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 Electrical Engineering

Curriculum Structure FY to B.Tech.

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First and Second Year Syllabus

Prepared by : Board of Studies for Department of Electrical Engineering

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

Revision: 2024

Effective from :2024-25

PREAMBLE-DEAN ACADEMICS

Accelerating Towards Excellence: Unveiling a New Era in Education

Dear Students, Faculty, and Stakeholders,

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

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

As we embark on this transformative journey, we invite all stakeholders to join us in shaping the futureof 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- BOS CHAIRPERSON

Established in 1994, the Electrical Engineering department, provides comprehensive programs spanning undergraduate, postgraduate, and Ph. D levels. Comprising a team of highly qualified and experienced faculty, the department distinguishes itself through its cutting-edge facilities such as the Renewable Laboratory, Protection Laboratory, Power Electronics, Drives and Control System Laboratory. Additionally, the program has received accreditation thrice in 2005, 2012, and 2018, maintaining its validity to date. Furthermore, the institute is scheduled to transition to autonomy from the academic year 2024-25.

The scheme and syllabus of the Department of Electrical Engineering under autonomy are centred entirely on fostering the development of learners and cultivating the essential attributes that graduates should possess. When crafting the curriculum, two primary considerations are taken into account: the essential domain knowledge, skill sets, and tools required for the diverse career paths available to contemporary Electrical engineers and the 12 attributes of Program Outcomes mandated by regulatory bodies. The NBA-SAR January 2016 serves as a benchmark for shaping the learning outcomes within each module of the syllabus. Electrical engineering curriculum is structured to cover a range of core areas and specialized topics, ensuring that graduates are well-equipped to tackle the challenges of the modern world.

National Educational Policy-2020 guidelines are considered as reference while designing the curriculum. It incorporates practical learning opportunities like mini projects and major projects, skills-based labs, and internships to foster creativity and problem-solving abilities. Furthermore, offering value-added courses, honours programs, and minors ensures a well-rounded educational experience that caters to students' unique interests and goals.

The curriculum offers abundant chances for educators to pioneer teaching methods and assessment approaches, with the goal of enriching students' learning experiences and cultivating a lifelong passion for learning.

With a strong foundation in electrical engineering principles and specialized knowledge in key areas, graduates of our program are well-prepared to make significant contributions to the field and drive innovation in technology.

As we embark on this transformative journey, we invite all stakeholders to join us in shaping the future of Electrical Engineering education.

BOS Chairperson,
Department of Electrical Engineering.

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A. Abbreviations

AEC	Ability Enhancement Course
AU	Audit Course
BSC	Basic Science Course including Mathematics
BSC-LC	Basic Science Laboratory Course
ELC	Experiential Learning Course
ESC	Engineering Sciences Course
ESC-LC	Engineering Sciences Laboratory Course
HMCC	Honours or Minor Core Course
HML	Honours or Minor Laboratory
HMMP	Honours or Minor Mini Project
HE	Honours Elective
HL	Honours Laboratory
HMP	Honours Mini Project
HSSM	Humanities Social Sciences and Management Course
IKS	Indian Knowledge System Course
INTR	Internship
L	Lecture
LC	Laboratory Course
LLC	Liberal Learning Course
MDM	Multidisciplinary Minor Course
ME	Minor Elective
MJP	Major Project
MP	Mini Project
OE	Open Elective Course
P	Practical
PCC	Program Core Course
PE	Program Elective Course
RP	Research Project
RPI	Research Project Internship
SBL	Skill Based Laboratory
SEC	Skill Enhancement Course
T	Tutorial
VEC	Value Education Course

B. Credit Structure

B. Tech in Electrical 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 (BSC-LC)	01	01	--	--	--	--	--	--	**02**		
Engineering Science Course (ESC)	05	02	--	--	--	--	--	--	**07**	**16**	**12-16**
Engineering Science Laboratory Course (ESC-LC)	04	05	--	--	--	--	--	--	**09**		
Program Core Course (PCC)	--	--	14	13	06	03	03	--	**39**	**51**	**44-56**
Laboratory Course (LC)	--	--	02	03	03	02	02	--	**12**		
Program Elective (PE)	--	--	--	--	03	03	06	03	**15**	**15**	**20**
Multidisciplinary Minor (MDM)	--	--	03	03	03	03	--	--	**12**	**12**	**14**
Open Elective (OE)	--	--	--	--	--	--	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 (HSSM)	--	--	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 (MP)	--	--	01	01	01	01	---	--	**04**	**10**	**04**
Major Project (MJP)	--	--	--	--	---	-	02	04	**06**		
Internship (INTR)	--	--	--	--	--	--	--	08	**08**	**08**	**12**
Liberal Learning Course (LLC)	---	--	--	--	--	02	--	---	**02**	**02**	**04**
Total Credits	**21**	**22**	**24**	**24**	**20**	**18**	**18**	**18**	**165**	**165**	**160-176**

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

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

Course Type	Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
			L	P	T	L	P	T	Total
BSC	BSC101	Engineering Mathematics I	3	--	1	3	--	1	4
BSC	BSC102	Engineering Physics-I	2	--	--	2	--	--	2
BSC	BSC103	Engineering Chemistry-I	2	--	--	2	--	--	2
ESC	ESC101	Engineering Mechanics	3	--	--	3	--	--	3
ESC	ESC102	Basic Electrical Engineering	2	--	--	2	--	--	2
BSC-LC	BSCLC101	Engineering Physics-I Laboratory	--	1	--	--	0.5	--	0.5
BSC-LC	BSCLC102	Engineering Chemistry-I Laboratory	--	1	--	--	0.5	--	0.5
ESC-LC	ESCLC101	Engineering Mechanics Laboratory	--	2	--	--	1	--	1
ESC-LC	ESCLC102	Basic Electrical Engineering Laboratory	--	2	--	--	1	--	1
ESC-LC	ESCLC103	Programming Laboratory-I (C)	--	2*+2	--	--	2	--	2
SEC	SEC101	Basic Workshop Practice-I	--	2	--	--	1	--	1
VEC	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. 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.

Examination Scheme – FY Semester-I

Course Type	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	
BSC	BSC101	Engineering Mathematics-I	20+25[@]	30	50	1.5	2	125
BSC	BSC102	Engineering Physics-I	15	20	40	1.0	1.5	75
BSC	BSC103	Engineering Chemistry-I	15	20	40	1.0	1.5	75
ESC	ESC101	Engineering Mechanics	20	30	50	1.5	2	100
ESC	ESC102	Basic Electrical Engineering	15	20	40	1.0	1.5	75
BSC-LC	BSCLC101	Engineering Physics-I Laboratory	25	--	--	--	--	25
BSC-LC	BSCLC102	Engineering Chemistry-I Laboratory	25	--	--	--	--	25
ESC-LC	ESCLC101	Engineering Mechanics Laboratory	25	--	--	--	--	25
ESC-LC	ESCLC102	Basic Electrical Engineering Laboratory	25	--	25	--	--	50
ESC-LC	ESCLC103	Programming Laboratory-I (C)	50	--	50	--	--	100
SEC	SEC101	Basic Workshop Practice-I	50	--	--	--	--	50
VEC	VEC101	Universal Human Values	50	--	--	--	--	50
Total			**360**	**120**	**295**	--	--	**775**

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

[@]For continuous assessment of tutorials.

Curriculum Structure – FY Semester-II

Course Type	Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
			L	P	T	L	P	T	Total
BSC	BSC204	Engineering Mathematics-II	3	--	1	3	--	1	4
BSC	BSC205	Engineering Physics-II	2	--	--	2	--	--	2
BSC	BSC206	Engineering Chemistry-II	2	--	--	2	--	--	2
AEC	AEC201	Professional Communication and Ethics-I	2	2	--	2	1	--	3
ESC	ESC203	Basic Electronics Engineering	2	--	--	2	--	--	2
BSC-LC	BSCLC203	Engineering Physics-II Laboratory	--	1	--	--	0.5	--	0.5
BSC-LC	BSCLC204	Engineering Chemistry-II Laboratory	--	1	--	--	0.5	--	0.5
ESC-LC	ESCLC204	Engineering Graphics Laboratory	--	2*+2	--	--	2	--	2
ESC-LC	ESCLC205	Programming Laboratory-II (Java)	--	2*+2	--	--	2	--	2
ESC-LC	ESCLC206	Basic Electronics Engineering Laboratory	--	2	--	--	1	--	1
SEC	SEC202	Basic Workshop Practice-II	--	2	--	--	1	--	1
IKS	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 Type	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	
BSC	BSC204	Engineering Mathematics-II	20+25[@]	30	50	1.5	2	125
BSC	BSC205	Engineering Physics-II	15	20	40	1.0	1.5	75
BSC	BSC206	Engineering Chemistry-II	15	20	40	1.0	1.5	75
AEC	AEC201	Professional Communication and Ethics-I	50	--	--	--	--	50
ESC	ESC203	Basic Electronics Engineering	15	20	40	1.0	1.5	75
BSC-LC	BSCLC203	Engineering Physics-II Laboratory	25	--	--	--	--	25
BSC-LC	BSCLC204	Engineering Chemistry-II Laboratory	25	--	--	--	--	25
ESC-LC	ESCLC204	Engineering Graphics Laboratory	50	--	50	--	--	100
ESC-LC	ESCLC205	Programming Laboratory-II (Java)	50	--	50	--	--	100
ESC-LC	ESCLC206	Basic Electronics Engineering Laboratory	25	--	25	--	--	50
SEC	SEC202	Basic Workshop Practice-II	50	--	--	--	--	50
IKS	IKS201	Indian Knowledge System	50	--	--	--	--	50
		Total	**415**	**90**	**295**	--	--	**800**

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

[@]For continuous assessment of tutorials.

Curriculum Structure – SY Semester-III

Course Type	Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
			L	P	T	L	P	T	Total
PCC	EEPCC301	Engineering Mathematics-III	3	--	1	3	--	1	4
PCC	EEPCC302	Circuit and Signal Analysis	3	--	1	3	--	1	4
PCC	EEPCC303	Elements of Power System	3	--	--	3	--	--	3
PCC	EEPCC304	Renewable Sources and Energy Storage	3	--	--	3	--	--	3
MDM	EEMDM301	Electronic Components and Circuits	3	--	--	3	--	--	3
LC	EELC301	Electronics Laboratory	--	2	--	--	1	--	1
LC	EELC302	Electrical System Laboratory	--	2	--	--	1	--	1
SBL	EESBL301	Python Laboratory	--	4	--	--	2	--	2
MP	EEMP301	Mini Project – 1A	--	3	--	--	1	--	1
HSSM	HSSM301	Product Design	2	--	--	2	--	--	2
Total			**17**	**11**	**2**	**17**	**5**	**2**	**24**

Examination Scheme – SY Semester-III

Course Type	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	
PCC	EEPCC301	Engineering Mathematics-III	20+25[@]	30	50	1.5	2	125
PCC	EEPCC302	Circuit and Signal Analysis	20+25[@]	30	50	1.5	2	125
PCC	EEPCC303	Elements of Power System	20	30	50	1.5	2	100
PCC	EEPCC304	Renewable Sources and Energy Storage	20	30	50	1.5	2	100
MDM	EEMDM301	Electronic Components and Circuits	20	30	50	1.5	2	100
LC	EELC301	Electronics Laboratory	25	--	25	--	--	50
LC	EELC302	Electrical System Laboratory	25	--	25	--	--	50
SBL	EESBL301	Python Laboratory	50	--	50	--	--	100
MP	EEMP301	Mini Project – 1A	50	--	--	--	--	50
HSSM	HSSM301	Product Design	50	--	--	--	--	50
Total			**350**	**150**	**350**	--	--	**850**

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

[@]For continuous assessment of tutorials.

Curriculum Structure – SY Semester-IV

Course Type	Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
			L	P	T	L	P	T	Total
PCC	EEPCC405	Engineering Mathematics-IV	3	--	1	3	--	1	4
PCC	EEPCC406	Control System	3	--	--	3	--	--	3
PCC	EEPCC407	Power Electronics	3	--	--	3	--	--	3
PCC	EEPCC408	Power System Engineering	3	--	--	3	--	--	3
MDM	EEMDM402	Internet of Things	3	--	--	3	--	--	3
LC	EELC403	Power Electronics Laboratory	--	2	--	--	1	--	1
LC	EELC404	Control System Laboratory	--	2	--	--	1	--	1
LC	EELC405	Measurements and Instruments Laboratory	--	2	--	--	1	--	1
SBL	EESBL402	PCB Fabrication and Circuit Testing Laboratory	--	4	--	--	2	--	2
MP	EEMP402	Mini Project – 1B	--	3	--	--	1	--	1
VEC	VEC402	Environment and Sustainability	2	--	--	2	--	--	2
Total			**17**	**13**	**1**	**17**	**6**	**1**	**24**

Examination Scheme – SY Semester-IV

Course Type	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	
PCC	EEPCC405	Engineering Mathematics-IV	20+25[@]	30	50	1.5	2	125
PCC	EEPCC406	Control System	20	30	50	1.5	2	100
PCC	EEPCC407	Power Electronics	20	30	50	1.5	2	100
PCC	EEPCC408	Power System Engineering	20	30	50	1.5	2	100
MDM	EEMDM402	Internet of Things	20	30	50	1.5	2	100
LC	EELC403	Power Electronics Laboratory	25	--	25	--	--	50
LC	EELC404	Control System Lab	25	--	25	--	--	50
LC	EELC405	Measurements and Instruments Laboratory	25	--	25	--	--	50
SBL	EESBL402	PCB Fabrication and Circuit Testing Laboratory	50	--	50	--	--	100
MP	EEMP402	Mini Project – 1B	50	--	50	--	--	100
VEC	VEC402	Environment and Sustainability	50	--	--	--	--	50
Total			**350**	**150**	**425**	--	--	**925**

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

[@]For continuous assessment of tutorials.

Curriculum Structure – TY Semester-V

Course Type	Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
			L	P	T	L	P	T	Total
PCC	EEPCC509	Electrical Machines	3	--	--	3	--	--	3
PCC	EEPCC510	Protection and Switchgear	3	--	--	3	--	--	3
MDM	EEMDM503	Microcontrollers	3	--	--	3	--	--	3
PE	EEPE501X	Program Elective -I	3	--	--	3	--	--	3
LC	EELC506	Switchgear and Safety Laboratory	--	2	--	--	1	--	1
LC	EELC507	Microcontroller and Embedded Laboratory	--	2	--	--	1	--	1
LC	EELC508	Electrical Machines Laboratory	--	2	--	--	1	--	1
AEC	AEC502	Professional Communication and Ethics-II	1	2	--	1	1	--	2
MP	EEMP503	Mini Project-2A	--	3	--	--	1	--	1
HSSM	HSSM502	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:

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

Course Code	Program Elective -I
EEPE5011	Advanced Power Electronics
EEPE5012	Engineering Electromagnetics
EEPE5013	Electric Vehicle Technology

Examination Scheme – TY Semester-V

Course Type	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	
PCC	EEPCC509	Electrical Machines	20	30	50	1.5	2	100
PCC	EEPCC510	Protection and Switchgear	20	30	50	1.5	2	100
MDM	EEMDM503	Microcontrollers	20	30	50	1.5	2	100
PE	EEPE501X	Program Elective -I	20	30	50	1.5	2	100
LC	EELC506	Switchgear and Safety Laboratory	25	--	25	--	--	50
LC	EELC507	Microcontroller and Embedded Laboratory	25	--	25	--	--	50
LC	EELC508	Electrical Machines Laboratory	25	--	25	--	--	50
AEC	AEC502	Professional Communication and Ethics-II	50	--	--	--	--	50
MP	EEMP503	Mini Project-2A	50	--	--	--	--	50
HSSM	HSSM502	Entrepreneurship	50	--	--	--	--	50
Total			305	**120**	**275**	--	--	**700**

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

Curriculum Structure – TY Semester-VI

Course Type	Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
			L	P	T	L	P	T	Total
PCC	EEPCC611	Drives and Control	3		--	3	--	--	3
MDM	EEMDM604	Artificial Intelligence and Machine Learning	3		--	3	--	--	3
PE	EEPE602X	Program Elective -II	3	--	--	3	--	--	3
LC	EELC609	Drives and Control Laboratory	--	2	--	--	1	--	1
LC	EELC610	Electrical Software Laboratory	--	2	--	--	1	--	1
SBL	EESBL603	Industrial Automation Laboratory	--	4	--	--	2	--	2
MP	EEMP604	Mini Project – 2B	--	3	--	--	1	--	1
ELC	ELC601	Research Methodology	2	--	--	2	--	--	2
LLC	LLC601X*	Liberal Learning Course	2	--	--	2	--	--	2
		Total	**13**	**11**	**--**	**13**	**5**	**--**	**18**

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.

***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:

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

Course Code	Program Elective -II
EEPE6021	Lighting System Design
EEPE6022	High Voltage DC transmission
EEPE6023	Advanced Control System

Examination Scheme – TY Semester-VI

Course Type	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	
PCC	EEPCC611	Drives and Control	20	30	50	1.5	2	100
MDM	EEMDM604	Artificial Intelligence and Machine Learning	20	30	50	1.5	2	100
PE	EEPE602X	Program Elective -II	20	30	50	1.5	2	100
LC	EELC609	Drives and Control Laboratory	25	--	25	--	--	50
LC	EELC610	Electrical Software Lab	25	--	25	--	--	50
SBL	EESBL603	Industrial Automation Laboratory	50	--	50	--	--	100
MP	EEMP604	Mini Project – 2B	50	--	50	--	--	100
ELC	ELC601	Research Methodology	50	--	--	--	--	50
LLC	LLC601X	Liberal Learning Course	50	--	--	--	--	50
Total			**310**	**90**	**300**	--	--	**700**

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

Curriculum Structure – B. Tech Semester-VII

Course Type	Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
			L	P	T	L	P	T	Total
PCC	EEPCC712	Electrical Systems Design and Auditing	3	--	--	3	--	--	3
PE	EEPE703X	Program Elective -III	3	--	--	3	--	--	3
PE	EEPE704X	Program Elective -IV	3	--	--	3	--	--	3
OE	OE701X	Open Elective –I	3	--	--	3	--	--	3
LC	EELC711	Electrical System Design and Audit Laboratory	--	2	--	--	1	--	1
LC	EELC712	Applied Power Electronics Laboratory	--	2	--	--	1	--	1
MJP	EEMJP701	Major Project A	--	6	--	--	2	--	2
HSSM	HSSM703	Financial Planning	2	--	--	2	--	--	2
Total			**14**	**10**	**--**	**14**	**4**	**--**	**18**

Program Elective-III:

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

Course Code	Program Elective-III
EEPE7031	Power System Operation and Control
EEPE7032	Digital VLSI Design
EEPE7033	High Voltage Engineering

Program Elective-IV:

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

Course Code	Program Elective-IV
EEPE7041	Smart Power System
EEPE7042	Power Quality and FACTS
EEPE7043	Artificial Intelligence in Renewable Energy System

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
OE7011	Product Lifecycle Management
OE7012	Reliability Engineering
OE7013	Management Information System
OE7014	Design of Experiments
OE7015	Operation Research
OE7016[@@]	Cyber Security and Laws
OE7017	Disaster Management and Mitigation Measures
OE7018	Energy Audit and Management
OE7019	Development Engineering

[@@] Students opting for Honours/Minor degree in Cybersecurity are not allowed to opt Cyber Security and Laws from list of Open Elective –I.

Examination Scheme – B. Tech Semester-VII

Course Type	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	
PCC	EEPCC712	Electrical Systems Design and Auditing	20	30	50	1.5	2	100
PE	EEPE703X	Program Elective-III	20	30	50	1.5	2	100
PE	EEPE704X	Program Elective -IV	20	30	50	1.5	2	100
OE	OE701X	Open Elective –I	20	30	50	1.5	2	100
LC	EELC711	Electrical Systems Design and Audit Laboratory	25	--	25	--	--	50
LC	EELC712	Applied Power Electronics Laboratory	25	--	25	--	--	50
MJP	EEMJP701	Major Project A	50	--	--	--	--	50
HSSM	HSSM703	Financial Planning	50	--	--	--	--	50
Total			**230**	**120**	**250**	--	--	**600**

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

Curriculum Structure – B. Tech Semester-VIII

Course Type	Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
			L	P	T	L	P	T	Total
PE	EEPE805X	Program Elective-V	3	--	--	3	--	--	3
OE	OE802X	Open Elective-II	3	--	--	3	--	--	3
MJP	MJP802	Major Project-B	--	12	--	--	4	--	4
INTR	INTR801	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:

Students should take one PE from one of the domains listed below. List of courses within the domains will be made available before the course registration.

Course Code	Program Elective-V
EEPE8051	Power Electronics and Control
EEPE8052	Advanced Power System
EEPE8053	Microgrid and Smart Grid

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
OE8021	Project Management
OE8022	Finance Management
OE8023	Entrepreneurship Development and Management
OE8024	Human Resource Management
OE8025	Professional Ethics and CSR
OE8026	Circular Economy
OE8027	IPR and Patenting
OE8028	Digital Business Management
OE8029	Environmental Management

Examination Scheme – B. Tech Semester-VIII

Course Type	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	
PE	EEPE805X	Program Elective-IV	20	30	50	1.5	2	100
OE	OE802X	Open Elective-II	20	30	50	1.5	2	100
MJP	MJP802	Major Project-B	50	--	50	--	--	100
INTR	INTR801	Internship	50	--	50	--	--	100
Total			**140**	**60**	**200**	--	--	**400**

[$]Please refer to the Syllabus of respective departments for guidelines of in-semester assessments for theory, laboratory, and internship 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 refer Institute level hand book.

D. Honours and Minors Degree Programme

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 Handbook for Honours/Minor/Honours in Research Degree Programs for further details.

