exercises: Implement branch and bound approach for the given problems and analyze their performance (Time and Space Complexity).	
	Learning Outcomes: *A learner will be able to* *LO6.1 Develop appropriate procedures/algorithms based on the programming objectives (P.I.-4.2.1)* *LO6.2 Implement various branch & bound algorithms. (P.I.-3.4.2)* *LO6.3 Use software tool to implement various branch & bound approach. (P.I.-5.1.2)* *LO6.4 Analyze branch and bound approach for the given problems based on their time and space complexity (P.I.-2.4.2)* *LO6.5 Facilitate the analysis by drawing conclusions and present in report form (P.I.-2.4.4, P.I.-8.2.1, P.I.-9.1.2)*	
	Total	**30**

Performance Indicators:

P.I. No.	**P.I. Statement**
2.2.4	Compare and contrast alternative solutions/methods to select the best methods
2.4.2	Analyze and interpret the results using mathematical principles (modified PI).
3.4.2	Able to implement functions and integrate the modules
4.2.1	Design and develop appropriate procedures/ algorithms based on the programming objectives (modified PI).
5.1.2	Create/adapt/modify/extend tools and techniques to solve engineering problems.
8.2.1	Demonstrate effective communication, problem-solving, and conflict resolution.
9.1.2	Produce clear, well-constructed, and well-supported written engineering documents

Course Outcomes: A learner will be able to-

1 Develop an algorithm or procedure for the given problem using specified approach. (LO1.1, LO1.2, LO1.3, LO1.4,LO1.5) (LO2.1, LO2.2, LO2.3, LO2.4, LO2.5) (LO3.1, LO3.2, LO3.3, L31.4, LO3.5) (LO4.1, LO4.2, LO4.3, LO4.4, LO4.5) . (LO5.1, LO5.2, LO5.3, LO5.4, LO5.5) (LO6.1, LO6.2, LO6.3, LO6.4, LO6.5)

2 Implement an algorithm for the given problem using appropriate software tool. . (LO1.1, LO1.2, LO1.3, LO1.4, LO1.5) (LO2.1, LO2.2, LO2.3, LO2.4, LO2.5) (LO3.1, LO3.2, LO3.3, L31.4, LO3.5) (LO4.1, LO4.2, LO4.3, LO4.4, LO4.5) . (LO5.1, LO5.2, LO5.3, LO5.4, LO5.5) (LO6.1, LO6.2, LO6.3, LO6.4, LO6.5)

3 Analyze and draw conclusions based on complexity of various algorithms. . (LO1.1, LO1.2, LO1.3, LO1.4, LO1.5) (LO2.1, LO2.2, LO2.3, LO2.4, LO2.5) (LO3.1, LO3.2, LO3.3, L31.4, LO3.5) (LO4.1, LO4.2, LO4.3, LO4.4, LO4.5) . (LO5.1, LO5.2, LO5.3, LO5.4, LO5.5) (LO6.1, LO6.2, LO6.3, LO6.4, LO6.5)

CO-PO Mapping Table with Correlation Level

CO ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CEPCC403.1	-	3	2	2	2	-	-	2	2	-	-
CEPCC403.2		3	2	2	2	-	-	2	2	-	-
CEPCC403.3	-	3	2	2	2	-	-	2	2	-	-
Average	**-**	**3**	**2**	**2**	**2**	**-**	**-**	**2**	**2**	**-**	**-**

Books:

1. Introduction to algorithms, T. H. Cormen, C.E. Leiserson,R.L. Rivest, and C. Stein, 3rd Edition, 2009, The MIT Press
2. Fundamentals of computer algorithms, Ellis Horowitz, Sartaj Sahni, S. Rajsekaran, 2nd Edition, 2008, Universities Press

Reference Books:

1. Algorithms, Sanjoy Dasgupta, Christos Papadimitriou, Umesh Vazirani, 1st Edition, 2006, McGraw- Hill India
2. Design Methods and Analysis of Algorithm, S. K. Basu, 2nd Edition, 2005, PHI

Other Resources:

1. NPTEL Course: Data Structures and Algorithms by Prof. Naveen Garg, Department of Computer Science and Engineering Department, IIT Delhi: -Web link- https://nptel.ac.in/courses/106/102/106102064/

2. NPTEL Course: Design and Analysis of Algorithms by Prof. Madhavan Mukund, Department of computer science at Chennai Mathematical Institute, Web link- https://nptel.ac.in/courses/106106131

CONTINUOUS ASSESSMENT (25 Marks)

Suggested breakup of distribution

Laboratory Exercises- 10 Marks

Internal Assessment-

Practical Test – 10 Marks

Evaluation of the conceptual, problem solving and programming skills of each student will be assessed based on their approach towards problem solving, implementation of concepts and execution of the task using a software tool.

Regularity and Active Participation - 5 Marks

END SEMESTER EXAMINATION (Practical/Oral Examination) (25 Marks)

Students will be assessed based on three parameters:

- Concept/Algorithmic and analysis knowledge
- Practical programming knowledge
- Oral

1. Students will be randomly allocated a program from the list of laboratory exercises and will be asked to write appropriate algorithm for the same. The algorithm and analysis are checked by the examiners (Internal and External) and weightage for this is 10 Marks.

Then the student will be allowed to start with the implementation of the program.

2. Students will be allocated 1 hour to complete the execution. The program is then checked by both the examiners for its correctness. The weightage of the program implementation is 5 Marks

3. Students will then be appearing for Oral in front of both Internal and External examiners. The weightage of Oral will be of 10 Marks.

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

ourse Type	Course Code	Course Name	Credits
LBC	CELBC404	OPERATING SYSTEM LABORATORY	01

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

Pre-requisite :

ESL103 - Programming Laboratory-I (C)

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. PO8: Individual and Collaborative team work
6. PO9: Communication

Course Objectives:

1. To familiarize various system calls, shell scripting and basic Linux commands.
2. To guide in implementing different process scheduling algorithms.
3. To facilitate in exploring the practical concepts of memory and deadlock avoidance.

Module	Detailed Contents	Hrs
	Course Introduction The course aims to explore the importance of the operating system, its function and different techniques used by the operating system to achieve its goals as resource manager. This course focuses on the practical experience of designing and implementing the important concept of Operating System.	
01.	**Linux Introduction** ***Learning Objective:*** *To familiarize the functioning of various Linux Tools and application.*	**06**
	Laboratory Exercise Implement basic Linux Commands.	
	Learning Outcomes: *A learner will be able to* *LO1.1: Identify and implement various operations related to File and directory structure using Linux based tool (P.I -2.1.2)* *LO1.2: Use Linux environment as a platform for implementing basic commands and demonstrate results. (P.I - 5.1.2, 8.2.1)*	

02.	**Shell Scripting and System Calls** ***Learning Objective:*** *To investigate various file manipulation and I/O operations using shell programming and system calls*	**06**
	Laboratory Exercises 1. Implement Shell scripting programs. 2. Implement system calls for process management and I/O management	
	Learning Outcomes : *A learner will be able to* *LO2.1: Identify the appropriate command to perform the given File, I/O and Process Management functions. (P.I - 2.1.2)* *LO2.2: Use Linux environment for implement system calls, shell scripting programs and demonstrate results. (P.I - 5.1.2, 8.2.1, 9.1.2)* *LO2.3: Implement the system call in both Linux as well as C environment and identify the strength and limitation of both. (P.I -5.2.1)*	
03.	**Process Scheduling** ***Learning Objective:*** *Learners are expected to select and implement efficient scheduling technique on the given problem.*	**06**
	Laboratory Exercises 1. Implement and justify which CPU Scheduling algorithm discriminates in favor of performance parameter. 2. Implement and show the following pairs of scheduling criteria with respect to: a. CPU utilization and response time b. Average turnaround time and maximum waiting time	
	Learning Outcomes : *A learner will be able to* *LO3.1: Implement and integrate different functions to carry out various operations related to the given scheduling algorithm. (P.I -3.4.2)* *LO3.2: Compare the scheduling algorithms and justify which is more effective with respect to CPU utilization and response time. (P.I -2.2.4)* *LO3.3: Facilitate the explanation and analysis for the calculation of turnaround time and waiting time. (P.I -4.3.3)* *LO3.4: Synthesize the information about the results, draw conclusion and demonstrate results. (P.I -4.3.4, 8.2.1, 9.1.2)*	
04.	**Process Synchronization and Deadlock** ***Learning Objective:*** *Learners are expected to implement suitable solution for the given classic Inter-process Communication problem and deadlock avoidance algorithm.*	**06**
	Laboratory Exercises: • **Synchronization problem** 1. Bounded-buffer (or Producer-Consumer) Problem 2. Dining-Philosophers Problem 3. Readers and Writers Problem	

	4. Sleeping Barber Problem • **Deadlock avoidance** 1. Banker's Algorithm	
	Learning Outcomes : *A learner will be able to* *LO4.1: Select the appropriate algorithm to develop functions carrying out various operations of the process synchronization problem and deadlock avoidance algorithm (P.I -4.1.2)* *LO4.2: Design and develop appropriate algorithm based on classic inter-process communication problems. (P.I -4.2.1)* *LO4.3: Implement solutions for different Synchronization problems and demonstrate results. (P.I. -3.2.2, 8.2.1, 9.1.2)*	
05.	**Virtual Memory** ***Learning Objective:*** *Learners are expected to select and implement efficient scheduling technique to implement the given real-world application*	**06**
	Laboratory Exercises: 1. For the given set of string with some finite page frames implement and analyse which algorithm produces minimum number of page faults. a. First Come First Serve b. Least Recently Used c. Optimal Page replacement	
	Learning Outcomes : *A learner will be able to* *LO5.1: Implement and integrate different functions to calculate page faults related to page replacement. (P.I.-3.4.2).* *LO5.2: Use appropriate programming tool for given parameter and demonstrate results in report format. (P.I - 4.3.1, 8.2.1, 9.1.2)* *LO5.3: Analyze the page replacement algorithm for their performance and limitations. (P.I - 4.3.2)*	
	Total	**30**

Performance Indicators:

P.I. No.	P.I. Statement
2.1.2	Identify 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.
3.2.2	Able to produce a variety of potential design solutions suited to meet functional requirements.
3.4.2	Able to implement functions and integrate the modules.
4.1.2	Able to choose appropriate procedure/algorithm(M).
4.2.1	Design and develop appropriate procedures/functions based on the programming objectives. (M)
4.3.1	Use appropriate procedures, tools and techniques to collect and analyze data.

4.3.2	Analyze data for trends, correlations and limitations.
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.
4.3.4	Synthesize information and knowledge about the problem from the raw data to reach appropriate conclusions.
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) modeling and simulating, (iii) monitoring system performance, and (iv) creating engineering designs.
8.2.1	Demonstrate effective communication, problem-solving, and conflict resolution.
9.1.2	Produce clear, well-constructed, and well-supported written engineering documents.

Course Outcomes: A learner will be able to-

1. Investigate and demonstrate the ability to select commands and perform the given operations using system calls and shell scripting in Linux Environment. (LO1.1, LO1.2, LO1.3, LO2.1, LO2.2, LO2.3)
2. Select appropriate process scheduling algorithm and integrating its function for evaluating performance parameter using suitable software tool.(LO3.1, LO3.2, LO3.3, LO3.4)
3. Develop appropriate procedure to propose solution of classic Inter-process Communication problems and effectively implement deadlock avoidance algorithm. (LO4.1, LO4.2, LO4.3)
4. Select appropriate page replacement algorithm and analyse their performance based on a given parameter.(LO5.1, LO5.2, LO5.3)

CO-PO Mapping Table with Correlation Level

CO ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CEPCC303.1	-	2	-	-	3	-	-	2	2	-	-
CEPCC303.2		2	2	3	-	-	-	2	2	-	-
CEPCC303.3	-	3	2	-	-	-	-	-	-	-	-
CEPCC303.4	-	-	2	2	-	-	-	2	2	-	-
CEPCC303.5	-	-	2	3	-	-	-	2	2	-	-
Average	**-**	**2**	**2**	**3**	**3**	**-**	**-**	**2**	**2**	**-**	**-**

Books :

1. Abraham Silberschatz, Peter Baer Galvin, and Greg Gagne, Operating System Concepts, 10th edition (Global edition), Wiley, 2018 (2023).
2. Tanenbaum and Herbert Bos, Modern Operating Systems, 5th edition, Pearson, 2023.
3. Willings, Operating Systems: Internals and Design Principles, 9th edition (Global edition), Pearson, 2018.

Reference Books :

1. Practicing Hand Book for Operating System Laboratory by Sathish Kumar Ravichandran, Archana Sasi.
2. Operating System Lab Programs: Guide to Shell and OS lab programs by S.Sydhani Begum.

Other Resources :

1. Operating System Fundamentals: https://archive.nptel.ac.in/courses/106/105/106105214/
2. Brian "Beej Jorgensen" Hall, Beej's Guide to Interprocess Communication, online tutorial.

CONTINUOUS ASSESSMENT (25 Marks)

Suggested breakup of distribution

Laboratory Exercises- 10 Marks

Internal Assessment-

Practical Test – 10 Marks

Evaluation of the conceptual and programming skills of each student will be assessed based on their skills to implement the concepts and execution of the task assigned using a software tool, during regular laboratory sessions.

Regularity and Active Participation- 5 Marks

END SEMESTER EXAMINATION (Practical/Oral Examination) -25 Marks

Students will be assessed based on three parameters:

- Concepts/Algorithmic knowledge
- Practical programming knowledge
- Oral

1. Students will be randomly allocated a program from the list of laboratory exercises and will be asked to write appropriate algorithm for the same. The algorithm is checked by the examiners (Internal and External) and weightage for this is 5 Marks.

   Then the student will be allowed to start with the implementation of the program.

2. Students will be allocated 1 hour to complete the execution. The program is then checked by both the examiners for its correctness. The weightage of the program implementation is 10 Marks.

3. Students will then be appearing for Oral in front of both Internal and External examiners. The weightage of Oral will be of 10 Marks.

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

Course Type	Course Code	Course Name	Credits
LBC	CELBC405	COMPUTER NETWORK LABORATORY	01

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

Pre-requisite:

ESL205- Programming Laboratory -II (Java)

Program Outcomes addressed:

1. PO3: Design/Development of solution
2. PO4: Conduct investigations of complex problems
3. PO5: Engineering tool usage
4. PO11: Life Long Learning

Course Objectives:

1. To guide in using network simulation tools.
2. To facilitate in developing the topological and routing strategies for an IP based networking infrastructure.
3. To guide in exploring various issues of a packet transfer from source to destination and to resolve them.

Module	Detailed Contents	Hrs.
	Course Introduction A network lab is a dedicated space equipped with hardware and software tools essential for experimenting with and studying computer networks. It provides hands-on learning opportunities for students and professionals to understand concepts such as network configuration, troubleshooting, and security measures. By simulating real-world scenarios, network labs foster practical skills development and facilitate deeper comprehension of networking principles. They serve as invaluable resources for honing expertise in designing, implementing, and maintaining robust network infrastructures.	**01**
01.	***Learning Objectives:*** *1. Impart the knowledge of Ethernet cabling and connection to setup computer network.* *2. Expected to use different Linux commands for computer networks* *3. Expected to know how to analyze network traffic*	**05**
	Ethernet Networking: Cabling, Linux Commands, Traffic Analysis **Laboratory Exercises:** 1. To demonstrate Ethernet cabling and connection (RJ45 connector and CAT6 cable). 2. Use basic networking commands in Linux/Windows (ping, tracert, nslookup, netstat, ARP, RARP, ip, ifconfig, dig, route, nmap) 3. Use simulation tool Wireshark to analyse network traffic.	

	Learning Outcomes: *A learner will be able to* *LO1.1 Identify various components required to setup computer network. (P.I.- 3.4.1)* *LO1.2 Basic tools of computer engineering required for analysing network traffic. (P.I.- 4.1.3)* *LO1.3 Crimp Ethernet network cable using CAT6 cable and RJ45 connector and check the cable using Line Tester. (P.I.- 4.3.1)* *LO1.4 Use basic networking commands in Linux/Windows (ping, tracert, nslookup, netstat, ARP, RARP, ip, ifconfig, dig, route) to analyze the network.(P.I.- 5.1.1)* *LO1.5 Use Wireshark tool for analysing network traffic. (P.I.- 5.2.1)* *LO1.6 Use network mapping tool Nmap to analyze the network. (P.I.- 5.2.2)*	
02.	***Learning Objective:*** *Expected to use network tools and simulators like NS2, Cisco Packet Tracer for building a simple network topology.*	**08**
	Network Topology Construction: NS2, Cisco Packet Tracer, and Tools **Laboratory Exercises:** 1. To use simulator (NS2) to understand functioning of ALOHA. 2. To build a simple network topology, configure it for static routing protocol and validate using Cisco Packet Tracer. 3. To configure network using static routing protocol and demonstrate the ability in identifying the advance protocols.	
	Learning Outcomes: *A learner will be able to* *LO2.1 Build a simple network topology using Cisco Packet Tracer. (P.I.- 4.1.3)* *LO2.2 Validate the created network using appropriate commands/tools. (P.I.- 4.2.1)* *LO2.3 Use network simulator to demonstrate ALOHA. (P.I.- 5.1.1)* *LO2.4 Apply static routing protocol to configure the network. (P.I.- 5.2.2, P.I.- 11.2.2)*	
03.	***Learning Objectives:*** *1. Expected to setup multiple IP addresses on a single LAN and configure routing information.* *2. Expected to create Virtual Private Network and Configure RIP/OSPF using Packet tracer.*	**08**
	Configuring Multi-IP LAN & VPN with Packet Tracer **Laboratory Exercises:** 1. Set up multiple IP addresses on a single LAN. 2. Using nestat and route commands of Linux, do the following: • View current routing table • Add and delete routes • Change default gateway 3. Design VPN and Configure RIP/OSPF using Packet tracer.	
	Learning Outcomes: *A learner will be able to* *LO3.1 Use linux commands to setup multiple IP addresses on a single LAN (IP Aliasing). (P.I.- 4.1.2)* *LO3.2 Use the appropriate tools for simulating computer networks. (P.I.- 4.1.3).* *LO3.3 Configure and update routing information using netstat and route command. (P.I.- 5.2.2)* *LO3.4 Create, configure and recognize virtual private network used in real life applications using Cisco Packet Tracer simulation tool. (P.I.- 5.1.1,11.2.2)*	

<table>
<tr><td>04.</td><td>Learning Objectives:
1. Expected to implement core programming APIs for networking concepts like Socket programming.
2. Expected to perform remote login using Telnet Server.</td><td>08</td></tr>
<tr><td rowspan="4"></td><td>Networking APIs: Socket Programming & Telnet Remote Access
Laboratory Exercises:
1. Write a program to implement socket programming using TCP
2. Write a program to implement socket programming using UDP.
3. To perform remote login using Telnet Server in Linux /windows</td><td rowspan="2"></td></tr>
<tr><td>Learning Outcomes:
A learner will be able to
LO4.1 Use JAVA/python language to write program for socket programming based on TCP or UDP. (P.I.- 4.1.3)
LO4.2 Setup and configure telnet server and client for remote login and apply these strategies in future for professional development. (P.I.- 4.1.2, P.I.- 11.1.1)</td></tr>
<tr><td>Minimum 2 or 3 laboratory exercises from each module, and total at least 10 exercises</td><td></td></tr>
<tr><td align="right">Total</td><td>30</td></tr>
</table>

P.I. No.	**P.I. Statement**
3.4.1	Able to refine architecture design into a detailed design within the existing constraints
4.1.2	Able to choose appropriate procedure/algorithm, dataset and filters.
4.1.3	Able to choose appropriate hardware/software tools to conduct the experiment.
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 such as computer aided drafting, modeling and analysis; 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.
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.

Course Outcomes: A learner will be able to-

1. Develop and setup network environment in Linux.(LO1.4, LO1.6, LO3.1)
2. Use Network tools and simulators such as NS2, Wireshark etc. to explore network algorithms and protocols. .(LO1.2, LO1.5, LO2.1,LO2.3)
3. Setup and configure network connections. .(LO1.1, LO1.2, LO1.3)
4. Implement programs using core programming APIs for understanding network concepts. .(LO2.1, LO2.4, LO3.1,LO3.2,LO3.3,LO3.4,LO4.1,LO4.2)

CO-PO Mapping Table with Correlation Level

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CELBC405.1	-	-	2	3	3	-	-	-	-	-	-
CELBC405.2	-	-	-	3	3	-	-	-	-	-	2
CELBC405.3	-	-	-	3	3	-	-	-	-	-	2
CELBC405.4	-	-	-	2	-	-	-	-	-	-	2
Average	**-**	**-**	**2**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**2**

Text Books:

1. Computer Network Simulation in NS2 Basic Concepts and Protocol implementation, Prof Neeraj Bhargava, Pramod Singh Rathore, Dr.Ritu Bhargava Dr.Abhishek Kumar, First Edition, 2020, BPB Publication.
2. Packet analysis with Wire shark, Anish Nath, 2015, PACKT publishing NS2.34 Manual.
3. Practical Packet Analysis Using Wireshark to Solve Real-World Network Problems, Chris Sanders, Second Edition,2007, No Starch Press.

Reference Books:

1. An Engineering Approach to Computer Networking, S. Keshav,1 Edition, 2007, Pearson.
2. Computer Networks: Principles, Technologies & Protocols for Network Design, Natalia Olifer & Victor Olifer, 1 Edition, 2006 Wiley India.
3. Computer Networks: A Systems Approach, Larry L.Peterson, Bruce S.Davie, , Second Edition, 2011, The Morgan Kaufmann Series in Networking.

Other Resources:

1. CISCO Network Academy: https://www.netacad.com/courses/packet-tracer/introduction-packet-tracer
2. A coursera Course- https://www.coursera.org/projects/data-forwarding-computer-networks
3. TUMx: iLabX: https://www.edx.org/course/ilabx-the-internet-masterclass

CONTINUOUS ASSESSMENT (25 Marks)

Suggested breakup of distribution
Laboratory Exercises- 10 Marks
Internal Assessment-
Practical Test– 10 Marks

Evaluation of the conceptual, problem solving and programming skills of each student will be assessed based on their approach towards problem solving, implementation of concepts and execution of the task using a software tool.

Regularity and Active Participation- 5 Marks

END SEMESTER EXAMINATION (Practical /Oral Examination) (25 Marks)

Students will be assessed based on three parameters:

- Concept/Tool knowledge
- Practical programming knowledge
- Oral

1. Students will be randomly allocated a practical from the list of laboratory exercises and will be asked to write appropriate concept/methodology/program for the same. This is checked by the examiners (Internal and External) and weightage for this is 5 Marks.

   Then the student will be allowed to start with the implementation.

2. Students will be allocated 1 hour to complete the execution. The execution is then checked by both the examiners for its correctness. The weightage of the program implementation is 10 Marks.

3. Students will then be appearing for Oral in front of both Internal and External examiners. The weightage of Oral will be of 10 Marks

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

Course Type	Course Code	Course Name	Credits
SBL	CESBL402	WEB DEVELOPMENT LABORATORY	02

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

Pre-requisite:

1. ESL103- Programming Laboratory -I (C)
2. ESL205- Java Programming Laboratory-II (Java)
3 CESBL301- Python Programming 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. PO7: Ethics
7. PO8: Individual and Collaborative team work
8. PO9: Communication
9. PO11: Life Long Learning

Course Objectives:

1. To familiarize various components of HTML and CSS.
2. To facilitate in developing a responsive web application using JavaScript for enhanced user experience across devices.
3. To guide in implementing database connectivity using PHP and JSP to create dynamic web applications with data-driven content.
4. To guide in creating an interactive web application using AJAX, JavaScript, and jQuery to fetch and display dynamic content without page reloads.

Module	Detailed Contents	Hrs
00	**Course Introduction** Incorporating web development in computer science engineering curricula helps students apply theoretical knowledge to real-world projects, enhancing problem-solving skills. Exposure to diverse technologies cultivates versatility, aiding adaptation to industry trends. Collaborative web projects also foster teamwork, communication, and project management skills crucial for professional success. This integration enriches technical proficiency and develops essential soft skills, ensuring comprehensive readiness for future careers.	**01**
01.	**Foundations of Web Communication and Markup Languages** ***Learning Objective:*** *Learners are expected to identify and apply appropriate HTML and HTML5 elements to improve webpage interactivity, structure, and media integration.*	**09**

	Content: 1.1 Clients, Servers, and Communication. The Internet-Basic- Internet Protocols, The World Wide Web-HTTP request, Message-response Message-Web Clients Web Servers. 1.2 Basics of HTML- HTML Tags and attributes, meta tags, character, entities, hyperlink, lists, tables, images, forms, divs, XHTML 1.3 HTML5 control elements, Semantic elements, Audio – Video controls **Laboratory Exercise/s** **1. Designing Static Web Pages for any open-ended problem.** **(Case Study- Institution Web Page)** **a) Designing the Home Page:** - Create a static home page with three frames layout, typically including a navigation frame, content frame, and footer frame. - The navigation frame should contain links to different sections of the website such as About Us, Courses, Events, Contact Us, etc. - The content frame should display introductory information about the institution, highlights, and upcoming events. - The footer frame can include contact information, social media links, and copyright details. **b) Creating the Login Page:** - Design a login page with input fields for username and password, along with a login button. - Optionally, include a Forgot Password link for password recovery functionality. **c) Developing the Catalog Page:** - Design a catalog page to display details of available books or resources in a tabular format. - Include columns such as book title, author, ISBN, publication date, and availability status. - Populate the table with sample book data for demonstration purposes ***Self-Learning Topics:*** *Drag and Drop* ***Learning Outcomes :*** *A learner will be able to* *LO 1.1: Apply acquired programming knowledge to establish logical flow and structure when creating static web pages (P.I 1.4.1)* *LO 1.2: Identify HTML tags used to design static web pages independently (P.I.-2.1.1, 8.1.1)* *LO 1.3: Create a webpage using a variety of HTML5 elements, focusing on semantic elements, and apply this knowledge in subsequent mini-projects for advanced web development in higher-level classes. (P.I.-2.3.2,11.1.1)* *LO 1.4: Integrate audio and video elements into webpages using HTML5 technique to create a more engaging multimedia experience for users. They will also adhere to fundamental programming ethics, produce clear and well-constructed written documents of their results. (P.I- 5.1.2, 7.1.1, 11.1.2.)*	
02.	**Mastering CSS for Modern Web Design** ***Learning Objective:*** *Learners expected to design and style static websites proficiently using CSS, showcasing diverse designs by applying a range of CSS properties.*	**10**

Content:

2.1 Introduction to CSS, Types of CSS, Syntax, selectors, Manipulating texts, using fonts, background images, colors, borders and boxes, margins, padding lists, positioning using CSS.

2.2 Gradients, Shadow Effects, Transformations, transitions and animations, etc., CSS box modal and CSS Flex, Positioning systems of CSS, CSS media Queries.

Laboratory Exercise/s

2. Enhancing Web Page Design with Advanced CSS Techniques

Use advanced CSS techniques to enhance the web design and user experience of the web pages created as first Laboratory Exercise. This Laboratory Exercise focuses on incorporating CSS Animations, Transformations, Transitions, and styling elements to achieve dynamic and visually appealing results.

a) Implement CSS Animations:

- Identify specific elements on the web pages where animations will be applied, such as buttons, images, or text.
- Use CSS key frames to define animation sequences, such as fading effects, sliding animations, or rotating elements.

b) Incorporate CSS Transformations:

- Laboratory Exercise with CSS transformations like scale, rotate, skew, and translate to modify the appearance and layout of elements.
- Apply transformations to images, text blocks, or navigation menus to create dynamic visual effects.

c) Integrate CSS Transitions:

- Add transitions to elements such as hover effects on buttons or menu items to improve user experience.
- Define transition properties like duration, timing functions, and specific style changes during transitions.

d) Design Stylish Elements:

- Add borders, margins, padding to elements to create well-defined layouts and spacing.
- Style lists with customized bullet points, indentation, or hover effects for interactive lists.

Self-Learning Topics:
Basics of Bootstrap

Learning Outcomes :
A learner will be able to

LO 2.1: Demonstrate the ability to create a diverse range of web page designs employing advanced CSS techniques and leverage this expertise in developing sophisticated web-based applications. (P.I.-3.2.2,5.1.1,11.1.1)

LO 2.2: Explore the design alternatives of web page in HTML document using various CSS properties independently (P.I.-3.2.1, 8.1.1)

LO 2.3: Enhance a static web pages using CSS techniques to apply borders, margins, padding, and lists for enhanced visual layout and styling. They will also adhere to fundamental programming ethics, produce clear and well-constructed written documents of their results. (P.I - 5.1.2, 7.1.1,9.1.2)

<table>
<tr><td rowspan="3">03.</td><td>JavaScript Fundamentals

Learning Objective:
Design and develop web pages with appropriate JavaScript functions while analyzing and recognizing the concepts of exception and event handling mechanisms</td><td rowspan="3">10</td></tr>
<tr><td>Content:
3.1 Client side scripting, Introduction to JavaScript, writing simple JavaScript, Introduction to ES6, Difference between ES5 and ES6. Variables, Condition, Loops, Functions, Events, Arrow functions
3.2 JavaScript alert, prompt and confirm. Objects in JavaScript, Access /Manipulate web browser elements using DOM Structure, forms and validations, JavaScript events
3.3 Setting CSS Styles using JavaScript, DOM manipulation, Classes and Inheritance.
3.4 Iterators and Generators, Promise, Client-server communication, Fetch Self Learning Topics: Topological Sorting.