E. Syllabi
First Year

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

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

*For Tutorial

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	Detailed Contents	Hrs	CO
00.	**Course Introduction** Mathematics is the fundamental step which creates a solid foundation for all Applied fields of Engineering. Professional Engineering applications have Mathematics as an integral part of their evolution. For example: 1. Formulation in Mathematics to various engineering field using case study 2. Application of matrices in control systems, wireless signals and computer graphics. 3. Introduction to function of several variables to apply in Marginal rate of technical substitution, Elasticity of substitution. 4. 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.	**1**	
01.	**Matrices - I** ***Learning Objective/s:*** *Learner will be able to* • *Analyse and interpret the basic fundamentals of matrices.* • *Determine the rank of a matrix by applying the concepts of elementary transformation of a matrix.*	**7-9**	**CO- 1**

	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* 1. *Express a square matrix as the sum of a Symmetric and Skew-Symmetric Matrix by identifying the correct definition. (2.1.1)* 2. *Identify the correct procedure to express a square matrix as the sum of a Symmetric and Skew-Symmetric Matrix. (2.2.3)* 3. *Express a square matrix as the sum of a Hermitian and Skew-Hermitian Matrix by identify the correct definition and. (2.1.1)* 4. *Identify the correct procedure to express a square matrix as the sum of a Hermitian and Skew-Hermitian Matrix. (2.2.3)* 5. *Use elementary transformations to determine the rank of a matrix. (1.1.1)* 6. *Determine the rank of a matrix by finding its normal form/canonical form.(1.2.1)*		
02.	**Matrices - II** ***Learning Objective/s:*** *Learner will be able to* • *Analyse the differences between homogeneous and non-homogeneous simultaneous equations* • *Apply these concepts to find their solutions, if they exist.* **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* 1. *Identify homogeneous and non-homogeneous simultaneous equations and express them into matrix form. (2.1.1)* 2. *Identify unknown variables to solve homogeneous and non-homogeneous simultaneous equations. (2.1.2)* 3. *Identify the appropriate method to solve homogeneous and non-homogeneous simultaneous equations. (2.2.3)* 4. *Interpret & use the concept of rank to solve simultaneous equations. (1.1.1)* 5. *Interpret & solve simultaneous equations based on the concept of rank. (1.2.1)*	**5-7**	**CO- 2**
03.	**Matrices-III** ***Learning Objective/s:*** • *Analyse and compute the Eigen Value and Eigen Vectors.* • *Enumerate and apply the concept of Eigen value and Eigen vector to Engineering Models.*	**6-8**	**CO- 2**

	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* 1. *Apply fundamentals of determinant to find Eigen Values and Eigen Vectors. (1.1.1)* 2. *Determine Eigen Values and Eigen Vectors by applying fundamentals of determinant. (1.2.1)* 3. *Analyse and Identify whether Cramer's Rule/homogeneous equation is applicable to find Eigen vectors. (2.1.1)* 4. *Identify and apply Cramer's Rule/ concept of homogeneous equations to find Eigen vectors. (2.1.3)* 5. *Determine Eigen vectors using Cramer's Rule/homogeneous equation.(2.2.4)*		
04	**Differential Calculus of Several Variables-I** ***Learning Objective/s:*** *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**	**CO- 3**
	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* 1. *Identify the basic concepts of partial differentiation (PD) with the prerequisite of differentiation of function of a single variable (calculus). (2.2.3)* 2. *Identify the suitable procedure to partially differentiate a function of several variables. (2.1.3)* 3. *Apply the learned concept to solve problems for several types of functions. (1.1.1)* 4. *Solve problems for several types of functions by applying the learned concept. (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**	**CO- 3**
	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* 1. *Apply Euler's Theorem of two variables to solve problems (1.1.1)* 2. *Solve problems based on homogeneous function of two variables by applying Euler's Theorem of to (1.2.1)* 3. *Identify the conditions for maxima and minima of functions of two variables and determine it. (2.1.3)* 4. *Determine maxima and minima of functions of two variables by identify its conditions. (2.2.3)*		
06.	**Vector Differentiation** ***Learning Objective/s:*** *Analyze the fundamentals of Gradient of scalar point function, Divergence & Curl of a vector point function and apply it to verify whether the field is irrotational or solenoidal.*	**7-9**	**CO- 4**

	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* 1. *Apply fundamentals of differentiation of several variables to evaluate Gradient, Divergence & Curl. (1.1.1)* 2. *Apply fundamentals of scalar product and vector product to evaluate Gradient, Divergence & Curl. (1.2.1)* 3. *Identify whether the given vector field is irrational or solenoidal and solve the problem. (2.1.3)* 4. *Identify the appropriate procedure to check whether a vector field is irrational or solenoidal and solve the problem. (2.2.3)*		
	Course Conclusion	**1**	
	Total	**45**	

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.
2. Analyse the characteristic equation to determine the Eigen value, Eigen vector, also function of a matrix by applying Cayley-Hamilton theorem.
3. Implement the fundamentals of partial differentiation to evaluate the maxima and minima of functions of several variables.
4. Apply the concepts of Gradient, Divergence, and Curl in order to analyse and state the two types of fields, Irrotational and Solenoidal

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.
2.1.2	Identify engineering systems, variables, and parameters to solve the problems
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.

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

IN-SEMESTER ASSESSMENT (75 Marks)

1. Continuous assessment (45 Marks)

Continuous Internal Evaluation of 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

Continuous internal evaluation of Tutorial (25 Marks)

1. Tutorials: 20 Marks
2. Regularity and active participation: 5 marks
3. Students must be encouraged to write atleast 6 class tutorials. Atleast class tests will be conducted based on class tutorials on entire syllabus. Each class test carries 20 Marks. Average will be taken of all class tests.

2. Mid Semester Exam (30 Marks)

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

END SEMESTER EXAMINATION (50 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	BSC102	ENGINEERING PHYSICS-I	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 society
4. PO7: Environment and sustainability

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	Detailed Content	Hrs	CO
00.	**Course Introduction** Importance of physics in various engineering field: Application of thin film Interference and diffraction in measurement techniques: Introduction to laser and fibre optics its utilization in optoelectronics field: Use of semiconductor devices and superconductors in technology.	**1**	
01.	**Interference in Thin Film and Diffraction** ***Learning Objective/s:*** •*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**	**CO-1**
	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* 1. *Diagrammatically describe the mechanism of thin film interference and diffraction. (P.I.-1.2.1)* 2. *Observe the interference phenomena in real life examples. (P.I.-1.2.1).* 3. *Solve problems using the concepts of thin film interference and diffraction. (P.I.-1.2.2)* 4. *Identify the parameters which defines the quality of a grating and solve the relevant problems. (P.I.-2.1.2)* 5. *Derive the conditions for maxima and minima in interference and diffraction. (P.I.-2.1.3)* 6. *Analyze the concept of thin film interference and diffraction for using in thin film coating and other measurements. (P.I.-2.2.3)*		
02.	**Laser** ***Learning Objective/s:*** *•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**	**CO3**
	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* 1. *Differentiate between spontaneous emission and stimulated emission. (P.I.-1.2.1)* 2. *State various parameters related to lasers. (P.I.-1.2.1)* 3. *Identify different types of lasers in terms of principle, construction and working for public use. (P.I.-2.2.3)* 4. *State the advantages, disadvantages and limitations in using lasers. (P.I.-6.2.2)* 5. *Identify the industrial and medical applications of laser. (P.I.-6.1.1)*		
03.	**Fiber Optics** ***Learning Objective/s:*** *•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**	**CO-3**

	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* 1. *State various parameters related to the optical fibre. (P.I.-1.2.1)* 2. *Solve problems on optical fibre using the concepts and basic formulae. (P.I.-1.2.2)* 3. *Classify the optical fibre in terms of various properties. (P.I.-2.1.2)* 4. *Derive the expression of numerical aperture for step index fibre. (P.I.-2.1.3)* 5. *Apply the concept of optical fibre in fibre optic communication system. (P.I.-6.1.1)* 6. *State the merits, demerits and challenges in using Fibre optic communication system in the society. (P.I.-6.2.2)*		
04.	**Semiconductor Physics** ***Learning Objective/s:*** *•To apply the fundamental knowledge of band gap in semiconductors* *•To evaluate the concept of fermi level in semiconductor for solving problems.*	**4-6**	**CO-2**
	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* 1. *State various parameters which defines a semiconductor. (P.I.-1.2.1)* 2. *Solve the problems involving fermi level. (P.I.-1.2.2)* 3. *Identify the types of semiconductors based on band gap. (P.I.-2.1.2)* 4. *Interpret the applications of semiconductors based on its band gap property. (P.I.-2.1.2)* 5. *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**	**CO-4**
	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* 1. *State the principles of various semiconductor devices. (P.I.-1.2.1)* 2. *Use the Hall Effect phenomena in determination of magnetic field. (P.I.-2.1.3)* 3. *Analyse Semiconductor devices in terms of their principle, construction, working. (P.I.-2.2.3)* 4. *State applications of semiconductor devices in society. (P.I.-7.1.2)* 5. *identify the role of semiconductor devices as a solution for sustainable development. (P.I.-7.2.1)*		
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**	**CO-4**
	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* *1. Recall the definitions of superconductor and its related parameters. (P.I.-1.2.1)* *2. Solve problems on superconductor using the concepts and basic formulae. (P.I.-1.2.2)* *3. Write the qualitative description of the Meissner effect. (P.I.-2.2.3)* *4. Differentiate Type I and Typr II superconductors in terms of their behaviour in magnetic field. (P.I.-2.1.2)* *5. State the principle, construction, working of MAGLEV. (P.I.-2.2.3)* *6. State the advantages, disadvantages and limitations of using MAGLEV in terms of socio-economic sustainability. (P.I.-7.1.2)* *7. identity the impact of superconductor applications in society. (P.I.-7.1.1)*		
	Course Conclusion	**1**	
	Total	**30**	

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.
2. Use the fundamental knowledge of semiconductor physics to identify the various parameters to solve the problem.
3. Apply the knowledge of Laser, fiber optics for health and safety issues by analyzing their properties and parameters.
4. Identify the role and impact of the semiconductor devices and superconductors for sustainable development by knowing their applications.

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.

7.1.2 Understand the relationship between the technical, socio economic and environmental dimensions of sustainability.

7.2.1 Describe devices and techniques for sustainable development.

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 Internal Evaluation of 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% 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	BSC103	ENGINEERING CHEMISTRY- I	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 society
4. PO7 - Environment and sustainability

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	Detailed Content	Hrs	CO
00.	**Course Introduction** Engineering chemistry provides the fundamental understanding of materials, substances and processes that engineers need to design, develop and manufacture products and systems.	1	
01.	**Green Chemistry** ***Learning Objectives:*** *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	CO- 2 CO- 3 CO-4

	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* 1. *Apply green chemistry principles for environmental benign practices for industries (1.3.1)* 2. *Use the principles of green chemistry as standard guidelines for various chemical industry processes. (6.2.1)* 3. *Identify the hazards involved in the use of conventional synthesis of drugs, chemical pesticides and industrial precursors in order to protect health and environment. (6.1.1)* 4. *Synthesize drugs, chemical pesticides and industrial precursors using green approach. (2.2.3)* 5. *Analyze Bhopal gas tragedy reaction (2.1.3)* 6. *Identify the impact of Bhopal gas tragedy reaction on society. (6.1.1)* 7. *Apply the concept of green solvents in chemical industries for the sustainable development, (7.2.2)* 8. *Use the concept of Carbon Sequestering and Carbon Credit to assess public health and environment. (6.1.1)* 9. *Calculate atom economy of the given reaction. (1.2.2)* 10. *Identify the principle of prevention of waste to the drug synthesis (7.2.2)*		
02.	**Water quality management** ***Learning Objectives:*** *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.	**4-6**	**CO- 1** **CO- 2** **CO- 3** **CO- 4**

	Learning Outcomes: *A learner will be able to* 1. *Analyze the impurities in water (2.1.3)* 2. *Classify different types of hardness in water (2.1.3)* 3. *Identify the effect of hard water in boiler and other chemical industries for assessing the public safety. (6.1.1)* 4. *Calculate the various types of hardness in water sample using EDTA method. (1.2.2)* 5. *apply various water treatments for assessing the public health (6.1.1)* 6. *Identify and estimate water quality indices to (7.2.1)* 7. *Calculate BOD and COD of sewage sample (1.2.2)*		
03.	**Science of Corrosion** ***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* 1. *Define corrosion and its types. (1.3.1)* 2. *State the mechanism of oxidation corrosion. (1.3.1)* 3. *Define the role of oxide layers in deciding the rate of corrosion. (1.3.1)* 4. *State the pilling Bedworth rule (1.2.1)* 5. *state the conditions for wet corrosion (1.2.1)* 6. *State the mechanisms of wet corrosion with the help of diagrams. (1.3.1)* 7. *State different types wet corrosion. (1.3.1)* 8. *Apply the various protection methods for safety of metallic equipments1 and structures. (6.1.1)* 9. *Apply the metallic coatings on various metal surfaces for protection of machine health. (6.1.1)*	**4-6**	CO- 1 CO- 3

04.	**Introduction to Thermodynamics** ***Learning Objective:*** *To state the fundamentals of thermodynamics and apply them in engineering.*	**4-6**	CO- 1
	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* 1. *Define a system, surroundings and variables. (1.3.1)* 2. *State first law of thermodynamics (1.2.1)* 3. *Apply first law of thermodynamics for calculation of work done or heat evolved. (1.2.2)* 4. *To show energy conversion in different forms. (1.3.1)* 5. *To calculate the enthalpy of given chemical system. (1.2.2)* 6. *To apply the concepts of thermodynamics in engineering (1.3.1)*		
05.	**Phase Equilibria** ***Learning Objective:*** *To interpret the various phase transformations using thermodynamics.*	**3-5**	CO- 1
	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* 1. *Apply phase rule equation to the given system, (1.2.1)* 2. *Draw the phase diagrams (1.3.1)* 3. *Identify various phase transformations occurring in a given 0system due to effect of different variables (1.3.1)* 4. *Calculate the number of degrees of freedom for each phase. (1.2.2)* 5. *Apply the condensed phase rule to the eutectic alloys. (1.2.1)* 6. *State the applications of eutectics in the solder alloys (1.3.1)*		

06.	**Energy from non-conventional sources** ***Learning Objective:*** *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.*	**3-5**	CO- 1 CO- 2 CO- 3
	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* 1. *Apply the concept of transesterification for the production of biodiesel (1.3.1)* 2. *Identify the properties of biodiesel as a green fuel for sustainability. (7.2.2)* 3. *Synthesize hydrogen by steam reforming of methane and electrolysis of water. (2.2.3)* 4. *Identify the challenges in hydrogen production, storage and transport for the benefit of society. (6.1.1)*		
	Course Conclusion	**1**	
	Total	**30**	

Course Outcomes:

A learner will be able to

1. Apply the laws of electrochemistry and thermodynamics for solving engineering problems.
2. Analyze the quality of water and challenges in non-conventional energy sources for solving the real-world problems.
3. Identify the suitable chemical product or material for the protection of environment and public health.
4. Interpret the impact of modern chemical industrial practices and energy sources for sustainable development.

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 knowledge to analyse a given problem.
2.2.3	Identify existing processes/solution methods for solving the problems.
6.1.1	Identify and describe the role of engineering chemistry pertaining to the protection of the public and public interest at global regional and local level.

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

7.2.1 Describe management technique for sustainable development.

7.2.2 Apply principles of preventive engineering and sustainable development to an engineering

Text Books:

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

Reference Books:

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

Other Resources:

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

IN-SEMESTER ASSESSMENT (35 Marks)

1. **Continuous Internal Evaluation of 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% 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
ESC	ESC101	ENGINEERING MECHANICS	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

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	Detailed Content	Hrs	CO
00.	**Course Introduction** The Engineering Mechanics Course marks the transition from physics to engineering applications. This course develops the ability to apply and analyze, which are paramount in engineering profession.	**1**	
01.	**Coplanar force System: System of Coplanar Forces:** ***Learning Objective/s:*** *To impart the knowledge of fundamental concepts of Mathematics and Physics to analyse forces in engineering system..*	**5-7**	**CO- 1**
	Contents: Classification of force systems (Concurrent, Parallel and General Force systems). Principle of Transmissibility, Composition and Resolution of Forces. Resultant of Coplanar Force Systems:		

	Resultant of coplanar force system (Concurrent, Parallel and non-concurrent non-parallel force systems). Moment of force about a point, Couples, Varignon 's Theorem and its significance. Force couple system.		
	Self-Learning Topics: *Composition and Resolution of Forces.* ***Learning Outcomes :*** *A learner will be able to* 1. *To apply fundamental engineering concepts for resolution of system of forces. (P.I.-1.3.1)* 2. *Apply mechanical engineering concepts to find resultant forces acting in a system under the action of load. (PI-1.4.1)* 3. *To identify unknown forces in engineering systems due to application of load. (PI-2.1.2)* 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/s:*** *To use fundamental concepts of engineering knowledge of equilibrium and to analyse reactions under the influence different types of loading conditions.*	**7-9**	**CO- 1**
	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….* 1. *Apply fundamental mathematical knowledge for application of equilibrium concepts on rigid bodies(P.I.-1.1.2).* 2. *Apply mechanical concepts to coplanar force systems and calculate reactions in beams(P.I.-1.4.1).* 3. *Apply fundamental mathematical knowledge to find frictional parameters of a rigid body (P.I.-2.1.2).* 4. *Apply friction concepts to real-world scenarios involving inclined planes and ladders (P.I.-2.2.1).*		
03.	**Kinematics of Particle** ***Learning Objective/s:*** *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.* **Contents:** Motion of particle with **Variable Acceleration**. Motion Curves (a-t, v-t, s-t curves). General Curvilinear Motion. Tangential and Normal Component of Acceleration. Projectile Motion: Trajectory Equation of Projectile. Application of the concepts of Projectile Motion in real life and related numerical. ***Self-Learning Topics:*** *Projectile Motion Basics, Variable acceleration concept.* ***Learning Outcomes:*** *A learner will be able to* 1. *apply knowledge to identify the motion of the object using the equations of motion (P.I.- 1.2.1).* 2. *apply the fundamental mathematics and mechanical engineering concepts to analyze different types of motions (P.I.-1.4.1).* 3. *Identify system variables to formulate trajectory equation of projectile motion (P.I.2.1.2).* 4. *Apply mathematical and engineering knowledge to find motion of the object in the real life situations (P.I.-2.1.3).*	**8-10**	**CO- 2**
04.	**Kinematics of Rigid Body** ***Learning Objective/s:*** *To understand the parameters required to quantify the Kinematics of Particle and Rigid body*.	**5-7**	**CO- 3**

	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. ***Learning Outcomes:*** *A learner will be able to* 1. *Apply engineering knowledge to identify the general plane motion(P.I.-1.3.1).* 2. *Apply mathematical knowledge to find translational, rotational and general plane motion of rigid bodies(P.I.-1.4.1).* 3. *Identify engineering systems and variables to find instantaneous center of rotation for link mechanism (P.I-2.2.1).* 4. *Use mathematical knowledge to find general plane motion analytically. (P.I.-2.1.3).*		
05.	**Kinetics of Particle: D'Alembert's** ***Learning Objective/s:*** *To understand the concept of kinetics of particle and the different methods to solve the engineering problems.* **Contents:** Introduction to basic concepts of D'Alemberts Principle, Concept of Inertia force, Equations of Dynamic Equilibrium,. (Analysis limited to simple systems only.) **Work – Energy Principle:** Work Energy principle for a particle in motion. Application of Work – Energy principle to a system consists of connected masses and Springs. **Impulse – Momentum Principle:** Principle of linear Impulse and Momentum. Application of Impulse Momentum Principle to particles in motion. **Impact and Collisions:** Law of conservation of momentum, Coefficient of Restitution, Direct Central Impact and Oblique Central Impact. Loss of Kinetic Energy in collision of inelastic bodies. ***Self-Learning Topics:*** *basic concepts and application in dynamic equilibrium for simple systems.* ***Learning Outcomes :*** *A learner will be able to* 1. *Apply D'Alembert's Principle to analyze the particles in dynamic equilibrium, (P.I.-1.3.1)* 2. *Apply mechanical engineering knowledge to use work-energy principle for mechanical systems(P.I.-1.4.1).* 3. *To use mathematical knowledge, to analyze the systems using Work-Energy and Impulse-Momentum Principles(P.I.-2.1.3).* 4. *To reframe complex problem in to sub problems to analyze the collisions occurring in the force system(P.I-2.2.1).*	**9-11**	**CO- 4**

06.	**Centroid** ***Learning Objective/s:*** *To understand the importance of Centroid which can affect the stability of the objects in the real life situations.* **Contents:** First Moment of Area. Centroid of Composite Plane Lamina. ***Self-Learning Topics:*** *Explore methods for calculating the First Moment of Area.* ***Learning Outcomes:*** *A learner will be able to* 1. *Apply fundamental knowledge to find first moment of area. (P.I.-1.1.1).* 2. *Apply mechanical engineering knowledge to find centroid of composite body(P.I.-1.4.1).*	**3-5**	**CO- 5**
	Course Conclusion	**1**	
	Total	**45**	

Course Outcomes:

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.
2. Analyze the motion of a particle using kinematic equations.
3. Analyze the General plane motion of a rigid body using the concepts of Instantaneous Center of Rotation to find velocity and acceleration for a link Mechanism.
4. Analyze the motion of a Particle using Kinetic equations.
5. Apply the concept of Centroid to locate it for a plane lamina

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.

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 Internal Evaluation of Theory (20 Marks)**

   Numerical Assignments (minimum 20 problems): 5 Marks

   Class Test based on similar problems which were given as an assignment: 5 Marks

   Open book test/Open notes test: 5 Marks

   Regularity and active participation: 5 Marks

2. **Mid Semester Exam (30 Marks)**

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

END SEMESTER EXAMINATION (50 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
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 society
4. PO9: Individual and 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 analyse DC circuits, AC circuits.
4. To introduce safety devices incorporated in residential electrical system for professional engineering practice.

Module	Detailed Content	Hrs	CO
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**	**CO- 1**
	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* 1. *Apply the concepts of electrical engineering to understand role of each component of electrical power system. (P.I.-1.4.1)* 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.* **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* 1. *Apply concepts of Ohm's law and Kirchoff's laws to solve DC circuits. (P.I.-1.4.1)* 2. *Use concepts of star delta transformation to simplify DC circuits. (P.I.-1.3.1)* 3. *Apply network theorems to analyze current distribution in DC circuits. (P.I.-2.1.3)* 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)*	**5-7**	**CO- 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.* **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* 1. *Analyze the performance of AC circuit by calculating phase angle (power factor) between voltage and current waveform. (P.I.-2.1.2)* 2. *Identify condition of resonance and calculate resonant frequency by overserving current and reactance in series AC circuits. (P.I.-2.1.3)*	**5-7**	**CO- 2**

04.	**Residential Electrical Systems** ***Learning Objective/s:*** *To acquire knowledge on residential electrical wiring incorporating suitable safety devices, testing and up-keeping of household electrical appliances and residential lighting system.*	**4-6**	**CO- 1** **CO- 3** **CO- 4**
	Contents: Components of residential electrical system, Residential wiring System, load calculation, Electrical safety Devices, Fuse, MCB, ELCB, grounding issues, safety precautions, Testing of domestic appliances and up-keeping, Luminous flux, Luminous intensity, Lumination, Types of lamps in residential lighting. Case study on residential lighting.		
	Self-Learning Topics: *Basic requirements of electrical system.* ***Learning Outcomes:*** *A learner will be able to* 1. *Identify components in residential electrical system by understanding basic system requirements. (P.I.-1.3.1)* 2. *Test and repair domestic appliances by applying concepts of basic electrical engineering. (P.I.-1.4.1)* 3. *Identify safety devices for the protection of residential electrical system. (P.I.-6.1.1)* 4. *Conduct a case study on residential lighting in a group to demonstrate communication, conflict resolution and leadership skills. (P.I.-9.2.1)* 5. *Present the case study on residential lighting system design effectively as a team. (P.I.-9.3.1)*		
05.	**Introduction to Residential Energy Measurements** ***Learning Objective/s:*** *To acquire knowledge on residential energy metering, energy tariff and understanding the residential electricity bill.*	**2-4**	**CO- 1** **CO- 4**
	Contents: Measurement of Energy, Understanding of electricity bill, energy tariff electricity bill calculation.		
	Self-Learning Topics: *Types of meters used for energy metering.* ***Learning Outcomes:*** *A learner will be able to* 1. *Calculate the electrical energy consumed over a specified time by applying concepts of electrical engineering. (P.I.-1.4.1)* 2. *Determine the energy tariff by referring meter reading and government guidelines. (P.I.-1.3.1)*		

06.	**Introduction to Electrical Machines** ***Learning Objective/s:*** *To identify motors for given application using concepts of construction, working and characteristics of different machines.*	**4-6**	**CO-5**
	Contents: Construction, working, characteristics and application of DC machines, Single phase Induction Motor, Servo motors, Brushless DC motor, Stepper motor. Factors to be considered for selection of motor and its rating. Selection of motors from motor and load characteristics.		
	Self-Learning Topics: *Working principle of electric motor.* ***Learning Outcomes:*** *A learner will be able to* 1. *Compare and identify electrical motors for given application based on characteristics of load and motor. (P.I.-2.2.4)* 2. *Decide the rating of motor by considering factors like power, speed, torque etc. of the given application. (P.I.-2.2.3)*		
	Course Conclusion	**1**	
	Total	**30**	

Course Outcomes: Learner will be able to

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

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.
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.
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.
9.2.1	Demonstrate effective communication, problem solving, and conflict resolution and

leadership skills.

9.3.1 Present results as a team, with smooth integration of contributions from all individual efforts.

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 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-LC	BSCLC101	ENGINEERING PHYSICS-I LABORATORY	0.5

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

Program Outcomes addressed:

1. PO1: Engineering Knowledge
2. PO2: Problem analysis
3. PO4: Conduct investigations of complex problems
4. PO9: Individual and team work
5. PO10: 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	Detailed Contents	Hrs	CO
00.	**Course Introduction** Introduction to various instruments and components used in physics lab; Rules and regulations to be followed; The fundamental concepts for all experiments, Explanation for performing the experiments.	**01**	
01.	***Learning Objective/s:*** • *To apply the knowledge of interference of light in thin film.* • *To determine a radius of curvature of lens and write valid conclusion.*	**02**	**CO- 1**
	Experiment 1 : Newton's Rings: Determine the radius of curvature (R) of given plano convex lens using Newton's Rings.		
	Learning Outcomes: *A learner will be able to* *1. Apply the concepts of interference in thin film for execution of experiment. (1.2.1)*		

	2. *Write the required theory and procedure for the experiment. (4.3.1)* 3. *Familiarize the apparatus like sodium lamp, travelling microscope. (4.3.1)* 4. *Assemble the set up for Newton's ring pattern. (4.2.1)* 5. *Observe the phenomenon for interference pattern ie formation of Newton's ring for reflected rays. (1.2.1)* 6. *Calculate radius of curvature of the given plano convex lens and write the result. (1.2.2, 4.3.3)*		
02.	***Learning Objective/s:*** • *To apply the knowledge of diffraction through multiple slit.* • *To find the wavelength of the LASER and write valid conclusion.*	**02**	**CO- 1**
	Experiment 2 : Diffraction through Grating: Measurement of wavelength of He-Ne laser		
	Learning Outcomes: *A learner will be able to* 1. *Apply the concepts of diffraction through multiple slit for execution of experiment. (P.I.- 1.2.1)* 2. *Write the required theory and procedure for the experiment. (P.I.- 4.3.1)* 3. *Familiarize the apparatus like laser source, single slit set up. (P.I.- 4.3.1)* 4. *Assemble the set up for diffraction pattern. (P.I.- 4.2.1)* 5. *Observe the phenomenon for diffraction through single slit. (P.I.- 1.2.1)* 6. *Calculate width of the given slit and write the result. (P.I.- 1.2.2, 4.3.3)*		
03.	***Learning Objective/s:*** • *To apply the knowledge of optical fibre.* • *To determine the numerical aperture of an optical fibre and write the conclusion.*	**02**	**CO- 1**
	Experiment 3: Optical Fibre: Measurement of Numerical aperture.		
	Learning Outcomes: *A learner will be able to* 1. *Apply the knowledge of numerical aperture for execution of experiment. (P.I.- 1.2.1)* 2. *Write the required theory and procedure for the experiment. (P.I.- 4.3.1)* 3. *Familiarize the apparatus like Fibre optic kit, numerical aperture measurement zig., optical fibre cable. (P.I.- 4.3.1)* 4. *Assemble the set up to get illumination circular patch of light on the screen. (P.I.- 4.2.1)* 5. *Observe the phenomena for different tip height of the optical fibre from the surface. (P.I.- 1.2.1)* 6. *Calculate numerical aperture of the given fibre and write the result. (P.I.- 1.2.2, 4.3.3)*		

04.	*Learning Objective/s:* • *To apply the knowledge of Hall effect.* • *To determine a magnetic field using Hall effect in semiconductors.*	**02**	**CO- 1**
	Experiment 4: Hall effect: Determination of magnetic field.		
	Learning Outcomes: *A learner will be able to* 1. *Apply the hall effect phenomena for execution of experiment. (P.I.- 1.2.1)* 2. *Write the required theory and procedure for the experiment. (P.I.- 4.3.1)* 3. *Familiarize the apparatus like Gauss meter, electromagnet, power supply. (P.I.- 4.3.1)* 4. *Assemble the set up for Hall effect experiment. (P.I.- 4.2.1)* 5. *Observe the Hall effect phenomena in given semiconductor. (P.I.- 1.2.1)* 6. *Calculate the number of carriers in the semiconductor and write the result. (P.I.- 1.2.2, 4.3.3)*		
05.	***Learning Objective/s:*** • *To gain the knowledge on working of a photodiode.* • *To study the V-I characteristic curve of a photodiode*	**02**	**CO- 1**
	Experiment 5 *:* Photodiode: Drawing the I-V characteristics of photo diode		
	Learning Outcomes : *A learner will be able to* 1. *Apply the working principle of photodiode for execution of experiment. (P.I.- 1.2.1)* 2. *Write the required theory and procedure for the experiment. (P.I.- 4.3.1)* 3. *Identify the photodiode. (P.I.- 4.2.1)* 4. *Draw the circuit diagram and connect the components accordingly. (P.I.- 4.2.1)* 5. *Draw the I-V characteristics of photo diode and analyze the characteristic curve and the result. (P.I.- 1.2.2, 4.3.3)*		
06.	***Learning Objective/s:*** • *To apply various concepts of physics in a project.* • *To develop the skill of execution of project through practical demonstration.*	**03**	**CO- 1** **CO- 2** **CO- 3**
	Project: Selection of a project based on physics concepts, Literature survey, and Topic presentation. ***Learning Outcomes:*** *A learner will be able to* 1. *Apply the concepts of physics for execution of project. (P.I.- 1.2.1, 1.2.2.)* 2. *Familiarize with the books, authors, work done on the selected topic through literature survey. (P.I.- 10.1.1)* 3. *Select a mini project and work as an individual and as a team in development of the project in a chosen area. (P.I.- 9.3.1)* 4. *Identify, discuss and justify the technical aspects of the chosen project with a Comprehensive and systematic approach. (P.I.- 9.1.2)* 5. *Write a report on the chosen project. (P.I.- 10.1.2)* 6. *Communicate and present effectively project related activities. (P.I.- 10.2.2)*		
	Course Conclusion	**01**	
	Total	**15**	

Course Outcomes:

A learner will be able to

1. Apply the fundamental knowledge of optical phenomena, optical fibre and semiconductor devices to determine various parameters through relevant experiments.
2. Use fundamental knowledge of physics for the effective preparation and execution of the chosen project as a team.
3. Apply the technical information required for the project to present proposed project work, write effective reports, and communicate effectively.

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.
4.2.1	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.
9.1.2.	Implement the norms of practice (e.g. rules, roles, charters, agendas, etc.) of effective teamwork, to accomplish a goal.
9.3.1	Present results as a team, with smooth integration of contributions from all individual efforts
10.1.1	Read, understand and interpret technical and non- technical information
10.1.2	Produce clear, well-constructed, and well- supported written engineering documents
10.2.2	Deliver effective oral presentations to technical and non- technical audiences

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

CONTINUOUS INTERNAL EVALUATION (25 Marks)

1. Lab Performance: 10 Marks
2. Project (Synopsis writing and Topic presentation): 10 marks
3. Regularity and active participation: 5 marks

Course Type	Course Code	Course Name	Credits
BSC-LC	BSCLC102	ENGINEERING CHEMISTRY - I LABORATORY	0.5

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

Program Outcomes addressed:

1. PO1: Engineering Knowledge
2. PO2: Problem Analysis
3. PO6: The engineer and society
4. PO9: Individual and 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	Detailed Contents	Hrs	CO
00.	**Course Introduction** • Laboratory familiarization • Code of conduct in chemistry laboratory • Safety and precautions to be observed in chemistry laboratory • Orientation on evaluation of laboratory performance	**01**	
01.	***Learning Objective/s:*** *To estimate the total, temporary and permanent hardness of water using EDTA method to understand its quality for industrial use.*	**02**	**CO- 3**
	Experiment 1: Estimation of Total, temporary and permanent hardness of water by EDTA method.		
	Learning Outcomes: *A learner will be able to* *1. Use the basics of titrimetric experiments. (1.3.1)* *2. Use complexometric titration method. (1.3.1)* *3. Analyse the quality of water (2.1.3)* *4. Distinguish between different types of hardness present in water. (1.3.1)* *5. To calculate various types of hardness (2.2.3)* *6. Determine the suitability of water for industrial use. (6.1.1)*		
02.	***Learning Objective/s:*** **T**o determine the chloride content of water to understand its suitability for domestic use.	**02**	**CO- 3**
	Experiment 2: Estimation of chloride content of water sample		

	Learning Outcomes: *A learner will be able to* 1. *Use the basics of titrimetric experiments. (1.3.1)* 2. *Use precipitation titration method. (Mohr's method) (1.3.1)* 3. *Analyse the quality of water (2.1.3)* 4. *Calculate the amount of chloride ions present in the water sample. (2.2.3)* 5. *Identify the type of hardness. (1.3.1)* 6. *Determine the suitability of water for domestic use. (6.1.1)*		
03.	***Learning Objective/s:*** *To synthesise aspirin by using acetylation process and calculate its percent yield and atom economy to determine the nature of reaction.*	**02**	**CO- 2**
	Experiment 3: To synthesize aspirin from salicylic acid		
	Learning Outcomes: *A learner will be able to* 1. *Apply acetylation process (1.3.1)* 2. *Use pyridine as a catalyst (1.3.1)* 3. *Synthesize aspirin in cold conditions (2.2.3)* 4. *Use the process of filtration (1.3.1)* 5. *Calculate practical and theoretical yield. (2.2.3)* 6. *Calculate percentage yield. (2.2.3)* 7. *Interpret the uses of aspirin (1.3.1)* 8. *calculate atom economy. (2.2.3)* 9. *Distinguish between green and non -green reaction. (1.3.1)*		
04.	***Learning Objective/s:*** *To calculate the enthalpy of dissolution of copper sulphate in water using simple calorimeter.*	**02**	**CO- 1**
	Experiment 4: 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* 1. *Use the basics of thermochemical experiments. (1.2.1)* 2. *Use calorimeter (1.3.1)* 3. *Apply the laws of thermodynamics (1.2.1)* 4. *Distinguish between endothermic and exothermic reactions (1.3.1)* 5. *Define specific heat (1.3.1)* 6. *Calculate enthalpy of the given system (2.2.3)*		
05.	***Learning Objective/s:*** *To determine the effect of various factors affecting the rate of corrosion of iron*	**02**	**CO- 1**
	Experiment 5: To determine the factors affecting rate of corrosion. ***Learning Outcomes:*** *A learner will be able to* 1. *Apply the knowledge of electrochemistry to study rate of corrosion (1.2.1) (1.3.1)* 2. *Determine the effect of moisture, oxygen, pH and presence of salt on the rate of corrosion of Fe. (1.2.1) (1.3.1)*		

	3. *Distinguish between dry and wet corrosion. (1.2.1) (1.3.1)*		
06.	***Learning Objective/s:*** *To develop the basic knowledge of analytical chemistry using titrimetric experiments* **Designing of experiment and presentation:** Standardization/estimation of chemical substances using titrimetric analysis. Selection of a chemical substance and specific method of titrimetry based on literature survey and presentation. **Learning Outcomes:** Learners will be able to 1. *Apply the knowledge of engineering chemistry. (1.3.1)* 2. *Identify existing processes to analyze the given substance. (2.2.3)* 3. *Present the experimental procedure and expected conclusion as a team. (9.3.1)* 4. *Demonstrate the ability to work as a team. (9.1.1)*	**03**	**CO-4**
	Course Conclusion	**01**	
	Total	**15**	

Course Outcomes:

A learner will be able to

1. Apply the laws of electrochemistry and thermodynamics for performing the practicals.
2. Formulate a drug by applying the concepts of chemistry.
3. Analyse the quality of water for assessing the public health.
4. Demonstrate an ability to work effectively in a team for project based activity.

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 knowledge to analyze a given problem.
2.2.3	Identify existing processes/solution methods for solving the problems.
6.1.1	Identify and describe the role of engineering chemistry pertaining to the protection of the public and public interest at global regional and local level.
9.1.1	Recognize a variety of working and learning preferences; appreciate the value of diversity on a team.
9.3.1	Present result as a team with smooth integration of contributions from all individual efforts.

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

Other Resources:

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

CONTINUOUS INTERNAL EVALUATION (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
ESC-LC	ESCLC101	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. PO9: Individual and 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	Detailed Contents	Hrs	CO
00	**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.	***Learning Objective/s:*** *Learner will be able to apply fundamental engineering concepts to demonstrate the concept of equilibrium of coplanar forces.*	**07**	**CO- 1**
	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* 1. *identify the type of force system in a team. (P.I.-1.3.1)* 2. *determine the whether the system is in equilibrium or not and present the results in a team. (2.2.3,9.3.1)* 3. *convert different mechanical systems into substems by using free body diagram. (2.2.1)* 4. *determine the reactions of the beam for various loading conditions as a team.(P.I.-1.4.1,9.2.1).*		
02.	***Learning Objective/s:*** *Learner will be able to apply mechanical engineering concepts to demonstrate the principle of Moments using the Bell Crank Lever apparatus.*	**07**	**CO- 2**
	To demonstrate law of moments. **Experiment 4:** To verify moment equilibrium condition using bell crank lever.		
	Learning Outcomes: *A learner will be able to* 1. *differentiate between moment and couple (P.I.-1.4.1).* 2. *verify moment equilibrium condition using bell crank lever and present the results as a team (P.I-1.3.1,9.3.1).* 3. *convert the bell crank lever diagram into subsystems by using free body diagram. (2.2.1)* 4. *Demonstrate effective communication while working as team for conducting the experiments (P.I-9.2.1).* 5. *Verify moment equilibrium condition using bell crank lever and present results as a team(P.I.-2.2.3,9.3.1).*		
03.	***Learning Objective/s:*** *Learner will be able to determine coefficient of friction between two different surfaces in contact.*	**07**	**CO- 3**
	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* 1. *Identify the effects of friction on different surfaces. (P.I.-1.4.1,9.2.1).* 2. *Identify the parameters affecting the friction values. (P.I.-2.1.2).* 3. *determine the coefficient of friction and present the results as a team (P.I.-1.3.1,9.3.1)* 4. *compare and select the accurate method to determine coefficient of friction .(P.I.-2.2.3)*		

04	*Learning Objective/s:* *Learner will be able to analyze the motion of particle.*	**08**	**CO4**
	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.		
	Learning Outcomes: *A learner will be able to* 1. *Identify the variables associated with the projectile motion (P.I-1.2.1).* 2. *Determine the range and height of the particle during projectile motion and present the result as a team. (P.I.2.1.2,9.3.1)* 3. *Estimate velocities and distance travelled by the particle with a collaborative effort of a team. (P.I.-2.2.3,9.2.1).* 4. *Measure the speed of the particle. (P.I.-1.4.1).*		
	Total	**30**	

Course Outcomes:

1. Learner will be able to Demonstrate the Equilibrium of Coplanar Force System.
2. Learner will be able to demonstrate law of moments.
3. Learner will be able to determine coefficient of friction between two different surfaces in contact.
4. Learner will be able to analyse motion of a particle.

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 subproblems.
2.2.3	Identify existing processes/solution methods for solving the problem, including forming justified approximations and assumptions.
9.2.1	Demonstrate effective communication, problem solving, conflict resolution and leadership skills.
9.3.1	Present results as a team, with smooth integration of contributions from all individual efforts.

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

CONTINUOUS INTERNAL EVALUATION (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
ESC-LC	ESCLC102	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 society
4. PO9: Individual and 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	CO
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**	**CO- 1** **CO- 2**
	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* 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, 9.3.1)* 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, 9.3.1)* 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, 9.2.1)*		
02.	***Learning Objective/s:*** *To impart knowledge on circuit assembly on breadboard and analysis of Alternating Current (AC) circuits.*	**08**	**CO- 1** **CO- 2**
	Experiment: Analyse series and parallel connected AC circuits by determining circuit elements and resonant conditions.		
	Learning Outcomes: *A learner will be able to* 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, 9.2.1)* 2. *Measure the resonance frequency in RLC series and parallel circuit and plot resonance curve. (4.1.4, 9.3.1)*		
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**	**CO- 1** **CO- 3**
	Experiment: Implementation of given residential electrical system incorporating safety devices and up-keeping of home appliances.		
	Learning Outcomes: *A learner will be able to* 1. *Assemble small electrical circuits similar to residential wiring system along with safety devices and submit a report. (4.1.3, 9.3.1)* 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)* 3. *Wire up PVC conduit wiring to control one lamp from two different places in a group. (Staircase wiring) (4.2.1, 9.3.1)* 4. *Maintenance and up-keeping of household electrical appliances and submit a report. (4.1.3, 9.2.1)*		
04	***Learning Objective/s:*** *To introduce concept of motor selection for given application, transformer connections and its testing.*	**05**	**CO- 4**
	Experiment: • Identify electrical motors for given application. • Analyse transformer by identifying name plate details, transformation ratio, polarity and regulation.		