Laboratory Exercise/s
3. Enhancing Web Page Design with JavaScript Interactivity

Building upon the foundation of designing static web pages and enhancing them with advanced CSS techniques, this Laboratory Exercise focuses on adding interactivity and functionality to web pages using JavaScript.

a) Incorporate JavaScript for user interactions:

- Implement event listeners for buttons, forms, and other elements to handle user actions.
- Use conditional statements for dynamic content display based on user input or events.

b) Access and manipulate DOM elements:

- Use document methods to select and modify HTML elements dynamically.
- Update text content, styles, and attributes of elements based on user interactions or data changes.

c) Implement client-side form validations:

- Validate user input for login credentials, form submissions, or other interactive elements.
- Display error messages or feedback based on validation results.

d) Use JavaScript dialog boxes:

- Implement alerts, prompts, and confirmations for user notifications and interactions.
- Customize dialog messages and responses based on application logic.

Note: Please ensure to add dedicated pages or functionalities to accommodate and perform the above Laboratory Exercises within an existing web page

Self-Learning Topics: JSON introduction</td></tr>
<tr><td>Learning Outcomes :
A learner will be able to
LO 3.1: Design and develop web pages using appropriate JavaScript Functions independently (P.I.-4.1.2, 5.1.2, 8.1.1)
LO 3.2: Demonstrate proficiency in integrating interactivity and functionality into web pages using JavaScript, recognizing the importance of designing interactive web pages in the digital age. Additionally, uphold fundamental programming ethics and produce well-constructed written documents detailing their results (P.I 4.2.1, 7.1.1,9.1.1, 11.1.1,11.2.2)</td></tr>
<tr><td>04.</td><td>JQuery Essentials

Learning Objective:
To explore jQuery's capabilities in enhancing web page interactivity through animations, AJAX requests, and dynamic content updates, apply form submission to a server using jQuery's $.post() method, and utilize key JavaScript and jQuery concepts to create interactive and dynamic web content.</td><td>10</td></tr>
</table>

	Content: 4.1 jQuery – Selectors :CSS Element Class Selector and Universal Selector,CSS Multiple Elements E, F, G Selector, jQuery Callback Functions 4.2 Query – Effects, JQuery Effect Methods, jQuery Load, jQuery Get , jQuery Post Hide and Show , jQuery Toggle , jQuery Slide – slideDown, slideUp, slideToggle, jQuery transition effects. **Laboratory Exercise/s** **4 Mastering jQuery Essentials for Web Development** Each Laboratory Exercise builds upon the previous one, gradually expanding your knowledge and skills in leveraging jQuery for dynamic and interactive web applications. **a) jQuery syntax and library inclusion in web pages.** - Use jQuery selectors to target HTML elements based on classes, IDs, and element types. - Create simple jQuery functions to manipulate DOM elements such as changing text, styles, and attributes dynamically. **b) Advanced jQuery Selectors and Events** - Utilize jQuery event handling methods (e.g., click, hover, submit) to create interactive user experiences. - Implement event delegation to handle events for dynamically added elements efficiently. **c) jQuery Effects and Animations** - Apply jQuery effect methods such as show, hide, toggle to control element visibility. - Implement slide animations (slideDown, slideUp, slideToggle) and fade animations (fadeIn, fadeOut, fadeTo) using jQuery. - Create custom animations using jQuery animate() method to animate CSS properties like height, width, opacity, etc. - Combine effects and animations to create engaging UI elements such as dropdown menus, accordions, and sliders. **Note:** Please ensure to add dedicated pages or functionalities to accommodate and perform the above Laboratory Exercises within an existing web page ***Self-Learning Topics:*** *React JS* ***Learning Outcomes :*** *A learner will be able to* *LO 4.1: Design and develop dynamic and interactive web pages using appropriate jquery independently (P.I.-4.1.2, 5.1.2, 8.1.1)* *LO 4.2: Demonstrate proficiency in web page development utilizing jQuery to integrate interactivity and dynamic elements, acknowledging the significance of designing dynamic web pages in the contemporary digital landscape. Additionally, uphold fundamental programming ethics and produce well-constructed written documents detailing their results (P.I 4.2.1, 7.1.1,9.1.1, 11.1.1,11.2.2)*	
05.	**Server-side Programming with Database Integration** ***Learning Objective:*** *To demonstrate proficiency in using PHP and JSP to create forms that validate user input, process and insert data into a database, and update or delete data, with verification using PHP and JSP.*	**10**

	Content: 5.1 Introduction to Server-side Programming: Fundamentals of PHP and JSP. Datatypes, Operators, Control Statements, Arrays and Functions of PHP and JSP. 5.2 Database interaction through PHP and JSP. **Laboratory Exercise/s** **5. Mastering PHP and MySQL Integration for Web Development** Each Laboratory Exercise builds upon the previous one, gradually expanding your knowledge and skills in PHP scripting, MySQL database connectivity, and handling data dynamically on the server side. **a) Building Dynamic Web Applications with PHP and MySQL** -Integrate PHP and MySQL functionalities to develop dynamic web applications such as content management systems, e-commerce platforms, or user management systems. -Implement user registration, login/logout functionality using PHP sessions and MySQL database storage. -Create interactive web pages that fetch, display, and update data from MySQL databases dynamically based on user interactions. **b) Debugging and Troubleshooting PHP and MySQL Interactions** -Learn debugging techniques for PHP code using logging, error reporting, and debugging tools like Xdebug. -Debug and troubleshoot common issues in PHP and MySQL interactions such as connection errors, query failures, and data retrieval problems. -Optimize PHP and MySQL configurations for performance, memory management, and scalability in production environments. -Implement error handling strategies and logging mechanisms for robust PHP and MySQL applications. **Note:** Please ensure to add dedicated pages or functionalities to accommodate and perform the above Laboratory Exercises within an existing web page ***Self-Learning Topics:*** *React Native* ***Learning Outcomes:*** *A learner will be able to* *LO 5.1: Demonstrate proficiency in creating and handling form submissions and database interactions using PHP independently. (P.I.-5.1.2, 8.1.1)* *LO 5.2: Handle server-side logic, interact with databases, and generate dynamic content using PHP and mysql. Recognize the fundamental skills in database management and interaction, providing a solid foundation for building more complex web applications and understanding how data is manipulated in real-world scenarios. They will also adhere to fundamental programming ethics, produce clear and well-constructed written documents of their results. (P.I-5.2.2,7.1.1,9.1.2 11.1.1, 11.2.2,)*	
06	**AJAX** ***Learning Objective:*** *Utilize AJAX (Asynchronous JavaScript and XML) to create dynamic web applications that fetch and display data asynchronously, enhancing user experience and reducing page reloads.*	**10**

Content:

6.1 Introduction to JavaScript and jQuery for AJAX, Handling JavaScript Events for AJAX, Asynchronous Programming in JavaScript for AJAX

6.2 Creating Visual Effects with jQuery Animations for AJAX, Building an AJAX-powered web application with JavaScript and jQuery, Debugging and Troubleshooting AJAX Code in JavaScript and jQuery.

Laboratory Exercise/s

6. Mastering AJAX Techniques with JavaScript and jQuery

Each Laboratory Exercise builds upon the previous one, gradually expanding your knowledge and skills in handling asynchronous data requests and integrating AJAX functionality into web projects.

a) AJAX with JavaScript

- Implement AJAX requests using vanilla JavaScript XML HttpRequest object to fetch data from a server asynchronously.

-Display fetched data dynamically on the web page using DOM manipulation techniques.

b) Handling JavaScript Events for AJAX

- Implement event-driven AJAX requests using JavaScript event handlers such as onclick, onchange, and onsubmit.

- Handle form submissions asynchronously using AJAX to prevent page reloads and improve user experience.

- Validate form data using JavaScript before sending AJAX requests to the server.

- Implement error handling and feedback mechanisms for AJAX responses (success and error scenarios).

c) Creating Visual Effects with jQuery Animations for AJAX

- Integrate jQuery library into the web project for enhanced DOM manipulation and animation capabilities.

- Implement jQuery animations (fadeIn, fadeOut, slideDown, slideUp, etc.) to create visual effects during AJAX interactions.

- Enhance user experience by adding loading spinners or progress bars during AJAX requests using jQuery animations.

- Combine jQuery animations with AJAX callbacks for seamless data updates and UI transitions

Note: Please ensure to add dedicated pages or functionalities to accommodate and perform the above Laboratory Exercises within an existing web page

***Self-Learning Topics:* ---** *Deployment of website*

Learning Outcomes:

A learner will be able to

LO 6.1: Explore the design alternatives to create dynamic and interactive web applications using AJAX independently. (P.I.- 3.2.1, 8.1.1, 11.2.1)

LO 6.2: Verify the functionalities and validate the web site design through AJAX. (P.I.- 3.4.3)

LO 6.3: Analyze challenges in web development and employ AJAX techniques to address them effectively, facilitating the development of precise and responsive websites. (P.I.-4.3.1,11,2,2)

LO 6.4: Represent the live data appropriately by AJAX techniques. (P.I.-4.3.3)

	LO 6.5: Identify the proper technique or method to debug the AJAX code using Javascript and jquery. Analyze challenges in web development and employ AJAX techniques to address them effectively, facilitating the development of precise and responsive websites. They will also adhere to fundamental programming ethics, produce clear and well-constructed written documents of their results ((P.I.-5.1.1, 5.2.2, 7.1.1,9.1.1)	
	Course Conclusion: Upon completion of the Web Development Lab, students will acquire the proficiency to develop dynamic and interactive web applications.	
	Total	**60**

Performance Indicators:

P.I. No.	**P.I. Statement**
1.4.1	Apply theory and principles of computer science and engineering to solve an engineering problem
2.1.2	Identify processes/modules/algorithms of a computer-based system and parameters to solve a problem
3.2.1	Able to explore design alternatives.
3.2.2	Able to produce a variety of potential design solutions suited to meet functional requirements.
3.3.1	Able to perform systematic evaluation of the degree to which several design concepts meet the criteria.
3.4.3	Able to verify the functionalities and validate the design.
4.1.2	Able to choose appropriate procedure/algorithm, dataset and test cases.
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	Adapt the tools and techniques to solve engineering problems.
5.2.2	Demonstrate proficiency in using discipline-specific tools.
7.1.1	Identify situations of unethical professional conduct and propose ethical alternatives.
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.
9.1.3	Create flow in a document or presentation - a logical progression of ideas so that the main point is clear.
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.

Course Outcomes: A learner will be able to-

1. Develop interactive web pages using HTML and CSS to engage users dynamically. *(LO 1.1, LO 1.2, LO 1.3, LO 1.4, LO 2.1, LO 2.2, LO 2.3)*
2. Design and create a responsive web application using JavaScript to ensure compatibility across devices and screen sizes. *(LO 3.1, LO 3.2)*
3. Construct an interactive web application powered by AJAX using JavaScript and jQuery for seamless data retrieval and dynamic updates. *(LO 4.1, LO 4.2, LO 4.3, LO 6.1, LO 6.2, LO 6.3, LO 6.4, LO 6.5)*
4. Demonstrate the integration of PHP and MySQL to facilitate data storage, retrieval, and manipulation in web applications. *(LO 5.1, LO 5.2)*

CO-PO Mapping Table with Correlation Level

CO ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CESBL402.1	3	3	3	-	3	-	3	3	2	-	3
CESBL402.2			-	3	2	-	-	2	2	-	3
CESBL402.3			3	3	2	-	-	2	2	-	3
CESBL402.4			-	-	3	-	2	2	2	-	3
Average	**3**	**3**	3	**3**	3	-	2	2	2	-	3

Books :

1. Developing Web Applications Ralph Moseley, Second Edition, 2007 Willy.
2. Web Technology Black Book, Kogent Learning Sol., First Edition, Dreamtech Press, 2009
3. Learning PHP, MySQL, JavaScript, CSS & HTML5, Robin Nixon, Third Edition, O'REILLY, 2014.
4. Professional Rich Internet Applications: AJAX and Beyond Dana Moore, Raymond Budd, Edward Benson, 2007 Wiley publications.
5. Learning React Functional Web Development with React and Redux, Alex Banks and Eve Porcello, First Edition, 2017, OREILLY.

Reference Books :

1. Responsive Web Design with HTML5 and CSS3 by Ben Frain , Second Edition, 2015, Packt.
2. jQuery in Action, Bear Bibeault, Yehuda Katz, 2nd Edition, 2010, Manning.

CONTINUOUS ASSESSMENT (50 Marks)

Suggested breakup of distribution

Laboratory Exercises: 15 Marks

Internal Assessment: 10 Marks

As a part of Internal Assessment, students will do course mini project. It is will be group activity [P. I. - 9.3.1]. Students will be tasked with developing a website using web programming. This project-based assessment will require students to apply their knowledge and skills gained throughout the course to design and implement a functional system using Web programming language.

Course Project Rules in Web Development Lab

1. Group Size: Groups of 2 to 4 members allowed.
2. Project Proposal: Detailed proposal with scope, objectives.
3. Project Requirements:
   - Develop a project having functional backend.
   - Deploy using basic web technologies.
   - Developed web sites should be optimized for all devices.
4. Presentation:
   - Present web site features, challenges faced, and deliverables.
   - Q&A session for evaluation.
5. Evaluation Criteria:
   - Adherence to requirements and objectives.
   - Look and feel of web site, extend of completion and organization.
   - Functionality, UI/UX and error handling.
   - Effective presentation and Q&A skills.

Regularity and active participation: 05 Marks

Practical Test: 20 Marks

Two practical tests will be conducted based on laboratory exercises.

1. Students will be randomly assigned two or more web development tasks to evaluate their web development skills.

2. Students will have a designated 2-hour time frame for code development/task execution. After the first hour, an internal examiner will assess the progress of each student's project and provide feedback for enhancements, focusing on evaluating web development skills. Alongside web development skills, problem-solving abilities will also be evaluated.

3. Towards the end of the practical or during assessment, students will be asked questions to gauge their conceptual understanding of web development principles and techniques.

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

For the End semester exams, practical examination will be conducted. The details of the end-semester evaluation are as follows. It will consist of three sections:

Section 1: Practical Examination (35 Marks)

This section will have practical exam based on the laboratory exercises conducted during the term. The assessment criteria will be similar to Internal Practical Test. Each laboratory exercise can focus on different aspects of web development, such as HTML/CSS layout, JavaScript interactivity, JQuery, AJAX, Server-side scripting or integrating APIs.

Section 2: Documentation and Presentation (05 Marks)

During the practical exam, students should incorporate comprehensive code comments for project organization and readability. Additionally, they should demonstrate visually engaging and responsive user interfaces, prioritizing accessibility considerations.

Section 3: Oral (10 Marks)

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

Course Type	Course Code	Course Name	Credits
MNP	CEMNP402	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, learner 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 IV (50 marks):
    - 15 marks for the In-Semester Two Presentations
    - 05 marks for the 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 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 AND 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: A learner will be able to-

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

H. Third Year Syllabi

Course Type	Course Code	Course Name	Credits
PCC	CEPCC509	THEORETICAL COMPUTER SCIENCE	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
3. PO3- Design/development of solutions
4. PO4- Conduct investigations of complex problems
6. PO9- Communication
7. PO11- Life-long learning

Course Objectives:

1. To familiarize with the fundamentals of TCS.
2. To develop the understanding of theoretical design of deterministic and non- deterministic finite automata, push down automata and Turing machine.
3. To equip the students with the concept of Context free grammar to recognize the language.
4. To introduce various properties of formal language.
5. To conceptualize the concept of Undecidability.

Module	**Details**	**Hrs.**
	Course Introduction The theory of computation plays a crucial role in helping engineers in the industry by providing a foundational understanding of how computational systems work. It equips engineers with the knowledge to design efficient algorithms, optimize processes, and build scalable systems. By understanding concepts like automata theory, formal languages, and complexity theory, engineers can better analyze the capabilities and limitations of different computational models, such as finite automata, pushdown automata, and Turing machines. This allows them to create software and hardware solutions that are both robust and efficient.	**01**
01.	**Basic concept and Finite Automata** ***Learning Objective***: *To familiarize the concepts of fundamentals of TCS and theoretical design of deterministic and non- deterministic finite automata*	**7-9**

	Contents: Importance of TCS, Alphabets, Strings, Languages Finite Automata (FA) and Finite State machine (FSM). Deterministic Finite Automata (DFA) and Nondeterministic Finite Automata (NFA): Definitions, transition diagrams and Language recognizers, Equivalence between NFA with and without ε- transitions, NFA to DFA Conversion, Minimization of DFA, FSM with output: Moore and Mealy machines.	
	Self-Learning Topics: *Efficiency in automata-based pattern recognition systems*	
	Learning Outcomes: *A learner will be able to* *LO 1.1: Apply engineering fundamentals to represent alphabets and strings to construct and analyze languages. (1.3.1)* *LO 1.2: Design NFA and DFA by generating potential solutions to accept strings containing a specific substring over a given input alphabet, ensuring they meet functional requirements. (P.I.-3.2.2)* *LO1.3: Apply the principal of computer science to construct Moore and Mealy machine to generate output for a given problem. (1.4.1)* *LO 1.4 Validate the correctness of Moore machine converting it to an equivalent Mealy machine. (P.I.-3.4.3)*	
02.	**Regular Expression and Language** ***Learning Objective:*** *Conceptualize the concept of regular expression and regular language*	**8-10**
	Contents: Regular expression, Equivalence of Regular Expression and Finite Automata, Arden's Theorem, Regular Expression Applications, Regular Language (RL), Closure properties of RLs, Pumping lemma for RLs.	
	Self-Learning Topics: *Decision properties of RLs*	
	Learning Outcomes: *A learner will be able to* *LO 2.1: Apply engineering fundamental to derive and interpret regular expression. (1.3.1).* *LO 2.2: Identify and apply regular expressions and grammars to recognize and analyze regular languages for computational problems. (P.I.-2.3.2)* *LO 2.3: Apply the knowledge of regular expression to understand its use in real world applications. (2.4.1)* *LO 2.3: Apply theory and principles to recall and validate closure properties in computational systems. (P.I.-1.4.1)*	
03.	**Grammar** ***Learning Objective:*** *Expected to conceptualize Context free grammar to recognize the language*	**8-10**
	Content Regular Grammar (RG), Equivalence of Left and Right linear grammar, Equivalence of RG and FA. Context Free Grammars (CFG): Definition, Sentential forms, Leftmost and Rightmost derivations, Parse tree, Ambiguity, Simplification and	

	Applications, Normal Forms: Chomsky Normal Forms (CNF) and Greibach Normal Forms (GNF), pumping lemma for CFG, Chomsky Hierarchy	
	Self-Learning Topics: *closure properties of context free language*	
	Learning Outcomes: *A learner will be able to* *LO 3.1: Apply the knowledge of discrete structure and construct Context-Free Languages by leveraging Context-Free Grammars (CFG) to solve computational problems. (P.I.-1.1.1)* *LO 3.2: Apply engineering fundamentals in simplifying and normalizing grammars to improve the accuracy and efficiency of language representation benefitting application in parsing, compiler design and natural language processing. (P.I.-1.3.1) (P.I.11.1.1)* *LO 3.3: Identify the characteristics and functionalities of language classes in the Chomsky Hierarchy, to understand computational power. (P.I.-2.2.2)* *LO 3.4: Build parse trees to address real world problem such as syntax validation in programming language and data verification. (P.I.-2.2.3) (P.I.-11.2.2) (P.I.-11.2.2)* *(syntax checking of programming language, data validation)*	
04.	**Push down Automata** ***Learning Objectives:*** *Familiarize with the theoretical design of pushdown automata*	**8-10**
	Contents: Definition, Language of PDA, PDA as generator, decider and acceptor of CFG, Deterministic PDA, Non-Deterministic PDA, Construction of PDA to CFG, Applications of PDA	
	Self-Learning Topics: *Multistack DPDA*	
	Learning Outcomes: *A learner will be able to* *LO 4.1: Apply engineering knowledge to construct PDA for the given language (1.3.1)* *LO 4.2: Apply Pushdown Automata(PDA) as a generator to model and construct structured language representation, demonstrating fundamental engineering knowledge in formal language (1.4.1).* *LO 4.3: Apply Pushdown Automata(PDA) as a decider and acceptor to analyze and validate programming language syntax, ensuring accurate parsing and error detecting in program and analysis. (2.4.4)* *LO 4.4: Apply pushdown automata (PDA) principal to design and develop efficient syntax parsers and effectively communicate formal solutions. (P.I- 3.2.1, P.I-9.2.1, P.I-9.2.2, P.I-11.1.2)* *LO 4.5: Construct deterministic and non-deterministic PDAs and explore multiple design solution to fulfill functional requirement. (3.2.2)*	
05.	**Turing Machine** ***Learning Objective:*** *Expected to design and employ the concept of Turing Machine and its variants.*	**5-7**
	Contents: Definition, Design of TM as generator, decider and acceptor. Variants of Turing machine: Multitrack, Multi-tape, Universal TM, Application, power and limitations.	
	Self-Learning Topics: *Nil*	

	Learning Outcomes : *A learner will be able to* *LO 5.1: Select and apply appropriate procedure for designing Turing machine as generators, deciders and acceptors to effectively model computational processes. (4.1.2)* *LO 5.2: Apply the knowledge of variants of Turing machine to solve real world problems (P.I.-2.2.4) (P.I.-6.4.2) (P.I.-11.2.2)* *(AI-powered chatbot, text editing software)* *LO 5.3: Design and implement a Universal Turing Machine by developing appropriate methodologies and procedures to simulate computation effectively. (P.I.-4.2.1)*	
6.	**Undecidability** ***Learning Objective:*** *Conceptualize the concept of Undecidability.*	**1-3**
	Contents: Decidability and Undecidability, Recursive and Recursively Enumerable Languages, Halting Problem, Rice's Theorem, Post Correspondence Problem.	
	Self-Learning Topics: *P-NP problems*	
	Learning Outcomes: *A learner will be able to* *LO 6.1: Apply engineering fundamental to analyse recursive and recursively enumerable languages, determining their properties and implication in computational problem solving. (P.I-1.3.1)* *LO 6.2: Apply the theory and principal od decidability and undecidability to understand computational problem and determine whether they can be algorithmically solved. (P.I-1.4.1)* *LO 6.3: Identify exiting method to analyse the post correspondence problem and apply Rice's theorem, forming justified approximation and assumption to determine the decidability and complexity of computational problem.(PI-2.2.3)* *LO 6.4: Identify and explain the halting problem by analyzing processes, modules, and algorithms to understand its significance in computational systems. (P.I.-2.1.2)*	
	Course Conclusion A Theory of Computation course concludes by establishing a foundational understanding of what problems computers can and cannot solve, providing insights into the limits of computation and laying the groundwork for designing efficient algorithms and software by exploring theoretical models like automata, Turing machines, and computational complexity, ultimately allowing developers to identify solvable problems, analyze algorithm efficiency, and avoid attempting to solve computationally impossible tasks.	**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 and engineering to solve an engineering problem
2.1.2	Identify processes/modules/algorithms of a computer-based system and parameters to solve a problem
2.2.2	Identify 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
2.3.2	Identify design constraints for required performance criteria.
2.4.1	Applies engineering mathematics to implement the solution.
2.4.4	Arrive at conclusions with respect to the objectives.
3.2.2	Able to produce a variety of potential design solutions suited to meet functional requirements.
3.4.3	Able to verify the functionalities and validate the design.
4.1.2	Able to choose appropriate procedure/algorithm, dataset and test cases.
4.2.1	Design and develop appropriate procedures/methodologies based on the study objectives
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
11.1.1	Deliver effective oral presentations to technical and non-technical audiences
11.1.2	Identify deficiencies or gaps in knowledge and demonstrate an ability to source information to close this gap
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 the basic concept of theory of computation to construct and analyse language *(LO 1.1, LO 1.2)*
2. Identify the language and accordingly design and simplify the appropriate computational models such as FA, PDA, and Turing machines. *(LO 1.3, LO 1.4, LO 4.1, LO 4.2, LO 5.1, LO 5.2)*
3. Identify and convert the grammar in various normal forms like CNF and GNF. *(LO 3.1, LO 3.2, LO 3.3)*
4. Write regular expression, prove the closure property and the type of language using pumping lemma. *(LO 2.1, LO 2.2, LO 2.3, LO 3.4)*
5. Demonstrate the concept of decidability and undecidability with through live case study. *(LO 5.3, 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
CEPCC509.1	3	-	3	-	-	-	-	-	-	-	-
CEPCC509.2	3	3	-	-	-	-	-	-	-	-	-
CEPCC509.3	3	3	-	-	-	-	-	-	-	-	3
CEPCC509.4	3	3	3	3	-	-	-	-	3	-	3
CEPCC509.5	3	3	-	-	-	-	-	-	-	-	-
Average	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**3**

Text Books :

1. John E Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, "*Introduction to Automata Theory Languages and Computation*", 3rd Edition, Pearson Education, 2011.
2. Michel Sipser, "*Introduction to Theory of Computation*", 2nd Edition, Thomson, 2012

Reference Books :

1. Mishra and Chandrashekaran, "*Theory of Computer Science – Automata Languages and Computation*", 3rd Edition, PHI, 2009
2. K V N. Sunitha, N. Kalyani, "*Formal Languages and Automata Theory*", 1st Edition, TMH, 2010

Other Resources :

1. Web Reference: https://swayam.gov.in/nd1_noc19_cs79/preview

IN-SEMESTER ASSESSMENT (50 MARKS)

1. Continuous Assessment - Theory-(20 Marks)

Suggested breakup of distribution

One MCQ test as per GATE exam pattern / level: 05 Marks.
One Class test: 05 Marks.
One Team-Pair-Solo activity: 05 Marks.
Regularity and active participation: 05 Marks.

1. 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 20%-30% weightage, and the syllabus covered from MSE to ESE carrying 70%-80% weightage.

Course Type	Course Code	Course Name	Credits
PCC	CEPCC510	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:

1. ESL205- Programming Laboratory –II (JAVA)
2. CESBL301- Python Programming Laboratory

Program Outcomes addressed:

PO 1- Engineering knowledge

PO 2- Problem analysis

PO 3 -Design/Development of Solutions

PO 4 - Conduct Investigations of Complex problems.

PO 6 -The Engineer and The World

PO 7- Ethics

PO 10 - Project Management and Finance

PO 11 -Life-long learning

Course Objectives:

1. To provide the detailed knowledge in the arena of software engineering.
2. To relate the principles of design, estimation and testing for software project development.
3. To familiarize students with the Quality Assurance and maintenance of the software.
4. To introduce the risk monitoring, reengineering and reverse engineering concepts.
5. To familiarize students with the need of software configuration management and SCM process.

Module	Details	Hrs
	Course Introduction Software Engineering course covers essential principles for designing computer software, crucial for software development and testing.	**01**

01.	**Software Engineering and Process Models.** ***Learning Objectives:*** *To study the basics and fundamentals of software engineering and process framework activities with the advanced trends in software engineering.* **Contents:** 1.1 Nature of Software-Defining software, software application domains, changing nature of software. 1.2 Software Engineering- The Software Process: -The process framework, Umbrella Activities, 1.3 Software Process Structure- A generic process model, defining a Task Set, Identifying a Task set, Process Patterns, CMM levels 1.3 Process Models-Prescriptive Process Models: - Waterfall model, Incremental models, evolutionary models, concurrent models 1.4 Agile Development- What is agility? Agility and the cost of change, what is an agile process? Agile Process models: - XP, Scrum 1.5 Modern Development Practices: What is engineering Devops?, Nine Pillars of Engineering Devops. ***Self-Learning Topics:*** *Kanban agile process model.* ***Learning Outcomes:*** *A learner will be able to* *LO 1.1: Apply engineering fundamentals of software to identify the need of software engineering process and framework activities for the software project development. (P.I.-1.3.1).* *LO 1.2: Select the best agile model for a given scenario. (P.I.-2.2.5).* *LO 1.3: Apply computer engineering fundamentals to identify the differences between various software process models and their applicability. (P.I.-1.4.1)* *LO 1.4: Recognize the cultural, technical, and organizational changes that DevOps brings to software engineering. (P.I.-2.2.4), (P.I.-11.2.2)*	**7-9**
02.	**Modeling** ***Learning Objectives:*** *To define concepts of requirement engineering and design different requirement models.* **Contents:** 2.1 Understanding the Requirements: Requirements Engineering, Eliciting Requirements, Negotiating Requirements, requirements Monitoring, Validating Requirements. 2.2 Requirement Modeling: Scenario Based Methods, class based Methods, Data Flow Diagram, SRS (Software Requirement Specification) document format (IEEE) ***Self-Learning Topics:*** *CRC Modeling.* ***Learning Outcomes:*** *A learner will be able to* *LO 2.1: Check out the various functions and features of software to be developed and categorize them based on their requirements. (P.I.-2.2.2).* *LO 2.2: Identify the process of requirement engineering for effective software design on a given problem statement. (P.I.-2.1.2)* *LO2.3: Design a requirement model for a given case study. (P.I.-3.2.1), (P.I.- 11.3.1)* *LO2.4: Design a software specification based on given requirement/data. (P.I.- 3.1.6), (P.I.- 11.1.1)*	**6-8**

03.	**Software Design** ***Learning Objectives:*** *To design and apply design principles for the development of software projects*.	**7-9**
	Contents 3.1 Design Concepts: Design within the context of software engineering, the design process, design concepts, design model. 3.2 Architectural Design: Software Architecture, Architectural Styles, Architectural designs. 3.3 Component Level Design: What is a component? Designing class- based components, Conducting component level Design. 3.4 User Interface Design: Usability of Interactive Systems, Guidelines, Principles, and Theories, Development Processes, Interaction Styles 3.5 Introduction to ethical design: the need for ethics in design, ethical design best practices.	
	Self-Learning Topics: *Developing a Swim Lane Diagram*	
	Learning Outcomes: *A learner will be able to* *LO 3.1: Assess the architectural considerations of a given application so as to meet its functional requirements. (P.I.-2.1.1)* *LO 3.2: Appraise the architecture styles and architecture design for the overall system and interaction with the external entities ethically. (P.I.-2.3.1), (P.I.-7.1.1)* *LO 3.3: Determine effects of modularity on the overall development of sustainable software design. (P.I.-3.4.2), (P.I.-6.3.2)* *LO 3.4: Implement an ethical design of a UI for a given case study using management techniques for sustainable development. (P.I.-3.1.1), (P.I.- 6.4.1), (P.I.-7.2.2)*	
04.	**Software Estimation Metrics and Managing Software Projects,** ***Learning Objectives:*** *To estimate the cost and effort, provide an overview of Software Metrics, and perform project scheduling.*	**7-9**
	Contents 4.1 Product Metrics: A Framework for Product Metrics, Metrics for the Requirement Model. 4.2 Process and Project Metrics: Metrics in the process and Project Domains, Software Measurement, Integrating Metrics within the software process. 4.3 Estimation for Software projects: Software Scope and feasibility, Resources, Decomposition Techniques: LOC-Based Estimation and FP-Based Estimation, Empirical estimation Model (COCOMO II). 4.4 Project Management Concepts: Management Spectrum, people, product, process. 4.5 Project Scheduling: Basic Concepts, project scheduling, defining a task set for the software project, Scheduling: - Time-line chart, tracking the schedule, earned value analysis.	

	Self-Learning Topics: *Estimation for Agile Development.* ***Learning Outcomes:*** *A learner will be able to* *LO 4.1: Estimate cost and effort using various software estimation techniques. (P.I.-2.1.1), (P.I.-10.1.2)* *LO 4.2: Identify the tasks and resources required to implement the given software project. (P.I.-2.2.2), (P.I.-10.3.1)* *LO 4.3: Construct a timeline chart to schedule the required tasks that are planned for the completion of a software project. (P.I.-3.1.1), (P.I.-10.3.2)* *LO 4.4: Utilizing the project management spectrum for the effective implementation of a software project explore various design alternatives. (P.I.-3.2.1), (P.I-10.2.1)*	
05.	**Software Testing** ***Learning Objectives:*** *To apply testing principles along with the maintenance of software projects.*	**4-6**
	Contents 5.1 Software testing Strategies: A strategic approach to software testing, Test strategies for Conventional software: - Unit Testing, Integration testing, Validation Testing, System testing. 5.2 Testing Conventional Applications: White-box testing: Basis path, Control structure testing black-box testing: Graph based, Equivalence, Boundary Value .	
	Self-Learning Topics: *Four-step strategy for real-time software testing.*	
	Learning Outcomes: *A learner will be able to* *LO5.1: Identify an appropriate testing strategy to create test cases for a given software application. (P.I.-4.1.2), (P.I.-6.3.1)* *LO5.2: Use a suitable white box testing and black box technique to derive test cases for ensuring validity of internal data structures. (P.I.-4.3.1), (P.I.-6.4.2).*	
06.	**Quality Assurance, Software Configuration Management, Maintenance and Reengineering** ***Learning Objectives:*** *To effectively plan and perform various aspects of software including Risk analysis, Quality assurance, management and maintenance.*	**6-8**
	Contents: 6.1 Quality Concepts, Review Techniques, Software Quality Assurance, SQA metrics 6.2 Software Configuration Management: -SCM Repository, SCM Process 6.3 Risk Management: Reactive versus Proactive risk strategies, Risk Identification, Risk projection, RMMM and RMMM plan 6.4 Introduction to sustainable and Green software development: code efficiency, Hyper efficient code, Performance versus efficiency versus greenness, Operational efficiency, GSMM (Green Software Maturity Matrix)	
	Self-Learning Topics: *Business process Reengineering Model*	

	Learning Outcomes: *A learner will be able to* *LO6.1: Determine the need of SCM for a given project by stating various processes of SCM. (P.I.-2.1.2), (P.I.-11.2.2)* *LO6.2: Use an appropriate review for uncovering the errors and improving software quality. (P.I.-4.3.1), (P.I.-11.3.1)* *LO 6.3: Construct an RMMM plan to assist a project team in defining risks by assessing its impact and probability of occurrence. (P.I.-3.1.1), (P.I.-6.3.1)* *LO6.4: Apply principles of software maintenance in an effective way for sustainable software (P.I.-2.3.1), (P.I.-6.4.1)* *LO6.5: Identify the need of green software practices and explore the strategies to improve the sustainability of software systems. (P.I.-2.1.2) (P.I.-6.3.2)*	
	Course Conclusion In conclusion, software engineering aims to develop expertise in the project planning, requirements, design, testing and quality assurance needed for effective software development.	**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	Identify functionalities and computing resources
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.
3.1.1	Able to define a precise problem statement with objectives and scope.
3.1.6	Able to develop software requirement specifications (SRS).
3.2.1	Ability to explore design alternatives.
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
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

10.1.2	Analyze different forms of financial statements to evaluate the financial status of an engineering project.
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.
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. Select the appropriate model of software process using basic fundamentals of software engineering.*(LO 1.1 ,LO 1.2, LO 1.3)*
2. Design and apply the requirement models for a given scenario.*(LO2.1, LO 2.2, LO 2.3, LO 2.4)*
3. Develop software architecture using various design principles. *(LO 3.2, LO 3.3, LO 3.4)*
4. Identify the software estimation metrics and track the progress of the software project. *(LO 4.1, LO 4.2, LO 4.3)*
5. Apply testing principles for various softwares. *(LO 5.1, LO 5.2)*
6. Analyze the need for SCM and risks for mitigation to manage quality of the software. *(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
CEPCC510.1	3	3	-	-	-	-	-	-	-	-	2
CEPCC510.2	-	3	3		-	-	-	-	-	-	3
CEPCC510.3	-	3	3	-	-	3	3	-	-	-	-
CEPCC510.4	-	3	3	-	-		-	-	-	3	-
CEPCC510.5	-	-		3	-	3	-	-	-	-	-
CEPCC510.6	-	3	2	2	-	3	-	-	-	-	3
Average	**3**	**3**	**3**	**3**	**-**	**3**	**3**	**-**	**-**	**3**	**3**

Text Books:

1. Software Engineering A Practitioner's Approach, Roger S. Pressman, 8th Edition, McGraw-Hill Publication.
2. The unified modeling language user guide, Grady Booch, James Rambaugh, Ivar Jacobson, 2nd edition, Pearson Education, 2005
3. Engineering Devops- A New Engineering Blueprint for Devops transformation-Marc Hornbeek Copyright © 2019 by Marc Hornbeek.
4. Building Green Software A Sustainable Approach to Software Development and Operations, Anne Currie, Sarah Hsu & Sara Bergman, O'Reilly Media, Copyright © 2024 WorkingProgram Ltd.
5. Designing the User Interface for effective human computer interaction, Ben Shneiderman, Catherine Plaisan, 4th Edition, Copyright ©2005 by Pearson Education, Inc
6. The Ethical Design Handbook was written by Trine Falbe, Kim Andersen, and Martin Michael Frederiksen; Published 2020 by Smashing Media AG, Freiburg, Germany.

Reference Books:

1. Fundamentals of Software Engineering, Rajib Mall, 5th edition, Prentice Hall India, 2014

Other Resources:

1. NPTEL Course: Software Engineering By Prof. Rajib Mall, IIT Kharagpur :- Web link- NPTEL

IN-SEMESTER ASSESSMENT (50 MARKS)

Continuous Assessment (20 Marks)

Suggested breakup of distribution

1. Assignment on live problems/ case studies: 10 marks
2. Orals/ Group discussion/ script writing/ public speaking/ technical report writing: 05 Marks
3. Regularity and active participation: 05 Marks

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
PEC	CEPEC5011	DATA MINING & BUSINESS INTELLIGENCE	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. CEPCC304 - Database Management System

Program Outcomes addressed:

1. PO1: Engineering knowledge.
2. PO2: Problem analysis.
3. PO3: Design/development of solutions.
4. PO5: Engineering tool usage
5. PO9: Communication
6. PO11: Life-long learning

Course Objectives:

1. To build an understanding about the principles of Data warehousing, Data Mining and Business Intelligence
2. To foster comprehensive knowledge about the architecture of a Data Mining system
3. To familiarize the concepts of the various data pre-processing Methods
4. To gain knowledge of the supervised and unsupervised learning algorithms.
5. To impart skills to approach business problems analytically identifying opportunities to derive business value from data

.

Module	Details	Hrs.
	Course Introduction Data mining and business intelligence (BI) are critical fields for computer engineering students, as they blend technical expertise with data-driven decision-making. Their significance stems from the growing role of data in every sector, enabling insights, optimizations, and innovation.	**01**

<table>
<tr><td>01.</td><td>Overview and concepts of Data Warehousing and Business Analysis

Learning Objective:
Learner is expected to familiarize with the significance of Data Warehousing, DW schemas and OLAP operations.</td><td>5-7</td></tr>
<tr><td></td><td>Contents:
Introduction to Data Warehouse, Need for data warehousing, data mart, Data Warehouse characteristics and architecture, Dimensional Modeling, Information Package Diagram, Data Warehouse Schemas; Star Schema, Snowflake Schema, Factless Fact Table, Fact Constellation Schema. ETL process OLTP versus OLAP, OLAP operations: Slice, Dice, Rollup, Drilldown and Pivot.</td><td></td></tr>
<tr><td></td><td>Self-Learning Topics:
Updation to the dimension tables.</td><td></td></tr>
<tr><td></td><td>Learning Outcomes:
A learner will be able to
LO 1.1: Apply engineering fundamentals to understand data warehouse architecture and need of creating data mart. (P.I.-1.3.1)
LO 1.2: Apply theory and principles of data warehousing to understand dimensional modeling. (P.I.-1.4.1)
LO 1.3: Evaluate the real-life problem statement. (P.I.-2.1.1)
LO 1.4: Able to produce design of data warehouse for a real-life problem statement using star schema and snowflake schema (PI-3.4.2, 11.1.1, 11.2.2)
LO 1.5: Identify the need of snowflake schema while designing data warehouse (PI-2.2.2)
LO 1.6: Able to construct a data cube to analyze an open-ended problem by applying OLAP operations. (PI-3.2.1)</td><td></td></tr>
<tr><td>02.</td><td>Introduction to Data Mining, Data Exploration and Data Pre-processing

Learning Objective:
To impart the importance of data mining principles, issues and its applications.</td><td>7-9</td></tr>
<tr><td></td><td>Contents:
Introduction to Data Mining: Importance of Data Mining: Data Mining functionalities, Data mining architecture, KDD process, Applications of Data Mining.
Data Exploration: Types of Attributes, Statistical Description of Data. Data Pre-processing: Why to pre-process data? Data cleaning: Missing Values, Noisy Data, Data Integration, Data Reduction: Attribute Subset Selection, Data Discretization: Normalization,
Binning, Histogram Analysis, Data Visualization.</td><td></td></tr>
<tr><td></td><td>Self-Learning Topics:
Major issues in Data Mining, Data Mining Task Primitives</td><td></td></tr>
</table>

	Learning Outcomes: *A learner will be able to* *LO 2.1: Define Data mining and explain the importance, functionalities, architecture, and Knowledge Discovery in Databases (KDD) process. (P.I.-1.4.1)* *LO 2.2: Identify different types of data attributes and their characteristics. (P.I.-1.1.1)* *LO 2.3: Apply statistical tools and techniques to explore and interpret data effectively for meaningful insights. (P.I.: 2.2.2)* *LO 2.4: Demonstrate the use of different data preprocessing techniques such as data cleaning, integration, data discretization and reduction to improve data quality. (P.I.-2.1.2).*	
03.	**Mining frequent patterns and associations** ***Learning Objective:*** *To acquaint data mining principles for finding frequent patterns and association between items recorded in a transactional database*	**6-8**
	Contents: Introduction to Market Basket Analysis, Frequent Itemset, Closed Itemset, and Association Rules. Mining Methods: The Apriori Algorithm: Finding Frequent Itemset Using Candidate Generation, Generating Association Rules from Frequent Itemset, Improving the Efficiency of Apriori Mining Frequent Itemsets without candidate generation (FP growth approach)	
	Self-Learning Topics: *Mining Frequent Itemset using vertical data formats. Mining Multilevel Association Rules and Multidimensional Association Rules*	
	Learning Outcomes: *A learner will be able to* *LO 3.1: Apply the engineering knowledge to understand market basket analysis. (P.I.- 1.3.1,)* *LO 3.2: Apply the fundamentals of market basket analysis to identify the patterns in given scenario. (P.I.- 1.4.1,)* *LO 3.3: Identify different pattern mining methods used for discovering hidden structures in data. (P.I.- 2.1.2).* *LO 3.4: Explore the functionality of different pattern mining methods. (P.I.- 3.2.1).* *LO 3.5: Demonstrate the use of pattern mining methods to find frequent itemsets and derive association rules from them. (P.I.- 3.4.2).* *LO 3.6: Compare different pattern mining to select the best for the given scenario. (PI-2.2.5*	
04.	**Classification**	**6-8**
	Learning Objectives: *To familiarize with concept of data mining task classification and applying it to solve a supervised learning problem.*	

	Contents: What is classification? Classification methods: Decision tree, Naïve Bayesian Classification, Introduction to evaluate the accuracy of a Classifier: Holdout, Random Sampling, Cross Validation, Bootstrap, Introduction of Ensemble methods: Bagging, Boosting.	
	Self-Learning Topics: *K nearest neighbor method* ***Learning Outcomes:*** *A learner will be able to* *LO 4.1: Apply the engineering knowledge to understand concept of classification (P.I.-1.3.1)* *LO 4.2: Apply theory and principles of computer science to understand significance of classification in data mining for extracting useful patterns. (P.I.-1.4.1)* *LO 4.3: Identify different types of classifiers to perform classification task. (P.I.-2.1.2)* *LO 4.4: Construct a Decision Tree or Naïve Bayes classifiers for a given dataset. (P.I.-3.4.2)* *LO 4.5: Demonstrate the use of constructed model to classify unknown samples based on given attributes. (P.I.- 3.4.3)* *LO 4.6: Identify various classification model evaluation techniques and explain their importance in assessing model performance. (P.I-2.1.2)*	
05.	**Clustering** ***Learning Objective/s:*** *To get familiarize with the concept of data mining task clustering and applying it to solve a unsupervised learning problem*	**7-9**
	Contents: Types of data in Cluster analysis, Partitioning Methods (*k*-Means), Hierarchical Methods (Agglomerative, Divisive).	
	Self-Learning Topics: *Partitioning Method: k-Medoids Hierarchical method: BIRCH, Density based method: DBSCAN* ***Learning Outcomes:*** *A learner will be able to* *LO 5.1: Apply the engineering knowledge to understand concept of clustering. (P.I.-1.3.1)* *LO 5.2: Apply theory and principles of computer science to understand its significance in data mining for extracting useful patterns. (P.I.-1.4.1)* *LO 5.3: Identify different types of clustering methods to group given dataset. (P.I.-2.1.2)* *LO 5.4: Explore different clustering methods and its functionality. (P.I.- 3.2.1)* *LO 5.5: Demonstrate the use of clustering methods to classify a given dataset into meaningful groups. (P.I.- 3.4.2)* *LO 5.6: Compare the performance of clustering methods (k-Means, Agglomerative, Divisive) based on evaluation measures such as within-cluster variance and dendrogram analysis. (P.I.-2.2.5)*	

06.	**Data Mining for Business Intelligence Applications** ***Learning Objective:*** *Learner is expected to apply BI to solve practical problems.*	**6-8**
	Contents: Introduction and overview of BI-Effective and timely decisions, Data Information and knowledge, BI Architecture, Development of a business intelligence system using Data Mining for business Applications like Fraud Detection, Market Segmentation, Telecommunication Industry, Banking and finance. Data Analytics life cycle : Introduction to Big data business analytics- State of the practice in analytics role of data scientists.	
	Self-Learning Topics: *Clickstream Mining, Retail industry, CRM, Epidemic prediction, Fake News Detection, Cyberbullying, Recommendation system, Sentiment Analysis etc*	
	Learning Outcomes: *A learner will be able to* *LO 6.1: Apply engineering fundamentals to understand BI Architecture and its components. (P.I.-1.3.1)* *LO 6.2: Apply principles of computer science to understand development of real life Business Intelligence systems. (P.I.-1.4.1, 11.1.1, 11.2.2)* *LO 6.3: Identify different Data Mining techniques used for Business Intelligence applications. (P.I.- 2.1.1)* *LO 6.4: Analyze the use of Data Mining techniques for Business Intelligence applications, explaining their significance and impact on decision-making. (P.I.- 2.2.3)* *LO 6.5: Visualize clustering results using appropriate data visualization tools to provide decision support using appropriate data visualization tools. (P.I. -5.1.1, 9.2.2)* *LO 6.6: Interpret visualized clustering results to gain insights and make decisions. (P.I. -5.2.2)*	
	Course Conclusion This course covers the fundamentals of storing, managing, and analyzing data to support business decision-making. It helps students understand data warehouse concepts, BI architecture, data mining techniques used to extract meaningful insights from data.	**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
1.4.1	Apply theory and principles of computer science and engineering to solve an engineering problem.
2.1.1	Evaluate problem statements and identifies objectives.
2.1.2	Identify and analyze appropriate tools and techniques for a given engineering problem.

2.2.2	Identify functionalities and computing resources.
2.2.3	Identify existing solution/methods to solve the problem including forming justified approximations and assumptions.
2.2.5	Compare and contrast alternative solution processes to select the best process.
3.2.1	Able to explore design alternatives
3.4.2	Able to implement and integrate the modules.
3.4.3	Able to verify the functionalities and validate the design.
5.1.1	Identify modern engineering tools, techniques and resources for engineering activities.
5.2.2	Demonstrate proficiency in using discipline-specific tools.
9.2.2	Deliver effective oral presentations to technical and non-technical audiences
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

Course Outcomes: A learner will be able to –

1. Apply data warehouse concepts for dimensional modeling and analyze data using OLAP operations for real life applications. *(LO 1.1, LO 1.2, LO 1.3, LO 1.4, LO 1.5, LO 1.6)*
2. Apply data mining principles for data preprocessing, transformation, and exploration to analyze and enhance data quality. *(LO 2.1, LO 2.2, LO 2.3, LO 2.4)*
3. Apply and analyze pattern mining and market basket analysis to discover associations, frequent itemsets, and recommend techniques for large-scale data challenges. *(LO 3.1, LO 3.2, LO 3.3, LO 3.4, LO 3.5, LO 3.6)*
4. Apply and analyze classification, clustering techniques to discover hidden patterns in datasets. *(LO 2.2, 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)*
5. Analyze real life applications and business case studies to demonstrate the use of data warehousing and data mining techniques and tools for better decision-making and effectively communicate insights. (*LO 1.1, LO 2.1, LO 6.1, LO 6.2, LO 6.3, LO 6.4, LO 6.5, 6.6*)

CO-PO Mapping Table with Correlation Level

CO ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CEPEC5011.1	3	3	3	-	-	-	-	-	-	-	3
CEPEC5011.2	3	3	-	-	-	-	-	-	-	-	-
CEPEC5011.3	3	3	3	-	-	-	-	-	-	-	-
CEPEC5011.4	3	3	3	-	-	-	-	-	-	-	-
CEPEC5011.5	3	3	3	-	3	-	-	-	2	-	3
Average	**3**	**3**	**3**	-	**3**	-	-	-	**2**	-	**3**

Text Books:

1. Data Mining Concepts and Techniques, Han, Kamber, 3rd Edition.
2. M.H. Dunham, "Data Mining Introductory and Advanced Topics", Pearson Education.
3. Data Warehousing Fundamentals: A Comprehensive Guide for IT Professionals, Paulraj Ponniah, Wiley Publications
4. P. N. Tan, M. Steinbach, Vipin Kumar, "Introduction to Data Mining", Pearson Education
5. Business Intelligence: Data Mining and Optimization for Decision Making by Carlo Vercellis, Wiley India Publications.

Reference Books:

1. Data Mining, Vikram Pudi & Radha Krishna, Oxford Higher Education.
2. Reema Theraja, "Data warehousing", Oxford University Press 2009.
3. Data Mining Techniques, Michael Berry and Gordon Linoff, 2nd Edition Wiley Publications.,
4. G. Shmueli, N.R. Patel, P.C. Bruce, "Data Mining for Business Intelligence: Concepts, Techniques, and Applications in Microsoft Office Excel with XLMiner", 2nd Edition, Wiley India.
5. Ian H. Witten, Eibe Frank and Mark A. Hall, "Data Mining", Morgan Kaufmann 3rd edition

Other References

1. https://www.coursera.org/specializations/data-mining
2. NPTEL Course: Data Mining by Prof. Pabitra Mitra, IIT Kharagpur Web Link- https://onlinecourses.nptel.ac.in/noc22_cs11/course

IN-SEMESTER ASSESSMENT (50 MARKS)

1. **Continuous Assessment (20 Marks)**

    1. Two Class test: 05 marks each
    2. Open book test/ Activity: 05 Marks
    3. 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 20%-30% weightage, and the syllabus covered from MSE to ESE carrying 70%-80% weightage.

Course Type	Course Code	Course Name	Credits
PEC	CEPEC5012	ADVANCE DATABASE SYSTEMS	03

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

Pre-requisite:

1. CEPCC304 - Database Management System.

Program Outcomes addressed:

1. PO1: Engineering knowledge.
2. PO2: Problem analysis.
3. PO3: Design/development of solutions.
4. PO5: Engineering Tools usage
5. PO8: Individual and Collaborative Team Work
6. PO9: Communication
7. PO11: Life-long learning.

Course Objectives:

1. To provide insights into distributed database designing.
2. To specify the various approaches used for using XML and JSON technologies.
3. To apply the concepts behind the various types of NoSQL databases and utilize it for Mongodb
4. To learn about the trends in advance databases

Module	Details	Hrs
	Course Introduction Advanced database management systems are essential for handling large volumes of complex data securely, optimizing performance, and enabling scalability. Proficiency in these systems opens up diverse career opportunities in fields such as database administration, data engineering, and business intelligence, offering competitive skills and prospects for career advancement.	**01**
01.	**Database System Architectures** ***Learning Objective/s:*** *Expected to apply database concepts, architectures, and system designs to address diverse computational requirements and enhance data management efficiency.*	**4-5**
	Contents: Heterogeneous and homogeneous databases, Centralized and client-server architectures, Server system, Architectures, Parallel systems, Distributed systems.	
	Self-Learning Topics: *Distributed Catalogue Management*	

	Learning Outcomes: *A learner will be able to* *LO1.1. Apply engineering principles to understand database architectures and evolution, highlighting technological advances that drive continuous learning by analysing source technical information. (P.I.-1.3.1, PI-11.2.1 and PI-11.3.2)* *LO1.2. To apply computer engineering concepts to illustrate the database system architecture with operational details. (P.I.-1.4.1)* *LO1.3. To identify design constraint of the various database systems. (P.I.-2.3.2)* *LO1.4. Compare and contrast various database system to select the best for the given scenario (P.I. 2.2.5)*	
02.	**Querry Processing:** ***Learning Objective/s:*** *Expected to apply algorithmic techniques in query processing and optimization, including sorting and join operations, to improve the efficiency and reliability of database systems.*	**5-7**
	Contents: Steps for processing a query, Sorting, Join Operation, Nested Loop Join Block Nested Loop Join, Hash Join , Basics , Recursive portioning, Handling of overflow	
	Self-Learning Topics: *Query Processing in Memory*	
	Learning Outcomes: *A learner will be able to* *LO2.1. Apply Engineering knowledge to determine the nature of the query. (P.I.-1.3.1)* *LO2.2. Apply theory and principles of processing a query and its optimization to improve real-world database performance. (P.I.-1.4.1, PI-11.2.1 and PI 11.2.2)* *LO2.3. Evaluate the query statement. (P.I.-2.1.1)* *LO2.4. Compare and contrast the performance of various join algorithms to determine the best. (P.I.-2.2.4)*	
03.	**Parallel databases** ***Learning Objective/s:*** *Expected to analyse and apply parallel database architectures and I/O parallelism techniques to design and optimize efficient database systems.*	**5-7**
	Contents: Introduction ,Parallel database architecture, I/O parallelism, Inter-query and Intra-query parallelism, Interoperation and Intra-operational parallelism, Factor to consider in parallel systems design.	
	Self-Learning Topics: *Parallel indexing.*	
	Learning Outcomes:	
	Learner should be able to *LO3.1. Apply Engineering knowledge to understand parallelism in database systems. (P.I.-1.3.1)* *LO3.2. Apply theory and principles of parallel databases. (P.I.-1.4.1)* *LO3.3. Identify processes of parallel database system to solve real world problem by analyzing any sourced technical information. (P.I.-2.1.2, PI-11.2.2 and*	

	P.I.11.3.2) *LO3.4. Compare and contrast I/O parallelism with respect to query and operations. (P.I.-2.2.4)*	
04.	**Distributed Databases** ***Learning Objective/s:*** *Expected to analyse and apply distributed DBMS architectures, transaction management, and concurrency control techniques, including fragmentation, replication, and locking-based methods.*	**9-11**
	Contents: Introduction, Distributed DBMS Architecture, Data Fragmentation, Replication and Allocation Techniques for Distributed Database Design. Distributed Transaction Management – Definition, properties, types, architecture, Distributed Concurrency Control- Taxonomy, Locking based, Basic TO algorithm	
	Self-Learning Topics: *Distributed Query Processing - Characterization of Query Processors, Layers/ phases of query processing,* *Recovery in Distributed Databases: Failures in distributed database, 2PC and 3PC protocol.*	
	Learning Outcomes: *A learner will be able to* *LO4.1. Apply Engineering knowledge to understand distributed database systems architecture and techniques for fragmentation and replication for distributed database design. (P.I.-1.3.1)* *LO4.2. Apply theory and principles of distributed databases to understand transaction management and concurrency control. (P.I.-1.4.1)* *LO4.3. Identify suitable concurrency control algorithm that applies to the real-world problem enabling lifelong learning. (P.I.-2.1.3,PI-11.2.1 and 11.2.2)* *LO4.4. Compare and contrast distributed concurrency control techniques. (P.I.-2.2.4)* *LO4.5 To demonstrate design alternative by applying data fragmentation technique on the given database and present the work using appropriate tools. (PI-3.2.1, P.I- 5.1.1, PI-5.2.2, PI-8.2.1, PI-8.3.1, PI-9.1.1 and PI-9.3.1)* *LO4.6 Produce Varity of design solutions which suits the problem statement. (PI-3.2.2)*	
05.	**Data interoperability – XML and JSON** ***Learning Objective/s:*** *Expected to demonstrate XML and JSON technologies for data representation, querying, transformation, and communication, comparing their efficiency and usage*	**7-9**
	Contents: XML Databases: Document Type Definition, XML Schema, Querying and Transformation: XPath and XQuery, Basic JSON syntax, (Java Script Object Notation), JSON data types, Stringifying and parsing the JSON for sending & receiving, JSON Object retrieval using key-value pair and jQuery, XML Vs JSON	

<table>
<tr><td></td><td>Self-Learning Topics:
MongoDB Shell

Learning Outcomes:
A learner will be able to
LO5.1. Apply and demonstrate Engineering knowledge to understand XML and JSON data representation and querying using appropriate tool and present the work in team. (P.I.-1.3.1, P.I- 5.1.1, PI-5.2.2, PI-8.2.1, PI-8.3.1, PI-9.1.1 and PI-9.3.1)

LO5.2. Apply theory and principles of XML and JSON in creation and representation and querying of data. (P.I.-1.4.1)

LO5.3. Evaluate problem statements and give appropriate XML and JSON for any real-world application. (PI-2.1.1, PI-11.2.1, PI- 11.2.2)

LO5.4 Compare and contrast XML and JSON methods to select the best methods for the given scenario. (PI-2.2.4)</td><td></td></tr>
<tr><td>06.</td><td>NoSQL Distribution Model
Learning Objective/s:
Apply and demonstrate NoSQL concepts, including data modelling, replication, sharding, and consistency, and compare key-value, document, and column-family stores with the CAP theorem and ACID properties.