	Learning Outcomes: 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, 9.2.1)* 2. *Verify terminals, study the name plate details and calculate transformation ratio of single-phase transformers. (4.1.3, 9.3.1)* 3. *Perform polarity test on transformers. (2.1.2, 9.3.1)* 4. *Determine voltage regulation of single-phase transformer by conducting direct load test and summarize results in a report. (4.2.1, 9.3.1)*		
	Total	**30**	

Course Outcomes:

Learner will be able to

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

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
9.2.1	Demonstrate effective communication, problem solving, conflict resolution and leadership skills.
9.3.1	Present results as a team, with smooth integration of contributions from all individual efforts

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

CONTINUOUS 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 EXAMINATION (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
ESC-LC	ESCLC103	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: Modern tool usage
4. PO12: 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	Detailed Contents	Hrs	CO
00.	**Course Introduction** Knowledge of problem solving and programming concepts is essential for those who develop applications for users. This course imparts basic knowledge in C programming along with the concepts of design and development of programs using C.	**01**	
01.	**Introduction to Algorithm, Flowchart and C.** ***Learning Objective/s:*** *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**	**CO- 1**
	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* 1. *Apply algorithms on problem statements. (P.I.- 1.1.1)* 2. *Use symbols to draw flowcharts for problems. (P.I.- 1.3.1)* 3. *Identify data types, variables and operators to be used in C according to a problem. (P.I.- 2.1.2)* 4. *Solve the problem using nested control structure in C. (P.I.- 2.2.3)* 5. *Adapt modern tool VS code to solve problem using data input/output, operators. (P.I.- 5.1.2)* 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/s:*** *Learner is expected to recall basics of Control Structures and understand Conditional structures. Also expected to apply it to solve problems in C.*	**16**	**CO- 2**
	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.(AF) **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* 1. *Apply if control statements in C. (P.I.- 1.1.1)* 2. *Use if else control statements in C. (P.I.- 1.3.1)* 3. *Identify data types, variables and loops to be used in C for a problem. (P.I.- 2.1.2)* 4. *Reframe the problem and use nested control structure to solve problems in C. (P.I.- 2.2.1)* 5. *Adapt modern tool VS code to solve problem using control structures (P.I.- 5.1.2)* 6. *Use VS code to check if the result of the C program using loops is accurate (P.I.- 5.3.2)*		

03.	**Functions in C** ***Learning Objective/s:*** *Learner is expected to recall function definition, declaration. and understand its usage. Also expected to apply it to solve problems in C.*	**12**	**CO- 3**
	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* 1. *Apply functions to write program in C. (P.I.- 1.1.1)* 2. *Use appropriate storage class in C. (P.I.- 1.3.1)* 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)* 4. *Reframe the problem and use recursive function to solve problems in C. (P.I.- 2.2.1)* 5. *Adapt modern tool VS code to solve problem using functions. (P.I.- 5.1.2)* 6. *Use VS code to check if the result of the C program using functions is accurate(P.I.- 5.3.2)*		
04.	**Arrays, Strings in C**	**12**	**CO- 4**
	Learning Objective/s: *Learner is expected to recall one dimensional arrays and understand its usage and apply it to solve problems in C.*		
	Contents: Array-Concepts, Declaration, Definition, Accessing array element, One-dimensional and Multidimensional array. String- Basic of String, Array of String, Functions in String.h **Task 8:** C Program to sort elements in ascending order in an array. **Task 9:** C Program to check if string is palindrome or not.		
	Self-Learning Topics: *Write two-dimensional array programs for matrix addition and multiplication.* ***Learning Outcomes:*** *A learner will be able to* 1. *Use 1D arrays to write program in C. (P.I.- 1.1.1)* 2. *Apply strings to write programs in C. (P.I.- 1.3.1)* 3. *Identify data types, variables and type of arrays to be used in C according to a problem. (P.I.- 2.1.2)* 4. *Reframe the problem and use arrays to solve problems in C. (P.I.- 2.2.1)* 5. *Adapt modern tool VS code to solve problem using arrays. (P.I.- 5.1.2)* 6. *Use VS code to check if the result of the C program using arrays is accurate(P.I.- 5.3.2)*		

05	**Structures and Pointers in C** ***Learning Objective/s:*** *Learner is expected to recall pointers, operations on pointers and its usage and apply it to solve problems in C.*	**12**	**CO-5**
	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.		
	A learner will be able to 1. *Apply structures to write program in C. (P.I.- 1.1.1)* 2. *Use pointers in C to write programs. (P.I.- 1.3.1)* 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)* 4. *Reframe the problem and use pointer arithmetic to solve problems in C. (P.I.- 2.2.1)* 5. *Adapt modern tool VS code to solve problem using pointers, structures. (P.I.- 5.1.2)* 6. *Use VS code to check if the result of the C program using pointers is accurate (P.I.- 5.3.2)* 7. *Learn new ways to use pointers and structures in professional work. (P.I.- 12.1.1)* 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.- 12.2.1)*		
	Total	**60**	

Course Outcomes:

Learner will be able to

1. Illustrate the basic terminology used in computer programming concept of data types, variables and operators using C.
2. Use control structure concepts in C programming.
3. Develop functions and use it to solve problems in C using modern tools.
4. Apply arrays and strings to solve problems in C.
5. Demonstrate the use of structures, dynamic memory allocation and pointers in C.

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.
12.1.1	Describe the rationale for the requirement for continuing professional development
12.2.1	Identify historic points of technological advance in engineering that required practitioners to seek education in order to stay current

Text Books:

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

Reference Books:

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

Other Resources:

1. NPTEL Course: Introduction to Programming in C By Prof. Satyadev Nandakumar, Department of Computer Science and Engineering, IIT Kanpur
   Web link- https://archive.nptel.ac.in/courses/106/104/106104128/

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

IN-SEMESTER ASSESSMENT (50 MARKS)

1. **Task Execution (30 Marks)**

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

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

Students will be evaluated based on following:

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

Refer the sample task given below.

Example: Write a menu driven (use Switch, do --- while) C program to perform different calculations using function,
Students are expected to,

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

Students are evaluated based on following:

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

2. **Regularity and active participation: (05 Marks)**
3. **Practical Test (15 Marks)**

a) Task Execution: 10 Marks

1. Logic building for the given task (04marks)
2. Rectifying logical errors and syntax errors (02 marks)
2. Well-structured and organized program (02 marks)

3. Verification of experiment output for different inputs (02 marks)

b) Oral: 05 Marks

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

1. Task Execution: 30 Marks

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

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

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

Examination Scheme		
Continuous Assessment	**End Semester Exam(ESE)**	**Total Marks**
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. PO5: Modern tool usage
2. PO6: The engineer and society
3. PO9: Individual and team work
4. PO12: 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	CO
00	**Course Introduction** The Basic Workshop Practice I course is intended to give participants with the core information and abilities required for working safely and effectively in a workshop environment. This hands-on course introduces the fundamental principles, equipment, and techniques utilised in a variety of workshop scenarios, such as fitting, hardware and networking, and welding.	**01**	
01.	***Learning Objectives:*** *1. To familiarize participants with reading and interpreting technical drawings, and schematics related to fitting tasks.* *2. To enhance participants' proficiency in fitting various components or materials together accurately and securely using various fitting tools.* *3. To make participants learn to use precision measuring tools to verify part dimensions and ensure quality control.*	**09**	**CO- 1**
	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 1. *Read and interpret technical drawings, or schematics related to fitting tasks, identifying dimensions, tolerances, and other specifications accurately. (P.I.- 12.3.1)* 2. *Demonstrate proficiency in fitting techniques. (P.I.- 5.3.1)* 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.- 5.2.2, 12.3.1, 12.3.2)*		
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**	**CO- 2** **CO- 3**
	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* 1. *Identify and understand the various hardware components of a computer system. (P.I.- 5.1.2, 12.1.1)* 2. *Assemble a computer system, set up and configure network infrastructure components to create a functional network environment. (P.I.- 5.2.2, 12.2.1)* 3. *Develop the skills to diagnose and troubleshoot common hardware and network problems. (P.I.- 6.1.1)*		
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**	**CO- 4**

	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* 1. *Interpret welding symbols and blueprints accurately, understanding weld joint designs, dimensions, and specifications as per industry standards. (P.I.- 9.3.1, 12.3.1)* 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.- 5.2.2, 5.3.1, 6.1.1, 9.1.1, 12.3.2)*		
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* 1. *Identify different parts of a lathe machine and understand operations that can be carried out on it. (P.I.- 12.1.1, 12.3.1)*		
	Total	**30**	

Course Outcomes:

A learner will be able to

1. Develop the necessary skill required to handle/use different fitting tools.
2. Develop skill required for hardware maintenance and installation of operating system.
3. Identify the network components and perform basic networking and crimping.
4. Prepare the edges of jobs and do simple arc welding.

Performance Indicators:

P.I. No.	**P.I. Statement**
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.
9.1.1	Recognize a variety of working and learning preferences; appreciate the value of

diversity on a team.

9.3.1 Present results as a team, with smooth integration of contributions from all individual efforts.

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

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

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

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

CONTINUOUS INTERNAL EVALUATION (50 Marks)

1. Job Work with complete workshop book: 40 Marks
2. Regularity 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 & society
2. PO7: Environment & sustainability
3. PO8: Ethics
4. PO12: 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:

Learners will be able to

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 Exam (ESE)			
Continuous Assessment	Mid-Semester Exam (MSE)		MSE	ESE	
20 + 25*	30	50	1.5	2	125

* For Tutorial

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 ofengineering.
2. To build a mathematical foundation of the methodology required for solving application basedproblems in the field of Engineering.

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

	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:*** *Application of differential equations of First Order and First Degree in electrical circuits and thermodynamics.* ***Learning Outcomes:*** *A learner will be able to* 1. *Identify the exact differential equation and linear differential equations. (P.I.-2.1.3)* 2. *Identify the method of solving exact differential equation and linear differential equations. (P.I.-2.2.3)* 3. *Apply the fundamentals of differentiation and integrations to solve the problems related to exact and linear differential equations. (P.I.-1.1.1)* 4. *Apply the fundamental engineering concepts to model a first order DE and solve it.(P.I.-1.3.1)*		
02.	**Linear Differential Equations with Constant Coefficients and Variable Coefficients of Higher Order type f(D)y = X** ***Learning Objective/s:*** *Learner will be able to* 1. *Analyse and interpret the basic fundamentals of higher order differential equations (HODE).* 2. *Determine the solution of a HODE by applying the basic concepts of complementary function and particular integral.* **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 a mathematical model of linear differential equations.* ***Learning Outcomes:*** *A learner will be able to* 1. *Identify the nature of HODE. (P.I.-2.1.3)* 2. *Solve a higher order differential equation by applying the concept of complementary function and particular integral. (P.I.-2.2.3)* 3. *Apply the fundamentals of differentiation and integrations to solve the problems related HODE. (P.I.-1.1.1)* 4. *Develop a mathematical model of linear differential equations and to find the solution of designed model. (P.I.-2.3.1)* 5. *Apply the fundamental engineering concepts to model a higher order DE and solve it. (P.I.-1.3.1) (Tutorial)*	**7-9**	**CO- 2**

03.	**Beta and Gamma Functions** ***Learning Objective/s:*** ***1.*** *Analyse and interpret the basic definition of Beta and Gamma Functions and their 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 ***Learning Outcomes:*** *A learner will be able to* ***1.*** *Identify a definite integral. (P.I.-2.1.3)* ***2.*** *Apply the basic definition of beta and gamma function to solve the definite integral. (P.I.-1.1.1)* ***3.*** *Analyze the problem by identifying the appropriate substitution to solve it. (P.I.-2.2.3)* ***4.*** *Apply the properties of beta and gamma function to solve the definite integral. (P.I.-1.2.1)*	**5-7**	**CO- 3**
04.	**Double Integration** ***Learning Objective/s:*** *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 theLamina.* **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* *1. Identify the region of integration. (P.I.-2.1.3)* *2. Determine the Change of coordinate systems. (P.I.-2.2.1)* *3. Apply the fundamentals of integration of a function of single variable to solve problem in double integration. (P.I.-1.1.1)* *4. Apply the concept of double integration to find area of bounded regions. (P.I.-1.2.1)*	**7-9**	**CO- 4**

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* 1. *Identify the region of integration. (P.I.-2.1.3)* 2. *Determine the Change of coordinate systems. (P.I.-2.2.1)* 3. *Apply the fundamentals of integration of a function of single variable to solve problem in double integration. (P.I.-1.1.1)* 4. *Apply the concept of triple integration to find the volume of a solid. (P.I.-1.2.1)*	**5-7**	**CO- 4**
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. **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* 1. *Apply the concept of definite integral to evaluate Line integral, surface integral and volume integral. (P.I.-1.1.1)* 2. *Apply the concept of vector differentiation to evaluate Line integral, surface integral and volume integral. (P.I.-1.2.1)* 3. *Identify the concept of vector differentiation to evaluate Line integral, surface integral and volume integral. (P.I.-2.1.3)* 4. *Differentiate between the problems and solve using appropriate theorem (Green's Theorem, Stoke's Theorem & Gauss Divergence Theorem). (P.I.-2.2.4)*	**7-9**	**CO- 5**

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

Course Outcomes:

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.

2. Analyse the procedure to find complementary function and particular integral of higher order differential equation solve it by applying the suitable method.

3. Implement the fundamentals of Beta and Gamma Function to evaluate the definite integral.
4. Apply the fundamentals of multiple integration to analyse and evaluate the area of a lamina and volume of a solid.

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.

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.
2.1.1	Identify engineering systems, variables, and parameters to solve the problems
2.1.2	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.
2.3.1	Combine mathematical principles and engineering concepts to formulate models of a system or process that is appropriate in terms of applicability

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 (45 Marks)

Continuous Internal Evaluation of 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

Continuous internal evaluation of Tutorial (25 Marks)

1. Tutorials: 20 Marks
2. Regularity and active participation: 5 marks
3. Students must be encouraged to write atleast 6 class tutorials. Atleast class tests will be conducted based on class tutorials on entire syllabus. Each class test carries 20 Marks. Average will be taken of all class tests.

2. Mid Semester Exam (30 Marks)

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

END SEMESTER EXAMINATION (50 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	BSC205	ENGINEERING PHYSICS-II	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 society
4. PO7: Environment and sustainability

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 theknowledge of physics in the field of engineering.

Module	Detailed Content	Hrs	CO
00.	**Course Introduction** Significances of Crystals and non–crystalline solid: Need of analysis of crystal: Applications of magnetic, dielectric and nanomaterials in Engineering.	**01**	
01.	**Crystal Structure** ***Learning Objective/s:*** *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**	**CO-1**
	Contents: Crystals: Unit cell: Space lattice: 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* 1. *state various parameters of unit cell of a crystal. (P.I.- 1.2.1)* 2. *diagrammatically describe the structure of different cubic unit cell. (P.I.- 1.2.1)* 3. *solve the problems related to crystal structure. (P.I.- 1.2.2.)* 4. *identify cubic crystal structure knowing their various parameters. (P.I.- 2.1.2)* 5. *derive the unit cell parameters of cubic crystal structure. (P.I.- 2.1.3)*		
02.	**Analysis of Crystal Structure** ***Learning Objective/s:*** 1. *To interpret the use of X-ray diffraction in Bragg's law.* 2. *To apply the concept of Miller Indices and Bragg's 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:*** *Diffraction of light through grating.* ***Learning Outcomes:*** *A learner will be able to* 1. *define crystal plane and miller indices of planes. (P.I.- 1.2.1)* 2. *draw the crystal planes from Miller indices. (P.I.- 1.2.1)* 3. *solve the problems related to miller indices and Bragg's law. (P.I.- 1.2.2)* 4. *derive interplanar distance in a simple cubic structure in terms of miller indices and lattice constant. (P.I.- 2.1.3)* 5. *diagrammatically describe Bragg's law and its application in crystal structure analysis. (P.I.- 2.2.3)* 6. *analyse the cubic crystal structure theoretically by using Bragg's spectrometer. (P.I.- 2.2.3)*	**4-6**	**CO-1**
03.	**Non-Crystalline Materials** ***Learning Objective/s:*** 1. *To gain the basic knowledge of non-crystalline solids.* 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.	**3-5**	**CO-1**

	Self-Learning Topics: *Application of non-crystalline materials.* ***Learning Outcomes:*** *A learner will be able to* 1. *differentiate crystalline and non-crystalline materials. (P.I.- 1.2.1)* 2. *define non-crystalline material. (P.I.- 1.2.1)* 3. *list the properties of non-crystalline solid. (P.I.- 1.2.1)* 4. *identify the importance of short range order in non-crystalline materials. (P.I.- 2.1.2)* 5. *identify various non crystalline materials by knowing their properties. (P.I.- 2.2.3)*		
04.	**Magnetic and Dielectric Materials** ***Learning Objective/s:*** 1. *To identify the properties of magnetic and dielectric materials.* 2. *To apply magnetic and dielectric materials as solutions to enhance existing and future technology.*	**6-8**	**CO-2**
	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* 1. *state various parameters related to magnetic and dielectric materials. (P.I.- 1.2.1)* 2. *solve the problems involving magnetic and dielectric materials using the concepts and basic formulae. (P.I.- 1.2.2)* 3. *identify the types of ferromagnetic materials. (P.I.- 2.1.2).* 4. *classify the dielectric materials as polar and non-polar dielectrics. (P.I.- 2.1.2)* 5. *Draw the hysteresis loop for ferromagnetic materials by knowing the concept of magnetization. (2.1.3)* 6. *use magnetic materials and dielectric materials in various applications. (P.I.- 6.1.1)* 7. *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**	**CO-3** **CO-4**

	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* 1. *define nanomaterial (P.I.- 1.2.1)* 2. *differentiate between two approaches of synthesizing nanomaterials. (P.I.- 1.2.1)* 3. *solve the problems related to surface area to volume ratio. (P.I.- 1.2.2)* 4. *classify various synthesis methods of nanomaterials in terms of approaches. (2.1.2).* 5. *write about various synthesis methods and identify the suitable method for the preparation of a different nanomaterials. (P.I.- 2.2.3)* 6. *state the advantages, disadvantages and limitations of using various synthesis methods. (P.I.- 6.2.2)* 7. *analyse the properties of nanomaterials. (P.I.- 6.1.1)* 8. *identify the applications of nanomaterials in technical and environmental fields. (P.I.- 7.1.2)*		
06.	**Characterization Techniques of Nanomaterials** ***Learning Objective/s:*** *The learner will be able to predict the tools for specific characterization of nanomaterials.*	**3-5**	**CO-3** **CO-4**
	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* 1. *state working principle of different tools (SEM, TEM and AFM). (P.I.- 1.2.1)* 2. *interpret the importance of electron microscope to characterize nanomaterials. (P.I.- 2.2.3)* 3. *analyse different characterization tools in terms of their principle, construction, working. (P.I.- 2.2.3)* 4. *identify different tools for specific characterization of nanoparticles. (P.I.- 6.1.1)* 5. *identify merits, demerits and challenges in using the characterization tools. (P.I.- 6.2.2)* 6. *apply the tools as a sustainable technique for the characterization of nanomaterials. (P.I.- 7.2.1)*		
	Course Conclusion	**01**	
	Total	**30**	

Course Outcomes:

Learner will be able to

1. Apply the fundamental knowledge of crystals and non-crystalline solids parameters to analyse therelevant basic engineering problems.
2. Apply the fundamental knowledge of magnetic and dielectric materials in various technical fieldsby analyzing their intrinsic behaviours.
3. Use the basic knowledge of nanomaterials and their characterization techniques to identify theirapplications in societal issues.
4. Apply the basic knowledge of nanomaterials and their characterization techniques to identify theirimpact and role as a sustainable solution.

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 givenproblem
2.2.3	Identify existing processes/solution methods for solving the problem, including forming justifiedapproximations and assumptions.
6.1.1	Identify and describe various role of science particularly as pertains to protection of the public andpublic 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.
7.1.2	Understand the relationship between the technical, socio economic and environmental dimensionsof sustainability.
7.2.1	Describe devices and techniques for sustainable development.

Text Books:

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

Reference Books:

1. Fundamentals of Physics, Halliday /Resnick/Walker, Twelve Edition, 2021, Wiley
2. Introduction to solid state physics, Charles Kittel, Eighth Edition, 2005, Wiley
3. Introduction to nanotechnology, Charles P Poole and Frank J Owens, 1st Edition, Wiley-Interscience.
4. 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 link- www.physics.rutgers.edu
3. NPTEL Course: Nano structured materials-synthesis, properties, self assembly and applications by Prof. A.K. Ganguli, IIT Delhi:- Web link- https://nptel.ac.in/courses/118102003

IN-SEMESTER ASSESSMENT (35 Marks)

1. Continuous Internal Evaluation (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% 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 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 society
4. PO7 - Environment and sustainability

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 systemsand green chemistry for sustainable development.

Module	Detailed Content	Hrs	CO
00	**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**	4-6	CO-1 CO-2
	Learning Objective: *To classify the different types of alloys and interpret their properties and applications in industry.*		
	Contents: Introduction, Significance of alloying, Ferrous Alloys-Plain carbonsteels and special steels: - Nichrome and Stainless steel, Non-ferrous: - Duralumin, Alclad, Shape memory alloys: definition, properties and uses. Calculations on mass of eutectic in alloys.		