Contents:
NoSQL database concepts: NoSQL data modelling, Benefits of NoSQL, comparison between SQL and NoSQL database system., Replication and sharding, Distribution Models Consistency in distributed data, CAP theorem, Notion of ACID Vs BASE, handling Transactions, consistency and eventual consistency, 6.3 Types of NoSQL databases: Key-value data store, Document database, Column Family Data store and Graph store, Comparison of NoSQL databases w.r.t CAP theorem and ACID properties.

Self-Learning Topics:
Graph NoSQL data store Neo4j.

Learning Outcomes:
A learner will be able to
LO6.1. Apply Engineering knowledge to understand NoSQL database Concepts. (P.I.-1.3.1)
LO6.2. Apply and demonstrate theory and principles of NoSQL in representing data in various types of NoSQL using appropriate tool and present the work. (P.I.-1.4.1, PI-5.1.1 ,PI-5.2.2, PI-8.2.1,PI-8.3.1,PI-9.1.1 and PI-9.3.1).
LO6.3. Compare and contrast various NoSQL datastores to choose the best for the given real-world scenario by analyzing sourced technical information. (PI-2.2.5, PI-11.2.2 and PI-11.3.2).
LO6.4 Identify the constraints of each of the NoSQL data store to understands its suitability in respective applications. (PI-2.3.2)</td><td>9-11</td></tr>
<tr><td></td><td>Course Conclusion
Mastering advanced database management systems equips students with the skills to manage complex data securely and efficiently, opening career opportunities in database administration, data engineering, and business intelligence, while providing a strong foundation for research in data optimization and emerging technologies.</td><td>01</td></tr>
<tr><td colspan="2">Total</td><td>45</td></tr>
</table>

Performance Indicators:

P.I. No.	**P.I. Statement**
1.3.1	Apply engineering fundamentals
1.4.1	Apply theory and principles of computer science and engineering to solve an engineering problem
2.1.1	Evaluate problem statements and identifies objectives
2.1.2	Identify 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
3.2.1	Able to explore design alternatives
3.2.2	Able to produce Varity 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 contribution from all individual efforts.
9.1.2	Produce clear, well-constructed and well supported written engineering document.
9.3.2	Use a verity of media effectively to convey a message in a document or presentation.
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.
11.3.2	Analyse sourced technical and popular information for feasibility, viability, sustainability etc.

Course Outcomes:

Learner will be able to

1. Apply and analyse database concepts to effectively address challenges related to data storage, retrieval, consistency, scalability, transaction management, query optimization, and handling large datasets in real-world applications. *(LO1.1, LO1.2, LO1.3, LO1.4)*
2. Analyse and optimize query to enhance execution efficiency, minimize memory usage, and improve scalability. *(LO2.1, LO2.2, LO2.3, LO2.4)*
3. Analyse and apply parallel architectures and I/O techniques for enhanced database performance. (*LO3.1, LO3.2, LO3.3, LO3.4)*
4. Design distributed database architectures, transaction management, concurrency control, and effectively demonstrate and present data fragmentation with replication techniques in a team-oriented approach. *(LO4.1, LO4.2, LO4.3, LO4.4, LO4.5, LO4.6)*
5. Apply and demonstrate XML and JSON technologies for efficient data representation, querying, and communication effectively through a collaborative teamwork.*(LO5.1, LO5.2, LO5.3, LO5.4)*
6. Apply and demonstrate NoSQL concepts for data modelling, distribution, and consistency and present outcome effectively through a contributory teamwork.
(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
CEPEC5012.1	3	3									3
CEPEC5012.2	3	3									3
CEPEC5012.3	3	3									3
CEPEC5012.4	3	3	3		3			3	3		3
CEPEC5012.5	3	3			3			3	3		3
CEPEC5012.6	3	3			3			3	3		3
Average	3	3	3		3			3	3		3

Text Books:

1. Database System Concepts, Korth, Slberchatz, Sudarshan, 6th Edition, McGraw Hill
2. Fundamentals of Database Systems, Elmasri and Navathe, 5th Edition, Pearson Education
3. Database Management Systems, Raghu Ramkrishnan and Johannes Gehrke, TMH

Reference Books:

1. Database Systems Design, Implementation and Management, Peter Rob and Carlos Coronel, 5th Edition, Thomson Learning
2. SQL and PL/SQL for Oracle 10g, Black Book, Dr. P.S. Deshpande, Dreamtech Press.
3. Database Management Systems, G. K. Gupta, 2012, McGraw Hill

Other Resources:

1. https://archive.nptel.ac.in/courses/106/104/106104135/
2. https://www.scaler.com/topics/dbms/distributed-database-in-dbms/

IN-SEMESTER ASSESSMENT (50 MARKS)

1. Continuous Assessment - Theory-(20 Marks)

Suggested breakup of distribution

Two Class test: 05 Marks.

One Open Book Class test/Group Activity: 05 Marks.

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 20%-30% weightage, and the syllabus covered from MSE to ESE carrying 70%-80% weightage.

Course Type	Course Code	Course Name	Credits
PEC	CEPEC5013	COMPUTER GRAPHICS AND ANIMATION	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. BSC101- Engineering Mathematics -I
2. BSC204- Engineering Mathematics -II
3. CEPCC301- Engineering Mathematics -III

Program Outcomes addressed:

1. PO1- Engineering knowledge
2. PO2- Problem analysis
3. PO5: Engineering Tool Usage
4. PO8: Individual and Collaborative Team work
5. PO9: Communication

Course Objectives:

1. To introduce the fundamental concepts and applications of computer graphics and its significance in various fields.
2. To develop an understanding of the algorithms and techniques for rendering, transformations, and visualizations in 2D and 3D.
3. To equip students with knowledge of advanced concepts like rendering, shading, and animation workflows for realistic and interactive graphics.
4. To foster problem-solving and programming skills using graphical libraries for real-world applications.
5. To encourage self-learning and exploration of emerging trends in computer graphics and animation technologies.

Module	Details	Hrs.
	Course Introduction Computer graphics and animation are essential because they allow for visual representation, design, and simulation in a variety of domains, including data visualization, virtual reality, and gaming. They foster creativity, promote cutting-edge technology like artificial intelligence and robotics, and create job possibilities in technical design, software development, and multimedia. These abilities are essential in engineering since they enhance problem-solving and communication.	**01**

01.	**Basic of Computer Graphics** ***Learning Objective:*** *To familiarize learners with the fundamental concepts and applications of computer graphics.* **Contents:** Introduction, Uses of Computer graphics, Application of computer graphics, Graphics display devices: Raster scan and random scan Graphics Hardware and Software: GPU & Graphic Cards, Graphic Libraries (OpenGL, DirectX), Input & Output devices Graphic Pipeline: Stages of the Graphics Pipeline, Fixed and Programmable Pipelines. ***Self-Learning Topics:*** *CRT, Overview of coordinate system, Scan conversion, rasterization, and rendering* ***Learning Outcomes:*** *A learner will be able to* ***LO 1.1****: Apply the basic concepts and scope of computer graphics to identify its suitability in given scenario. (P.I.- 1.3.1)* ***LO 1.2:*** *Identify the components of the graphics pipeline and their functionalities in solving engineering problems. (P.I.- 1.4.1)* ***LO 1.****3: Identify the importance of computer graphics in real-world applications. (P.I.- 2.3.1)* ***LO 1.****4: Identify the appropriate type of graphic pipeline in given scenario(P.I.- 2.2.4)*	**3-5**
02.	***Graphics Primitives and Drawing Algorithms*** ***Learning Objective:*** *To explore algorithms for rendering shapes using graphics primitives.* **Contents:** Points, Lines, and Polygons: Representation of Points and Lines, Polygon Types and Properties Line Drawing Algorithms: Digital Differential Analyzer (DDA) Algorithm, Bresenham's Line Drawing Algorithm Circle and Ellipse Drawing Algorithms: Midpoint Circle Algorithm, Midpoint Ellipse Algorithm Polygon Filling Algorithms: Scan-Line Algorithm, Flood Fill and Boundary Fill Aliasing, Antialiasing techniques like Pre and post filtering, super sampling, and pixel phasing ***Self-Learning Topics:*** *Mathematical derivation of ellipse & circle* ***Learning Outcomes:*** *A learner will be able to* ***LO 2.1:*** *Identify the appropriate type of polygons in given problem (P.I.- 2.2.4)* ***LO 2.2****: Apply engineering fundamentals to use various algorithms to show output in tabular form and draw basic geometric shapes. (P.I.- 1.3.1)* ***LO 2.3****: Apply polygon filling techniques to solve the given problem. (P.I.- 2.1.2)* ***LO 2.4****: Apply antialiasing in the given scenario. (P.I.- 1.4.1)*	**9-11**

03.	**2D & 3D Transformations** ***Learning Objective:*** *To explore mathematical principles and techniques for object transformations.*	**9-11**
	Content Two dimensional geometric transformations – Translation, Scaling, Rotation, Reflection and Shear, Composite Transformation. Homogeneous Coordinates – Need of Homogeneous Coordinates, Transformation Matrices. Three-dimensional geometric transformation – translation, scaling, rotation, reflection and shear Projection – Parallel Projection (Orthographic, oblique), Perspective Projection (one-Point, Two-Point, Three-Point)	
	Self-Learning Topics: *closure properties of context free language*	
	Learning Outcomes: *A learner will be able to* ***LO 3.1****: Develop and apply transformation techniques to manipulate 2D and 3D objects using appropriate tools, while effectively collaborating and communicating results to class. (P.I.- 5.1.2, 5.2.2, 8.2.1, 8.3.1, 9.2.2, 9.3.2)* ***LO 3.2:*** *Identify the appropriate type of projection in given problem (P.I.- 2.2.4)* ***LO 3.3:*** *Solve problems related to object transformations and visualization (P.I.- 1.4.1)* ***LO 3.4****: Apply transformation techniques to manipulate objects in 2D and 3D spaces. (P.I.- 2.4.1)*	
04.	**Viewing and Clipping** ***Learning Objectives:*** *To familiarize learners with viewing transformations and techniques to manage visibility.*	**6-8**
	Contents: Viewing Pipeline: Viewing Coordinate System, Steps in the Viewing Process Window to Viewport Transformation: Mapping Algorithms, Aspect Ratio Preservation Line Clipping Algorithms: Cohen-Sutherland Line Clipping Algorithm, Liang-Barsky Line Clipping Algorithm Polygon Clipping: Sutherland-Hodgman Algorithm, Weiler-Atherton Algorithm.	
	Self-Learning Topics: *Midpoint subdivision line clipping algorithm, Cyrus-Beck polygon clipping algorithm*	

	Learning Outcomes: *A learner will be able to* ***LO 4.1:*** *Apply the concept of the viewing pipeline and its stages on given scenario. (P.I.- 1.3.1)* ***LO 4.2:*** *Use clipping algorithms to manage the visibility of objects. (P.I.- 2.4.1)* ***LO 4.3:*** *Perform window-to-viewport transformations effectively on a given problem (P.I.- 1.1.1)* ***LO 4.4****: Compare different line clipping algorithm. (P.I.- 2.2.4)* ***LO 4.5:*** *Compare different polygon clipping algorithm. (P.I.- 2.2.4)*	
05.	**Rendering and Shading** ***Learning Objective/s:*** *Explore rendering and shading techniques for realistic visual effects.*	**5-7**
	Contents: Introduction to Rendering- Basic Rendering Pipeline, Role of Rendering in Graphics Illumination Models- Ambient Light, Diffuse Reflection, Specular Reflection, Phong Reflection Model Shading Models- Flat Shading, Gouraud Shading, Phong Shading Texture Mapping and Bump Mapping - Texture Coordinates and Mapping, Procedural Textures, Normal and Bump Mapping Techniques.	
	Self-Learning Topics: *Study advanced techniques in procedural texture generation and their applications in graphics*	
	Learning Outcomes : *A learner will be able to* *LO 5.1: Apply the principles of rendering and shading for the given problem. (P.I.- 1.4.1)* *LO 5.2: Apply the knowledge of engineering fundamentals on various illumination models to enhance realistic rendering in computer graphics. . (P.I.- 1.3.1)* *LO 5.3: Apply shading models to create realistic graphical objects. (P.I.- 2.1.2)* *LO 5.4: Identify how texture and bump mapping can be used to enhance visual effects using appropriate tools (P.I.- 2.2.3, 5.1.1, 5.2.2)*	
06.	**Introduction to Animation** ***Learning Objective/s:*** *To explore the fundamental animation techniques and workflows.*	**5-7**
	Contents:	
	Basics of Animation- Principles of Animation, Frame Rate and Persistence of Vision Keyframing and Tweening- Keyframe Animation Workflow, Interpolation Techniques Animation Techniques- Traditional Animation, Computer Animation, Procedural Animation, Physics-Based Animation Introduction to Motion Capture- Motion Capture Systems, Applications of Motion Capture.	

	Self-Learning Topics: ***Visible Surface Detection algorithms***	
	Learning Outcomes : *A learner will be able to* *LO 6.1: Apply the basic concepts of animation and its principles on given scenario (P.I.- 1.3.1)* *LO 6.2: Apply keyframing and tweening techniques to solve the given problem. (P.I.- 1.4.1)* *LO 6.3: Differentiate between traditional and modern animation methods. (P.I.-2.2.4)* *LO 6.4: Identify the appropriate type of motion capturing in given problem (P.I.- 2.4.1)* *LO 6.5: Apply various animation techniques on given problem to transform techniques objects in 2D and 3D environment using suitable tools, collaborate effectively, and present results clearly to class. (P.I.- 5.1.2,5.2.2, 8.2.1, 8.3.1, 9.2.2, 9.3.2)*	
	Course Conclusion This course provides students with comprehensive knowledge of computer graphics and animation, equipping them with the skills needed to implement graphical and animation techniques in real- world applications and fostering a deeper understanding of the underlying principles and technologies.	**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 and engineering to solve an engineering problem
2.1.2	Identify 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
2.2.4	Compare and contrast alternative solution/methods
2.3.1	Able to apply computer engineering principles to formulate modules of a system with required applicability and performance
2.4.1	Apply engineering mathematics to solve the given problem
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
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

Course Outcomes: A learner will be able to –

1. Apply & analyse the basic concepts of Computer graphics to the given problem.(*LO 1.1, LO 1.2, LO 1.3, LO 1.4*)
2. Identify & apply various algorithms for generating basic graphical objects.(*LO 2.1, LO 2.2, LO 2.3, LO 2.4*)
3. Develop skills to manipulate and visualize objects in 2D and 3D environments using appropriate tools, while effectively collaborating and communicating results to diverse audiences (*LO 3.1, LO 3.2, LO 3.3, LO 3.4, LO 6.5*)
4. Apply & compare various clipping algorithms on graphical objects. (*LO 4.1, LO 4.2, LO 4.3, LO 4.4, LO 4.5*)
5. Identify & analyse rendering techniques to achieve realistic visual effects. (*LO 5.1, LO 5.2, LO 5.3, LO 5.4*)
6. Apply & analyse various animation techniques to find solution of given problem. (*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
CEPEC5013.1	3	3	-	-	-	-	-	-	-	-	-
CEPEC5013.2	3	3	-	-	-	-	-	-	-	-	-
CEPEC5013.3	2	3	-	-	3	-	-	3	3	-	-
CEPEC5013.4	3	3	-	-	-	-	-	-	-	-	-
CEPEC5013.5	3	3	-	-	3	-	-	-	-	-	-
CEPEC5013.6	3	3	-	-	3	-	-	-	-	-	-
Average	**3**	**3**	**-**	**-**	**3**	**-**	**-**	**3**	**3**	**-**	**-**

Text Books :

1. J. D. Foley, A. Van Dam, S. K. Feiner, J. F. Hughes, "Computer Graphics: Principles and practice", Second Edition in C, Addison Wesley, 1997.
2. Donald Hearn, Pauline Baker M, "Computer Graphics", Prentice Hall, New Delhi, 2007.
3. Andleigh, P. K, Kiran Thakrar, "Multimedia Systems and Design", PHI, 2003
4. Hearn &Baker,"Computer Graphics C version", 2nd Edition, Pearson Publication

Reference Books :

1. D. F. Rogers, J. A. Adams, “Mathematical Elements for Computer Graphics”, Second Edition, McGraw Hill International Edition, 1990
2. F. S. Hill Jr., “Computer Graphics using OpenGL”, Second Edition, Pearson Education, 2003
3. Judith Jeffcoate, “Multimedia in Practice: Technology and Applications”, PHI, 1998
4. Zhigang Xiang, Roy Plastock, “Computer Graphics”, Schaum‟s Outlines McGraw-Hill Education
5. Rajesh K. Maurya,“Computer Graphics”,Wiley India Publication

Other Resources :

1. https://www.classcentral.com/course/interactivegraphics-2067
2. https://nptel.ac.in/courses/106106090https://nptel.ac.in/courses/106106090
3. https://onlinecourses.swayam2.ac.in/ntr20_ed15/preview

IN-SEMESTER ASSESSMENT (50 MARKS)

1. Continuous Assessment - Theory-(20 Marks)

Suggested breakup of distribution

Two Class test: 05 marks each

Group discussion/public speaking/technical report writing: 05 Marks

Regularity and Active participation : 05Marks

1. 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 20%-30% weightage, and the syllabus covered from MSE to ESE carrying 70%-80% weightage.

Course Type	Course Code	Course Name	Credits
PEC	CEPEC5014	DISTRIBUTED COMPUTING	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
3. PO4- Design/development of solutions
4. PO8- Individual and Collaborative Team work
5. PO9- Communication
6. PO11- Life Long Learning

Course Objectives:

1. To provide students with contemporary knowledge in distributed systems.
2. To explore the various methods used for communication in distributed systems.
3. To provide skills to measure the performance of distributed synchronization algorithms.
4. To provide knowledge of resource management, and process management including process migration.
5. To guide in case of issues involved in replication and consistency and how fault tolerance can be achieved
6. To equip students with skills to analyse and design distributed applications.

Module	Details	Hrs
	Course Introduction A distributed computing course introduces the concept of distributed systems, which are computer systems that use multiple computers to solve a single problem. The course may cover topics such as fault tolerance, how to divide tasks into smaller subtasks, and how to coordinate activities between computers	**01**
01.	**Introduction to Distributed Computing**	**4-6**
	Learning Objective: *To introduce students with contemporary knowledge in distributed systems.*	

	Contents: Characterization of Distributed Systems: Issues, Goals, Types of distributed systems: Grid and Cluster Computing Models, Hardware and Software Concepts: NOS, DOS. Middleware: Models of middleware, Services offered by middleware.	
	Self-Learning Topics: *Middleware platforms such as CORBA, COM+*	
	Learning Outcomes: *A learner will be able to* *LO1.1: Apply the concept of distributed system to identify the appropriate hardware and software required for distributed computing. (P.I.- 1.3.1)* *LO1.2: Apply computer network concepts to identify issues in distributed systems, evaluate techniques to address these challenges, and integrate new information to bridge knowledge gaps. (P.I.- 1.4.1, P.I 11.1.2)* *LO1.3: Recognize the need of distributed computing in the real-world applications (P.I.- 11.2.2)*	
02.	**Communication** ***Learning Objective:*** *To explore the various methods used for communication in distributed systems.*	**4-6**
	Contents: Interprocess communication: Remote Procedure Call (RPC), Remote Method Invocation (RMI). Message-Oriented Communication, Stream Oriented Communication, Group Communication.	
	Self-Learning Topics:NA	
	Learning Outcomes: *A learner will be able to* *LO2.1: Apply the concept of distributed computing to differentiate RPC, RMI and MOM (P.I.- 1.4.1)* *LO2.2: Differentiate between message oriented and stream oriented communication (P.I.- 1.3.1)* *LO2.3: Source and comprehend the technical literature related group communication in distributed computing. (P.I.- 11.3.1)*	
03.	**Synchronization** ***Learning Objective:*** *Expected to provide skills to measure the performance of distributed synchronization algorithms.*	**9-11**
	Contents: Clock Synchronization: Physical clock, Logical Clocks, Election Algorithms Distributed Mutual Exclusion: Requirements of Mutual Exclusion Algorithms and Performance measures. Non-token Based Algorithms: Lamport, Ricart–Agrawala's and Maekawa's Algorithms. Token-based Algorithms: Suzuki-Kasami's Broadcast Algorithms and Raymond's Tree-based Algorithm; and Comparative Performance Analysis.	

	Deadlock: Introduction, Deadlock Detection: Centralized approach, Chandy_Misra_Hass Algorithm.	
	Self-Learning Topics: NA	
	Learning Outcomes: *A learner will be able to* *LO3.1: Analyze physical and logical clock synchronization methods, identify existing solutions, and formulate justified approximations and assumptions to address timing issues in distributed systems. (P.I.- 2.2.3)* *LO3.2: Apply election algorithms to elect the new coordinator in distributed systems. (P.I.- 2.2.4)* *LO3.3: Create simulations or small-scale applications to evaluate token-based and non-token-based distributed mutual exclusion algorithms and present the findings in a group discussion. (P.I.- 2.1.2, 8.2.1, 8.4.1, 9.1.1, 9.2.2)* *LO3.4: Use the concept of 'happened before' relations for logical clock implementation in distributed systems. (P.I.- 1.3.1)* *LO3.5: Apply Chandy-Misra-Haas algorithm to detect deadlock situation. (P.I.- 1.4.1)*	
04.	**Resource and Process Management**	**6-8**
	Learning Objective: ***Expected to provide knowledge of resource management, and process management including process migration.***	
	Contents: Desirable Features of Global Scheduling algorithm, Task assignment approach, Load balancing approach and load sharing approach. Introduction to Process Management, Process Migration, Code Migration..	
	Self-Learning Topics: NA	
	Learning Outcomes: *A learner will be able to* *LO4.1: Apply task assignment approach to solve the given problem to improve the efficiency of the system. (P.I.- 1.3.1)* *LO4.2: Identify the desirable features of global scheduling algorithms (P.I.- 1.4.1)* *LO4.3: Compare the techniques used in address space transfer mechanism. (P.I.- 2.2.5)* *LO4.4: Analyze and apply existing solutions and methods for process management, forming justified approximations and assumptions to optimize scheduling, synchronization, and resource allocation in computing systems (P.I-2.2.3).* *LO4.5: Develop a small-scale application to compare load balancing and load sharing techniques, ensuring efficient task distribution across resources in distributed systems, and present the findings in a group discussion.(P.I.- 2.2.4, 8.2.1, 8.4.1, 9.1.1, 9.2.2)*	
05.	**Consistency, Replication and Fault Tolerance** ***Learning Objective/s:*** *Expected to learn issues involved in replication and consistency and how fault tolerance can be achieved.*	**7-9**

	Contents: Distributed Shared Memory (DSM): Architecture, design issues. Introduction to replication and consistency, Data-Centric and Client-Centric Consistency Models, Replica Management. Fault Tolerance: Introduction, Process resilience, Recovery. ***Learning Outcomes:*** *A learner will be able to* *LO5.1: Identify the appropriate consistency model for the given scenario and vice versa. (P.I.- 4.1.2)* *LO5.2: Identify the design issues involved in DSM. (P.I.- 1.3.1)* *LO5.3: Gain knowledge of replication techniques and the importance of consistency in distributed systems. (P.I.- 1.4.1)* *LO5.4: Differentiate between data-centric and client-centric consistency models to find their impact on system design and performance in distributed systems. (P.I.- 2.2.4)* *LO5.5: Identify and evaluate existing solutions and methods for replica management, forming justified approximations to enhance the performance in distributed systems.(P.I- 2.2.3)* *LO5.6: Use the appropriate techniques to find the faulty processes in distributed systems.(P.I.- 4.3.1)*	
06.	**Distributed File Systems** ***Learning Objective:*** *Expected to be equipped with skills to analyse and design distributed applications.*	**5-7**
	Contents: Introduction and features of DFS, File models, File Accessing models, File-Caching Schemes, File Replication, Case Study: Network File System (NFS). Designing Distributed Systems: Google Case Study. ***Self-Learning Topics: NA*** ***Learning Outcomes:*** *LO6.1: Summarize the features and functionalities of Distributed File Systems (DFS) and explain its importance with respect to the evolving technologies in distributed computing. (P.I.- 1.3.1, P.I- 11.1.1)* *LO6.2: Apply the theory and principles of computer science and engineering to optimize cache location for enhancing system performance and solving engineering problems related to data access and latency. (P.I- 1.4.1)* *LO6.3: Apply the concept of distributed file system to analyse the given case study (P.I.- 11.2.2)*	
	Course Conclusion After studying the course distributed computing the student should have a solid understanding of the fundamental concepts and techniques used in the design, implementation, and management of distributed systems.	**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 and engineering to solve an engineering problem
2.1.2	Identify 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
2.2.4	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.
2.4.4	Arrive at conclusions with respect to the objectives.
4.1.2	Able to choose appropriate procedure/algorithm, dataset and test cases.
4.3.1	Use appropriate procedures, tools and techniques to collect and analyze data
8.2.1	Demonstrate effective communication, problem-solving, conflict resolution and leadership skills
8.4.1	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
9.2.2	Deliver effective oral presentations to technical and non-technical audiences
11.1.2	Identify deficiencies or gaps in knowledge and demonstrate an ability to source information to close this gap
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.

Course Outcomes: A learner will be able to -

1. Apply distributed system technologies to identify the necessity of distributed computing and the mechanisms used for Inter-process communication in real-world application. *(LO1.1, LO1.2, LO1.3, LO2.1, LO2.2, LO2.3)*
2. Apply and analyse various techniques for clock synchronization, mutual exclusion, and deadlock.*(LO3.1, LO3.2, LO3.4)*
3. Effectively manage resources and processes in distributed computing systems, ensuring optimal resource allocation, load balancing, fault tolerance, and scalability to enhance system performance and reliability.*(LO4.1, LO4.2, LO4.3, LO4.4)*
4. Demonstrate the concepts of consistency, replication management, and fault tolerance by analyzing their principles, implementing strategies to maintain data integrity and availability, and evaluating their impact on the reliability and performance of distributed systems. *(LO5.1, LO5.2, LO5.3, LO5.4, LO5.5)*
5. Apply the knowledge of Distributed File systems in building large-scale distributed applications and effectively communicate and present results as a team, and produce clear, well-structured result. *(LO3.3, LO4.5, LO6.1, LO6.2, LO6.3)*

CO-PO Mapping Table with Correlation Level

CO ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CEPEC5014.1	3	-	-	-	-	-	-	-	-	-	3
CEPEC5014.2	3	3	-	-	-	-	-	3	3	-	-
CEPEC5014.3	3	3	-	-	-	-	-	3	3	-	-
CEPEC5014.4	3	3	-	3	-	-	-		-	-	-
CEPEC5014.5	3	-	-	-	-	-	-	-	-	-	3
Average	**3**	**3**	**-**	**3**	**-**	**-**	**-**	**3**	**3**	**-**	**3**

Text Books:

1 Andrew S. Tanenbaum and Maarten Van Steen, "*Distributed Systems: Principles and Paradigms"*, 2nd edition, Pearson Education.

2 Mukesh Singhal, Niranjan G. Shivaratri, "*Advanced concepts in operating systems: Distributed, Database and multiprocessor operating systems*", MC Graw Hill education.

3 Pradeep K.Sinha, *"Distributed Operating System-Concepts and design"*, PHI.

Reference Books:

1 M. L. Liu, "*Distributed Computing Principles and Applications*", Pearson Addison Wesley, 2004

2 George Coulouris, Jean Dollimore, Tim Kindberg, *"Distributed Systems: Concepts and Design"*, 4th Edition, Pearson Education, 2005.

Other Resources:

1 https://nptel.ac.in/courses/106106168
2 http://csis.pace.edu/~marchese/CS865/Lectures/Chap7/Chapter7fin.htm
3 https://nptel.ac.in/courses/106104182

IN-SEMESTER ASSESSMENT (50 MARKS)

1. **Continuous Assessment - Theory-(20 Marks)**

Suggested breakup of distribution

Assignment on Live problems/case studies: 10 Marks.
Group Discussion/ Technical Report writing: 05 Marks.
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 20%-30% weightage, and the syllabus covered from MSE to ESE carrying 70%-80% weightage.