	Self-Learning Topics: *Applications of aluminum alloys in aeronautical engineering.* ***Learning Outcomes:*** *A learner will be able to* 1. *State the significance of making alloys (P.I.-1.3.1)* 2. *State the role of carbon in steels (P.I.-1.3.1)* 3. *Classify the plain carbon steels on the basis of their carbon content. (P.I.-2.1.3)* 4. *Distinguish between plain carbon steels and alloy steels (P.I.-2.1.3)* 5. *Identify the role of various alloying elements in alloy steel (P.I.-2.1.3)* 6. *Apply the knowledge of properties of SS and Heat resistant steel in engineering industries. (P.I.-1.3.1)* 7. *State the composition, properties and applications of duralumin. (P.I.-1.3.1)* 8. *State the applications of alclad in aircraft industries. (P.I.-1.3.1)* 9. *State the concept of shape memory alloys. (P.I.-1.3.1)* 10. *Apply the knowledge of shape memory alloys in industries (P.I.-1.3.1).* 11. *Calculate mass of eutectic in alloys (P.I.-1.2.2)*		
02.	**Polymers** ***Learning Objective:*** *To use the knowledge of synthesis, properties and uses of various polymers in industry. This will aid in identifying the impact of disposal of plastics on general health and the environment.* **Contents:** Preparation, properties and uses of Phenol formaldehyde, PMMA, Kevlar. Effect of heat on the polymers (Glass transition temperature). Molecular weight of polymer and numericals. Conducting polymers and their applications. Electroluminescent polymer, Biodegradable polymers. ***Self-Learning Topics:*** *Classification of polymers, Thermoplastic and Thermosetting plastics.* ***Learning Outcomes:*** *A learner will be able to* 1. *Apply the basic concepts of polymer chemistry (P.I.-1.3.1)* 2. *Synthesize thermoplastic and thermosetting polymers for industrial use. (P.I.-2.2.3)* 3. *Calculate the molecular weight of polymer by number average and weight average methods. (P.I.-1.2.2)* 4. *Apply the knowledge of high-performance polymeric materials for the protection of public. (P.I.-6.1.1)* 5. *Define glass transition temperature and melting temperature of polymers. (P.I.-1.3.1)*	**4-6**	**CO- 1** **CO- 2** **CO- 3** **CO- 4**

	6. *State the factors affecting glass transition temperature and melting temperature of polymers. (P.I.-1.3.1)* 7. *Identify the correct polymer for various applications on the basis of glass transition temperature. (P.I.-2.1.3)* 8. *Identify the types of conducting polymers, for various applications in industry. (P.I.-2.1.3)* 9. *State the concept of Electroluminescent polymer and biodegradable polymers. (P.I.-1.3.1)* 10. *Apply the knowledge of disposal of biodegradable polymers for protection of environment and sustainable development. (P.I.-7.2.1)*		
03.	**Advanced Functional materials** **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* 1. *State the properties of composite materials (P.I.-1.3.1)* 2. *State the functions of matrix and dispersed phase (P.I.-1.3.1)* 3. *Classify the composite materials on the basis of types of reinforced materials used. (P.I.-2.3.1)* 4. *Analyze the structural and mechanical properties of composites for industrial use. (P.I.-2.3.1)* 5. *Analyze the properties of composite materials for the applications in aeronautical engineering. (P.I.-2.3.1).*	**4-6**	**CO- 1** **CO- 2** **CO- 3**
04.	**Carbon Nanomaterials** ***Learning Objective:*** *To use carbon nanomaterials on the basis of their mechanical and electrical properties in various industrial applications and modern devices.* **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:***	**3-5**	**CO- 1** **CO- 2**

	A learner will be able to 1. *Define nanomaterials (P.I.-1.3.1)* 2. *Analyze the structures of graphene, CNTs and fullerene for their electrical and mechanical properties. (P.I.-2.3.1)* 3. *Apply the knowledge of carbon nanomaterials in industry. (P.I.-1.3.1)*		
05.	**Batteries** ***Learning Objective:*** *To relate the knowledge of different kinds of batteries and their applications which will aid in the e waste management for the protection of health and environmental safety.* **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* 1. *State the characteristic properties of batteries (1.3.1)* 2. *Write the construction and working of Li-ion and fuel cell batteries. (1.3.1)* 3. *Analyze the uses of batteries in various devices for solving the real-world problems. (2.1.3)* 4. *Identify the impact of disposal of batteries on the environment and society. (6.1.1)* 5. *Apply e-waste management of batteries for sustainable development and environment protection. (7.2.1)*	**4-6**	**CO- 1** **CO- 2** **CO- 3** **CO- 4**
06.	**Spectroscopic Techniques** ***Learning Objective:*** *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 florescence 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* 1. *Analyze the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques. (P.I.-2.1.3)* 2. *Classify spectroscopic techniques on the basis of atomic or molecular level of study. (P.I.-2.1.3)* 3. *Identify various electronic and molecular transitions occurring in photo excited electrons. (P.I.-2.1.3)* 4. *State the fundamental selection rules in spectroscopic technique (P.I.-1.3.1)*	**3-5**	**CO- 1** **CO- 2**

	5. *State the Beer Lambert's law (P.I.-1.2.1)* 6. *Apply Beer Lambert's law to absorption spectroscopy (P.I.-1.2.1)* 7. *State the applications of UV visible spectroscopy. (P.I.-1.3.1)* 8. *To calculate absorbance, concentration and molar extinction coefficient of given compounds using Beer Lambert's law. (P.I.-1.2.2)* 9. *State the phenomena of fluorescence and phosphorescence. (P.I.-1.3.1)* 10. *Analyze the various radiative and non-radiative transitions occurring in a photo excited electron with the help of Jablonsky diagram. (P.I.-2.1.3)* 11. *Analyze the chemical substances using various spectroscopic techniques (P.I.-2.1.3)*		
	Course Conclusion	**01**	
	Total	**30**	

Course Outcomes:

Learners will be able to

1. Apply the concepts of engineering chemistry for solving the engineering problems.
2. Analyze the quality and properties of engineering materials for solving real world problems.
3. Identify the suitable engineering material for the protection of the environment and public health.
4. Apply the knowledge of e- waste management and biodegradable polymers for the sustainable development.

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 numericalproblems.
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
7.2.1	Describe management technique for sustainable development

Text books:

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

Reference Books:

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

Other Resources:

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

IN-SEMESTER ASSESSMENT (35 Marks)

1. Continuous Internal Evaluation (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% 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
AEC	AEC 201	PROFESSIONAL COMMUNICATION & ETHICS-I	02+01

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

Program Outcomes addressed:

1. PO8: Ethics
2. PO9: Individual and teamwork
3. PO10: Communication
4. PO12: 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	Detailed Content	Hrs	CO
00	**Course Introduction** Every learning should lead toward the building of a holistic individual and a good citizen. Communication Skills and Ethics as a subject is the very fundamental requirement of a human being in any social and/or professional ecosystem. The syllabus has been compiled with the strategic idea of helping individual students to enhance, incorporate and implement the four pillars of Communication, Listening, Speaking, Reading and Writing (LSRW Skills), in all walks of life. There is an added emphasis on Ethical behavior and communication which is an integral value that every good human being, who also aims at being an impressive professional, should imbibe. The learner will also gain basic skills in professional writing and public speaking, exude confidence in presenting themselves and their work, with hands on training in real time.	**01**	
01.	**Fundamentals of Communication** ***Learning Objective/s:*** *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 be shared using ICT tools, ethical use of social media and appropriate professional etiquette as individuals and team members.*	**7-9**	**CO-1** **CO-4** **CO-6**

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 them and 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

1. *Identify the various channels of communication in a business organization (10.2.1)*
2. *Differentiate between verbal and non-verbal communication. (9.2.3)*
3. *Apply verbal and non-verbal cues to communicate more effectively in a group (9.2.1)*
4. *Identify barriers in communication and overcome them efficiently (8.1.1)*
5. *Implement the correct method of listening, speaking, reading and writing keeping 'You-attitude' in perspective. (8.2.2)*
6. *Deliver a short speech for special occasions or an extempore with appropriate professional tools and social etiquette. (10.2.2, 10.3.2))*
7. *Introduce self with confidence and composure to the class. (9.2.4)*
8. *Differentiate between formal and casual clothing (12.1.1)*
9. *Implement appropriate grooming and ethical way of presenting oneself (12.1.1)*

	10. *Utilise the knowledge of responsible and ethical use of social media (8.1.1)* 11. *Exhibit flexibility and empathy in the professional space (9.2.2)* 12. *Identify conflict situations and attempt to come up with a resolution. (9.2.1)*		
02.	**Verbal Aptitude For Employment** ***Learning Objective/s:*** *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 f) Standard Abbreviations 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* 1. *Identify the commonly found grammatical errors in the written and spoken format of communication. (10.1.1)* 2. *Apply appropriate words and parts of speech such as prefixes, suffixes, synonyms and antonyms in the written and oral form of communication. (10.2.2)* 3. *Eliminate the use of pleonasms, tautologies and redundancies during communication (10.1.3)* 4. *Employ proper idioms, proverbs and clichés in their written and spoken communication (10.1.3)* 5. *Listen to grammatically correct input, understand and analyse the same (12.3.1)*	**2-4**	**CO-2** **CO-3**
03.	**Developing Basic Language Skills-Lsrw** ***Learning Objective/s:*** *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**	**CO-1** **CO-2** **CO-3**

	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 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) Paraphrasing b) Understanding Copyrights 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* 1. *Listen to team members, peers respectfully, without prejudice to understand ideas and opinions. (9.2.2, 9.2.3, 10.2.1)* 2. *Read and comprehend long/short, technical/non-technical passages. (10.1.1)* 3. *Comprehend and derive appropriate answers to the questions related to each passage. (10.2.1)* 4. *Analyse and derive significant information from a given passage (10.1.1)* 5. *Summarise passages in paragraph format and as graphical organisers (10.1.3)* 6. *Identify the utility and importance of Copyrights (8.2.2, 10.3.1, 12.1.1)* 7. *Generate plagiarism reports by running a plagiarism check (8.2.2, 10.3.2, 12.3.1)*		
04.	**Business Correspondence**	**6-8**	**CO- 4**

Learning Objective/s:

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.

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

1. *Apply the 7 C's of Business correspondence? Why is 'You attitude' important in business communication? (8.1.1, 8.2.2)*
2. *Write a Sales/Complaint/Adjustment/Request letter using the correct format. (10.3.2)*
3. *Generate a job application letter? State: How does it promote your growth? (12.1.1)*

05.	**Basic Technical Writing**	**4-6**	**CO- 5**
	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.*		
	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* 1. *Delineate the difference between technical writing, academic writing and literary writing. (10.1.1)* 2. *Frame clear definitions (10.1.3)* 3. *Write and present a clear set of instructions for the end user for a particular task (10.1.3, 10.2.2)* 4. *Critically choose a research topic and write a research paper (12.3.1)*		
06.	**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.	**4**	**CO-1** **CO-2**
	2. Self-Introduction and introducing others - Learning formal self-introduction and introducing colleagues through practice activity.	**2**	**CO-3** **CO-4**
	3. Group Discussion on various relevant topics - Minimum three rounds to be conducted for facilitating enough practice.	**6**	**CO-5** **CO-6**
	4. Debates on several relevant issues- Two rounds to be conducted.	**4**	
	5. Selection of Ethical Case Study, Analysis, discussion and report documentation.	**2**	
	6. Reading of short stories, writing summaries and learning to critically evaluate the stories – Students will be given selected list of short stories and guided for writing summaries after critical evaluation of the same.	**2**	
	7. Selecting a socio-psychological or socio-technical or socio economic problem, creating a short paper in the relevant format – Detailed discussion about format for	**2**	

	technical paper will be held. Students will create a short paper as per the above areas using the template. *8. Team activity: Poster Presentation on a specific theme based on Awareness creation – Students will work as a team of four members to create the poster as per the given guidelines and the presentation session will be conducted with open evaluation.* *9. Assignment on business Correspondence – Practice for drafting various business letters.* *10. Assignment on writing accurate technical instructions for the users.*	**4** **2** **2**	
	Course Conclusion	**01**	
	Total	**60**	

Course Outcomes: The Lerner 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 analyze 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.

Performance Indicators:

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

10.2.2	Deliver effective oral presentations to technical and non-technical audiences
10.3.2	Use a variety of media effectively to convey a message in a document or a presentation
12.1.1	Describe the rationale for the requirement for continuing professional development
12.3.1	Source and comprehend technical literature and other credible sources of information

Text Books:

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

Reference Books:

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

CONTINUOUS INTERNAL EVALUATION (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 Exam (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. PO12: Life-long learning

Course Objectives:

1. To impart the knowledge to demonstrate competence in comprehending the concepts ofsemiconductor 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 lifeapplications such as an amplifier, switch, etc.
3. To introduce number system and use logic gates to analyse and design circuits for a givenexpression.
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 newdevelopments in the relevant fields.

Module	Detailed Content	Hrs	CO
00.	**Course Introduction** Electronics is a branch of engineering that has grown exponentially in recent years, and now electronics has become a very important part of our lives. This is foundation course deals with fundamental concepts of semiconductors devices, transistors, number system, logic gates, measuring instruments, transducers and sensors. With the growing popularity and production of electric vehicles (EVs) in India, it is projected that semiconductor use in fields including safety, electrification, communication, and networking would rise.	**01**	
01.	**Introduction to Basic Electronic system** ***Learning Objective/s:***	**5-7**	**CO-1**

	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* 1. *Apply fundamental engineering concepts to comprehend the characteristics and parameters of semiconductor diodes. (P.I.-1.3.1)* 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)* 3. *Identify engineering systems to analyze the applications of diode such as switch, rectifier, clipper, clampers etc. (P.I.-2.1.2)* 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/s:*** 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**	**CO- 2**
	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* 1. *Apply fundamental engineering concepts to comprehend the concept of biasing with potential divider bias circuit. (P.I.-1.3.1)* 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)* 3. *Identify engineering systems to find gain, operating point of bipolar junction transistor etc. (P.I.-2.1.2)* 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/s:*** 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**	**CO- 3**
	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* 1. *Integrate mathematical tools to perform conversion in number system. (P.I.-2.2.2)* 2. *Compare alternative solutions to select the best methodology to implement logic gates. (P.I.-2.2.4)* 3. *Determine design objectives to implement electronic circuits using logic gates. (P.I.-3.1.6)* 4. *Apply formal design principles to build simplified circuits using universal gates. (P.I.-3.3.3)*		
04.	**Electronic Instruments** ***Learning Objective/s:*** 1. *To comprehend the working of CRO, DSO, function generators, power supply and access sources to read technical datasheets of instruments.*	**1-3**	**CO- 4**
	Contents:		

	Introduction to Basic instruments: Components of generalized measurement system Concept of accuracy, precision, linearity, sensitivity, resolution, hysteresis, calibration.		
	Learning Outcomes: *A learner will be able to* 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)* 2. *Comprehend technical datasheets of instruments. (P.I.-12.3.1)*		
05.	**Introduction to Transducers** ***Learning Objective/s:*** *To demonstrate competence in engineering fundamentals to introduce the concept transducer for the desired application.*	**2-4**	**CO- 5**
	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* 1. *Apply fundamental engineering concepts to comprehend the concept of transducers and its working. (P.I.-1.3.1)* 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**	**CO- 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* 1. *Apply laws of natural science to an engineering problem to understand the concept of sensors. (P.I.-1.2.1)* 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**	

Course Outcomes:

1. Apply the fundamentals of engineering to demonstrate the concepts of semiconductor diodes andanalyse its applications.
2. Apply the fundamentals of engineering to design transistor-based applications such as anamplifier, switch, etc
3. Formulate mathematical models to introduce number system and use logic gates to design circuitsfor a given expression.
4. Recognize the utilisation of measuring devices and its working.
5. Apply the fundamentals of engineering to introduce various transducers and sensors to adapt tothe current technologies regarding new developments in the relevant fields.

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 solveengineering 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 justifiedapproximations 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 forparticular specifications.
12.3.1	Source and comprehend technical literature and other credible sources of information.

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 PublishingCompany Pvt Ltd,.
3. Electronic Devices and Circuits, Salivahanan, N Suresh Kumar, 2013, 3rd edition, McGraw HillPublications.
4. Basic Electronics & Linear Circuits, Bhargava N. N., D C Kulshreshtha and S C Gupta, 2013,2nd edition, Tata McGraw Hill.

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, PHILearning.

4. Electronic Instrumentation and Measurements (3rd Edition) – David A. Bell, 2013, OxfordUniversity Press.
5. Electronic Communication Systems, George Kennedy, 4th Edition, TMH, 2009.

Other Resources:

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

IN-SEMESTER ASSESSMENT (35 MARKS)

1. Continuous Assessment (15 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 (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 30% weightage, and the syllabus covered from MSE to ESE carrying 70% weightage.

Course Type	Course Code	Course Name	Credits
BSC-LC	BSCLC203	ENGINEERING PHYSICS-II LABORATORY	0.5

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

Program Outcomes addressed:

1. PO1: Engineering Knowledge
2. PO4: Conduct investigations of complex problems
3. PO9: Individual and team work
4. PO10: 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	Detailed Contents	Hrs	CO
00.	**Course Introduction** Introduction to various instruments and components used in physics lab; Rules and regulations to be followed; The fundamental concepts for all experiments, Explanation for performing the experiments.	**01**	
01.	***Learning Objective/s:*** • *To apply the concept of miller indices to identify principal crystal planes.* • *To determine the interplanar distance in simple cubic structure..*	**02**	**CO- 1**
	Experiment 1: Miller Indices: Study of miller indices for planes in simple cubic structure.		
	Learning Outcomes: *A learner will be able to* *1. apply the hall effect phenomena for execution of experiment. (P.I.- 1.2.1)* *2. write the required theory and procedure for the experiment. (P.I.- 4.3.1)* *3. draw the principal planes of simple cubic structure. (P.I.- 4.3.3)* *4. identify the principal planes of simple cubic structure from the given models. (P.I.- 1.2.1)* *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)*		

02.	***Learning Objective/s:*** *To simulate XRD pattern for a given crystal system*	**02**	**CO- 1**
	Experiment 2: X-ray Diffraction: Simulation of X-ray Diffraction (XRD) pattern of a material.		
	Learning Outcomes: *A learner will be able to* 1. *apply the knowledge of x-ray diffraction for execution of experiment. (P.I.-1.2.1)* 2. *write the required theory and procedure for the experiment. (P.I.- 4.3.1)* 3. *use the software to simulate XRD pattern for various materials. (P.I.- 4.1.3)* 4. *visualize the crystal structure of the materials and write the result. (P.I.- 1.2.2, P.I.- 4.3.3)*		
03.	***Learning Objective/s:*** • *To apply the knowledge magnetic materials in order to study the phenomena of magnetic hysteresis.* • *To gain the knowledge of importance of hysteresis loop.*	**02**	**CO- 1**
	Experiment 3: Magnetization: Drawing hysteresis curve (B-H curve) of a magnetic material.		
	Learning Outcomes: *A learner will be able to* 1. *apply basic concepts of magnetization for execution of experiment. (P.I.- 1.2.1)* 2. *write the required theory and procedure for the experiment. (P.I.- 4.3.1)* 3. *familiarize the apparatus included in hysteresis curve set up. (P.I.- 4.3.1)* 4. *draw the circuit diagram and connect the components accordingly. (P.I.- 4.2.1)* 5. *assemble the set up for Hysteresis loop experiment. (P.I.- 4.2.1)* 6. *draw the B-H curve of a ferromagnetic material. (P.I.- 4.3.3)* 7. *determine the loss of energy per unit volume to magnetize the material and write the result. (P.I.- 1.2.2, 4.3.3)*		
04.	***Learning Objective/s:*** • *To apply the knowledge of dielectric materials.* • *To determine the dielectric constant of a given material.*	**02**	**CO- 1**
	Experiment 4:		
	Dielectrics: Determination of dielectric constant of a given material.		

	Learning Outcomes: *A learner will be able to* 1. *apply the knowledge of dielectrics for execution of experiment. (P.I.- 1.2.1)* 2. *write the required theory and procedure for the experiment. (P.I.- 4.3.1)* 3. *draw the circuit diagram and connect the components accordingly. (P.I.- 4.2.1)* 4. *assemble the set up for the experiment. (P.I.- 4.2.1)* 5. *determine the dielectric constant of the given material and write the result. (P.I.- 1.2.2, 4.3.3)*		
05.	***Learning Objective/s:*** *To simulate and visualize nanostructures.* **Experiment 5:** Nanomaterials: Simulation experiment for structure of nanomaterials. ***Type your self-learning topics here*** *Learning Outcomes:* *A learner will be able to* 1. *apply the knowledge of nanomaterials for execution of experiment. (P.I.- 1.2.1)* 2. *write the required theory and procedure for the experiment. (P.I.- 4.3.1)* 3. *use the software to simulate the structure of a nanomaterial using (P.I.- 4.1.3)* 4. *visualize the structure of the nanomaterials and write the result. (P.I.- 1.2.2, 4.3.3)*	**02**	**CO- 1**
06.	***Learning Objective/s:*** • *To apply various concepts of physics in a project.* • *To execute the chosen project through practical demonstration.* **Project:** Report writing and Demonstration of the project. ***Type your self-learning topics here*** *Learning Outcomes:* *A learner will be able to* 1. *use the concepts and principles of physical science for execution of project. (P.I.- 1.2.1, 1.2.2)* 2. *collect and assemble the components as per the requirement. (P.I.- 4.2.1)* 3. *design and develop the set up as well as the procedure for execution of the project (P.I.- 4.2.1)* 4. *execute the project with the help of proper demonstration. (P.I.- 4.3.1)* 5. *communicate and present effectively project related activities. (P.I.- 10.2.2)* 6. *work as an individual and as a team in development of the project in a chosen area. (P.I.- 9.3.1)* 7. *identify, discuss and justify the results found in a systematic approach. (P.I.- 9.1.2)* 8. *conclude the results and submit final report work as an individual and in a team for successful completion of the project. (P.I.- 10.1.2)*	**03**	**CO- 1** **CO- 2** **CO- 3**
	Course Conclusion	**01**	
	Total	**15**	

Course Outcomes:

Learners will be able to

1. Apply the fundamental knowledge of different materials to determine various parameters throughrelevant experiments/simulations.
2. Use fundamental knowledge of physics for the effective preparation and execution of the chosenproject to draw the result and conclusion as a team.
3. Apply the knowledge gained from the project to present the project work, write effective reports,and communicate effectively.

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.
4.1.3	Apply appropriate instrumentation and/or software tools to make measurements of physicalquantities.
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.
9.1.2.	Implement the norms of practice (e.g. rules, roles, charters, agendas, etc.) of effective teamwork,to accomplish a goal.
9.3.1	Present results as a team, with smooth integration of contributions from all individual efforts.
10.1.1	Produce clear, well-constructed, and well- supported written engineering documents.
10.2.2	Deliver effective oral presentations to technical and non- technical audiences.

Text Books:

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

Reference Books:

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

CONTINUOUS INTERNAL EVALUATION (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
BSC-LC	BSCLC204	ENGINEERING CHEMISTRY II LABORATORY	0.5

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

Program Outcomes addressed:

1. PO1: Engineering Knowledge:
2. PO2: Problem Analysis:
3. PO6: The engineer and society
4. PO9: Individual and teamwork

Course Objectives:

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

Module	Detailed Contents	Hrs	CO
00	**Course Introduction** 1. Code of conduct in chemistry laboratory 2. Safety and precautions to be observed in chemistry laboratory 3. Orientation on evaluation of laboratory performance	**01**	
01.	***Learning Objective/s:*** *To calculate percentage of iron in plain carbon steel and relate it with the classification of plain carbon steel.*	**02**	**CO- 2**
	Experiment 1 : To determine the percentage of iron present in a plain carbon steel		
	Learning Outcomes :		
	A learner will be able to *1. Use the basics of titrimetric experiments. (P.I.-1.2.1)* *2. Use of redox titration method. (P.I.-1.3.1)* *3. Calculate the amount and composition of iron present in a given sample of steel. (P.I.-2.2.3)*		

02.	***Learning Objective/s:*** *To apply the knowledge of condensation polymerization for the synthesis of urea formaldehyde.*	**02**	**CO- 3**
	Experiment 2: Synthesis of Urea formaldehyde.		
	Learning Outcomes: *A learner will be able to* 1. *Apply the condensation polymerization reaction for the synthesis of thermosetting resin (P.I.-1.2.1)* 2. *Use of catalyst in the polymerization process. (P.I.-1.3.1)* 3. *Calculate the yield of synthesized polymers. (P.I.-2.2.3)* 4. *Use of urea formaldehyde in everyday life (P.I.-6.1.1)*		
03.	***Learning Objective/s:*** *To compare the viscosity of pure solvent and the solution of polymer for calculating the molecular weight of polymer.*	**02**	**CO- 2**
	Experiment 3 : To Determine molecular weight of a polymer using Ostwald's viscometer.		
	Learning Outcomes: 1. *A learner will be able to* 2. *Use the concept of viscosity coefficient. (1.2.1)* 3. *Use Ostwald Viscometer. (1.3.1)* 4. *Calculate the viscosity of pure solvent and polymer (2.2.3)* 5. *Calculate specific viscosity and molecular weight of polymer (2.2.3)*		
04.	***Learning Objective/s:*** *To construct the Daniel cell and calculate its E^0 using Nernst equation.*	**02**	**CO- 1**
	Experiment 4 : To determine the emf of galvanic cell-Daniel cell.		
	A learner will be able to 1. *Use of salt bridge and electrodes for the construction of Daniel cell (1.2.1)* 2. *Represent Daniel cell with electrode reactions. (1.3.1)* 3. *Calculate E^0 of Daniel cell (2.2.3)* 4. *Compare theoretical voltage and measured voltage of cell. (2.2.3)* 5. *Conclude whether Daniel cell is working or not. (1.3.1)*		
05.	***Learning Objective/s:*** *To determine the concentration of iron and verify Beer Lambert's law.*	**02**	**CO- 1** **CO- 2**
	Experiment 5 : To determine iron from the given sample using UV-Visiblespectrophotometer.		