Course Type	Course Code	Course Name	Credits
LBC	CELBC506	SOFTWARE ENGINEERING LABORATORY	01

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

Pre-requisite:

1. ESL205- Programming Laboratory-II (Java)
2. ESCL103 - Python Programming

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. PO7 : Ethics
6. PO8 : Individual and collaborative team work
7. PO9 : Communication
8. PO10 : Project management and finance
9. PO11 : Life-long learning

Course Objectives:

1. To divulge knowledge on Software Engineering and UML in an interactive manner through online methods.
2. To relate case studies to demonstrate the practical applications in areas of software engineering.
3. To provide an exposure to the students where they can solve small, real life problems.

Module	Detailed Contents	Hrs.
	Course Introduction Software Engineering Laboratory is the center of software development applications, driving detailed step by step approach for the creation of a given project. It focuses mainly on providing hands on environment to apply theoretical knowledge of software engineering concepts. This laboratory enables students with the practical skills and tools to build responsive and efficient real world software.	**01**

01.	**Software Process Models and Requirement gathering** ***Learning Objective:*** *To identify requirements and apply software process model to selected case study.*	6
	Contents: Introduction to basics of software engineering, analysis of a traditional and an agile model by identifying the requirements for a given problem statement, preparing a software requirement specification in a standard form.	
	Demonstration: 1. Application of a traditional process model. 2. Application of an agile process model. 3. Design a SRS document in IEEE format. 4. Construct a requirement model for the given case study. **Task1:** 1) Select a given case study (eg. Course Registration System) analyse and apply atleast one traditional process model. 2) Select a different case study (eg, Online Food Delivery System), analyse and apply atleast one agile model. **Task 2:** Identify the requirements (functional and non-functional) for any one of the above selected problem statement and design an SRS document in an IEEE format. **Task 3:** Using requirement modeling techniques construct Data flow diagram or class diagram for the same case study.	
	Self-Learning Topics: *Implement Scrum process model* ***Learning Outcomes:*** *A learner will be able to* *LO 1.1: Analyze and apply the process model for a given case study. (P.I.-2.2.5), (P.I.- 3.1.1), (P.I.- 4.1.1), (P.I.-8.1.1) (P.I.- 9.1.1)* *LO 1.2: Design a software specification based on given requirement/data using appropriate requirements modeling technique. (P.I.- 2.1.2) (P.I.- 3.1.2), (P.I.- 3.1.4), (P.I.- 3.1.6), (P.I.- 4.3.3), (P.I.-8.3.1), (P.I.- 9.1.2)*	
02.	**Modelling and Designing** ***Learning Objective:*** ***To develop architectural models for the selected case study.***	8
	Contents: Designing the framework architecture of the given case study with the help of UML diagrams.	

	Demonstration: 1) Construct a use case diagram for the same case study using Dia 2) Construct an activity diagram for the same case study Dia **Task 4:** Set up the development environment, design and develop UML diagrams(use case, activity, state) with appropriate layouts, for the given problem statement by applying fundamental concepts of the development environment and UML components.	
	Self-Learning Topics: *Modelling of Component Diagrams* *Modelling of Swimlane Diagrams* ***Learning Outcomes:*** *A learner will be able to* *LO 2.1: Explore and Assess the architectural considerations of a given application so as to meet its functional requirements and interaction with the external entities.* *(P.I.-2.1.1), (P.I.-3.2.2), (P.I.-4.1.1), (P.I.-5.1.1), (P.I.- 9.1.1), (P.I.-11.3.2)* *LO 2.2: Proficiently apply the appropriate tools for modeling the given problem statement.* *(P.I.-2.4.2), (P.I.-3.1.1), (P.I.-4.1.3), (P.I.-5.2.2), (P.I.-8.3.1), (P.I.- 9.3.1)*	
03.	**Planning and Software Configuration Management:** ***Learning Objective:*** ***To be able to perform scheduling and version controlling***	**08**
	Contents: To provide hands-on in project management tools and techniques, enabling students to effectively manage tasks, costs, progress, and versioning in real-world projects. **Demonstration:** 1) Estimate cost and effort required for the development of the given software project. 2) Construction of a timeline chart using Ganttpro, Trello 3) Assess the status of the ongoing software project 4) Manage version control using Github	

	Task 5: Applying mathematical models to predict the overall project expenses using empirical models like COCOMO model. **Task 6:** Creation of a timeline chart, such as a Gantt chart or using project management tools like Trello, to effectively schedule tasks within a project and manage task dependencies. **Task 7:** Application of earned value analysis (EVA) to monitor and track the progress of a project. **Task 8:** Lastly manage changes, track different versions, and collaborate efficiently in team-based projects by using GitHub's version control system. ***Self-Learning Topics:*** *Estimation of Test Coverage Metrics and Structural Complexity* ***Learning Outcomes:*** *A learner will be able to* *LO 3.1: Demonstrate the ability to estimate the cost and effort using various software estimation techniques for a given problem statement. (P.I.-2.2.3), (P.I.-3.1.3), (P.I.-7.1.1), (P.I.-9.1.2), (P.I.-10.1.2), (P.I.-10.2.1), (P.I.-10.3.1)* *LO3.2: Create a timeline chart to schedule the required tasks that are planned for the completion of a software project and assess the status of the ongoing project. (P.I.-2.1.1), (P.I.-3.1.1), (P.I.-4.3.3), (P.I.-5.1.1), (P.I.-8.3.1), (P.I.-9.3.1), (P.I.-10.3.2)* *LO 3.3: To demonstrate the proficiency in performing version controlling using an appropriate tool. (P.I.-4.1.3), (P.I.-5.2.2), (P.I.-7.2.2)*	
04.	**Software Testing and Risk Monitoring** ***Learning Objective:*** ***To monitor risks and check the performance of the software by using testing strategies.***	**07**
	Contents: Introduction to basics of testing environment by including creation of test cases and effective risk management in software development. **Demonstration:** 1) Creation of test cases using white box testing 2) Creation of test cases using black box testing 3) Construction of an RMMM plan. **Task 9:** Developing test cases based on the internal logic of the given system to ensure all branches, paths, and conditions in the code are covered. (white box testing).	

	Task 10: Further testing the software without any knowledge of its internal workings so as to focus on the software's functionality from an end-user perspective by constructing test cases (black box testing). **Task 11:** Finally, Construction of a plan for managing and mitigating risks throughout the software development lifecycle. (RMMM plan) ***Self-Learning Topics:*** *Develop Test plan* ***Learning Outcomes:*** *A learner will be able to* *LO 4.1: Select a suitable white box testing and black box testing technique to create test cases for a given case study. (P.I.-2.2.3), (P.I.-2.2.4), (P.I.-3.4.3), (P.I.-4.1.2), (P.I.-5.1.1), (P.I.-8.3.1), (P.I.-9.1.1), (P.I.-9.1.2), (P.I.-11.3.1).* *LO 4.2: Create an RMMM plan in identifying the risks with respect to its impact and probability to occur. (P.I.-2.1.1), (P.I.-3.1.1), (P.I.-4.3.1), (P.I.-4.3.2), (P.I.-5.2.2), (P.I.-7.2.2), (P.I.-9.3.1), (P.I.-11.3.2)*	
	Course Conclusion: Upon completion of the Software Engineering Lab, students will acquire the proficiency of teamwork and project management by working on real-world projects.	
	Total	**30**

Performance Indicators:

P.I. No.	**P.I. Statement**
2.1.1	Evaluate problem statements and identifies objectives
2.1.2	Identify 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
2.2.4	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.
2.4.2	Analyze and interpret the results using contemporary tools.
3.1.1	Able to define a precise problem statement with objectives and scope.
3.1.2	Able to identify and document system requirements from stake holders.
3.1.3	Able to review state-of-the-art literature to synthesize system requirements.
3.1.4	Able to choose appropriate quality attributes as defined by ISO/IEC/IEEE standard.
3.1.6	Able to develop software requirement specifications (SRS).
3.2.2	Able to produce a variety of potential design solutions suited to meet functional requirements.
4.1.1	Define a problem for purposes of investigation, its scope and importance.
4.1.2	Ability to choose appropriate procedure/algorithm, data set and test cases.
4.1.3	Able 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.
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.
5.1.1	Identify modern engineering tools, techniques and resources for engineering activities.
5.2.2	Demonstrate proficiency in using discipline-specific tools.
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.
8.1.1	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 non-technical information.
9.1.2	Produce clear, well-constructed, and well-supported written engineering documents.
9.3.1	Create engineering-standard figures, reports and drawings to complement writing and presentations.
10.1.2	Analyze different forms of financial statements to evaluate the financial status of an engineering project.
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.
10.3.2	Use project management tools to schedule an engineering project so it is completed on time and on budget.
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. To identify requirements and apply process model to the selected case study. *(LO 1.1, LO 1.2)*
2. To analyze and design models for the selected case study using UML modeling *(LO 2.1, LO 2.2)*
3. To use various software engineering management tools. *(LO 3.1, LO 3.2, LO 3.3)*
4. To apply testing principles and RMMM for the selected case study *(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
CELBC506.1	-	3	3	3	-	-	-	3	3	-	-
CELBC506.2	-	3	3	3	3	-	-	2	3	-	2
CELBC506.3	-	3	3	3	3	-	3	2	3	3	-
CELBC506.4	-	3	3	3	3	-	2	2	3	-	3
Average	-	3	3	3	3	-	3	3	3	3	3

Text Books:

1. Software Engineering A Practitioner's Approach, Roger S. Pressman, 8th Edition, McGraw-Hill Publication.
2. The unified modeling language user guide, Grady Booch, James Rambaugh, Ivar Jacobson, 2nd edition, Pearson Education, 2005

3. **Reference Books:**

1. Fundamentals of Software Engineering, Rajib Mall, 5th edition, Prentice Hall India, 2014.

Other Resources:

1. Dia diagram Editor: http://dia-installer.de/
2. GitHub for Open Source Projects: https://github.com
3. Trello (opensource): https://trello.com/

CONTINUOUS ASSESSMENT (25 Marks)

Suggested breakup of distribution Practical Exercises- 10 Marks Internal Assessment-
Practical Test – 10 Marks

Evaluation of the conceptual, problem solving and programming skills of each student will be assessed based on their approach towards problem solving, implementation of concepts and execution of the task using a software tool.

Regularity and active participation - 5 Marks.

END SEMESTER EXAMINATION (Practical/Oral Examination) (25 Marks)

Students will be assessed based on three parameters:

- Concept/Algorithmic knowledge
- Practical programming knowledge
- Oral

- Students will be randomly allocated an experiment from the list of laboratory exercises and will be asked to write appropriate steps for the same. The steps are checked by the examiners (Internal and External) and weightage for this is 05 Marks.

Then the student will be allowed to start with the implementation of the experiment.

- Students will be allocated 1 hour to complete the execution. The experiment is then checked by both the examiners for its correctness. The weightage of the program implementation is 10 Marks.
- Students will then be appearing for Oral in front of both Internal and External examiners. The weightage of Oral will be of 10 Marks.

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

Course Type	Course Code	Course Name	Credits
LBC	CELBC507	APPLICATION DEVELOPMENT LABORATORY	01

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

Pre-requisite:

1. ESL205- Programming Laboratory-II (Java)

Program Outcomes addressed:

1. PO2 : Problem Analysis
2. PO3 : Design/Development of Solutions
3. PO5: Engineering Tool Usage
4. PO6 : The Engineer & The World
5. PO7 : Ethics
6. PO11: Life-long learning

Course Objectives:

1. To familiarize with the lifecycle of mobile applications.
2. To facilitate in developing a responsive mobile application for enhanced user experience across devices.
3. To provide hands-on experience in implementing database connectivity to create dynamic mobile applications with data-driven content.
4. To encourage in exploring emerging trends such AI and ML to build intelligent mobile applications.

Module	Detailed Contents	Hrs.
	Course Introduction This laboratory enables students to understand the entire ecosystem of mobile applications, from design and development to deployment. It equips students with the skills to build responsive, secure, and efficient mobile applications, which enable them to excel in a rapidly evolving technology landscape.	**01**
01.	**User Interface Design and Navigation** ***Learning Objective:*** *Expected to implement basic and advanced UI components for mobile apps.*	**4-6**
	Contents: Introduction to basics of development environment and UI components for mobile applications including set up, creating a basic application with proper layouts and UI/UX interface.	

	Laboratory Exercise (Suggested Tasks): Set up the development environment, design and develop a basic application with appropriate layouts, and ensure a user-friendly UI/UX interface for the given problem statement by applying fundamental concepts of the development environment and UI components.	
	Self-Learning Topics: *Implement touch events and gestures* ***Learning Outcomes:*** *A learner will be able to* *LO 1.1: Demonstrate the ability to design and implement responsive layouts that adapt to different screen sizes and orientations using XML for the given problem statement. (P.I.- 2.1.1, 2.2.4, 3.2.1,3.2.2)* *LO 1.2: Explore the advanced UI components to build interactive user interfaces for the given problem statement. (P.I.- 2.1.2, 3.2.2,5.1.2)* *LO 1.3: Enhance the mobile app by implementing various navigation patterns for the given problem statement. (P.I. – 2.2.4, 3.2.1, 3.2.2)*	
02.	**Back End Integration and Data Handling** ***Learning Objective:*** *To demonstrate proficiency in using RESTful API and SQLLite database to create a database, manipulate the database and update or delete data with user authentication.*	**7-9**
	Contents: Basics of back end (CRUD operations), integration of back end with Android applications including authorization and handling of data. **Laboratory Exercises (Suggested Tasks):** Develop an Android application based on the given problem statement by implementing backend functionality. Perform CRUD operations, integrate the backend with the application, and implement authorization and data handling to ensure secure and efficient communication between the frontend and backend.	
	Self-Learning Topics: *Store and retrieve data from Firebase Firestore.* *Implement Firebase Cloud Messaging (FCM) for push notifications* ***Learning Outcomes:*** *A learner will be able to* *LO 2.1: Integrate RESTful APIs into mobile applications using appropriate libraries XML for the given problem statement. (P.I.- 2.1.1, 3.2.1, 5.2.2)* *LO 2.2: Execute CRUD operations on local databases and ensure data synchronization with remote servers XML for the given problem statement (P.I.- 2.2.2, 2.3.1, 3.4.2)* *LO 2.3: Proficiently use SQLite for local data storage for better data management XML for the given problem statement.(P.I.- 5.1.2,5.2.2)*	

03.	**Network Connections and Multimedia, Entertainment and GPS Based Services** ***Learning Objective:*** *Utilize the network connections to communicate with other devices for the exchange of data efficiently.* *To demonstrate proficiency in using multimedia and GPS-based services to build value added mobile app.*	**7-9**
	Contents: Introduction to network connections for data communication with other devices, integration of multimedia, GPS based services with mobile applications. **Laboratory Exercises (Suggested Tasks):** Develop a mobile application based on the given problem statement by implementing network connections for data communication with other devices. Integrate multimedia features and GPS-based services to enhance functionality and user experience.	
	Self-Learning Topics: *Monitor app performance using Firebase Analytics* ***Learning Outcomes:*** *A learner will be able to* *LO 3.1: Select and implement the appropriate network connection for data exchange using Mobile for the given problem statement. (P.I.- 2.1.1, 2.2.4, 3.2.1, 3.4.2, 7.1.1)* *LO3.2: Recognize fundamental skills in multimedia and entertainment services interaction with mobile app for the given problem statement (P.I.-5.1.2, 5.2.2, 7.1.1)* *LO 3.3: Demonstrate proficiency in creating GPS-based services to add more value to mobile app for the given problem statement (P.I.-5.1.2, 5.2.2, 7.1.1)*	
04.	**Emerging Trends** ***Learning Objective:*** *Utilize emerging trends – Machine Learning and IoT to build intelligent and efficient mobile applications that enhance mobile usability and user experience.*	**7-9**
	Contents: Exploring emerging trends such as ML, IoT towards building a smart, efficient and dynamic mobile applications. **Laboratory Exercises (Suggested Tasks):** Develop a smart and dynamic mobile application based on the given problem statement by integrating emerging technologies such as Machine Learning (ML) and the Internet of Things (IoT). Utilize these technologies to enhance efficiency, automation, and intelligent decision-making within the application.	

	Self-Learning Topics: *Build an Android app that uses ML Kit to recognize and extract text from images.* ***Learning Outcomes:*** *A learner will be able to* *LO 4.1: Demonstrate the ability to develop a diverse range of mobile apps employing machine learning techniques for the given problem statement (P.I.- 2.1.1, 2.2.4, 2.3.1, 3.2.1, 3.4.2, 5.2.2, 6.1.1, 6.2.1, 7.1.1, 11.2.1)* *LO 4.2: Explore the expertise in the field of IoT developing sophisticated mobile apps to control devices from remote location for the given problem statement. (P.I.-3.2.1, 5.1.1, 5.1.2, 6.1.1, 6.2.1, 7.1.1,11.1.1)*	
	Course Conclusion: Upon completion of the Application Development Lab, students will acquire the proficiency to develop dynamic, interactive, and intelligent mobile applications.	
	Total	**30**

Performance Indicators:

P.I. No.	**P.I. Statement**
2.1.1	Evaluate problem statements and identifies objectives
2.1.2	Identify processes/modules/algorithms of a computer-based system and parameters to solve a problem
2.2.2	Identify functionalities and computing resources.
2.2.4	Compare and contrast alternative solution/methods to select the best methods.
2.3.1	Able to apply computer engineering principles to formulate modules of a system with required applicability and performance.
3.2.1	Able to explore design alternatives.
3.2.2	Able to produce a variety of potential design solutions suited to meet functional requirement.
3.4.2	Able to implement and integrate the modules.
5.1.2	Adapt the 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 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
7.1.1	Identify situations of unethical professional conduct and propose ethical alternatives
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. Design and develop responsive user interface for mobile applications. *(LO 1.1, LO 1.2, LO 1.3)*
2. Develop a mobile application which connects the user interface with the back-end to store, retrieve, and manage data using modern tools. *(LO 2.1, LO 2.2, LO 2.3)*
3. Analyze and develop interactive mobile applications incorporating network, multimedia, and GPS services using modern tools, while ensuring data privacy and ethical practices. *(LO 3.1, LO 3.2, LO 3.3)*
4. Develop competent mobile applications using modern tools, considering societal impact, ethics and the need for continuous learning. *(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
CELBC507.1	-	3	3	-	2	-	-	-	-	-	-
CELBC507.2	-	3	3	-	3	-	-	-	-	-	-
CELBC507.3	-	3	3	-	3	-	2	-	-	-	-
CELBC507.4	-	3	3	-	3	3	2	-	-	-	3
Average	-	3	3	-	3	3	2	-	-	-	3

Text Books:

1. Professional Android 4 Application Development, Reto Meier, Wrox Publications.
2. Android User Interface Design, Ian G. Clifton, Pearson Education.
3. Beginning Android Programming with Android Studio, Wei-Meng Lee, Wiley.

Reference Books:

1. Head First Android Development, Dawn Griffiths and David Griffiths, O'Reilly.
2. Android: A Programmer's Guide, Jerome DiMarzio, McGraw-Hill.
3. Android Application Development All-in-One For Dummies, Barry Burd, Wiley.

Other Resources:

1. Android Developers Official Documentation: https://developer.android.com
2. Udacity Free Courses on Android: https://www.udacity.com
3. GeeksforGeeks Android Programming: https://www.geeksforgeeks.org
4. GitHub for Open Source Projects: https://github.com
5. Stack Overflow for Developers: https://stackoverflow.com

CONTINUOUS ASSESSMENT (25 Marks)

Suggested breakup of distribution Practical Exercises- 10 Marks Internal Assessment- Practical Test – 10 Marks

Evaluation of the conceptual, problem solving and programming skills of each student will be assessed based on their approach towards problem solving, implementation of concepts and execution of the task using a software tool.

Regularity and active participation - 5 Marks.

END SEMESTER EXAMINATION (Practical/Oral Examination) (25 Marks)

Students will be assessed based on three parameters:

- Concept/Algorithmic knowledge
- Practical programming knowledge
- Oral

- Students will be randomly allocated a program from the list of laboratory exercises and will be asked to write appropriate algorithm for the same. The algorithm is checked by the examiners (Internal and External) and weightage for this is 05 Marks.

Then the student will be allowed to start with the implementation of the program.

- Students will be allocated 1 hour to complete the execution. The program is then checked by both the examiners for its correctness. The weightage of the program implementation is 10 Marks.
- Students will then be appearing for Oral in front of both Internal and External examiners. The weightage of Oral will be of 10 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- 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**	
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.
	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, interpersonal skills and leadership skills so as to become a well-rounded professional in their field of expertise.	**01**

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:**	

	○ Introduction of Self and Topic ○ Understanding the audience, building rapport ○ Time Management ○ 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** ○ Copyrights ○ Trademarks ○ Patents ○ Geographical Indication ○ Industrial Designs ○ Trade Secrets **5.2. Start- Up Skills:** ○ Financial Literacy ○ Risk Assessment ○ Data Analysis. **5.3. Gender Equity & Inclusivity at the Work Place** ○ Study on Cases related to Gender Equity in India & Global ○ Corporate Social Responsibility ○ Inclusivity at the work place ○ 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 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
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 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
9.2.3	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	CEMNP503	Mini Project- 2A	02

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

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.

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.

Course Type	Course Code	Course Name	Credits
HSS	HSS502	ENTREPRENEURSHIP	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

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.	**1**

<table>
<tr><td>1</td><td>Fundamentals of Entrepreneurship</td><td>5-6</td></tr>
<tr><td></td><td>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.</td><td></td></tr>
<tr><td></td><td>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.</td><td></td></tr>
<tr><td></td><td>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</td><td></td></tr>
<tr><td>2</td><td>Technological Innovation and Entrepreneurship</td><td>4-5</td></tr>
<tr><td></td><td>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.</td><td></td></tr>
<tr><td></td><td>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.</td><td></td></tr>
<tr><td></td><td>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</td><td></td></tr>
<tr><td>3</td><td>Ideation, Prototyping, Testing, Validation and Commercialisation</td><td>5-6</td></tr>
<tr><td></td><td>Learning Objectives:
• Experiment to test Minimum Viable Products (MVPs) and validate business ideas.
• To formulate a Build-Measure-Learn feedback loop for continuous improvement.</td><td></td></tr>
</table>

	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.*	
4	**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.*	
5	**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: *The learner would be able to* • *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.*	
6	**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.*	
7	***Course Conclusion***	1

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: Learner will be able to

CO1: State the concept of Entrepreneurship and Indian Start-up ecosystem

CO2: Identify the business ideas and to analyse the environment for potential business opportunity.

CO3: Identify the specific measures to design, test, and validate Minimum Viable Product.

CO4: State the key concepts, and strategies related to fundraising for entrepreneurial ventures.

CO4: Identify the legal and regulatory framework for entrepreneurs in Indian context.

CO5: 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	CEPCC611	CRYPTOGRAPHY AND SYSTEM SECURITY	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. CEPCC408: Computer Network

Program Outcomes addressed:

1. PO1: Engineering knowledge.
2. PO2: Problem analysis.
3. PO3: Design/development of solutions.
4. PO7: Ethics
5. PO11: Life-long learning.

Course Objectives:

1. To familiarize learners with the basic concepts of classical encryption techniques, modular arithmetic, and number theory.
2. To facilitate the learners to apply the concept of various cryptographic algorithms including key management and their roles providing different security services
3. To familiarize hashing and MAC techniques for providing integrity and message authentication security services.
4. To foster comprehensive knowledge about the different attacks on networks and security protocols like SSL, IPsec, and PGP.
5. To impart knowledge of the system security concept to recognize malicious code.

Module	Details	Hrs.
	Course Introduction Cryptography and system security are essential for computer engineering students, as they provide the foundation for protecting data, ensuring privacy, and securing digital communications. With rising cyber threats, mastering these fields is crucial for building resilient and trustworthy systems.	**01**
01.	**Introduction - Number Theory and Basic Cryptography** ***Learning Objective:*** *To explore classical encryption techniques and their role in data protection.*	**5-7**

	Contents: 1.1 Security Goals, Attacks, Services and Mechanisms, Techniques. Modular Arithmetic: Euclidean Algorithm, Fermat's and Euler's theorem. 1.2 Classical Encryption techniques, Symmetric cipher model, Monoalphabetic and Polyalphabetic Substitution techniques: Vigenère cipher, Playfair cipher, Hill cipher, Transposition techniques: keyed and keyless transposition ciphers.	
	Self-Learning Topics: *Other encryption techniques, Chinese remainder theorem*	
	Learning Outcomes: *A learner will be able to* *LO 1.1: Use the principles of engineering to understand the basic concepts and fundamentals of system security. (P.I.-1.3.1), (P.I.-11.2.2)* *LO 1.2: Apply the basic concepts of number theory in cryptography. (P.I.-1.4.1)* *LO1.3: Compare different encryption techniques with the help of example. (P.I.-2.4.4)* *LO1.4: Use the appropriate encryption technique to decode given cipher text. (P.I.- 2.1.3)*	
02.	**Symmetric and Asymmetric key Cryptography and key management**	**7-9**
	Learning Objective: *To acquaint learners with cryptographic algorithms, key management techniques, and their role in cybersecurity.*	
	Contents: 2.1 Block cipher principles, block cipher modes of operation, DES, Double DES, Triple DES, Advanced Encryption Standard (AES), Stream Ciphers: RC4 algorithm. 2.2 Public key cryptography: Principles of public key cryptosystems- The RSA Cryptosystem, The knapsack cryptosystem. 2.3 Symmetric Key Distribution: Key management techniques: Diffie Hellman Key exchange algorithm, IKE.	
	Self-Learning Topics: *RC5, RC6*	
	Learning Outcomes: *A learner will be able to* *LO 2.1: Use the concept of symmetric key and public-key cryptography to solve the given problems. (P.I.-1.3.1)* *LO 2.2: Classify different modern cryptography techniques. (P.I.-1.4.1), (P.I.-11.2.2)* *LO 2.3: Identify symmetric (DES, AES, RC5), asymmetric key algorithms (RSA, Diffie Hellman) with benefits and limitations of different modes of operation for a block cipher. (P.I.-2.2.2), (P.I.-11.1.1)* *LO 2.4: Solve numerical problems based on the Diffie Hellman algorithm and IKE. (P.I.- 2.1.3).*	

03.	**Cryptographic Hash Functions and Digital Certificates** ***Learning Objective:*** *To explore different hashing and MAC techniques for providing integrity and message authentication security services* **Contents:** 3.1 Cryptographic hash functions, Properties of secure hash function, MD5, SHA-1, MAC, HMAC, CMAC. 3.2 Digital Certificate: X.509 format, PKI ***Self-Learning Topics: SHA-256*** ***Learning Outcomes:*** *A learner will be able to* *LO 3.1: Identify the use of hash function and state the properties applications. (P.I.- 1.3.1), (P.I.-11.2.2)* *LO 3.2: Differentiate between different MD5, SHA1. (P.I.-1.4.1)* *LO 3.3: Use different MAC techniques, HMAC and CMAC and identify which one is better. (P.I.- 2.1.3)* *LO 3.4: Compare HMAC and CMAC Hash techniques (P.I.-2.4.4)*	**5-7**
04.	***Authentication Protocols & Digital Signature Schemes*** ***Learning Objectives:*** *To explore different User Authentication, Entity Authentication tech. to provide user authentication security service.* **Contents:** 4.1 User Authentication, Entity Authentication: Password Base, Challenge Response Based, Needham Schroeder Authentication protocol, Kerberos Authentication protocol. 4.2 Digital Signature, Attacks on Digital Signature, Digital Signature Scheme: RSA. ***Self-Learning Topics: Other Digital Signature Schemes*** ***Learning Outcomes:*** *A learner will be able to* *LO 4.1: Explore basic idea of user authentication techniques like password base, challenge response based. (P.I.-1.3.1), (P.I.-11.1.1)* *LO 4.2: Identify and categorize common attacks on Digital Signature Algorithms, such as replay attacks, key recovery attacks, and forgery. (P.I.-1.4.1)* *LO 4.3: Explore Digital Signature Scheme: RSA. (P.I.-3.2.1), (P.I.-11.2.2)* *LO 4.4: Solve numerical based on RSA Digital Signature Scheme to verify the functionalities and validate the results. (P.I.-3.4.3)*	**6-8**
05.	***Network Security and Applications*** ***Learning Objective/s:*** *To study different attacks on networks and security protocols like SSL, IPsec, and PGP.* **Contents:** 5.1 Network security basics: TCP/IP vulnerabilities (Layer wise), Network Attacks: Packet Sniffing, ARP spoofing, port scanning, IP spoofing.	**7-9**

	5.2 Denial of Service: DOS attacks, ICMP flood, SYN flood, UDP flood, Distributed Denial of Service. 5.3 Internet Security Protocols: PGP, SSL, IPSEC. Network security: IDS, Firewalls	
	Self-Learning Topics: Other Internet Security Protocols	
	Learning Outcomes: *A learner will be able to* *LO 5.1: Identify TCP/IP vulnerabilities (Layer wise). (P.I.-2.2.2)* *LO 5.2: Explore different attacks on networks. (P.I.- 2.4.4), (P.I.-11.2.2)* *LO 5.3: Summarize different types of firewalls and IDS to provide security to network. (P.I.-1.3.1), (P.I.-11.1.1)* *LO 5.4: Summarize IP level Security protocol- IPsec, transport level security protocol - SSL, and email security protocol - PGP(P.I.-1.4.1), (P. 7.1.1), (P. 7.2.2)*	
06.	**System Security**	**7-9**
	Learning Objective/s: *Analyze and apply system security concept to recognize malicious code.*	
	Contents: 6.1 Software Vulnerabilities: Buffer Overflow, Format string, cross- site scripting, SQL injection 6.2 Malware: Viruses, Worms, Trojans, Logic Bomb, Bots, Rootkits.	
	Self-Learning Topics: Other types of malwares	
	Learning Outcomes: *A learner will be able to* *LO 6.1: Explore malicious programs and types of malwares. (P.I.-1.3.1)* *LO 6.2: Comparison between different types of malwares. (P.I.-1.4.1)* *LO 6.3: Identify different measures taken to avoid presence of malware in a system. (P.I.-2.2.2), (P. 7.1.1), (P.I.-7.2.2)* *LO 6.4: Compare SQL injection and XSS in terms of attack vector, impact, and defense mechanisms. (P.I.- 2.4.4)*	
	Course Conclusion In this course, students will be able to apply theoretical knowledge of system security to practical scenarios.	**01**
	Total	**45**

Performance Indicators:

P.I. No.	**P.I. Statement**
1.3.1	Apply engineering fundamentals
1.4.1	Apply fundamental engineering concepts to solve computer engineering problems
2.2.2	Identifies functionalities and computing resources
2.4.4	Arrive at conclusions with respect to the objectives
3.2.1	Able to explore design alternatives.
3.4.3	Able to verify the functionalities and validate the design

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

11.1.1 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

Course Outcomes: A learner will be able to -

1. Apply system security concepts and classical encryption techniques based on fundamental engineering and scientific principles. *(LO 1.1, LO 1.2, LO 1.3, LO 1.4)*
2. Compare and apply encryption and decryption techniques for confidentiality using mathematical and computational models. *(LO 1.1, LO 1.4, LO 2.1, LO 2.2, LO 2.3, LO 2.4)*
3. Analyze cryptographic checksums and message digest algorithms through data analysis and mathematical modeling. *(LO 1.2, LO 3.1, LO 3.2, LO 3.3, LO 3.4)*
4. Apply different digital signature algorithms to achieve authentication using engineering expertise and secure practices. *(LO 1.1, LO 1.2, LO 3.1, LO 4.1, LO 4.2, LO 4.3, LO 4.4)*
5. Analyze different attacks on networks and security protocols by leveraging research insights and critical analysis of cybersecurity threats. *(LO 1.1, LO 5.1, LO 5.2, LO 5.3, LO 5.4)*
6. Apply system security concept to recognize malicious code while upholding ethical and professional responsibilities. *(LO 1.1, 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
CEPCC611.1	3	2	-	-	-	-	-	-	-	-	2
CEPCC611.2	2	3	-	-	-	-	-	-	-	-	3
CEPCC611.3	3	2	-	-	-	-	-	-	-	-	2
CEPCC611.4	3	-	3	-	-	-	-	-	-	-	3
CEPCC611.5	3	3	-	-	-	-	3	-	-	-	3
CEPCC611.6	3	3	-	-	-	-	3	-	-	-	-
Average	**3**	**3**	**3**	**-**	**-**	**-**	**3**	**-**	**-**	**-**	**3**

Textbooks:

1. Cryptography and Network Security, Principles and Practice, William Stallings, 6th Edition, March 2013, Pearson Education.
2. Cryptography & Network Security, Behrouz A. Ferouzan, 1st Edition, February 2007, Tata Mc Graw Hill
3. Cryptography and Network Security, Behrouz A. Forouzan & Debdeep Mukhopadhyay, 3rd Edition, 2015, Tata Mc Graw Hill

Reference Books:

1. Applied Cryptography, Protocols Algorithms and Source Code in C, Bruce Schneier , Second Edition November 1995, Wiley.
2. Cryptography and Network Security, Atul Kahate, 4th Education, 2003, Tata McGraw-Hill Education.
3. Network Security Bible, Eric Cole, Second Edition,2011, Wiley.