	A learner will be able to 1. *Use UV-Visible spectrophotometer(P.I.-1.2.1)* 2. *Distinguish single beam spectrophotometer and double beamspectrophotometer (P.I.-1.2.1)* 3. *State and explain Beer Lambert's Law (P.I.-1.3.1)* 4. *Determine the λmax and measure absorbance of standard and unknownconcentrations of given analyte. (P.I.-2.2.3)* 5. *Plot a calibration curve of concentration Vs absorbance (P.I.-2.2.3)* 6. *Verify Beer Lambert's law (P.I.-1.3.1)* 7. *Calculate the concentrations of given samples (P.I.-1.3.1)*		
06.	***Learning Objective:*** *To develop the basic knowledge of analytical chemistry using titrimetric experiment.* **Demonstration:** Demonstration of titrimetric experiment and conclusion. ***Learning Outcomes: -*** The learner will be able to 1. *Apply fundamental laws of engineering chemistry (1.2.1)* 2. *Apply the basic concepts of engineering chemistry. (1.3.1)* 3. *Analyze the proposed substances* in an *experiment in the laboratory. (2.1.3)* 4. *Calculate the results of the proposed experiments (1.2.2)* 5. *Demonstrate the ability to work as a team. (9.1.1)* 6. *Present the results as a team (9.3.1)*	**04**	**CO-4**
	Total	**15**	

Course Outcomes:

Learner will be able to

1. Apply the laws of electrochemistry and spectroscopy for performing the practicals.
2. Analyze the materials for engineering applications.
3. Synthesize the polymer and use it for societal benefits.
4. Demonstrate an ability to work effectively in a team for the project

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 formula based on the concepts of engineering chemistry for solving the numerical problems.
1.3.1	Apply fundamental engineering concepts to solve engineering problems
2.1.3	Identify the engineering chemistry knowledge to analyse a 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.

9.1.1 Recognize a variety of working and learning preferences; appreciate the value of diversity on a team.

9.3.1 Present result as a team with smooth integration of contributions from all individual efforts

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

CONTINUOUS INTERNAL EVALUATION (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
ESC-LC	ESCLC204	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. PO10: 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	Detailed Contents	Hrs	CO
00.	**Course Introduction** This is foundation course which deals with fundamental concepts of technical drawing and modern tools associated with it. This course will empower the imagination and visualization which will help in communicating the technicality of the product.	**01**	
01.	***Learning Objective/s:*** *To identify different types of lines and dimensioning standards as per IS system.*	**08**	**CO- 1**
	Content: **Introduction to Engineering Graphics:** 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* 1. *represent the fundamental drawing essentials such as line types, line weights, dimensioning systems, tolerance, etc. (P.I.-2.2.3)* 2. *identify standard procedures according to IS conventions. (P.I.-2.2.2)* 3. *demonstrate the use of basic AutoCAD commands. (P.I.-5.1.1)* 4. *draw simple drawings with the use of basic AutoCAD commands.(P.I.-5.2.2)*		
02.	***Learning Objective/s:*** *To develop the imagination in creating the orthogonal and sectional orthographic views for communicating the features in the product.*	**20**	**CO- 2**
	Content: 2.1 Projection of Points and Lines: Projection of points in different quadrants. Projection of lines keeping the ends in different quadrants. 2.2 Orthographic Projections: Concept of First Angle and Third Angle Projection. Fundamentals of Orthographic Projections. Different views of a simple machine part as per the first angle projection method recommended by I.S. Multi view drawing from pictorial views using CAD Software (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 into orthogonal and sectional orthographic drawings.		
	Learning Outcomes: *A learner will be able to* 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.-1.3.1,10.3.1)* 2. *develop the ability to create orthographic projections of objects in different views, including front, top, and side views. (P.I.-1.4.1,10.1.1)* 3. *create sectional orthographic projections of objects including half and full sections. (P.I.-2.1.3, 10.1.1)* 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.-2.2.3,10.3.1)* 5. *demonstrate the use of basic AutoCAD commands. (P.I.- 5.1.1)* 6. *apply the basics of AutoCAD to create the simple orthographic drawings(P.I.-5.2.2,10.3.1)*		
03	***Learning Objective/s:*** *To develop the ability in visualization of the two-dimensional views of the object to produce the isometric drawing.*	**12**	**CO- 3**

	Content: Isometric Drawing: Principles of Isometric Projection, Isometric Views, Conversion of Orthographic Views to Isometric Views. (Excluding Sphere). Construction of Isometric View from Orthographic views with CAD Software (Auto CAD) **Experiment:** To demonstrate the ability to convert the orthographic views into isometric drawings.		
	Learning Outcomes: *A learner will be able to* 1. *identify the nature of simple geometries when plotted on isometric plane (P.I.-1.3.1)* 2. *apply the fundamental geometrical procedures from mathematics to draw the given isometric views. (P.I.-1.2.1)* 3. *develop their ability to visualize three-dimensional objects and represent them on a two-dimensional surface. (P.I.-2.1.3,10.3.1)* 4. *draw the isometric drawings from the two-dimensional views. (P.I.-2.2.3)* 5. *create isometric drawings of objects in AutoCAD. (P.I.-5.1.1,10.1.1)* 6. *develop proficiency in the orientation and scale of the object while drawing the AutoCAD (P.I.-5.2.2,10.1.1)*		
04.	***Learning Objective/s:*** *To develop the ability of the students to read the orthographic and sectional orthographic projections to draw the missing views.*	**05**	**CO-5**
	Content: 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* 1. *Read and interpret technical drawings that use orthographic and sectional orthographic projections. (P.I.-,2.2.3,10.1.1)* 2. *identify the missing view by visualizing the two views in combined manner. (P.I.-1.3.1)* 3. *redraw the simple orthographic view into sectional orthographic view (P.I.-1.2.1)* 4. *identify the position and orientation of the missing view.(P.I.-2.2.1)*		

	5. *Demonstrate the use of basic AutoCAD commands to produce the missing view by reading the orthographic projections on a tw-dimensional space. (P.I.-5.1.1,10.3.1)* 6. *use the theory of projection efficiently to create the missing view in AutoCAD (P.I.-5.2.2)*		
05.	***Learning Objective/s:*** *To develop the ability to imagine the solid geometries and represent the views in a two dimensional space.*	**14**	**CO-4**
	Content: 5.1 Projection of Planes: Projection of Triangular, Square, Rectangular, Pentagonal, Hexagonal or Circular planes inclined to either HP or VP only. 5.2 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. 5.3 Section of Solids: Section of Prism, Pyramid, Cylinder and Cone cut by plane perpendicular to at least one reference plane and incline to otherin simple positions of the solid. (Section in initial position only)		
	Learning Outcomes: *A learner will be able to* 1. *create orthographic projections of planes and different types of solids. (P.I.-1.3.1)* 2. *create different views of solid geometries. (P.I.-1.2.1)* 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.-2.2.4,10.1.1)* 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.-2.2.3,10.3.1)*		
	Total	**60**	
	MINIMUM 2 experiments should be conducted from each module.		

Course Outcomes:

A learner will be able to

1. Apply the basic concepts and standards in accordance with IS conventions.
2. Apply the basic principles of projections in converting pictorial views into orthographic Views.
3. Apply the basic principles of projections in converting orthographic Views into isometric drawing.
4. Represent the internal features of the objects by providing the sectional views of the object.
5. Apply the basic principles of projections to draw the missing views.

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 givenproblem
2.2.2	Identify, assemble and evaluate information and resources.
2.2.3	Identify existing processes/solution methods for solving the problem, including formingjustified 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.
10.1.1	Read, understand and interpret technical and non-technical information.
10.3.1	Create engineering-standard figures, reports and drawings to complement writing andpresentations.

Text Books:

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

Reference Books:

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

Other Resources:

1. NPTEL Course: Engineering Drawing by Prof. P.S. Robi, Department of Mechanical Engineering, IIT Guwahati:-Web link- https://nptel.ac.in/courses/112103019.
2. NPTEL Course: Engineering Graphics and Design by Prof. S.R.Kale, Department of MechanicalEngineering, 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 (Practical Exam) (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
ESC-LC	ESCLC205	PROGRAMMING LABORATORY-II (JAVA)	02

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

Pre-requisite:

1. ESCLC103: Programming Laboratory-I (C)

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO3: Design/development of solutions
4. PO5: Modern tool usage
5. PO12: 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 reusabilityfor faster development.
4. To introduce usage of Exception Handling, Multithreading, Input Output streams in variousapplications.
5. To impart the knowledge of designing, implementing, testing, and debugging graphical userinterfaces in Java using Swings and AWT components that can react to different user events.

Module	Detailed Contents	Hrs	CO
00.	**Course Introduction** Java is platform independent, open-source object oriented programming language enriched with free and open source libraries. In current industrial scenario Java has the broad industry support and is prerequisite with many allied technologies like Advanced Java, Java Server Pages, and Android Application Development. Thus, current industrial trends necessitate acquiring Java knowledge for graduates.	**01**	
01.	**Introduction to Java** ***Learning Objective:*** *Learner is expected to gain proficiency in concept like programming tokens like variables, data types, operators, control structures, function. Also expected to apply the concepts for writing program*	**11**	**CO-1**
	Contents: OOP concepts: Objects, class, Encapsulation, Abstraction, Inheritance,		

Polymorphism, message passing.

Java development kit, Java Virtual Machine, Garbage collection in java
Basic programming constructs: variables, data types operators,expressions, branching and looping.

Setup a Java Programming development environment by using:
a) Command prompt. (Classpath and path setup)
b) Any IDE (Eclipse, Netbeans etc.)

Demonstration

1. How to Install Java?
2. Setting environment Variables to Run Java Programs.
3. Editing a Java Program and its Compilation and Execution.
4. About main () Method
5. Few Simple Java Programs
6. Writing and running simple Java programs
7. Explain control structures in java

Task 1:

Write simple java program

1. To show basic syntax, variables, and data types
2. Implement basic arithmetic operations using Java.
3. Write a program using if statement (eg. to check if a number is even or odd.)
4. Implement a simple calculator using methods for arithmetic operations. Use switch control to write menu driven program.

Task 2:

Practice method overloading by creating multiplemethods with different parameters.

Learning Outcomes:

A learner will be able to

1. *Illustrate the concept of keywords, data types, variables, operators, and expressions (PI-1.1.1)*
2. *Apply the fundamental control structures to solve problem (PI-1.3.1)*
3. *Identify mathematical expression or formula to write and execute a program (PI-2.1.3)*
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)*
5. *Use modern JAVA IDE like eclipse, NetBeans (PI-5.1.1).*
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/s:*** 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**	**CO- 2**
	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 privatevariables with public accessors /mutators. **Demonstration** 1. Use of print (), println () and printf (). 2. Command Line Input in Java 3. Take Input using Scanner Class 4. Read Input with DataInputStream **Task 5:** Write a Java program that prints out informationabout any entity (eg. Student, Animal etc.) **Task 6:** Write a Java program that takes input from userwith following ways 1. Command line arguments. 2. Use the Scanner class to prompt the user for the required input Read information with DataInputStream		

	Learning Outcomes: *A learner will be able to* 1. *Use print statement (PI-1.1.1)* 2. *Implement a program by taking input from user (PI-1.3.1)* 3. *Identify classes and objects for problem statement (2.1.1)* 4. *Apply concept of constructors overloading to write java program (2.3.1)* 5. *Explore the concept and write recursive function (3.2.1)* 6. *Write static, non-static and recursive method in java program (3.4.2)*		
03.	**Inheritance, Interfaces, Packages** ***Learning Objective/s:*** 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**	**CO- 3**
	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* 1. *Summarize the concept of polymorphism using inheritance, concept of abstraction using interfaces, and packages in java (PI-2.4.1)* 2. *Show polymorphism by inheriting the features of one class to other class (PI-2.4.4)* 3. *Explore the single inheritance and multilevel inheritance (PI-3.2.1)* 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 Objective/s:*** 1. *To impart skills that can enable students to check and handle the proper functioning of applications. Also expected to apply the exception handling for proper functioning of applications* 2. *Learner is expected to know the concept of multithreading. Also expected to apply it for multitasking*	**08**	CO- 4
	Contents: Exception handling using try, catch, finally, throw and throws, Multiple try 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 exceptionusing try, catch, finally, throw and throws. **Demonstration** 1. Creating Threads using the Thread Class. 2. Creating Threads Implementing the Runnable Interface. 3. Life cycle of thread: Thread Methods: wait(). sleep(), notify(), resume(), suspend(). stop(). **Task 12:** Create threads to run the given multiple processesin the given program. ***Learning Outcomes:*** *A learner will be able to* *1. Illustrate the concept the exception handling and threads in java (PI-1.1.1)* *2. Apply the fundamentals of exception handling to handle error (PI-1.3.1)* *3. Write a program to show exception handling in java (PI-2.1.3)* *4. Create user-defined exception handling (PI-2.2.3)* *5. Explore the multiple task handling with threads (PI-3.2.1).* *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.* **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	**16**	**CO-5**

	  **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* *1. List all data and techniques to solve problem (PI-1.1.1)* *2. Determine different layout manager to develop software (PI-1.4.1)* *3. Examine layout managers for flexible window layouts while creating GUI (PI-3.1.6)* *4. Write modules to handle events through components of GUI using applets and Abstract Window Toolkit (AWT) (PI-3.4.2)* *5. Extend study on eclipse to solve problem (PI-5.1.1)* *6. Adapt eclipse and HTML to create GUI using applet and AWT (PI-5.1.2)* *7. Illustrate the path from CLI to GUI (PI-12.2.1)* *8. Summarize the advantages of GUI of problem (PI-12.2.2)*		
	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.

Course Outcomes:
Learner will be able to

1. Install java environment and write a java program using fundamental concepts.
2. Apply concepts of classes, objects, members of a class and the relationships among them needed for a finding the solution to specific problem.
3. Achieve reusability in programming by using concept of Inheritance, Interface and Packages.
4. Implement concept of Multithreading, and exceptions to obtain robust and faster programmed solutions to problems.
5. Design and develop application using Abstract Window Toolkit, Swings with database connectivity

Performance Indicators:

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

12.2.2 Recognize the need and be able to clearly explain why it is vitally important to keep currentregarding new developments in your field

Text Books:

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

Reference Books:

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

Other Resources:

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

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
ESC-LC	ESCLC 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 society
6 PO9: Individual and Team work
7 P10: Communication
8 P12: Life-long learning

Course Objectives:

1. To familiarize with electronics components, measuring devices, source devices for building andanalyzing 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	Detailed Contents	Hrs	CO
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.	***Learning Objective/s:*** *Analyze experimental results to validate theoretical concepts and understand practical implications. Evaluate circuit parameters to achieve desired performance characteristics.*	**10**	**CO-1** **CO-2**

	Experiments: **Electronic Devices** 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.		**CO-3**
	Self-Learning Topics: *Advanced Component Testing using LCR Meters* ***Learning Outcomes:*** *A learner will be able to* *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.- 10.3.1).* *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.- 9.3.1).*		
02.	***Learning Objective/s:*** *Explore digital circuit fundamentals by understanding logic gates, Boolean expressions, universal gates, and their practical applications.* **Suggested List of Experiments: (Any Two)** **Digital Circuits** 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* *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.- 9.3.1)* *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.- 10.3.1)*	**8**	**CO-1** **CO-2** **CO-3**

03.	***Learning Objective/s:*** *To teach the fundamentals of sensor/transducer and model the basic data acquisition system.*	**4**	**CO-1** **CO-2** **CO-3** **CO-4**
	Suggested List of Experiments: (Any One) **Sensor/ Transducer Applications** 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* *1. Identify and analyze various sensors/transducers required for a dataacquisition system, use systematic techniques to test and verify same as a team.(P.I.- 2.4.1, P.I.-.9.3.1)* *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.- 10.3.1)*		
04	***Learning Objective/s:*** *Develop practical electronic skills through designing and implementing real-life applications.* **Suggested List of Experiments: (Any One)** **Real life Applications** 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	**6**	**CO-1** **CO-2** **CO-3** **CO-4**

	Self-Learning Topics: *Smart sensors in the field of IoT* ***Learning Outcomes:*** *A learner will be able to* *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.- 10.3.1)* *2. To design for real life scenarios and check for the sustainability and feasibility of the application (P.I.- 3.3.3, P.I.- 12.3.1)* *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.- 9.3.1)* *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**	
	Minimum Ten Experiments		
	Total	**30**	

Course Outcomes:

Learners 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.
2. Demonstrate and analyze the use of basic gates and apply it in various applications in digital domain.
3. Analyze sensors/transducers and assemble a prototype for a basic data acquisition system.
4. Design analyze, test, and ensure functionality of real-life electronic applications using acquired skills and electronic test instruments.

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.

9.3.1 Present results as a team, with smooth integration of contributions from all individual efforts

10.3.1 Create engineering-standard figures, reports and drawings to complement writing and presentations

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

Text Books:

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

Reference Books:

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

Other Resources:

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

CONTINUOUS INTERNAL EVALUATION (25 Marks)

1. Lab Experiments: 10 Marks
2. Internal Assessment –

i) Practical Test 1 (Based on 50% of the Practical list): 5Marks

ii) Practical Test 2 (Based on remaining 50% of the Practical list):5 Marks

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		
Continuous Assessment	End Semester Exam(ESE)	Total Marks
50	--	50

Pre-requisite:

1. SEC101- Basic Workshop Practice I

Program Outcomes addressed:

1. PO5: Modern tool usage
2. PO6: The engineer and society
3. PO7: Environment and sustainability
4. PO9: Individual and team work
5. PO11: Project management and finance
6. PO12: 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	CO
00.	**Course Introduction** The Basic Workshop Practice II course is intended to give students with the coreinformation and abilities required for developing engineering skill sets andgetting 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**	**CO- 1**

	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* 1. *Accurately measure and layout components of carpentry projects using appropriate tools and techniques, ensuring precision and alignment. (5.2.1, 12.3.1)* 2. *Exhibit proficiency in the use of common carpentry hand tools and power tools, including accurate handling, operation, and maintenance. (5.2.2, 12.3.2)*		
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**	**CO- 2**
	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* 1. *Select appropriate electronic components based on design requirements and place them effectively on the PCB layout. (5.2.1, 5.2.2, 12.3.1)* 2. *Demonstrate a clear understanding of what PCBs are, how they function, and their importance in electronic devices and systems. (9.2.1, 9.3.1, 11.3.1)* 3. *Comprehend the basic principles of PCB design, including component placement, routing, signal integrity, and manufacturability. (6.1.1, 7.2.2, 9.2.1, 9.3.1, 11.3.1, 12.3.2)*		
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**	**CO- 3** **CO- 4**
	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* 1. *Use various sheet metal working tools and equipment proficiently. (5.2.2, 5.3.2, 12.1.1, 12.3.2)* 2. *Demonstrate competence in operating forging equipment and tools, including heating furnaces, power hammers, presses, and hand tools, to manipulate metal effectively. (5.2.2, 7.2.2, 9.1.1, 9.3.1, 12.1.1, 12.3.2)*		
	Total	**30**	

Course Outcomes:

A learner will be able to

1. Develop the necessary skill required to handle/use different carpentry tools.
2. Identify different electronic components to design, fabricate and assemble PCB.
3. Develop the necessary skill required to use different sheet metal and brazing tools.
4. Demonstrate the forging operation with the help of a simple job.

Performance Indicators:

P.I. No.	**P.I.Statement**
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 ofthe public and public interest at the global, regional and local level.
7.2.2	Apply principles of preventive engineering and sustainable development to an engineeringactivity or product relevant to the discipline.
9.1.1	Recognize a variety of working and learning preferences; appreciate the value of diversityon a team.
9.2.1	Demonstrate effective communication, problem-solving, conflict resolution and leadershipskills.
9.3.1	Present results as a team, with smooth integration of contributions from all individual efforts.
11.3.1	Identify the tasks required to complete an engineering activity, and the resources required tocomplete the tasks.
12.1.1	Describe the rationale for the requirement for continuing professional development.
12.3.1	Source and comprehend technical literature and other credible sources of information.
12.3.2	Analyse sourced technical and popular information for feasibility, viability, sustainability,etc.

CONTINUOUS INTERNAL EVALUATION (50 Marks)

1. Job Work with complete workshop book: 40 Marks
2. Regularity 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 & society
3. PO7 : Environment & sustainability
4. PO8 : Ethics
5. PO12: Life-long learning

Course Objectives:

1. To introduce fundamentals of Ancient Indian Educations to understand the pattern and purpose ofstudying 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 Indianknowledge 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 humanright, well-being and sustainable development.