Other Resources:

1. NPTEL Course: Cryptography and Network Security by Prof. D. Mukhopadhyay, Department of Computer Science and Engineering, IIT Kharagpur. Web Link: http://www.nptelvideos.in/2012/11/cryptography-and-network-security.html

IN-SEMESTER ASSESSMENT (50 MARKS)

1. Continuous Assessment-Theory (20 Marks)

Suggested breakup of distribution

Two Class test: 05 marks each

Group discussion/public speaking/technical report writing: 05 Marks

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 20%-30% weightage and the syllabus covered from MSE to ESE carrying 70%-80% weightage.

Course Type	Course Code	Course Name	Credits
PEC	CEPEC6021	MACHINE LEARNING	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. CEPCC301- Engineering Mathematics-III
2. CEPCC405- Engineering Mathematics-IV

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 and The World
7. PO9: Communication
8. PO11: Life-long learning

Course Objectives:

1. To familiarize learners with the basics of machine learning.
2. To guide learners to identify if the problem is a machine learning problem.
3. To introduce in depth concepts and working of various supervised and unsupervised machine learning approaches.
4. To guide learners to leverage the performance metrics to assess a machine learning model.
5. To facilitate the learners to apply various ensemble techniques for optimizing machine learning models.
6. To familiarize the dimensionality reduction techniques.

Module	Details	Hrs.
	Course Introduction: Learning machine learning is essential for leveraging data to drive innovation, improve decision-making, enhance efficiency, and stay competitive in various industries. A Machine Learning course equips computer engineering students with skills to design algorithms that enable systems to learn from data and make predictions or decisions. This foundational knowledge is crucial for developing innovative AI-driven applications in diverse domains like healthcare, finance, and robotics.	**01**

01.	**Introduction to Machine Learning** ***Learning Objectives:*** *Learners are expected to explore the basics of machine learning and be able to identify if the given problem is a machine learning problem or not and, in that case, identify the type of the problem and design the life cycle of machine learning model.*	**4-6**
	Contents: 1.1 Machine learning, Types of machine learning problems, Issues in ML, Strategy of machine learning 1.2 Applications of machine learning, Machine learning life cycle. 1.3 Training Error, Bias-Variance trade-off.	
	Self-Learning Topics: *Reinforcement Learning*	
	Learning Outcomes: *A learner will be able to* *LO 1.1: Identify the type of ML problem for the given scenario. (P.I. -2.1.2)* *LO 1.2: Define a precise the machine learning problem by analyzing the given scenario. (P.I.-3.1.1)* *LO 1.3: Design a machine learning life cycle for a given machine learning problem. (P.I. -3.2.1)* *LO 1.4: Analyze the effects of Bias and variance on given machine learning problem (P.I. 2.4.4)*	
02.	***Machine learning- Supervised Approach*** ***Learning Objective/s:*** *Learners are expected to identify if the given problem belongs to supervised approach and if so, which of the categories in particular- Regression or classification also they should be able to build the model and analyze on the basis of performance of the model.*	**10-12**
	Contents: 2.1 ***Regression*****:** Linear Regression, Ridge Regression, Lasso Regression, Performance Metrics- Mean Squared Error (MSE). Root Mean Squared Error (RMSE). Mean Absolute Error (MAE). 2.2 ***Classification:*** Linear Classification, logistic Regression, Decision trees, Gini Index, CART- Classification and Regression trees, Performance Metrics: Confusion Matrix, [Kappa Statistics], Sensitivity, Specificity, Precision, Recall, F-measure, ROC curve. 2.3 Real world Case study : Stock price prediction, medical diagnosis.	
	Self-Learning Topics: *Autoregressive models, probabilistic classification*	

	Learning Outcomes: *A learner will be able to* *LO 2.1. Apply the concepts of statistics and theory of principles of machine learning to solve problems related to Machine learning (P.I. -1.1.1)* *LO 2.2: Apply theory and principles of computer science and engineering to solve an engineering problems related to supervised Machine learning (P.I. 1.4.1)* *LO 2.3 Compare and contrast alternate solutions to select the best fit model for given scenario on the basis of performance indicators by verifying using modern tools. (P.I. – 2.2.4, 4.1.2, 5.1.2, 11.1.2).* *LO 2.4 Design a model for real world case studies by analyzing feasibility of regression and classification. (P.I. – 3.2.2, 9.1.1, 9.1.2, 11.3.2).* *LO 2.5 Critically analyze data for trends and correlations for supervised problems, stating possible errors and limitations (P.I. 4.3.2, 6.3.1, 11.1.2)*	
03.	**Machine learning- Unsupervised Approach**	**7-9**
	Learning Objective: *Learners are expected to acquire basic knowledge about distance metrics and clustering and analyze how clusters are formed, by following various clustering techniques*	
	Contents: 3.1 Introduction to clustering- soft clustering, Hard clustering, Distance metrics 3.2 Basic Clustering approaches- K-means, Hierarchical, Fuzzy clustering. 3.3 Graph Based Clustering: Clustering with minimal spanning tree 3.4 Model based Clustering: Expectation Maximization Algorithm 3.5 Density Based Clustering: DBSCAN 3.6 Real world Case study: Fraud detection	
	Self-Learning Topics: *Clustering in high dimensional data*	
	Learning Outcomes: *A learner will be able to* *LO 3.1: Analyze the impact of the distance metrics and clustering to solve an Engineering problem. (1.4.1)* *LO 3.2: Identify the type of unsupervised machine learning approach for the given problem definition. (P.I. -2.1.2).* *LO 3.3: Explore the design alternatives for clustering for real world case studies. (P.I. -3.2.1).* *LO 3.4: Choose an appropriate experimental design plan for unsupervised approach based on the study objectives (P.I.-4.2.1)* *LO 3.5: Synthesize information and knowledge about the problem from the raw data to reach appropriate conclusions for unsupervised problems (P.I.-4.3.4, P.I.-9.1.1, P.I.- 9.1.2)*	
04.	**Support Vector Machines**	**6-8**
	Learning Objectives: *Learners are expected to apply the concept of support vector machines to find optimal boundary for classification.*	
	Contents: 4.1 Constrained Optimization, Optimal decision boundary, Margins and support vectors, SVM as constrained optimization problem, SVM for linear and nonlinear classification, Basics of Kernel trick. 4.2 Support Vector Regression, Multiclass Classification.	

	4.3 Real world Case study: E-mail classification. ***Self-Learning Topics:*** *Kernel optimization, kernel machines* ***Learning Outcomes:*** *A learner will be able to* *LO 4.1: Apply the concepts of decision boundary and margins to solve an Engineering problem (P.I.-1.1.1)* *LO 4.2: Apply theory and principles of computer science and engineering to solve a classification problem using support vector machine (P.I. - 1.4.1)* *LO 4.3: Compare and contrast alternative methods to select the best classification methods (P.I. 2.2.4)* *LO 4.4: Identify design constraints of machine learning model with required applicability and performance for a given real world case study based on classification (P.I.-2.3.2)* *LO 4.5: Select the best fit classification model for given scenario on the basis of performance indicators by verifying using modern tools. (2.2.5, 5.1.2, 11.1.2)*	
05.	**Ensemble Learning** ***Learning Objective/s:*** *Learners are expected to optimize predictive modeling using ensembling techniques* **Contents:** 5.1 Ensemble concept, cross validation- validation set approach, leave p- out, leave one out, k-fold, stratified k fold, Hold out method 5.2 Boosting- Adaboost, Gradient boosting, Stumping, XGBoost, Catboost 5.3 Bagging, Sub bagging, Random Forest 5.4 Stacking, Blending 5.5 Hyperparameter optimization, Combining classifiers 5.6 Real world Case study: Heart attack Analysis and Prediction ***Self-Learning Topics:*** *DECORATE Ensemble of ANN* ***Learning Outcomes :*** *A learner will be able to* *LO 5.1: Identify the processes of ensemble method to solve a machine learning problems based on ensembling and cross validation. (P.I.-2.1.2)* *LO 5.2: Compare and contrast alternative methods for ensembling to select the best methods (P.I.- 2.2.4)* *LO 5.3: Produce potential design alternatives by applying the concepts of cross validation and ensembling for given case study. (P.I.-3.2.2)* *LO 5.4: Perform systematic evaluation of the problem to which several design constraints meet the criteria for ensembling and present the conclusions effectively (P.I.-3.3.1, 9.1.1, 9.1.2)*	**6-8**
06.	**Dimensionality Reduction** ***Learning Objective/s:*** *Learners are expected to apply dimensionality reduction techniques to optimize the machine learning models.* **Contents:** 6.1 Curse of Dimensionality, Dimensionality Reduction Techniques, Principal Component Analysis	**4-6**

	6.2 Feature Selection 6.3 Linear and nonlinear techniques for dimensionality Reduction	
	Self-Learning Topics: *Singular Value Decomposition*	
	Learning Outcomes: *A learner will be able to* *LO 6.1: Apply the knowledge of Linear Algebra to solve a PCA problem (P.I.-1.1.1)* *LO 6.2: Apply the concepts of principal Component analysis to solve a ML problem (P.I.- 1.4.1)* *LO 6.3: Identify mathematical algorithmic knowledge that applies to a given dimensionality reduction problem (P.I.-2.1.3)* *LO 6.4: Compare and contrast alternative methods for dimensionality reduction to choose appropriate method for the given scenario (P.I. 2.2.4)*	
	Course Conclusion: After completing a Machine Learning course, students will gain the ability to design data-driven models for prediction, classification, and decision- making. They will also develop analytical skills which will help them to implement ML algorithms across various domains, preparing them for advanced research and industry roles.	**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
1.4.1	Apply theory and principles of computer science and engineering to solve an engineering
2.1.2	Identify processes/modules/algorithms of a computer-based system and parameters to solve a problem
2.1.3	Identify mathematical algorithmic knowledge that applies to a given 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.
2.3.2	Identify design constraints for required performance criteria.
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.
3.2.1	Able to explore design alternatives.
3.2.2	Able to produce a variety of potential design solutions suited to meet functional requirements.
3.3.1	Able to perform systematic evaluation of the degree to which several design concepts meet the criteria.
4.1.2	Able to choose appropriate procedure/algorithm, dataset and test cases.
4.2.1	Design and develop appropriate procedures/methodologies based on the study objectives
4.3.2	Critically analyse data for trends and correlations, stating possible errors and limitations
4.3.4	Synthesize information and knowledge about the problem from the raw data to reach appropriate conclusions
5.1.2	Create/adapt/modify/extend tools and techniques to solve engineering problems
6.3.1	Identify risks/impacts in the life-cycle of an engineering product or activity

9.1.1 Read, understand and interpret technical and non-technical information

9.1.2 Produce clear, well-constructed, and well-supported written engineering documents

11.1.2 Identify deficiencies or gaps in knowledge and demonstrate an ability to source information to close this gap

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

Course Outcomes: A learner will be able to -

1. Design life cycle of a machine learning experiment for a given scenario at a coarse granular level. *(LO 1.1, LO 1.2, LO 1.3, LO 1.4)*
2. Design a strategy for building machine learning models such as regression, classification, and clustering for the given machine learning problem. *(LO 2.1, LO 2.2, LO 2.4, LO 3.1 to LO 3.5, LO 4.1, LO 4.2, LO 4.3)*
3. Analyse the performance of a supervised machine learning model using appropriate performance metrics. *(LO 2.3, LO 2.5, LO 4.4, LO 4.5)*
4. Design a strategy using various ensemble techniques to optimize a machine learning algorithm for the given problem. *(LO 5.1, LO 5.2, LO 5.3, LO 5.4)*
5. Apply dimensionality reduction techniques to improve machine learning by enhancing performance. *(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
CEPEC6021.1	-	3	3	-	-	-	-	-	-	-	-
CEPEC6021.2	3	3	3	3	-	-	-	-	3	-	2
CEPEC6021.3	-	3	-	3	2	2	-	-	-	-	2
CEPEC6021.4	-	3	3	-	-	-	-	-	3	-	-
CEPEC6021.5	3	3	-	-	-	-	-	-	-	-	-
Average	3	3	3	3	2	2	-	-	3	-	2

Text Books :

1. Peter Harrington, “Machine Learning n Action”, DreamTech Press
2. Tom M. Mitchell, “Machine Learning”, McGraw Hill
3. Ethem Alpaydın, “Introduction to Machine Learning”, MIT Press
4. Stephen Marsland, “Machine Learning An Algorithmic Perspective”, CRC Press

Reference Books :

1. Han Kamber, ―Data Mining Concepts and Techniques‖, Morgan Kaufmann Publishers
2. Richard Duda, Peter Hart, David G. Stork, “Pattern Classification”, Second Edition, Wiley Publications.
3. Margaret. H. Dunham, ―Data Mining Introductory and Advanced Topics, Pearson Education.

Other Resources :

1. https://www.coursera.org/learn/machine-learning
2. Data sets for Machine Learning algorithms: https://www.kaggle.com/datasets
3. UCI Machine Learning Repository
4. https://towardsdatascience.com/machine-learning/home

IN-SEMESTER ASSESSMENT (50 MARKS)

1. Continuous Assessment - Theory-(20 Marks)

1. *Suggested breakup of distribution*

   Assignment on live problems/case studies, wherein problems are given prior. Students are expected to research and collect required resources. They can use the resources and solve the problem on assigned date and time in institute premises in presence of faculty member: 10 Marks.

   Group Discussions/Technical Report Writing: 05 Marks.
   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 20%-30% weightage, and the syllabus covered from MSE to ESE carrying 70%-80% weightage.

Course Type	Course Code	Course Name	Credits
PEC	CEPEC6022	BIG DATA ANALYTICS	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:

CEPCC304-Database Management System

Program Outcomes addressed:

PO1- Engineering knowledge

PO2- Problem analysis

PO3- Design/development of solutions

PO4-Conduct investigations of complex problems

PO5-Engineering Tool Usage

PO8-Individual and Collaborative Team Work

PO9-Communication

PO11-Life Long learning

Course Objectives:

1. To inculcate the concepts related to big data platforms, its use cases and Hadoop ecosystem.
2. To familiarize programming skills to build simple solutions using big data technologies such as Map Reduce
3. To familiarize with programming skills to build simple solutions using big data technologies like Scripting for No SQL
4. To instill the fundamental techniques and principles in achieving big data analytics with scalability and streaming capability
5. To acquaint students with skills that will help them to solve complex real-world problems for decision support.
6. To guide the students to develop programs in R language for understanding and visualization of data using statistical, functions and plots

<table>
<tr><th>Module</th><th>Details</th><th>Hrs.</th></tr>
<tr><td></td><td>Course Introduction

The objective of this subject is to equip students with a comprehensive understanding of big data technologies, tools, and techniques. It aims to provide practical knowledge in managing, processing, and analyzing large-scale datasets using Hadoop, HDFS, MapReduce, and NoSQL databases. Students will gain expertise in stream data management, real-time data processing, and performance optimization for big data systems. Additionally, the course focuses on applying advanced analytics techniques, including recommendation systems, community detection, and data visualization using R. By the end of the course, students will be prepared to solve complex big data challenges, make data-driven decisions, and optimize solutions for real-world applications.</td><td>01</td></tr>
<tr><td rowspan="4">01.</td><td>Introduction to Big Data &Hadoop:
Learning Objective:
Students are expected to familiarize and use the concepts of Big Data Analytics.</td><td rowspan="4">5-7</td></tr>
<tr><td>Contents:
Introduction to Big data, Big Data Characteristics. Type of Big Data, Traditional vs. Big Data business approach Case Study of Big Data Solutions Hadoop Concept, Core Hadoop Components Hadoop Ecosystem and Hadoop Limitations.</td></tr>
<tr><td>Self-Learning Topics: Case study related to big data fundamentals</td></tr>
<tr><td>Learning Outcomes:
A learner will be able to
LO 1.1: Identify key characteristics of big data relevant to specific problem scenarios. (P.I. -2.1.2)
LO 1.2: Use the concept of big-data categorize given data into one of the big data types (P.I. -1.4.1)
LO 1.3: Compare and contrast the fundamental differences between big data and traditional data approaches. (P.I. -2.2.4)
LO 1.4: Select and recommend appropriate tools or technologies from the big data ecosystem to solve real-world challenges. (P.I. -2.1.2)
LO 1.5: Evaluate the limitations and challenges associated with big data storage systems like HDFS. (P.I. -1.4.1)</td></tr>
<tr><td rowspan="2">02.</td><td>Hadoop HDFS and Map Reduce:</td><td rowspan="2">6-8</td></tr>
<tr><td>Learning Objective:
Students are expected to use programming skills to build simple solutions using big data technologies such as Map Reduce</td></tr>
</table>

	Contents: Distributed File Systems: Physical Organization of Compute Nodes, Large-Scale File-System Organization, the Map Tasks, grouping by Key, The Reduce Tasks, Combiners, Details of Map Reduce Execution. Coping with Node Failures, Algorithms using Map Reduce: Matrix vector multiplication by map reduce Relational Algebraic operations, Computing selection by Map Reduce, Computing Projection by Map reduce Set Operations using Map Reduce, Union, Intersection and Set Difference using map reduce Hadoop Limitation.	
	Self-Learning Topics: *Case study related to map reduce*	
	Learning Outcomes: *A learner will be able to* *LO 2.1: Solve the problem related to HDFS storage and Replication Analysis (P.I. -1.1.1)* *LO 2.2: Design a solution to solve problems such as word count, matrix operations, and set operations using Map Reduce programs (P.I. -3.4.1)* *LO 2.3: Use Combiners, Practitioners, and Distributed Caching technique to optimize MapReduce tasks (P.I. -2.3.1)* *LO 2.4: Apply mathematical principals to solve Map reduce tasks. (P.I. -1.3.1)* *LO 2.5: Apply DBS operation to solve map reduce task (P.I. -1.4.1)*	
03.	**NoSQL**	**7-9**
	Learning Objective: *Student are expected to analyze different No SQL solutions used in handling big data* **Contents:** Introduction to NoSQL, NoSQL Business Drivers NoSQL Data Architecture Patterns: Key-value stores, Graph stores Column family (Big table) stores, Document stores variations of NoSQL architectural patterns, No SQL Case Study Understanding the types of big data problems, Analyzing big data with a shared-nothing architecture Choosing distribution models: master-slave versus peer-to- peer, four ways that NoSQL systems handle big data problems	
	Self-Learning Topics: *Case studies*	
	Learning Outcomes: *A learner will be able to* *LO 3.1: Compare and differentiate the characteristics and use cases of NoSQL and SQL databases (P.I. -2.2.4)* *LO 3.2: Evaluate the appropriateness of NoSQL and SQL databases for different applications based on given criteria (P.I. -3.3.1)* *LO 3.3: Identify and summarize key features of NoSQL databases (P.I. -1.4.1)* *LO 3.4: Compare consistency, availability, and partition tolerance for models in distributed systems (P.I. -2.4.4)* *LO 3.5: Analyze different NoSQL data architecture patterns. (P.I. -2.3.1)* *LO 3.6: Critically analyze the limitations of NoSQL databases, especially in critical applications. (P.I. -4.3.2)* *LO 3.7: Contrast different distribution models in database systems (1.3.1)*	

04.	**Mining Data Streams** ***Learning Objectives:*** *To acquire the fundamental techniques and principles in achieving big data analytic with scalability and streaming capability* **Contents:** The Stream Data Model: A Data-Stream-Management System, Examples of Stream Source, Stream Queries, Issues in Stream Processing. Sampling Data techniques in a Stream, Filtering Streams: Bloom Filter with Analysis Counting Distinct Elements in a Stream, Count Distinct Problem Flajolet-Martin Algorithm Combining Estimates, Space Requirements ,Counting Ones in a Window: The Cost of Exact Counts, The Datar-Gionis-Indyk-Motwani Algorithm , Query Answering in the DGIM Algorithm, Decaying Windows ***Self-Learning Topics:*** *Case study related to data stream management system* ***Learning Outcomes:*** *A learner will be able to* *LO 4.1: Designing Stream Data Management Systems for specific platform (P.I. -3.2.2)* *LO 4.2: Implement a solution real time Stream Queries and Data Sampling Techniques (P.I. -2.1.2)* *LO 4.3: Apply Optimizing Space and Memory Efficiency in Stream Processing (P.I. -1.3.1)* *LO 4.4: Designing Scaling Stream Processing Systems for Large-Scale Data (P.I. -4.2.1, P.I. -5.1.1, P.I. -8.2.1,PI-11.3.2)* *LO 4.5: Design Real-Time Query Processing system for specific system using modern tools (P.I. -3.3.2, P.I. -5.1.2, P.I. -11.3.1)* *LO 4.6: Apply Query Answering and Performance algorithm (P.I. -1.4.1)* *LO 4.7: Apply Anomaly Detection in Streams (P.I. -1.3.1)* *LO 4.8:Demonstrate algorithms using discipline specific tools(P.I. -5.2.2)*	**7-9**
05.	**Real Time Big Data Models** ***Learning Objective/s:*** *students to have skills that will help them to solve complex real-world problems for decision support* **Contents:** A Model for Recommendation Systems ,Content-Based Recommendations, Collaborative Filtering Case Study: Product Recommendation, Social Networks as Graphs, Clustering of Social-Network, Graphs, Direct Discovery of Communities in a social graph ***Self-Learning Topics: Nil*** ***Learning Outcomes :*** *A learner will be able to* *LO 5.1: Design a content-based approach and collaborative filtering for re commander systems (P.I. -4.2.1, P.I. -11.3.1, P.I. -8.3.1,PI -9.1.3)* *LO 5.2: Apply clustering techniques that can be used for community detection in a social graph (P.I. -2.1.2)* *LO 5.3: Apply algorithms for direct discovery of communities in a social network (P.I. -2.1.1)*	**6-8**

	LO 5.4: Analyze various stream sampling techniques and provide valuable justification (P.I. -2.2.3) *LO 5.5: Apply the concept of Blooms filter to solve given stream of data (P.I. -1.4.1)*	
06.	**Data Analytics with R** ***Learning Objective/s:*** *Develop programs in R language for understanding and visualization of data using statistical, functions and plots* **Contents:** Exploring Basic features of R, Exploring RGUI, Exploring RStudio ,Handling Basic Expressions in R Variables in R, Working with Vectors, Storing and Calculating Values in R Creating and using Objects interacting with users, Handling data in R Workspace Executing Scripts, Creating Plots, Accessing help and documentation in R	**6-8**
	Self-Learning Topics: *Solving more problems with programmed approach*	
	Learning Outcomes : *A learner will be able to* *LO 6.1: Apply various basic plots for given problem (P.I. -1.4.1)* *LO 6.2: Analyze dataset and querying of the dataset using R script and functions. (P.I. -2.4.2)* *LO 6.3: Analyze various visualization types and their application (P.I. -1.3.1)* *LO 6.4: Design a solution to big data problems using modern tools (P.I. -4.1.2, P.I. -5.2.2, P.I. -8.2.1, P.I.9.1.1,PI-11.3.1)* *LO 6.5:Use R programming to handle Expressions(P.I. -1.4.1)* *LO 6.7: Apply various basic plots for given problem with programming approach demonstrate with innovative method (P.I. -5.1.1, P.I. -8.3.1, P.I. -9.1.3)*	
	Conclusion	**01**
	This course provides a thorough exploration of big data technologies, starting with key concepts such as big data characteristics, types, and how it contrasts with traditional data. Students gain practical skills in utilizing Hadoop, HDFS, and MapReduce, with a focus on performance optimization techniques. The NoSQL module equips learners with the knowledge to choose the appropriate database architecture for specific applications. Emphasis on stream data management, real-time querying, and space optimization prepares students to handle large-scale data systems. The course also covers real-time big data models like recommendation systems and community detection in social networks. By the end, students will be adept at managing, analyzing, and visualizing big data, applying their skills to solve complex, real-world challenges	
	Total	**45**

Performance Indicators:

P.I. No.	P.I. Statement
1.1.1	Apply the knowledge statistics and numerical techniques to solve problems
1.3.1	Apply engineering fundamentals
1.4.1	Apply theory and principles of computer science and engineering to solve an engineering problem
2.1.1	Evaluate problem statements and identifies objectives
2.1.2	Identify 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
2.2.4	Compare and contrastdifferent methods based on certain criteria
2.3.1	Able to apply computer engineering principles to formulate modules of a system with required applicability and performance]
2.4.3	Identify the limitations of the solution and sources/causes.
2.4.4	Arrive at conclusions with respect to the objectives.
3.2.2	Able to produce a variety of potential design solutions suited to meet functional requirements.
3.3.1	Able to perform systematic evaluation of the degree to which several design concepts meet the criteria
3.3.2	Able to provide an optimal solution that meets the criteria
3.4.1	Able to provide design solution to given problem using specific techniques
4.1.2	Able to choose appropriate procedure/algorithm, dataset and test cases.
4.2.1	Design and develop appropriate procedures/methodologies based on the study objectives
4.3.2	Critically analyze data or application based on certain criteria 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
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 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
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 Design a system to analyse real-time big data by applying the fundamental principles of big data and its associated technologies. *(LO 1.1,LO 1.2,LO1.3,LO 2.1,LO2.2,LO 2.3,LO 2.4,LO 6.5,LO 3.2)*

2 Apply advanced tools and architectures for storing, processing and managing big data efficiently. *(LO 1.4,,LO 3.3,LO 3.7,LO 2.5,LO 5.4.LO 5.5)*

3 Design strategies for managing data storage, retrieval, and processing in a distributed environment
(LO 1.5,LO 3.1,LO3.4,LO3.5,LO 4.4,LO4.7,LO5.1,LO6.4,LO 4.8)

4 Designing a solution to complex real-world problems for decision support
(LO 4.1,LO 4.2,LO 4.3,,LO 4.5,LO4.6,LO 5.2,LO 3.6,LO 6.7)

5 Utilize data analytics and visualization tools to process and analyse large-scale data sets.
(LO 5.3,LO 6,1,LO 6.2,LO 6.3,LO 6.5)

CO-PO Mapping Table with Correlation Level

CO ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CEPEC6022.1	3	3	3								
CEPEC6022.2	3	3									
CEPEC6022.3	3	3		3	3			3	3		3
CEPEC6022.4	3	3	3	3	3			3	3		3
CEPEC6022.5	3	3									
Average	**3**	**3**	**3**	**3**	**3**			**3**	**3**		**3**

Text Books :

1. Cre Anand Rajaraman and Jeff Ullman, “Mining of Massive Datasets”, Cambridge University Press.
2. Dan McGary and Ann Kelly, “Making Sense of NoSQL – A guide for managers and the rest of us”, Manning Press
3. DT Editorial Services, “Big Data Black Book”, Dreamtech Press

Reference Books :

1. Bill Franks, “Taming The Big Data Tidal Wave: Finding Opportunities In Huge Data Streams With Advanced Analytics”, Bill Franks
2. Jared Dean, “Big Data, Data Mining, and Machine Learning: Value Creation for Business Leaders and Practitioners”, 2014,Wiley India Private Limited
3. Jiawei Han and Micheline Kamber, “Data Mining: Concepts and Techniques”, 3rd edition, Morgan Kaufmann Publications.
4. Radha Shankarmani, “Big Data Analytics”, Wiley Publication.
5. Anil Maheshwari, “Big Data”, Mc Graw Hill Publications.