Module	Detailed Content
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 conceptsin 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 PaintingTechnology), 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, theTriguṇa 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, andethics, 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 theircontributions to global knowledge and technological advancement.
4. Engage with interdisciplinary perspectives in Humanities and Social Sciences rooted in ancientIndian wisdom, fostering critical thinking and holistic development.
5. Apply insights from ancient Indian knowledge systems to contemporary challenges, promotinginnovation and sustainable solutions.
6. Cultivate a deeper appreciation for Indian heritage while developing analytical skills andinterdisciplinary insights for real-world application.

Text Books:

1. Exploring the Indian Knowledge System: Insights from Prof. B Mahadevan, Prof. B Mahadevan, IIM Bengaluru Press

Kapur K and Singh A. K (Eds) 2005). Indian Knowledge Systems, Vol. 1. Indian Institute of

2. Advanced Study, Shimla. Tatvabodh of sankaracharya, Central chinmay mission trust,Bombay,1995.

3. Nair, Shantha N. Echoes of Ancient Indian Wisdom. New Delhi: Hindology Books, 2008

Reference Books:

1. Reshmi ramdhoni, Ancient Indian Culture and Civilisation, star publication ,2018

2. Supriya Lakshmi Mishra, Culture and History of Ancient India (With Special Reference of Sudras), 2020.

3. DK Chakkrabarty, Makkhan Lal, History of Ancient India (Set of 5 Volumes), Aryan book Internation publication, 2014

Other Resources:

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

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

F. Syllabi
Second Year

Course Type	Course Code	Course Name	Credits
PCC	EEPCC301	ENGINEERING MATHEMATICS-III	03+01*

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

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	CO
	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 Electrical engineering such as • To introduce the study of Harmonic Analysis, Circuit Analysis and Control system using the various Mathematical Transforms, • Application of Fourier series in Spectrum analysis, and Concept of complex numbers and variables provides a knowledge to solve electrical engineering problems.	**01**	
01.	**Laplace Transform**	**7-9**	CO1
	Learning Objective/s: *To analyze the standard Laplace Transforms using basic definitions and apply it to solve mathematical problems.*		
	Contents: Definition of Laplace Transforms, Condition of existence of Laplace Transform, Laplace Transforms of standard functions: $e^{at}, sinat, cosat, sinhat, coshat, t^n\ n > 0.$ Properties of Laplace Transform: Linearity, First Shifting Theorem, Change of scale Property, Multiplication by t, Division by t, Laplace Transform of derivatives and integrals, Heaviside's Unit Step function.		

	Self-Learning Topics: *Second Shifting Theorem, Laplace Transform of Periodic functions.*		
	Learning Outcomes : *A learner will be able to* 1. *Interpret standard Laplace transforms and its applicability to a given mathematical problem. (P.I.- 1.1.1)* 2. *Apply the properties of Laplace Transform and use it for solving advanced mathematical problems. (P.I.- 1.1.2)* 3. *Identify unit steps functions to solve engineering problems. (P.I-2.1.2)* 4. *Identify the correct properties of Laplace Transform applicable to a given problem (P.I.-2.1.3)*		
02.	**Inverse Laplace Transform**	**6-8**	CO1
	Learning Objective/s: *To analyze and apply the techniques of Laplace and inverse Laplace transform to solve differential equations. .*		
	Contents: Definition of Inverse Laplace Transform, Properties of Inverse Laplace Transform: Linearity, Shifting Theorem, Finding Inverse Laplace Transform using partial fraction, Finding Inverse Laplace Transform using differentiation Property, Solution of Differential equations-initial value problem and Boundary Value Problem.		
	Self-Learning Topics: Convolution Theorem.		
	Learning Outcomes : *A learner will be able to* 1. *Interpret standard Inverse Laplace transforms and its applicability to a given mathematical problem. (P.I.-1.1.1)* 2. *To solve initial and boundary value problems of differential equation by applying advanced mathematical techniques. (P.I.-1.1.2)* 3. *Identify the correct properties of inverse Laplace Transform applicable to a given problem (P.I.-2.1.3)* 4. *Identify the types of partial fraction method to find the solution of inverse Laplace transform. (P.I.-2.2.3)*		
03.	**Fourier Series**	**7-9**	CO2
	Learning Objective/s: *To analyze various wave forms and use the knowledge of periodic wave forms in determining a function in terms of its sine and cosine counterparts.*		
	Contents: Dirichlet's conditions, Definition Periodic function and graphical representation of periodic function: sine wave form, cosine wave form, square wave form, saw tooth wave form, Definition of Fourier series, Fourier series of periodic function with period 2π and Fourier series of periodic function with period 2l, Fourier series of even and odd functions, Half range Sine and Cosine Series.		
	Self-Learning Topics: *Parseval's Identity, Complex form of Fourier Series, Orthogonal and orthonormal set of functions.*		

	Learning Outcomes : *A learner will be able to* 1. *To apply mathematical techniques of algebra and calculus in determining Fourier coefficients. (P.I.-1.1.1)* 2. *To apply fundamental concept of mathematics to solve engineering problems. (P.I.-1.3.1)* 3. *Articulate and interpret the basics of periodic functions and series. (P.I.-2.1.1)* 4. *Identify the knowledge of periodic functions to solve given engineering problems. (P.I.-2.1.3)* 5. *To synthesize the information about any given mathematical function and express it in terms of sine and cosine waveforms. (P.I.-2.1.3)*		
04.	**Z-Transform** ***Learning Objective/s:*** *To identify the properties and theorem of z-transform to apply and solve engineering problems.* **Contents:** Significance of z-transform, Definition and Region of Convergence, z-Transform of Standard Functions, Properties of z-transform: Linearity, Change of Scale, Shifting Property, Multiplication and Division property, Convolution theorem. ***Self-Learning Topics:*** *Initial Value Theorem and Final Value Theorem* ***Learning Outcomes :*** *A learner will be able to* 1. *Interpret standard z-transforms and its applicability to a given mathematical problem. (P.I.-1.1.1)* 2. *Apply the properties of z-transform and use it for solving advanced mathematical problems. (P.I.- 1.1.2)* 3. *To apply knowledge of fundamental engineering concepts in finding z-Transforms. (P.I.- 1.3.1)* 4. *Identify the correct properties of z-Transform applicable to a given problem. (P.I.-2.1.3).* 5. *Identify the existing solutions to solve given problems.(P.I.-2.2.3)*	**6-8**	CO3
05.	**Inverse z-Transform** ***Learning Objective/s:*** *To apply the concept of Inverse z-transform and analyze its methods to solve difference equations in discrete time system.* **Contents:** Definition of Inverse z-transform, Region of Convergence, Finding Inverse z-transform using Partial fraction, Finding Inverse z-transform using Convolution theorem, Solution of Difference Equations. ***Self-Learning Topics:*** *Finding Inverse z-transform using Binomial expansion.*	**5-7**	CO3

	Learning Outcomes: *A learner will be able to* 1. *To apply inverse z-transforms and its applicability to a given mathematical problem. (P.I.-1.1.1)* 2. *To apply knowledge of fundamental engineering concepts in finding inverse z-transforms. (P.I.-1.3.1)* 3. *To identify the various methods such as Partial fraction, Convolution theorem to finding solution of inverse z-transform. (PI-2.2.3)* 4. *To apply the knowledge of Partial fraction, and Convolution theorem to finding solution of given problems. (PI-2.1.3)*		
06.	**Complex Variables-I**	**6-8**	CO4
	Learning Objective/s: *To analyses if a given complex function is analytic or not by applying basic definitions and theorems of Complex Variables.*		
	Contents: Statement of D'Moivre's Theorem, Expansion of sinnθ, cosnθ in terms of sines and cosines of multiples of θ ,Expansion of sinnθ, cosnθ in powers of sinθ, cosθ .Complex Variables, Calculus of Complex Variables: Limit, Continuity Differentiability Analytic Functions: Necessary and sufficient conditions for f(z) to be analytic, Cauchy-Riemann equations: Cartesian coordinate and Polar coordinates.		
	Self-Learning Topics: *Roots of a complex number, Conformal mapping*		
	Learning Outcomes: *A learner will be able to* 1. *To apply mathematical techniques such as calculus and algebra to solve mathematical problems of complex variables and functions. (P.I-1.1.1)* 2. *To apply the fundamental concept of complex functions to solve engineering problems. (P.I.-1.3.1)* 3. *To interpret complex functions using the knowledge of complex variables. (P.I-2.1.2)* 4. *Identify if given complex function is analytic or not using Cauchy Riemann Equations. (P.I-2.1.2)* 5. *To identify the concept of analyticity by using Cauchy-Riemann equations to solve given problem. (P.I-2.1.3)* 6. *To Identify if the derivatives of a given complex function exist or not by applying the theory of complex variables to a given problem. (P.I-2.1.3)*		
	Course Conclusion Engineering Mathematics provides the problem solving skills necessary for electrical engineering to design, analyse and optimize system and device across a wide range of applications.	**01**	
	Total	**45**	

Course Outcomes :

1. Analyse the techniques of Laplace and inverse Laplace transform and apply it to determine the solutions of differential equations.

2. Analyse the periodic functions and expand it by using Fourier series to solve complex engineering problems.
3. Apply the concept of Z-transform and Inverse Z-Transform to analyse its methods to solve difference equations.
4. Apply the concept of complex variables to analyse the function is holomorphic or not.

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 engineering problems
1.3.1	Apply fundamental engineering concepts to solve engineering problems.
2.1.1	Articulate problem statements and identify objectives
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 solution/methods to solve the problem, including forming justified approximations and assumptions.

Text Books :

1. Higher Engineering Mathematics, Dr.B.S.Grewal, Khanna Publication
2. Advanced engineering mathematics, H.K. Das, S. Chand, Publications

Reference Books :

1. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Eastern Limited,
2. Complex Variables and Applications, Brown and Churchill, McGraw-Hill Education.
3. Higher Engineering Mathematics B.V. Ramana, McGraw Hill Education
4. Laplace transforms, Murray R. Spiegel, Schaum's Outline Series

Other Resources :

1 NPTEL Course: Laplace Transform,IMSc By Prof. .Indrava Roy, Web link- https://nptel.ac.in/courses/111/106/111106139/

IN-SEMESTER ASSESSMENT (75 Marks)

1. Continuous Assessment (45 Marks)

Continuous Internal Evaluation of Theory (20 Marks)

Numerical Assignments: 5 Marks
Class test based on above numerical Assignment: 5 Marks
Team-pair- Solo: 5 Marks
Regularity and attentiveness: 5 Marks

Continuous Internal Evaluation of Tutorial (25 Marks)

Minimum six Tutorials: 20 Marks
Regularity and attentiveness: 5 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.

2. Mid Semester Exam (30 Marks)

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

END SEMESTER EXAMINATION (50 Marks)

End semester examination will be based on the syllabus coverage up to Mid Semester Examination (MSE) carrying 20%-30% weightage, and the syllabus covered from MSE to ESE carrying70%- 80% weightage.

Course Type	Course Code	Course Name	Credits
PCC	EEPCC302	CIRCUIT AND SIGNAL ANALYSIS	03+01*

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

Pre-requisite :

1. BSC101- Engineering Mathematics I
2. BSC204 - Engineering Mathematics II
3. ESC102- Basic Electrical Engineering

Program Outcomes addressed :

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO5: Modern tool usage

Course Objectives:

1. To impart the knowledge of various fundamental electrical theorems for analysis of electrical circuits from application point of view.
2. To inculcate the problem solving and analysis skills in students.
3. To impart knowledge on signals and system.

Module	Details	Hrs	CO
	Course Introduction Overview of course, application of course in Industry/real life problem. This is a foundation course which deals with fundamental knowledge of signals and systems, basic elements of electrical network, analysis of electrical network using fundamental laws. The fundamental concepts of this subject are essential for analyzing the electrical power system/machines/electronic system under various conditions.	**01**	
01.	**Network Theorems**	**7-9**	CO1 CO5
	Learning Objective/s: *To* apply the fundamental theorems in electrical engineering to analyze electrical network with dependent voltage/current sources and validate the results of analysis with software tool.		
	Contents: With DC Dependent Sources: Mesh analysis, Nodal analysis, Superposition theorem, Thevenin's theorems and Norton's theorem and Maximum power transfer theorem; With AC Sources: Magnetic coupling, Thevenin's theorem, Superposition theorem, Norton's theorem and Maximum power transfer theorem.		

	Simulation of electrical network with software tools and verification using theorem		
	Learning Outcomes: *A learner will be able to* 1. *Apply fundamental KVL, KCL and theorems in electrical engineering to simplify any complex electrical network with DC dependent sources and AC sources (PI-1.4.1)* 2. *Apply advanced mathematical techniques to model and solve the electrical network. (PI-1.1.2)* 3. *Apply network theorems to identify and determine various circuit parameters such as current and voltage. (PI- 2.1.2).* 4. *Apply network theorems to identify and determine power dissipated across circuit elements, optimum load to be connected for maximum power flow and role of source resistance that applies to a given electrical network. (PI- 2.1.3).* 5. *Identify software tool to model/build an electrical network. (PI-5.1.1)* 6. *Simulate the electrical circuit in software and validate the results analytically using network theorems. (PI-5.3.1)*		
02.	**Graph Theory and Network Topology**	**5-7**	CO1
	Learning Objective/s: *To develop the problem-solving skills to analyze complex electrical network using graph theory techniques*		
	Contents: Introduction, Graph of network, Tree, Co-tree, Loop incidence matrix, Cut set matrix, Tie set matrix and Loop current matrix, Number of possible trees of a graph, Application of graph theory to circuit analysis. Principle of duality.		
	Self-Learning Topics: *KCL and KVL equilibrium equation representation of electrical network.*		
	Learning Outcomes: *A learner will be able to* 1. *Model the graphical structure of an electrical network with the use of graph theory (PI-1.1.2)* 2. *Identify tree, Co-tree, twig, link of graph using electrical engineering concept of nodes and meshes. (PI-1.4.1)* 3. *Derive the loop incidence matrix, tieset matrix and loop current matrix of the graph. (PI-2.3.1)* 4. *Derive the equilibrium equation from the graph of electrical network. (PI-2.3.1)* 5. *Apply engineering mathematics tools to solve the equilibrium equation for voltage/ current. (PI-2.4.1)*		
03.	**Switching Transients Analysis**	**8-10**	CO2 CO5
	Learning Objective/s: *To analyze the effect of energy storage elements inductor, capacitor and energy dissipating element resistor in the electrical network under transient and steady state conditions and validate the results of analysis with software tool*.		

	Contents: Transient analysis of DC and AC circuit: Solution of first and second order differential equations for series and parallel R-L, R-C, R-L-C circuits, forced and natural response, time constant, steady state and transient state response. Introduction to transient analysis in ac circuits. Laplace Transforms: Application of Laplace transform to solve RL, RC and RLC electrical network. Simulation of RL, RC & RLC electrical network with software tools for switching transient and steady state.		
	Self-Learning Topics: *Application of Fourier transform in electrical network.*		
	Learning Outcomes: *A learner will be able to* 1. *Reframe the switching conditions in electrical network into initial condition, transient and steady state condition. (PI-2.2.1)* 2. *Derive the equivalent circuit of electrical network for different stages of switching condition by fundamental laws. (PI-2.3.1)* 3. *Apply fundamental laws of KVL and KCL to formulate the differential equation and Laplace mathematical model of the equivalent network. (PI-1.4.1)* 4. *Apply advanced mathematical techniques to solve a first order and second order differential equation of voltage/current of electrical network in time domain. (PI-1.1.2)* 5. *Apply engineering mathematics and computations to solve Laplace equation model of the equivalent network. (PI-2.4.1)* 6. *Combine the initial, transient and steady state response to obtain the total response of the network. (PI-2.3.1)* 7. *Analyze the behaviour of the circuit in terms of voltage, current, time constant for different switching conditions. (PI-2.4.4)* 8. *Identify software tool to model/build an electrical network. (PI-5.1.1)* 9. *Demonstrate the electrical circuit in discipline specific software and analyse switching transients in network. (PI-5.2.2)*		
04.	**Two port parameters and network functions**	**6-8**	CO3
	Learning Objective/s: *Derive circuit parameters and network functions to analyze the two-port representation of an electrical network, which describe the concise representation of the network's behaviour.*		
	Contents: Circuit parameters: Open circuit and short circuit parameters, reciprocity and symmetry conditions. Network Functions: Network functions for one port and two port networks, driving point and transfer functions of ladder network, general network. Poles and zeros of network functions, time domain behaviour from pole - zero plot.		

	Learning Outcomes: *A learner will be able to* 1. *Apply electrical engineering concepts to derive various parameters associated with two-port networks. (PI-1.4.1)* 2. *Apply fundamental engineering concepts to derive the network functions associated with two-port network. (PI-1.3.1)* 3. *Apply engineering mathematics and computations to solve for the poles and zeros associated with the network functions. (PI-2.4.1)* *Identify location of poles and zero, from the network functions to comment on the stability of the system (PI-2.1.3)*		
05.	**Signals and Systems**	**6-8**	CO4
	Learning Objective/s: *To acquire information on fundamental classification and operations on signals and systems in the field of electrical engineering.*		
	Contents: Classification of signals: Continuous time (CT) and Discrete Time (DT) signals, periodic & aperiodic signals, even and odd. Classification of systems: Linear/ Non-Linear, time variant/invariant, causal /anti causal. Basic operations on signals: Folding, scaling and time shifting. Introduction to convolution in signals and system.		
	Self-Learning Topics: *Energy and power signals, stable and unstable system, memory and memoryless system*		
	Learning Outcomes: *A learner will be able to* 1. *Apply mathematical techniques to model the mathematical expression of various standard signals in the time domain (PI-1.1.2)* 2. *Apply fundamental engineering concepts to differentiate periodic and aperiodic signals, even and odd signals, energy and power signals (PI-1.3.1)*		
06.	**Discrete Time Signal and z-transform**	**5-7**	CO2 CO3
	Learning Objective/s: *To apply Z-Transform technique to convert discrete time signal/system from time domain into Z domain and analyze the stability characteristics with pole zero plot.*		
	Contents: Sampling theorem. Representation of discrete time signals. Z-transform of bilateral signal, Inverse Z-Transform. Stability analysis in Z plane with pole zero plot. Minimum phase, Maximum phase and Mixed phase system. Formation of difference equation, solution of difference equation using Z-transform.		
	Self-Learning Topics: *Definition of ROC, Properties of ROC, Properties of Z-transform*		

	Learning Outcomes: *A learner will be able to* 1. *Use sampling theorem to convert continuous signals into discrete signals (PI-2.1.3)* 2. *Apply electrical engineering concepts to formulate the difference equation representation of signals/system. (PI-1.4.1)* 3. *Apply engineering mathematics to solve difference equations under various initial conditions. (PI-2.4.1)* 4. *Apply mathematical techniques such as calculus to convert discrete time domain signal representation of signals into z domain representation. (PI-1.1.1)*		
	Course Conclusion The course will conclude with a mathematical modeling of an electrical system, analyze it with respect to the transient, steady state and stability behaviour emphasizing the fact that it is a foundation course in Electrical Engineering	**01**	
	Total	**45**	

Course Outcomes:

1. Apply the knowledge of fundamental network theorems, graph theory, two port network to solve a given electrical circuit.
2. Formulate a mathematical model of an electrical network through differential equations and Laplace transforms to analyse the effect of switching transients.
3. Formulate the transfer function and network parameters to analyse two port model of an electrical network.
4. Differentiate types of signals/systems, apply Z- transform technique to convert discrete time signals to z domain and analyse the stability.
5. Use IT tools to model and simulate electrical network.

Performance Indicators:

P.I. No.	**P.I. Statement**
1.1.2	Apply advanced mathematical techniques to model and solve electrical 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
2.2.1	Reframe complex problems into interconnected sub problems
2.3.1	Combine scientific principles and electrical engineering concepts to formulate model of a system that is appropriate in terms of applicability and required accuracy.
2.4.1	Apply engineering mathematics and computations to solve mathematical models.
2.4.4	Extract desired understanding and conclusions consistent with objectives and limitations of the analysis
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
5.3.1	Discuss limitations and validate tools, techniques and resources

Text Books :

1. Engineering Circuit Analysis, W H Hayt, S M Durbin, J E Kemmerly, 2013, Tata McGraw-Hill Education
2. Network Analysis, M. E. Van Valkenburg, 3rd Edition, PHI Learning
3. Digital Signal Processing, Salivahan S, Edition, Year, Publisher
4. Signals & Systems, Authors A. Nagoor Kani, 2010, Publisher McGraw-Hill Education (India) Pvt Limited
5. Networks and System, D. Roy Choudhury, 2nd Edition, New Age International.

Reference Books :

1. Network Analysis and Synthesis, F. F. Kuo, John Wiley and sons
2. Network Analysis and Synthesis, B. Somanathan Nair, Elsevier Publications
3. Digital Signal Processing, 2001, Mitra S.K, TMH Publication
4. Digital Signal Processing, Proakis & Manolakis, 1995, PHI Publication

Other Resources :

1. NPTEL/ Swayam Course: Basic Electric Circuits By Prof. Ankush Sharma, IIT Kanpur :- Web link - https://swayam.gov.in/nd1_noc19_ee36/preview
2. NPTEL Course: Basic Electrical Circuits by Prof. Nagendra Krishnapura, IIT Madras:- Web link - https://nptel.ac.in/noc/courses/noc20/SEM2/noc20-ee64/

IN-SEMESTER ASSESSMENT (75 Marks)

1. Continuous Assessment (20+25@ Marks)

Continuous Internal Assessment of Theory (20 marks)

Class test 1: 5 Marks
Class test: 2 :5 Marks
Open notes test: 5 Marks
Regularity and attentiveness: 5 Marks

Continuous Internal Assessment of Tutorial (25 marks)

Minimum ten Tutorials: 20 Marks
Each tutorial consists of 5 questions which will be shared in advance. Doubts will be cleared during the tutorial session. Solution of the selected questions is to be submitted at the end of each session.
Regularity and attentiveness: 5 Marks

2. Mid Semester Exam (30 Marks)

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

END SEMESTER EXAMINATION (50 Marks)

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

Course Type	Course Code	Course Name	Credits
PCC	EEPCC303	ELEMENTS OF POWER SYSTEM	03

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

Pre-requisite:

1. ESC102- Basic Electrical Engineering

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO7: Environment and sustainability
4. PO 9: Individual and team work
5. PO 10: Communication

Course Objectives:

1. To impart the knowledge of electrical system, various energy sources towards its sustainability
2. To familiarize with transmission line parameters and formulate them for different power system configurations
3. To introduce the representation of power system network and model it to analyse its performance.