Other Resources :

1. NPTEL Course: Big Data Computing By Prof. Rajiv Mishra, Department of Computer Science Engineering, IIT Patna :-Web link- https://onlinecourses.nptel.ac.in/noc20_cs92/

IN-SEMESTER ASSESSMENT (50 MARKS)

1. Continuous Assessment - Theory-(20 Marks)

1. *Suggested breakup of distribution*

   Assignment on live problems/case studies, wherein problems are given prior. Students are expected to research and collect required resources. They can use the resources and solve the problem on assigned date and time in institute premises in presence of faculty member: 10 Marks.

   Group Discussions/Technical Report Writing: 05 Marks.
   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 20%-30% weightage, and the syllabus covered from MSE to ESE carrying 70%-80% weightage.

Course Type	Course Code	Course Name	Credits
PEC	CEPEC6023	ADVANCED NETWORKS	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. CEPCC408: Computer Network

Program Outcomes addressed:

1. PO1: Engineering knowledge.
2. PO2: Problem analysis.
3. PO3: Design/development of solutions.
4. PO7: Ethics
5. PO11: Life-long learning.

Course Objectives:

1. To impart a fundamental understanding of advanced computer networks.
2. To acquaint learners with the fundamental concepts of network technologies and their application in real-life scenarios.
3. To explore various internetworking routing protocols used in distributed systems
4. To familiarize learners with emerging trends and their application in real-time scenarios.

Module	Details	Hrs.
	Course Introduction Advanced network models are crucial for computer engineering students, as they integrate technical knowledge with efficient data transmission and communication. Their importance lies in supporting modern applications like streaming, video conferencing, and online gaming by ensuring optimized performance, reliability, and security in complex networking environments.	**01**
01.	**Networking Models & Protocols**	**5-7**
	Learning Objective: *To explore the fundamentals of computer engineering and learn the concepts of advanced computer networks and their requirements for real-life applications.*	
	Contents: OSI reference model, TCP/IP reference model, ATM reference model;	

	Applications (WWW, Audio/Video Streaming, Video conference, Networked Games, Client/Server); Traffic Characterization (CBR, VBR); Switching Paradigms; Multiplexing; Error Control; Flow Control, FTH, DTH, PON, ISDN, DSL, CATV, SONET.	
	Self-Learning Topics: *Optical Networks*	
	Learning Outcomes: *A learner will be able to* *LO 1.1: Use the computer engineering concept to identify the roles of different modern networking technologies. (P.I.-1.3.1), (P.I.-11.1.1)* *LO 1.2: Use the principles of engineering to understand the basic concepts and fundamentals of advanced computer networks useful in the future. (P.I.-1.4.1), (P.I.-11.2.2)* *LO1.3: Compare different reference models (OSI, TCP/IP, and ATM) and conclude which model is more suitable for modern networking environments considering their performance. (P.I.-2.4.4),* *LO 1.4: Identify the key functionalities of optical networks and explain how (WDM) technology enhances data transmission capacity. (P.I.-2.2.2)*	
02.	**Local Area Network Technologies**	**7-9**
	Learning Objective: *To introduce different Local Area Network (LAN) technologies and their functionalities.*	
	Contents: Fast Ethernet, Gigabit Ethernet, IEEE 802.11 WLAN, Bluetooth, Connecting LANs, VLANS.	
	Self-Learning Topics: VLAN Security	
	Learning Outcomes: *A learner will be able to* *LO 2.1: Use the computer engineering concept to explore wireless network standards, security, and performance factors. (P.I.-1.3.1), (P.I.-11.1.1)* *LO 2.2: Apply computer engineering fundamentals to understand the concepts VLAN tagging (802.1Q) and inter-VLAN routing for efficient network management. (P.I.-1.4.1)* *LO 2.3: Compare Bluetooth and Wi-Fi technologies in terms of range, data rates, and typical applications. Which technology is more appropriate for IoT devices and personal area networks (P.I.-2.4.4), (P.I.-11.2.2)* *LO 2.4: Apply engineering fundamentals to decide between wired and wireless solutions for specific business needs. (P.I.-2.2.2), (P.I.- 7.2.2)*	
03.	**Internetworking**	**5-7**
	Learning Objective: *To explore different internetworking routing protocols.*	
	Contents: Interdomain Routing, BGP, IPv6, Multicast Routing Protocols, Multi-Protocol Label Switching, Virtual Private Networks, High speed transport protocols, Quality of Service Mechanisms, Improving QoS in	

	Internet, DiffServ and IntServ Architectures. ***Self-Learning Topics: RSVP*** ***Learning Outcomes:*** *A learner will be able to* *LO 3.1 Use the concepts of computer engineering to summarize Interdomain Routing Protocols. (P.I.-1.4.1)* *LO 3.2: Use the principles of engineering to gain a deep understanding of various routing protocols and traffic management techniques to efficiently manage and optimize data flow across different network domains. (P.I.-1.3.1)* *LO 3.3: Design and implement securely to connect remote encryption, integrity, scalability, and optimal performance across diverse geographical locations. and verify the functionalities. (P.I.-3.4.3)* *LO 3.4: Compare DiffServ and IntServ architectures to manage traffic flows. Choose the most appropriate model based on based on network functionalities. (P.I.-2.4.4)* *LO 3.5 Apply classful vs. classless addressing and determine which design best meets network requirements for different use cases to explore design alternatives. (P.I.-3.2.1), (P.I.- 7.2.2), (P.I.- 7.2.2)* *LO3.6 Summarize the core functionalities of MPLS and explain how it enhances traffic engineering, QoS, and scalability in modern networks. (P.I.-2.2.2)*	
04.	**Distributed Systems** ***Learning Objectives:*** *To explore different Distributed Systems* **Contents:** Naming, DNS, Paradigms for Communication in Internet, Caching, Issues of Scaling in Internet and Distributed Systems, Caching Techniques for Web, Protocols to Support Streaming Media, Multimedia Transport Protocols, Content Delivery Networks, Overlay and P2P Networks. ***Self-Learning Topics: Other caching techniques*** ***Learning Outcomes:*** *A learner will be able to* *LO 4.1: Use the engineering fundamentals to summarize the role of DNS and DDNS in the Internet's naming system (P.I.-1.3.1)* *LO 4.2: Identify the challenges of scaling caching systems in large-scale distributed networks. (P.I.-2.2.2)* *LO 4.3: Compare client-server, peer-to-peer (P2P), and publish-subscribe paradigms for Internet communication and conclude with respect to the given objectives. (P.I.-2.4.4)* *LO 4.4: Apply fundamental engineering concepts of Content Delivery Network (CDN) principles to enhance the performance of a global news website. (P.I.-1.4.1). (P.I.- 7.1.1), (P.I.- 7.2.2)*	**6-8**
05.	**Other Networking Technologies and Applications** ***Learning Objective/s:*** *To study different Other Networking Technologies and Applications.* **Contents:** RTP, RTSP, SIP, VoIP, Ad-hoc, MANET, VANET: Network Basics	**7-9**

	Characteristics, applications, challenges, Architecture	
	Self-Learning Topics: SDN	
	Learning Outcomes: *A learner will be able to* *LO 5.1: Use the engineering fundamentals to summarize RTP and its role in delivering real-time multimedia data over the Internet. (P.I.-1.3.1)* *LO 5.2: Identify the functionalities and computing resources used in practical applications of MANETs and VANETs in fields such as disaster recovery, military operations, and smart transportation systems etc. (P.I.-2.2.2),(P.I.11.2.2)* *LO 5.3: Compare Ad-hoc networks, MANETs, and VANETs in terms of architecture, scalability, mobility and conclude with respect to the given objectives. (P.I.-2.4.4)* *LO 5.4: Apply fundamental characteristics of RTP, RTSP, SIP, and VoIP protocols in real-time communication. (P.I.-1.4.1)*	
06.	**Emerging Trends and Applications** ***Learning Objective/s:*** *To study emerging trends and applications Integrated to 5G and IoT.*	**7-9**
	Contents: Integration with 5G and IoT: Role of MANET/VANET in 5G networks, IoT edge devices in wireless networks. Edge and Cloud Computing in Wireless Networks: Resource allocation, latency reduction, and data offloading. Simulation Tools: NS-3, Mininet for SDN, SUMO for VANET simulation.	
	Self-Learning Topics: Other Simulation Tools	
	Learning Outcomes: *A learner will be able to* *LO6.1: Use the engineering fundamentals to summarize the role of MANET/VANET in 5G networks role. (P.I.-1.3.1)* *LO 6.2: Identify the functionalities and computing resources required while using different simulation tools (P.I.-2.2.2)* *LO 6.3: Compare MANETs, and VANETs in 5G networks and specify which one is better. (P.I.-2.4.4)* *LO 6.4: Apply fundamental simulation tools for real-time applications. (P.I.-1.4.1), (P.I.-11.1.1),(P.I.-11.2.2)*	
	Course Conclusion In this course, students will be able to apply theoretical knowledge of Advanced computer network to practical scenarios.	**01**
	Total	**45**

Performance Indicators:

P.I. No.	**P.I. Statement**
1.3.1	Apply engineering fundamentals
1.4.1	Apply fundamental engineering concepts to solve computer engineering problems
2.2.2	Identifies functionalities and computing resources
2.4.4	Arrive at conclusions with respect to the objectives
3.2.1	Able to explore design alternatives.

3.4.3 Able to verify the functionalities and validate the design

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 analyse data

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

11.1.1 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

Course Outcomes: A learner will be able to -

1. Apply different network architectures and protocols to real-life applications by leveraging fundamental engineering principles and systematic theory-based knowledge. *(LO 1.1, LO 1.2, LO 1.3, LO 1.4)*
2. Analyze and optimize LAN and VLAN technologies based on computing principles to enhance network performance and security. *(LO 1.1, LO 2.1, LO 2.2, LO 2.3, LO 2.4)*
3. Apply internetworking concepts and improve QoS in networks by integrating engineering expertise and resource-efficient design principles. *(LO 3.1, LO 3.2, LO 3.3, LO 3.4. LO 3.5, LO 3.6)*
4. Analyze various solutions for distributed systems and their scalability issues using research-based knowledge and critical thinking. (*LO 4.1, LO 4.2, LO 4.3, LO 4.4)*
5. Compare types of networks with reference to their functionalities and societal impact while incorporating sustainability and professional responsibilities. *(LO 1.1, LO 5.1, LO 5.2, LO 5.3, LO 5.4)*
6. Analyze advanced networking applications and emerging trends using research literature and problem-solving methodologies. *(LO 1.1, 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
CEPEC6023.1	3	3	-	-	-	-	-	-	-	-	3
CEPEC6023.2	3	3	-	-	-	-	2	-	-	-	3
CEPEC6023.3	3	3	3	-	-	-	3	-	-	-	-
CEPEC6023.4	3	3	-	-	-	-	3	-	-	-	-
CEPEC6023.5	3	3	-	-	-	-	-	-	-	-	2
CEPEC6023.6	3	3	-	-	-	-	-	-	-	-	3
Average	**3**	**3**	**3**	**-**	**-**	**-**	**3**	**-**	**-**	**-**	**3**

Text Books:

1. Data Communications and Networking, Behrouz A. Forouzan, 5th Edition,2013, Tata McGraw Hill.
2. Larry L. Peterson and Bruce S. Davie, Computer Networks: A Systems approach, 4th edition, 2007, Morgan Kaufmann.
3. J. Walrand and P. Varaiya, High Performance Communication Networks,2nd edition, 2000, Morgan Kaufmann.

   Markus Hoffmann and Leland R. Beaumont, Content Networking: Architecture, Protocols and Practice, 2005, Morgan Kauffman.

Reference Books:

1. Distributed Computing: Principles, Algorithms, and Systems, Kshemkalyani, A. D., and Singhal, M., 1st Edition, 2008, Cambridge University Press.
2. IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things, Hanes, D., Salgueiro, G., Grossetete, P., Barton, R., and Henry, J., 1st Edition, 2017, Cisco Press.
3. 5G Mobile and Wireless Communications Technology, Osseiran, A., Monserrat, J. F., and Marsch, P., 1st Edition, 2016, Cambridge University Press.

Other Resources:

1. NPTEL Course: Advanced Computer Networks by Prof. Neminath Hubballi, Prof. Sameer G Kulkarni, Department of Computer Science and Engineering, IIT Indore, IIT Gandhi Nagar, Web Link: **https://onlinecourses.nptel.ac.in/noc23_cs35/preview**

IN-SEMESTER ASSESSMENT (50 MARKS)

1. **Continuous Assessment-Theory (20 Marks)**

   Suggested breakup of distribution

   Two Class test: 05 marks each

   Group discussion/public speaking/technical report writing: 05 Marks

   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 20%-30% weightage and the syllabus covered from MSE to ESE carrying 70%-80% weightage.

Course Type	Course Code	Course Name	Credits
PEC	CEPEC6024	HIGH PERFORMANCE COMPUTING	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. CEPCC407-Operating System

Program Outcomes addressed:

1. PO1: Engineering Knowledge
2. PO2: Problem Analysis
3. PO5: Engineering Tool Usage
4. PO8: Individual and Collaborative Team work
5. PO9: Communication
6. PO11: Life-long learning

Course Objectives:

1. Enable students to understand, classify, and evaluate parallel computing and its architectures.
2. Prepare students to analyze, design, and optimize pipeline and parallel computing systems, focusing on performance metrics, architectural models, and trends.
3. Train students to design, analyze, and optimize parallel algorithms, emphasizing decomposition techniques, load balancing, and interaction overhead.
4. Guide students to measure, analyze, and optimize the performance and scalability of parallel systems.
5. Provide students with a comprehensive understanding of message passing programming principles to develop, analyze, and optimize high-performance computing applications using MPI and OpenMP, while fostering communication, problem-solving, and teamwork skills.

Module	Details	Hrs
	Course Introduction The High-Performance Computing (HPC) course introduces parallel computing concepts, programming paradigms, performance optimization, and memory models, enabling students to develop efficient parallel applications using MPI and OpenMP for problem-solving.	**01**
01.	**Introduction to High Performance Computing:** ***Learning Objective/s:*** *Understand the fundamental principles and classification models of high performance computing.*	**5-7**

	Contents: 1.1. Introduction to Parallel Computing: Motivating Parallelism, Scope of Parallel Computing, Levels of parallelism (instruction, transaction, task, thread, memory, function) 1.2. Classification Models: Architectural Schemes (Flynn‘s, Shore‘s, Feng‘s, Handler‘s) and Memory access (Shared Memory, Distributed Memory, Hybrid Distributed Shared Memory) 1.3. Parallel Architectures: Pipeline Architecture, Array Processor, Multiprocessor Architecture, Systolic Architecture, Data Flow Architecture	
	Self-Learning Topics: Parallelism and Its Potential in HPC	
	Learning Outcomes: *A learner will be able to* *LO 1.1: Apply the knowledge of discrete structures and numerical techniques to understand the fundamentals of parallel computing, including the motivation and scope of parallelism. (P.I. 1.1.1)* *LO 1.2: Apply engineering fundamentals to classify and compare different architectural schemes and memory access models in parallel computing. (P.I. 1.3.1)* *LO 1.3: Evaluate problem statements related to parallel computing, identify objectives, and determine the appropriate levels of parallelism (instruction, transaction, task, thread, memory, function) to optimize performance. (P.I. 2.1.1)* *LO 1.4: Identify functionalities and computing resources required for implementing various parallel architectures, such as pipeline, array processor, multiprocessor, systolic, and data flow architectures, and assess their effectiveness in real-world applications. (P.I. 2.2.2)*	
02.	**Pipeline Processing** ***Learning Objective/s:*** *Learner is expected to familiarize with the concepts of pipeline processing, analyze pipeline performance, arithmetic pipelines, instruction processing, and stage design, and evaluate the impact of instruction scheduling on execution efficiency.*	**7-9**
	Contents: 2.1. Introduction, Pipeline Performance, Arithmetic Pipelines, 2.2. Pipeline instruction processing, Pipeline stage design, Hazards, Dynamic instruction scheduling	
	Self-Learning Topics: Speculative Execution in Modern Processors	
	Learning Outcomes: A learner will be able to *LO 2.1: Apply theoretical principles of computer science and engineering to understand pipeline performance and arithmetic pipelines, demonstrating effective communication and problem-solving skills, and interpreting technical information accurately. (P.I. 1.4.1, 8.2.1, 9.1.1)* *LO 2.2: Apply engineering fundamentals to design pipeline instruction processing stages, identify and resolve hazards, and present results as a team with clear, well-constructed documentation. (P.I. 1.3.1, 8.3.1, 9.1.2)* *LO 2.3: Compare and contrast various dynamic instruction scheduling methods to select the most efficient process for optimizing pipeline performance. (P.I. 2.2.4)* *LO 2.4: Identify design constraints for required performance criteria in pipeline stage design and evaluate their impact on overall system performance. (P.I. 2.3.2)*	

03.	**Parallel Programming Platforms** ***Learning Objective/s:*** *Learner is expected to understand implicit parallelism, analyze trends in microprocessor architectures, evaluate memory performance limitations, explore parallel computing platforms, and assess communication costs in parallel machines for efficient system design.*	**5-7**
	Contents: 3.1. Parallel Programming Platforms: Implicit Parallelism: Trends in Microprocessor & Architectures, Limitations of Memory System Performance. 3.2. Parallel Computing Platforms, Physical Organization of Parallel Platforms, Communication Costs in Parallel Machines.	
	Self-Learning Topics: CUDA and GPU Computing for Parallel Processing	
	Learning Outcomes: *LO 3.1: Apply engineering fundamentals to understand the limitations of memory system performance and the physical organization of parallel platforms. (P.I. 1.3.1)* *LO 3.2: Apply theoretical principles of computer science and engineering to analyze implicit parallelism and communication costs in parallel machines, demonstrating a comprehensive understanding of parallel programming platforms. (P.I. 1.4.1)* *LO 3.3: Evaluate problem statements related to parallel programming platforms, identify objectives, and recognize the importance of staying current with trends in microprocessor architectures and memory system performance. (P.I. 2.1.1, 11.2.2)* *LO 3.4: Compare and contrast various parallel computing platforms and their physical organization, analyze communication costs in parallel machines, and assess the feasibility, viability, and sustainability of different parallel computing solutions. (P.I. 2.2.4, 11.3.2)*	
04.	**Parallel AlgorithmDesign**	**6-8**
	Learning Objective/s: *Learner is expected to familiarize with the principles of parallel algorithm design, including decomposition techniques, task interactions, load balancing, interaction overhead management, and parallel algorithm models for efficient execution.*	
	Contents: 4.1. Principles of Parallel Algorithm Design: Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions, 4.2. Mapping Techniques for Load Balancing, Methods for Containing Interaction Overheads, Parallel Algorithm Models	
	Learning Outcomes:	
	A learner will be able to	
	LO 4.1: Apply engineering fundamentals to understand the principles of parallel algorithm design, including decomposition techniques and characteristics of tasks and interactions. (P.I. 1.3.1) *LO 4.2: Apply theoretical principles of computer science and engineering to develop and analyze parallel algorithm models, ensuring effective load balancing and interaction overhead containment. (P.I. 1.4.1)* *LO 4.3: Evaluate problem statements related to parallel algorithm design, identify objectives, and determine appropriate mapping techniques for load balancing. (P.I. 2.1.1)*	

<table>
<tr><td></td><td>LO 4.4: Identify functionalities and computing resources required for implementing parallel algorithms, and assess methods for containing interaction overheads to optimize performance. (P.I. 2.2.2)</td><td></td></tr>
<tr><td>05.</td><td>Performance Measures
Learning Objective/s:
Learner is expected to familiarize with the performance measures in parallel computing, including speedup, execution time, efficiency, cost, scalability, granularity effects, scalability models, and performance laws like Amdahl’s and Gustavson’s to identify bottlenecks and optimize system performance.

Contents:
5.1. Performance Measures: Speedup, execution time, efficiency, cost, scalability, Effect of granularity on performance,
5.2. Scalability of Parallel Systems, Amdahl‘s Law, Gustavson‘s Law, Performance Bottlenecks

Self-Learning Topics: Roofline Model for Performance Analysis in HPC

Learning Outcomes:
A learner will be able to
LO 5.1: Apply the knowledge of discrete structures and numerical techniques to measure performance metrics such as speedup, execution time, efficiency, cost, and scalability, demonstrating effective communication and problem-solving skills, and interpreting technical information accurately. (P.I. 1.1.1, 8.2.1, 9.1.1)
LO 5.2: Apply theoretical principles of computer science and engineering to analyze the scalability of parallel systems, including Amdahl's Law and Gustavson's Law, and present results as a team with clear, well-constructed documentation. (P.I. 1.4.1, 8.3.1, 9.1.2)
LO 5.3: Compare and contrast various performance bottlenecks and methods to improve scalability, selecting the most efficient process for optimizing parallel system performance. (P.I. 2.2.4)
LO 5.4: Identify design constraints for required performance criteria in parallel systems and evaluate their impact on overall system performance, considering the effect of granularity on performance. (P.I. 2.3.2)</td><td>7-9</td></tr>
<tr><td>06.</td><td>HPC Programming
Learning Objective/s:
Learner is expected to familiarize with the principles of message-passing programming, MPI fundamentals and the basics of OpenMP and OpenMPI for efficient parallel programming.

Contents:
6.1. Programming Using the Message-Passing Paradigm: Principles of Message Passing Programming
6.2. The Building Blocks: Send and Receive Operations
6.3. MPI: Message Passing Interface, Topology and Embedding, Overlapping Communication with Computation, Collective Communication and Computation Operations,
6.4. Introduction to OpenMP, OpenMPI
6.5. Case Studies: HPC in scientific Computing, HPC in Machine learning and AI, HPC in Big data analytics.

Self-Learning Topics: OpenMP Programming for Multi-Core Systems</td><td>7-9</td></tr>
</table>

	Learning Outcomes: *A learner will be able to* *LO 6.1: Apply the knowledge of discrete structures and numerical techniques to understand the principles of message passing programming, demonstrating effective communication and problem-solving skills, and interpreting technical information accurately. (P.I. 1.1.1, 8.2.1, 9.1.1)* *LO 6.2: Apply theoretical principles of computer science and engineering to develop and analyze message passing programs using MPI, ensuring effective team collaboration, proficiency in using discipline-specific tools, and producing clear, well-constructed documentation. (P.I. 1.4.1, 5.2.2, 8.3.1, 9.1.2)* *LO 6.3: Compare and contrast various message passing techniques and tools, such as MPI and OpenMP, to select the most efficient methods for overlapping communication with computation, while recognizing the importance of staying current with new developments in the field. (P.I. 2.2.4, 5.1.1, 11.2.2)* *LO 6.4: Identify design constraints for required performance criteria in high-performance computing applications, evaluate their impact on overall system performance, and analyze sourced technical information for feasibility, viability, and sustainability. (P.I. 2.3.2, 5.2.2, 11.3.2)*	
	Course Conclusion: The High-Performance Computing (HPC) course equips students with fundamental and advanced concepts of parallel computing, algorithm design, performance optimization, and programming paradigms like MPI and OpenMP. Students gain hands-on experience in designing scalable, efficient, and high-performance parallel applications for real-world problems.	**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 and engineering to solve an engineering problem.
2.1.1	Evaluate problem statements and identifies objectives
2.2.2	Identify functionalities and computing resources.
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.
2.3.2	Identify design constraints for required performance criteria.
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.
9.1.1	Read, understand and interpret technical and non-technical 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 Analyse sourced technical and popular information for feasibility, viability, sustainability etc.

Course Outcomes: A learner will be able to -

1. Apply mathematical foundations and core principles to evaluate parallel computing models, assess problems, and determine necessary computing resources. *(LO 1.1, LO 1.2, LO 1.3, LO 1.4)*
2. Apply core principles and theoretical concepts to enhance pipeline performance, design parallel computing platforms in a team and present effectively. *(LO 2.1, LO 2.2, LO 2.3, LO 2.4)*
3. Develop and analyze parallel algorithm models using core principles, assess problems, and determine necessary computing resources to remain in tune with current technologies. *(LO 3.1, LO 3.2, LO3.3, LO 3.4, LO 4.1, LO 4.2, LO 4.3, LO 4.4)*
4. Assess and optimize parallel system performance using mathematical foundations, fostering a lifelong learning mind-set to adapt to evolving computational challenges. *(LO 5.1, LO 5.2, LO 5.3, LO 5.4)*
5. Develop message passing programs using parallel computing principles and evaluate design constraints to optimize system performance, demonstrating proficiency in technical communication and collaboration to foster lifelong learning in the evolving field of high-performance computing. *(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**
CEPEC6024.1	3	3	-	-	-	-	-	-	-	-	-
CEPEC6024.2	3	3	-	-	-	-	-	3	3	-	-
CEPEC6024.3	3	3	-	-	-	-	-	-	-	-	3
CEPEC6024.4	3	3	-	-	-	-	-	-	-	-	3
CEPEC6024.5	-	-	-	-	3	-	-	-	-	-	3
Average	3	3	-	-	3	-	-	3	3	-	3

Reference Books :

1. Michael J. Quinn - *Parallel Programming in C with MPI and OpenMP*, McGraw-Hill, 2008.
2. Kai Hwang, Zhiwei Xu - *Scalable Parallel Computing: Technology, Architecture, Programming*, McGraw Hill, 1998.
3. Laurence T. Yang, Minyi Guo - *High-Performance Computing: Paradigm and Infrastructure*, Wiley, 2006.

Other Resources :

1. NPTEL – High Performance Computing – http://nptel.ac.in/courses/106/108/106108055
2. Swayam – Parallel and Distributed Computing – http://swayam.gov.in/explorer?searchText=Parallel%20Computing
3. Coursera – Parallel Programming with MPI – http://www.coursera.org/learn/parallel-programming-mpi
4. MPI Benchmarks and Tutorials – http://github.com/mpitutorial/mpitutorial

IN-SEMESTER ASSESSMENT (50 MARKS)

1. Continuous Assessment - Theory-(20 Marks)

Suggested breakup of distribution
Class Test 1: 05 Marks

Class Test 2: 05 Marks

Article reading and summarization: 05 Marks

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 20%-30% weightage, and the syllabus covered from MSE to ESE carrying 70%-80% weightage.

Course Type	Course Code	Course Name	Credits
LBC	CELBC608	SYSTEM SECURITY LABORATORY	01

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

Pre-requisites:

ESL205- Programming Laboratory –II (Java)

CEPCC408- Computer Network

CE SBL301- Python Programming Laboratory

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. PO7: Ethics
6. PO11: Lifelong learning

Course Objectives:

1. Apply the knowledge of symmetric cryptography to implement classical ciphers
2. To develop the topological and routing strategies for an IP based networking infrastructure.
3. To identify the various issues of a packet, transfer from source to destination and to resolve them.

Module	Detailed Contents	Hrs.
	Course Introduction: System security lab provides a comprehensive understanding of cryptographic techniques and system security measures, offering both theoretical foundations and practical applications.	**01**

01.	***Learning Objectives:*** 1. *Expected to perform encryption and decryption of a given plain text using classical cipher.* **Classical Encryption techniques** **Laboratory Exercises: (Suggested Tasks):** Implementation of Caesar Cipher (shift-based), Playfair Cipher (digraph-based), Rail Fence Cipher (zigzag pattern) and Columnar Transposition Cipher (keyword-based column ordering) for secure message encryption. Combine substitution (Caesar/Playfair) and transposition (Rail Fence /Columnar) to create a stronger encryption scheme. Generate ciphertext and decrypt it back to plaintext, ensuring accuracy of encryption and decryption operations. Analyze weaknesses using frequency analysis, brute-force attacks, and decryption without a key to test cipher robustness. Use cryptographic tools to validate the correctness of encryption outputs and compare with implemented algorithms.	**4-6**
	Learning Outcomes: *A learner will be able to* *LO 1.1: Demonstrate the ability to explore different classical ciphers, implement substitution and transposition ciphers using Java or Python, and utilize online tools to generate and verify ciphertext, ensuring accuracy and security of the output (PI: 2.1.2, 2.4.2, 3.2.1, 3.4.2, 5.1.1, 5.2.2)* *LO 1.2: Validate and analyze the security of classical ciphers by performing cryptanalysis, testing encryption strength, and comparing cipher effectiveness using frequency analysis and other evaluation techniques. (PI: 4.1.1, 4.3.1, 5.2.2)*	
02.	***Learning Objective:*** *Expected to use open source tool or virtual lab or programming language to implement modern encryption algorithms, hashing techniques and digital signature algorithms.*	**8-10**
	Modern encryption algorithms (symmetric and asymmetric algorithms), hashing techniques and digital signature algorithms. **Laboratory Exercises: (Suggested Tasks):** Comparison of DES and AES encryption performance in different modes of operation, implement and analyze RSA public-key cryptosystem for encryption and digital signatures, perform Diffie-Hellman key exchange, test message integrity using MD-5 and SHA-1 for varying message sizes, and evaluate the efficiency and security of hashing protocols. ***Learning Outcomes:*** *A learner will be able to* *LO 2.1: Compare the performance of DES and AES in different modes of operation using online tools or virtual lab and implement RSA digital signature scheme, Diffie-Hellman key exchange, and MD-5 and SHA-1 hash functions using Java or Python. (PI: 2.1.2, 2.2.5, 3.2.2, 3.4.2, 5.1.1)* *LO 2.2: Test and verify the integrity of messages using MD-5 and SHA-1 by generating hash values for different message sizes, comparing them to detect any modifications, (PI: 4.1.1, 4.3.1, 5.2.2, 11.1.1, 11.2.2)*	

03.	*Learning Objective/s:* *Expected to use different network reconnaissance tools like sniffers, port scanners and other related tools to gather information about networks domain registrars.*	**6-8**
	Network Reconnaissance, Packet Analysis, and Vulnerability Assessment.	
	Laboratory Exercises: (Suggested Tasks): Perform network reconnaissance using WHOIS, dig, traceroute, and nslookup; capture and analyze ICMP, TCP, and HTTP packets using Wireshark in promiscuous and non-promiscuous modes; install and configure Nmap and Nessus for host discovery, port scanning, OS fingerprinting, and vulnerability assessment.	
	Learning Outcomes: *A learner will be able to* *LO 3.1: Demonstrate and ability to apply network reconnaissance tools or commands and packet analysis techniques to identify network structures and potential vulnerabilities. (PI: 2.1.2, 2.4.2, 3.2.2, 3.4.2, 7.1.1, 7.2.2)* *LO 3.2: Proficiently use security assessment tools to analyze network behavior and system vulnerabilities. (PI: 5.1.1, 5.2.2)*	
04.	***Learning Objectives:*** • *Expected to setup personal firewall or install IDS (e.g. SNORT) and study the logs.* • *Expected to simulate buffer overflow attack.* • *Expected to implement virus and antivirus .*	**6-8**
	Simulation of Cyberattacks and Security Countermeasures **Laboratory Exercises: (Suggested Tasks):** Configure a personal firewall using iptables in Linux to control incoming and outgoing network traffic based on security rules. Simulate a buffer overflow attack using Splint or Cppcheck to analyze and detect vulnerabilities in C/C++ code. Implement email security using the GPG tool in Linux/Windows to encrypt and decrypt email messages for secure communication. Demonstrate the concept of viruses and antivirus mechanisms by implementing a simple virus program and analyzing antivirus detection techniques. Simulate a Denial-of-Service (DoS) attack using Hping, Hping3, and other tools to analyze network flooding and its impact on system performance.	
	Learning Outcomes: *A learner will be able to* *LO 4.1: Identify security vulnerabilities in a system, analyze potential threats, and implement preventive mechanisms such as firewalls, encryption, and antivirus techniques to enhance system security. (PI: 2.1.1, 2.2.3, 3.4.2, 5.1.1 11.2.2, 11,1.1)* *LO 4.2: Verify and test security implementations by analyzing vulnerabilities, simulating attacks, and assessing system defenses. (PI: 4.1.3, 4.3.2, 5.2.2, 7.1.1, 7.2.2)*	
	By end of the course student will learn how to protect systems by using encryption, security tools, and testing for weaknesses. It teaches them to find threats and apply security measures.	
	Total Hours	**30**

Performance Indicators:

P.I. No.	P.I. Statement
2.1.1	Evaluate problem statements and identifies objectives.
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.
2.4.2	Analyse and interpret the results using contemporary tools.
3.2.1	Able to explore design alternatives
3.2.2	Able to produce a variety of potential design solutions suited to meet functional requirements .
3.4.2	Able to implement and integrate the modules.
3.4.3	Able to verify the functionalities and validate the design
4.1.3	Able to choose appropriate hardware/software tools to conduct the experiment.
4.3.2	Critically analyse data for trends and correlations, stating possible errors and limitations.
5.1.1	Identify modern engineering tools such as computer aided drafting, modeling and analysis; techniques and resources for engineering activities
5.2.2	Demonstrate proficiency in using discipline-specific tools.
7.1.1	Identify situations of unethical professional conduct and propose ethical alternatives
7.2.2	Apply principles of preventive engineering and sustainable development to an engineering activity or product relevant to the discipline
11.1.1	Describe the rationale for the requirement for continuing professional development
11.2.1	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 the knowledge of symmetric cryptography to implement classical ciphers. (LO 1.1, LO 1.2,)
2. Implement and analyze public key cryptosystem, hashing techniques and digital signature algorithm while continuously adapting to evolving encryption methods. (LO 2.1, LO 2.2)
3. Implement and evaluate system security measures using tools and techniques while continuously updating knowledge on emerging security threats and defense techniques. (LO 3.1, LO 3.2)
4. Simulate and mitigate various types of attacks using appropriate tools and techniques while continuously adapting to new attack vectors and counter measures. (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
CELBC608.1	-	3	3	3	3	-		-		-	-
CELBC608.2	-	3	3	3	3	-	3	-		-	3
CELBC608.3	-	3	3	-	3	-	3	-		-	3
CELBC608.4	-	3	3	-	3	-	3	-		-	3
Average	-	3	3	-	3	-	3	-		-	3

Text Books :

1. William Stallings, *"Cryptography and Network Security, Principles and Practice"*, 6th Edition, Pearson Education, March 2013
2. Behrouz A. Ferouzan, *"Cryptography & Network Security"*, Tata McGraw Hill
3. Practical Packet Analysis Using Wireshark to Solve Real-World Network Problems, Chris Sanders, Second Edition,2007, No Starch Press

Reference Books:

1. Atul Kahate, *"Cryptography and Network Security",* Tata McGraw-Hill Education, 2003.
2. Eric Cole, *"Network Security Bible",* Second Edition, Wiley, 2011
3. Computer Networks: A Systems Approach, Larry L.Peterson, Bruce S.Davie, , Second Edition, 2011, The Morgan Kaufmann Series in Networking

Other Resources:

1. https://www.wireshark.org/download.html
2. https://nmap.org/
3. https://www.tenable.com/products/nessus
4. https://cse29-iiith.vlabs.ac.in/
5. https://www.onlinecryptographytools.com/
6. https://www.cryptool.org/en/cto/

TERM WORK (25 Marks)

Suggested breakup of distribution

Lab Experiments: 10 Marks

Internal Assessment: Mid Practical examination: 10 marks

Attendance: 5 marks

END SEMESTER ASSESSMENT (Practical /Oral Examination) (25 Marks)

Practical performance: 15 Marks

Oral performance: 10 Marks

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

Course Type	Course Code	Course Name	Credits
LBC	CELBC609	IOT & CLOUD COMPUTING LABORATORY	01

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

Pre-requisite:

1. CEPCC408 Computer Network

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. PO11: Life-long learning

Course Objectives:

1. To guide students in deploying IoT devices to collect and transmit data.
2. To assist students in exploring various cloud computing service models and implement them to solve the given problems.
3. To lead students toward connecting IoT devices to cloud platforms for data storing and visualization.
4. To direct students in analysing and visualizing IoT data using cloud-based tools.

Module	Details	Hrs.
	Course Introduction This course emphasizes the practical implementation of designing and managing IoT systems integrated with cloud platforms, focusing on handling large data volumes for real-time monitoring and decision-making in IoT applications.	**01**
01.	**Introduction of IOT (Arduino/Raspberry Pi)** ***Learning Objective:*** *Learners will be able to design, implement, and manage IoT systems using (Arduino/Raspberry Pi), gaining practical skills in sensor integration, data collection and communication protocols.* **Contents:** Introduction to IoT and development of basic IoT systems using Arduino and Raspberry pi including setup and configuration, Integrating various sensors/ actuators and displaying the output.	**6-8**

	Laboratory Exercises (Suggested Task): Setup the environment, develop basic IoT system on a given problem statement which integrates sensors like temperature sensor/ultrasonic sensor, actuators like LED/ servo motor and display output on the serial monitor/ LCD display.	
	Self-Learning Topics: Self-Learning Topics: Linux command, SSH(Secure shell), Git and PWM signal	
	Learning Outcomes: *A learner will be able to* *LO1. Design and Develop an IoT system to read data from sensors, analyze the output on the actuators and Identify the factors affecting its accuracy. (P.I.- 2.2.2, 3.4.2, 3.4.3, 5.1.2, 2.4.2, 5.3.1)*	
02.	**Introduction of Cloud Computing**	**7-9**
	Learning Objective: *Learners will be able to identify and comprehend with various service models such as IaaS, SaaS, PaaS and Database as a Service and Deploy and configure these cloud service models on cloud platforms.*	
	Contents: Introduction to virtualization, Cloud Computing and AWS services. Basics of Docker and running docker on cloud. **Laboratory Exercises (Suggested Tasks):** Design and develop a cloud applications on a given problem statement by implementing services like EC2, Beanstalk, IAM, containerizing instances using ECS and using virtualization techniques.	
	Self-Learning Topics: VPC, Migration	
	Learning Outcomes: *A learner will be able to* *LO 2. Design and Develop a cloud application by implementing techniques like virtualization, containerization and using AWS services like EC2, IAM, Beanstalk, ECS, etc. (P.I.- 1.3.1, 5.1.2, 3.2.1, 5.1.1, 3.4.2, 1.4.1)*	
03.	**Storing data from IoT device on Cloud.**	**5-7**
	Learning Objective: *To storing IoT data using cloud services.*	
	Contents: Basics of Cloud storage and databases. Integration of IoT systems with cloud storage. **Laboratory Exercises (Suggested Tasks)**: Design and develop a cloud integrated IoT system for a given problem statement by using AWS storage services such as RDS, S3, EBS.	
	Self-Learning Topics:	
	Learning Outcomes: *A learner will be able to* *LO 3: Design and Develop a Cloud-integrated IoT system to integrate IoT sensors to cloud databases with security. (P.I.- 1.1.1, 5.1.1, 11.3.1, 1.3.1, 5.2.1, 11.2.2)*	

04.	**Analyzing of Data using IOT and Cloud**	**7-9**
	Learning Objectives: *To store and analyze IoT data using cloud services.*	
	Contents: Data processing and analysis on cloud. Visualization and dashboards using cloud. **Laboratory Exercises (Suggested Tasks):** Develop cloud analytics system based on a given problem statement which analyzes real-time data from IoT system and generates reports for the user.	
	Self-Learning Topics: *Analysis tools*	
	Learning Outcomes: *A learner will be able to* *LO 4: Design and Develop a cloud analytics application which analyzes sensor data and generates user report in the form of visualizations to monitor IoT systems..(P.I.- 4.3.1, 5.1.1, 11.3.2, 4.3.4, 5.3.2, 11.2.2)*	
	Course Conclusion *The course conclusion will emphasize the learner's ability to implement, analyze and manage IoT systems integrated with cloud platforms. The learner will gain practical skills in handling large data volumes, ensuring real-time data processing, and enabling informed decision-making. By the end, the learner will be equipped to build secure, and efficient IoT solutions for various applications using cloud.*	
	Total	**30**

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 and engineering to solve an engineering problem
2.2.2	Identify functionalities and computing resources.
2.4.2	Analyze and interpret the results using contemporary tools.
3.2.1	Able to explore design alternatives.
3.4.2	Able to implement and integrate the modules.
3.4.3	Able to verify the functionalities and validate the design.
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
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
5.2.1	Identify the strengths and limitations of tools for (i) acquiring information, (ii) modeling and simulating, (iii) monitoring system performance, and (iv) creating engineering designs.
5.3.1	Discuss limitations and validate tools, techniques and resources
5.3.2	Verify the credibility of results from tool use with reference to the accuracy and limitations, and the assumptions inherent in their us
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. Design and analyse IoT systems that integrate various sensors, actuators, microcontrollers. (*LO 1*)
2. Analyze and implement various Cloud Computing service models (IaaS, PaaS, SaaS) to design and develop solutions for given real-world problems. (*LO 2)*
3. Integrate IoT applications on cloud services, enabling scalable data processing, storage, and real-time analytics using cloud-based solutions. (*LO 3*)
4. Visualize and analyze IoT-generated data using cloud-based tools, extracting meaningful insights and making data-driven decisions for IoT applications. (*LO 4*)

CO-PO Mapping Table with Correlation Level

CO ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CELC610.1	-	3	3	-	3	-	-	-	-	-	-
CELC610.2	3	-	3	-	3	-	-	-	-	-	-
CELC610.3	3	-	-	-	3	-	-	-	-	-	3
CELC610.4	-	-	-	3	3	-	-	-	-	-	3
Average	3	3	3	3	3	-	-	-	-	-	3

Text Books :

1. Vijay Madisetti and Arshdeep Bahga, Internet of Things (A Hands-on-Approach), 1st Edition, VPT, 2014.
2. Hakima Chaouchi, “The Internet of Things - Connecting Objects to the Web”, 1st Edition, Wiley, 2010.
3. Francis daCosta,, “Rethinking the Internet of Things: A Scalable Approach to Connecting Everything”, 1 st Edition, Apress Publications, 2013. 4. Cuno Pfister,” Getting Started with the Internet of Things”, O’Reilly Media, 2011, ISBN: 978-1- 4493-9357-1.
4. Thomas Erl, Zaigham Mahmood, and Ricardo Puttini, "Cloud Computing: Concepts, Technology & Architecture".
5. Ricardo Puttini, Thomas Erl, Zaigham Mahmood, “Cloud Computing: Concepts, Technology & Architecture”, 1 st Edition, 2013, Prentice Hall International.
6. K. Chandrasekaran,“Essentials of Cloud Computing”, 1 st Edition, 2015, CRC Press Talyor & Francis.

Reference Books :

1. Borko Furht, Armando Escalante, “Handbook of Cloud Computing”,1 st Edition, 2010, Springer US.
2. Rajkumar Buyya, Christian Vecchiola , S.Thamarai Selvi, “Mastering Cloud Computing Foundations and Applications Programming”,1st Edition, 2013, Morgan Kaufmann.

Other Resources :

1. https://www.udemy.com/course/aws certified-solutions-architect
2. https://www.coursera.org/learn/aws-cloud-technical-essentials

IN-SEMESTER ASSESSMENT (25 MARKS)

Continuous Assessment - Theory-(15 Marks)

Suggested breakup of distribution

Practical Exercises- 10 Marks

Practical Test – 10 Marks

Regularity and Active Participation - 5 Marks.

END SEMESTER EXAMINATION (25 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.

Students will be assessed based on three parameters:

- Concept/ knowledge of IOT devices and Cloud Services
- Practical knowledge of IOT integration with Cloud
- Oral

Students will be randomly allocated a program from the list of laboratory exercises and will be asked to write appropriate Steps for the same. The Process steps is checked by the examiners (Internal and External) and weightage for this is 10 Marks.

Course Type	Course Code	Course Name	Credits
SBL	CESBL603	FULL STACK DEVELOPMENT LABORATORY	02

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

Pre-requisite:

1. ESL205 - Programming Laboratory-II (Java)
2. CESBL301 - Python Programming Laboratory
3. CESBL402 - Web Development Laboratory

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. PO7: Ethics
7. PO9: Communication
8. PO 11: Life-long learning

Course Objectives:

1. To foster a deep understanding of UI/UX design principles and their application in creating user- centered web experiences.
2. To assist in developing proficiency in frontend development using React.js, including state management, routing, and component-based architecture.
3. To equip students to build robust and scalable backend applications using Node.js, Express.js, and MongoDB, mastering API design, data modeling, and advanced query techniques within the NoSQL paradigm.
4. To direct students to System design practices and cybersecurity practices.

Module	Detailed Contents	Hrs.
	Course Introduction This course introduces the MERN stack, a popular JavaScript-based technology stack for building modern web applications. Students will learn the fundamental concepts and practical skills required to develop full-stack web applications using MongoDB, Express.js, React.js, and Node.js, with a strong emphasis on user interface (UI) and user experience (UX) design principles.	**01**
01.	**Introduction to UI/UX Design** ***Learning Objective:***	**14-16**

	Learners will be able to foster a deep understanding of UI/UX design principles and their application in creating user-centered web experiences. **Content:** Introduction to UI/UX Design: Principles of User Experience (UX) and User Interface (UI), Design Thinking Process: Empathize, Define, Ideate, Prototype, Test User Research Methods: User Interviews, Surveys, User Personas, Introduction to wire framing tools (Figma /Adobe XD), Creating low-fidelity and high- fidelity prototypes, User Testing and Iterative Design ,WCAG guidelines, designing for users with disabilities Responsive Design Principles: Designing for different screen sizes and devices	
	Laboratory Exercises: (Suggested Tasks): Design UI/UX for given problem statement. (Study any existing applications) and design wireframes and low- fidelity prototypes for the same. – Test the usability of your prototypes with a small group of users and gather feedback – Produce a comprehensive report on the accessibility issues and proposed fixes on created app.	
	Self-Learning Topics: - ***Learning Outcomes:*** *A learner will be able to* *LO 1.1: Demonstrate an ability to identify UI/UX principles and design intuitive interfaces, create wireframes, low- fidelity prototypes using tools like Figma or Adobe XD for a given problem (P.I : 2.1.1,2.1.2,3.2.1,3.2.2,5.1.1,5.3.2)* *LO 1.2: Perform usability testing by collecting and analyzing user feedback to enhance usability, and effectively document and present insights using structured formats. (P.I- 4.1.1,4.3.4,9.1.2,9.1.3)*	
02.	**Frontend Development with React NextJS** ***Learning Objective****: Learners will be able to focus on mastering Next.js features like SSR, SSG, and routing while gaining hands-on experience in project setup, data fetching, and incremental static regeneration. Students will learn to build optimized, scalable web applications using modern Next.js practices.* **Content:** Introduction to React, Study of Next.js framework, Setting Up a Next.js Project, Routing in Next.js, Server-Side Rendering (SSR),Static Site Generation (SSG)	**12-14**
	Laboratory Exercises: (Suggested Tasks): Design a simple web pages for a given problem statement and display the product details, images, and allows users to add items to their cart using Next.js. – Add a simple "About Us" page and link to it from the homepage using the `next/link` component in existing web pages. – Add a dynamic blog post page that displays the full content of a specific blog post. (**Requirements:** Use `getServerSideProps()` to fetch the specific blog post data based on the URL slug.)	

	Learning Outcomes: *A learner will be able to* *LO 2.1: Demonstrate the ability to design and implement responsive dynamic web pages using Next.js for a given problem statement with required details (P.I: 2.1.1,2.2.4,3.2.2,5.1.1,5.2.2)* *LO 2.2 : Refine the architecture by incorporating efficient client-side navigation using next/link, server-side data fetching with getServerSideProps and enhancing rendering performance with SSR for dynamic blog posts (P.I : 3.4.1,4.3.1,4.3.2)*	
03.	**Backend Development with Node.js, Express and MongoDB** ***Learning Objective:*** *Learners will be able to build RESTful APIs with Node.js, Express, and MongoDB, focusing on authentication, data management, and performance optimization. Gain hands-on experience deploying secure and scalable backend applications*	**14-16**
	Content: Core concepts, modules, events, streams, building a Server with Express.js: Handling HTTP requests (GET, POST, PUT, DELETE), Middleware: Body parsing, logging, authentication, RESTful API Design: Principles of REST, designing API endpoints, connecting to MongoDB, CRUD operations with Mongoose, Schema Design: Defining data models, relationships. Implementing user authentication (e.g., JWT), authorization mechanisms (roles, permissions) , Error Handling and Validation: Handling API errors, input validation	
	Laboratory Exercises: (Suggested Tasks): Develop a RESTful API for given problem statement using Node.js and Express.js by adding features like user registration, login, content posting, following users, and retrieving user feeds. – Additionally, create a Node.js application that integrates with a MongoDB database to manage user data and perform CRUD operations for user profiles and preferences in given problem statement.	

	Learning Outcomes: *A learner will be able to* *LO 3.1: Integrate RESTful API principles and implement them using Node.js and Express.js. Refine the existing API design by incorporating additional features and enhancing its functionality based on the given problem statement. (P.I: 2.1.1,3.2.1, 2.3.2,3.4.1,5.2.2,)* *LO 3.2: Integrate Node.js with MongoDB using Mongoose, execute queries, implement secure authentication and authorization, and ensure data integrity through input validation and sanitization. (P.I:5.1.1,6.1.1,6.2.1)*	
04.	**Best practices (System design, Cybersecurity)** ***Learning Objective:*** *Learners will be able to apply system design principles, including microservices architecture, load balancing, caching, and scalability, while implementing cybersecurity best practices to secure web applications through HTTPS, authentication and authorization (OAuth, JWT), and mitigation of common vulnerabilities.*	**14-16**

	Content: System Design Principles: Micro services architecture, load balancing, caching, scalability, Cybersecurity Best Practices: Securing web applications (HTTPS), authentication and authorization (OAuth, JWT), preventing common vulnerabilities.	
	Laboratory Exercises: Design and develop a full-stack web application to solve a real-world problem, incorporating UI/UX design, frontend and backend development, database management, and deployment. Utilize micro services architecture with load balancing and caching for scalability. Implement security best practices, including HTTPS, authentication and authorization, and protection against common vulnerabilities. Provide system design, security measures, and architectural decisions with justifications.	
	Learning Outcomes: *A learner will be able to* *LO 4.1:Design, develop, and evaluate scalable, secure full-stack web applications using micro services architecture, integrating UI/UX, frontend, backend, database management, and deployment while ensuring authentication, data integrity, security best practices, and adherence to ethical and professional standards.(P.I:3.3.1,3.4.2,5.1.1,5.2.1,6.1.1,6.2.1, 7.1.1,7.2.2,11.1.1,11.2.2)*	
	Course Conclusion: By end of the course student will gain expertise in developing scalable, secure full-stack web applications by integrating UI/UX design, micro services architecture, and cybersecurity best practices. They will also enhance their ability to optimize performance and document system design effectively.	**01**
	Total	**60**

Performance Indicators

PI No.	**P.I. Statement**
2.1.1	Evaluate problem statements and identifies objectives
2.1.2	Identify 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.
2.3.2	Identify design constraints for required performance criteria.
3.2.1	Able to explore design alternatives.
3.2.2	Able to produce a variety of potential design solutions suited to meet functional requirement.
3.3.1	Able to perform systematic evaluation of the degree to which several design concepts meet the criteria.
3.4.1	Able to refine architecture design into a detailed design within the existing constraints.
3.4.2	Able to implement and integrate the modules.
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
4.3.2	Critically analyze data for trends and correlations, stating possible errors and limitations
4.3.4	Synthesize information and knowledge about the problem from the raw data to reach appropriate conclusions

5.1.1 Identify modern engineering tools, techniques and resources for engineering activities

5.2.1 Create/adapt/modify/extend tools and techniques to solve engineering problems

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

6.2.1 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

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

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

Course Outcomes: A learner will be able to-

1. Develop a strong understanding of user-centered design principles and apply them to create effective and user-friendly interfaces. (*LO 1.1, LO 1.2)*
2. Design an application using Next.js framework, including component-based architecture, state management, and advanced techniques like routing and server-side rendering. (*LO 2.1, LO 2.2)*
3. Create robust and scalable backend applications using Node.js and Express.js, integrating with databases and implementing secure APIs. (*LO 3.1, LO 3.2)*
4. Adapt best practices for building secure, scalable, and maintainable web applications. (*LO 4.1)*

CO-PO Mapping Table with Correlation Level

CO ID	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CESBL603.1	-	3	3	3	3	-	-	-	3	-	-
CESBL603.2	-	3	3	3	3	-	-	-	-	-	-
CESBL603.3	-	3	3	-	3	3	-	-	-	-	-
CESBL603.4	-	-	3	-	3	3	3	-	-	-	3
Average	-	**3**	**3**	**3**	**3**	**3**	**3**	-	**3**	-	**3**

Text Books:

1. Joel Marsh, “UX for Beginners”, O’Reilly , 2022
2. Next.js Cookbook: Learn how to build scalable and high-performance apps from scratch
3. *Pro Git* by Scott Chacon and Ben Straub

Reference Books:

1. Jenifer Tidwell, Charles Brewer, Aynne Valencia, “Designing Interface” 3 rd Edition , O’Reilly 2020
2. Git Pocket Guide by Richard E. Silverman, O'Reilly Media 2013 ISBN: 978-1449325862

Other Resources:

1. https://www.interaction-design.org/literature

CONTINUOUS ASSESSMENT (50 Marks)

Laboratory Exercises: 15 Marks

Internal Assessment: 10 Marks

Regularity and active participation: 05 Marks

Practical Test: 20 Marks

Two practical tests will be conducted based on laboratory exercises.

1. Students will be randomly assigned two or more web development tasks to evaluate their web development skills.

2. Students will have a designated 2-hour time frame for code development/task execution. After the first hour, an internal examiner will assess the progress of each student' and provide feedback for enhancements, focusing on evaluating web development skills. Alongside web development skills, problem-solving abilities will also be evaluated.

3. Towards the end of the practical or during assessment, students will be asked questions to gauge their conceptual understanding of web development principles and techniques.

END SEMESTER EXAMINATION (Practical/Oral Examination) (50 Marks)

For the End semester exams, practical examination will be conducted. The details of the end- semester evaluation are as follows. It will consist of three sections:

Section 1: Practical Examination (35 Marks)

This section will have practical exam based on the laboratory exercises conducted during the term. The assessment criteria will be similar to Internal Practical Test. Each laboratory exercise can focus on different aspects of Full stack development such as UI/UX, Front end development, Backend development such as Node js , Express and MongoDB.

Section 2: Documentation and Presentation (05 Marks)

During the practical exam, students should incorporate comprehensive code comments for project organization and readability. Additionally, they should demonstrate visually engaging and responsive user interfaces, prioritizing accessibility considerations.

Section 3: Oral (10 Marks)

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

Course Type	Course Code	Course Name	Credits
MNP	CEMNP604	Mini Project 2B	02 each

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

- 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 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 & 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**
1	**Fundamentals of Research Methodology**	**4-5**
	Content: 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	

	Exercise: A group discussion on what is research and ethics in research with related case studies shall be conducted.	
2	**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.*	
3	**Research Design**	**4-5**
	Content: 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.*	
4	**Sampling Method**	**3-4**
	Content: 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.*	
5	**Data Collection & Data Analysis**	**4-5**
	Content: 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*	

6	**Report Writing and Journal Publication**	**3-4**
	Content: 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**
	Total	**30**

Course Outcome: Learner will be able to

CO1: Identify and demonstrate the importance of research process in science and technology domains

CO2: Perform literature reviews using print and online databases.

CO3: Analyse the data using qualitative and quantitative methods

CO4: Identify and prepare the key elements of a research report/ paper

CO5: 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 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 & Society
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 fo safety.

Course Type	Course Code	Course Name	Credits
LLC	LLC6015	PERSONALITY DEVELOPMENT	02

Program Outcomes addressed:

1. PO6 : The Engineer & Society
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).