Module	Details	Hrs.	CO
	Course Introduction Power System is the backbone of modern infrastructure. It is responsible for generation, transmission and distribution of electrical energy to residence, commercial and industrial establishments and even to agriculture. Studying this subject will give better insights how this critical infrastructure operates. As the demand for electricity continues to rise globally, ensuring energy security becomes increasingly important. The knowledge of power systems allows students to understand the challenges associated with meeting this demand and the strategies for ensuring a sustainability.	**01**	
01.	**Introduction:** ***Learning Objective/s:*** *To gain the knowledge of both conventional and alternative energy sources utilized in power production, and to compare conventional methods with renewable ones in pursuit of sustainability, as well as to familiarize oneself with the economic terms associated with power system operations.*	**6-8**	CO1 CO2

	Contents: Single line diagram of typical AC supply system, Conventional energy sources; Thermal power plant (block diagram, Rankine cycle), Hydro power plant (Schematic and types of HPP, Pumped storage power plant, Gas Turbine power plant (basic principle, types of GTP), Nuclear (Nuclear reactor, function of each component), Oil (Block diagram). Review of Non-Conventional Energy Sources: Solar PV, Wind, Fuel Cell, and Geothermal energy. Co-relation of CO_2 emission with reference to conventional power plant Economics of Power System: Connected load, maximum demand, demand factor, Average load, load factor, diversity factor, Load Curves and Selection of Generating Units ***Self-Learning Topics:*** *Societal impact of renewable energy sources.* ***Learning Outcomes:*** *A learner will be able to* 1. *To apply the knowledge of fundamental engineering to understand basic operation of various power plants. (P.I.-1.3.1)* 2. *To apply the electrical engineering concepts to understand general structure of power system network and economics of power generation. (P.I.-1.4.1)* 3. *To understand the relationship between fossil fuel consumption by conventional power plants and CO2 emissions. (P.I.-7.1.2)* 4. *Demonstrate the societal impact of renewable energy sources towards energy sustainability by presenting it as a group work. (P.I.- 9.3.1, 10.2.2)*		
02.	**Single Phase Transformer and Polyphase Circuits** ***Learning Objective/s:*** *To gain the knowledge of single-phase transformers and evaluate their performance through equivalent circuit parameters, and to grasp the concepts of three-phase networks and compute the three-phase power across various network configurations.* **Contents:** Working principle of single-phase transformer, EMF equation of a transformer, Transformer losses, Actual (practical) and ideal transformer, Phasor diagram (considering winding resistance and magnetic leakage), Equivalent circuit, Open-circuit test (no-load test), short circuit (SC) test, efficiency. Generation of Three-Phase Voltages, voltage & current relationships in Star and Delta Connections, three phase power measurement. ***Self-Learning Topics:*** *Condition for maximum efficiency and All day efficiency* ***Learning Outcomes:*** *A learner will be able to* 1. *To apply fundamental engineering concepts to understand the working principle of single phase transformer and transformer losses. (P.I.-1.3.1)* 2. *To apply the electrical engineering concepts to derive the EMF equation of transformer.(P.I.-1.4.1)* 3. *To identify the test to derive the equivalent circuit parameters of the transformer, and develop the equivalent circuit of the transformer.(P.I.-2.1.2)*	**8-10**	CO3

	4. *To identify phasor relationship for star and delta connected three phase network and calculate the power in three phase circuits.(P.I.-2.1.3)*		
03.	**Three Phase Transmission/Distribution Line and Its Components**	**6-8**	CO1 CO4
	Learning Objective/s: *To acquire the knowledge of different types transmission system and different types of overhead line insulator and apply non-uniform voltage distribution concept to analyze performance of insulator string*		
	Contents: Three Phase transmission line (Symmetrical and Unsymmetrical spacing), Single Circuit and Double Circuit transmission line, Representation of three phase distribution line. Concept of Composite conductor, bundle conductor and their application. Types of overhead line insulator, potential distribution across insulator string, string efficiency, methods for improving string efficiency.		
	Learning Outcomes: *A learner will be able to* 1. *To apply fundamental engineering concepts to identify different types of conductor and system and specify their role in transmission and distribution network. (P.I.-1.3.1)* 2. *To apply electrical engineering concepts to identify different types of overhead line insulators and their applications in power system network. (P.I.-1.4.1)* 3. *To identify the knowledge of potential distribution across the insulator string to derive the expression for string efficiency. (P.I.-2.1.3)* 4. *To identify among the different methods to apply for the string efficiency improvement. (P.I.-2.2.3)*		
04.	**Transmission / Distribution Line Parameters**	**8-10**	CO4
	Learning Objective/s: *To acquire the skill, to identify the line parameters and derive expressions for transmission line parameters for different configurations of power system network*		
	Contents: Definition of inductance, internal and external flux linkage of single conductor, inductance of single phase two wire line, inductance of three phase three wire line with symmetrical and unsymmetrical spacing, concept of GMR and GMD, inductance of three phase double circuit line, inductance of bundle conductor lines, Capacitance of transmission line, capacitance of single phase line, capacitance of three phase line with symmetrical and unsymmetrical spacing.		

	Self-Learning Topics: *Resistance of transmission line, skin effect, proximity effect* ***Learning Outcomes:*** *A learner will be able to* 1. *To apply the fundamental engineering concepts to derive magnetic flux linkage with the conductor and electrostatic potential on the charged conductor. (P.I.-1.3.1)* 2. *To apply the knowledge electrical engineering to derive the expression of inductance and capacitance for different system configurations. (P.I.-1.4.1)* 3. *To identify the knowledge of transposition of conductors in three phase unsymmetrical spacing transmission line network to derive inductance and capacitance. (P.I.-2.1.3)* 4. *To identify and apply the system of GMR and GMD, to find the inductance of multi-conductor configurations of a transmission line. (P.I.-2.1.2)*		
05.	**Representation of Power System Components** ***Learning Objective/s:*** *To gain the knowledge to calculate the PU values of each power system components and apply it to get the simplified per unit impedance diagram of complex three phase network* **Contents:** Single phase solution of balanced three phase networks, one-line diagram and impedance or reactance diagram, Per Unit (PU) system, advantage of PU system, PU impedance diagram ***Learning Outcomes:*** *A learner will be able to* 1. *To apply the concept of fundamental engineering to convert complex three phase network into simple single line diagram. (P.I.-1.3.1)* 2. *To apply the concept of electrical engineering to derive the per unit equivalent circuit of a transformer. (P.I.-1.4.1)* 3. *To identify the parameters of complex three phase network to calculate its equivalent per unit value on the base values. (P.I.-2.1.2)* 4. *To reframe complex three phase network into its equivalent per unit impedance diagram. (P.I.-2.2.1)*	**3-5**	CO5
06.	**Transmission / Distribution Line Parameters** ***Learning Objective/s:*** *To acquire the knowledge of modelling of transmission line concept to determine performance parameters of transmission line* **Contents:** Classification and modelling of short, medium and long lines, regulation and efficiency of short and medium transmission lines, evaluation and estimation of generalized circuit constant (ABCD) for short and medium lines. ***Self-Learning Topics:*** *Ferranti effect*	**6-8**	CO6

	Learning Outcomes: *A learner will be able to* 1. *To apply the concept of electromagnetic wave propagation over a transmission line to model it into as short, medium and long transmission line. (P.I.-2.3.1)* 2. *To apply the knowledge of electrical engineering to solve short, medium and long transmission line models. (P.I.-2.4.1)* 3. *To identify the phasor relationship between the equivalent electrical parameters of short, medium transmission line to develop its phasor diagram. (P.I.-2.1.3)*		
	Course Conclusion The conclusion of an Elements of Power System course would typically emphasize the foundational understanding gained in various aspects of power systems, including generation, transmission, and distribution. Additionally, it could stress the importance of sustainable and efficient energy generation to meet growing demands while minimizing environmental impact. It also could stress the significance of applying this knowledge to solve practical problems and design efficient and reliable power systems. Ultimately, the conclusion might encourage students to continue exploring advanced topics in power engineering and to contribute to the development of sustainable and resilient energy infrastructure.	**01**	
	Total	**45**	

Course Outcomes :

1. To apply knowledge of electrical engineering to summarize the general structure of power system network and to calculate different terms related to economics of power system
2. To compare the societal impact of renewable sources with conventional energy sources towards sustainability and present it as group work
3. To analyze the performance of transformer and calculate the three phase power measurement
4. To analyze string efficiency of insulator string, identify different transmission line parameter and derive the expression for those parameters
5. To apply per unit system representation of complex three phase network and model it as equivalent per unit impedance diagram
6. To determine the performance parameters of transmission line using modelling techniques

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, electrical engineering and other relevant 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 problem, including forming justified approximations and assumptions
2.3.1	Combine scientific principles and engineering concepts to formulate model/s (Mathematical or otherwise) of a system or process that is appropriate in terms of applicability and required accuracy.

2.4.1	Apply engineering mathematics and computations to solve mathematical models.
7.1.2	Understand the relationship between the technical, socio-economic and environmental dimensions of sustainability
9.3.1	Present results as a team, with smooth integration of contributions from all individual efforts
10.2.2	Deliver effective oral presentations to technical and non-technical audiences

Text Books :

1. "Power System Analysis", Grainger, J. J., Stevenson, W. D. (2016), McGraw-Hill.
2. "Modern Power System Analysis", J. Nagrath, D. P. Kothari, 3rd Edition, 2003, Tata McGraw Hill Publishing Co. Ltd.
3. "Power System Analysis", Saadat Hadi, 2010, TMH Publication.
4. "Electric Machinery", Bimbhra P. S., 2003, Khanna Publisher
5. "Power Plant Engineering", Fredrick T Morse, East-West Press Pvt Ltd

Reference Books:

1. "Elements of Power System Analysis", W. D. Stevenson, 4 Edition, TMH Publication
2. "Electrical Power Systems", Wadhwa C. L., Sixth Edition, New Age International
3. "Electrical Machines", Nagrath and Kothari, Fifth Edition, TMH Publication

Other Resources:

1	NPTEL Course: Power System Engineering By Prof. Debapriya Das, Department of Electrical Engineering, IIT Kharagpur :-Web link- https://nptel.ac.in/courses/108105104/
2	NPTEL Course: Power System Analysis, By Prof. A.K. Sinha, Department of Electrical Engineering, IIT Kharagpur :-Web link- https://nptel.ac.in/courses/108105067/

IN-SEMESTER ASSESSMENT (50 MARKS)

1. Continuous Assessment (20 Marks)

Suggested breakup of distribution

Numerical Assignment/s (min. 20 problems) covering the entire syllabus: 05 Marks
Class test based on above numerical assignment: 05 Marks
Seminar on societal impact of renewable sources: 05 Marks
Regularity and active participation in class: 05 Marks

2. Mid Semester Exam (30 Marks)

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

END SEMESTER EXAMINATION (50 MARKS)

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

Course Type	Course Code	Course Name	Credits
PCC	EEPCC304	RENEWABLE SOURCES AND ENERGY STORAGE	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. EEPCC- Basic Electrical Engineering

Program Outcomes addressed :

1. PO 2: Problem analysis
2. PO 3: Design/Development of Solutions
3. PO 7: Environment and sustainability

Course Objectives :

1. To review Conventional and Non-conventional energy sources.
2. To give the students basic knowledge of solar and wind energy system
3. To give the students basic knowledge about other renewable energy sources.
4. To explore the various energy storage technologies and their major applications
5. To increase awareness of ES suitability and capacity calculation for given application

Module	Details	Hrs	CO
	Course Introduction In our rapidly evolving world, the quest for sustainable energy solutions has become more critical. Renewable energy sources are available in abundance to fuel our planet's future. However, unlocking the full potential of renewable energy requires overcoming challenges such as intermittency and variability. This is where energy storage technologies step in, providing the means to capture and store renewable energy. Together, renewable energy and energy storage is a path towards greener, more resilient energy future.	**01**	
01.	**Global & Indian Energy Sources: Production, Reserves, & Alternatives**	**2-4**	CO1
	Learning Objective/s: *To compare and contrast India's energy production and reserves with global trends, highlighting regional variations, energy security concerns, and implications for national energy policies and strategies.*		
	Contents: World's and India's production and reserves of commercial energy sources, energy alternatives, review of conventional and non-conventional energy sources. Statistic of net potential and current generation status of different energy alternatives		

	Self-Learning Topics: *Overview of Global and Indian Energy Landscape: Understand the current energy consumption patterns, sources, and trends both globally and within India.* *Commercial Energy Sources: Study conventional energy sources such as coal, oil, natural gas, and nuclear energy,* ***Learning Outcomes :*** *A learner will be able to* 1. *Identify the key factors influencing the production and distribution of commercial energy sources worldwide, including geological, geopolitical, economic, and technological factors. (PI 2.2.1)* 2. *Evaluate the advantages, limitations, and environmental implications of conventional and non-conventional energy sources through a critical review. (PI 2.2.2)*		
02.	**Solar & Wind Energy Technology** ***Learning Objective/s:*** *To identify the process of power generation through solar thermal, solar photovoltaic (PV), and wind energy system.* **Contents:** Solar Thermal applications -Review of solar thermal applications, solar thermal conversion devices and storage applications. Solar Photovoltaic- Solar cell, Solar PV modules, MPPT algorithms, types of PV systems: standalone, grid connected systems; BOS of PV system, Battery charge controllers, Power Conditioning Unit, Solar PV Micro-inverters & Solar Plant design Wind Energy Technology: Review of wind energy system and its components, types of wind turbines, characteristics, Power generation and control in wind energy systems, MPPT algorithm, performance calculations of wind energy systems. ***Learning Outcomes :*** *A learner will be able to* 1. *Identify the process of power generation through solar thermal energy, solar photovoltaic and wind energy system. (PI 2.3.1)* 2. *Investigate Maximum Power Point Tracking (MPPT) algorithms employed in solar photovoltaic and wind turbines to maximize power output under varying wind speeds and directions. (PI 2.2.3)* 3. *Synthesize the latest advancements in solar cell technology and their impact on enhancing efficiency, durability, and cost-effectiveness for efficient utilization of solar energy. (PI 3.1.3)* 4. *Design methodology of standalone PV system and grid connected system. (PI 3.1.6)*	**7-9**	CO2
03.	**Other Non-Conventional Energy Sources: Features And Applications** ***Learning Objective/s:*** *To identify the process of power generation other non-conventional resources along with its features and application.* **Contents:** Review of other nonconventional sources, their features and applications; Biomass, Tidal, Ocean Thermal Electric Conversion, geothermal, and Micro-hydro.	**5-7**	CO3

	Learning Outcomes: *A learner will be able to* 1. *Identify the process of power generation through biomass, tidal, ocean thermal electric conversion, geothermal, and micro-hydro system. (PI 2.3.1)* 2. *Identify emerging technologies and innovations in energy generation biomass, tidal, ocean thermal electric conversion, geothermal, and micro-hydro system (PI 2.2.3)*		
04.	**Energy Storage Systems**	**6-8**	CO4
	Learning Objective/s: *To identify the significance of energy storage for future sustainability and investigate its potential to alter the energy sector.*		
	Contents: Storage Needs, Variations in Energy Demand, Interruptions in Energy Supply, Demand for Portable Energy, Environmental and sustainability issues, Necessity of energy storage, different types of energy storage.		
	Self-Learning Topics: *Working principle of different energy storage systems* ***Learning Outcomes :*** *A learner will be able to* 1. *Identify driving innovation in energy storage technologies that have the potential to revolutionize the way energy is stored. (PI 2.2.3)* 2. *Compare different types of energy storage devices and their importance in power and transportation sectors. (PI 2.2.4)* 3. *Analyze the concept of sustainability in the context of energy storage systems. (PI 7.1.1)* 4. *Evaluate factors influencing fluctuations in energy demand strategies to mitigate environmental impacts and promote sustainable energy practices. (PI 7.1.2)*		
05.	**Design, Sizing and Applications of Energy Storage**	**7-9**	CO5
	Learning Objective/s: *To analyze design considerations for sizing energy storage systems across diverse applications*		
	Contents: Design considerations for sizing of different types of energy storage systems for various applications, case studies, Battery sizing for stand-alone applications, Small scale application- Portable storage systems. E-mobility storage applications- Electric vehicle: V2X, G2V and V2G modes of operation. Hybrid Energy storage systems: configurations and applications, Charging methodologies.		
	Self-Learning Topics: *State of the art technology in energy storage*		

	Learning Outcomes: *A learner will be able to* 1. *Analyze case studies to gain insights into the practical implementation of energy storage systems in diverse applications. (PI 2.3.1)* 2. *Identify storage applications in e-mobility, including electric vehicles (EVs), and Vehicle-to-Everything (V2X) paradigm along with their implications for energy management and grid integration. (PI 2.3.2)* 3. *Determine specific requirements and constraints for sizing energy storage systems across diverse applications, integrating considerations such as power demand, energy usage patterns, and environmental conditions. (PI 7.2.1)* 4. *Evaluate the role of energy storage in supporting the transition towards sustainable transportation and energy systems. (PI 7.2.2)*		
06.	**Economic and Policy Considerations** ***Learning Objective/s:*** *To identify energy conversion calculations, energy auditing principles, and methods to improve energy efficiency.* **Contents:** Calculations related to energy conversion and energy auditing, and outline their underlying principles, outline the economic and environmental benefits of energy efficiency, current methods employed to improve energy efficiency in all areas of the energy supply sector, principles of distributed generation systems in relationship efficiency and renewable energy systems. ***Self-Learning Topics:*** *Standards related to energy audit ISO 50002:2014* ***Learning Outcomes :*** *A learner will be able to* 1. *Identify the economic and environmental benefits of energy efficiency measures. (PI 2.2.2)* 2. *Identify methods employed to improve energy efficiency across all areas of the energy supply sector, including generation, transmission, distribution, and end-use applications. (PI 2.2.3)* 3. *Identify the principles of distributed generation systems and their relationship with energy efficiency. (PI 3.1.3)* 4. *Apply knowledge of energy conversion calculations, energy auditing techniques, and distributed generation principles to real-world scenarios for effective implementation of energy efficiency measures. (PI 3.1.6)*	**10-12**	CO2 CO3
	Course Conclusion In conclusion, renewable energy and energy storage stand at the forefront of the sustainable energy revolution. By harnessing the power of renewable resources and leveraging innovative energy storage technologies, we have the potential to transition towards a cleaner, more resilient energy future. However, realizing this vision requires collaborative efforts from policymakers, industry stakeholders, and the broader community to invest in research, development, and widespread adoption of renewable energy and energy storage solutions.	**01**	
	Total	**45**	

Course Outcomes :

1. Identify and analyze the opportunities and constraints for reliable, economical, and sustainable energy.
2. Identify and analyze the process of collection, storage & utilization of solar thermal, solar PV and wind energy power systems.
3. Summarize different features, types and current state-of-the-art for other non-conventional sources of energy in India.
4. Identify the importance of energy storage systems in power systems and other application domains.
5. Identify and analyze the design methodology to determine capacity of energy storage system for various application.
6. Analysis of energy consumption patterns, identifying areas of inefficiency and proposing recommendations for energy conservation and optimization.

Performance Indicators:

P.I. No.	P.I. Statement
2.2.1	Reframe complex problems into interconnected sub problems
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.
2.3.1	Combine scientific principles and engineering concepts to formulate model/s (mathematical or otherwise) of a system or process that is appropriate in terms of applicability and required accuracy.
2.3.2	Identify assumptions (mathematical and physical) necessary to allow modeling of a system at the level of accuracy required.
3.1.3	Synthesize engineering requirements from a review of the state-of-the-art
3.1.6	Determine design objectives, functional requirements and arrive at specifications
7.1.1	Identify risks/impacts in the life-cycle of an engineering product or activity
7.1.2	Understand the relationship between the technical, socio-economic and environmental dimensions of sustainability
7.2.1	Describe management techniques for sustainable development
7.2.2	Apply principles of preventive engineering and sustainable development to an engineering activity or product relevant to the discipline

Text Books :

1. Weber, Edward P. (Summer 2008). "Review of Alternative Energy: Political, Economic, and Social Feasibility". Washington State Magazine. Retrieved 2008-11-11.
2. Robert Huggins, Fundamentals, Materials and Applications Second Edition, Springer, 2016.
3. Dincer I., and Rosen M. A. (2011); Thermal Energy Storage: Systems and Applications, Wiley.
4. Ahmed Faheem Zobaa, Energy storage – Technologies and Applications, InTech Publication 2013.
5. K.T. Chau, Energy Systems for Electric and Hybrid Vehicles, IET, UK, 2016.

Reference Books :

1. Green M.A "Solar Cells": Operating Principles, technology and System Applications, Prentice Hall Inc, Englewood Cliffs N.J, U.S.A, 1982.
2. Chetan Singh Solanki, Solar Photo Voltaics , PHI Learning Pvt Ltd., New Delhi,2009 Hashem Nehrir and Caisheng Wang, Modeling and control of fuel cells: Distributed Generation Applications, IEEE Press, 2009.
3. S. Chakraborty, M. G. Simões and W. E. Kramer, Power Electronics for Renewable and Distributed Energy System, Springer 2013.
4. N. Femia, G. Petrone, G. Spagnuolo and M. Vitelli, Power Electronics and Control Techniques for Maximum Energy Harvesting in Photovoltaic Systems, CRC Press, 2013.
5. J.F. Manwell and J.G. McGowan, Wind Energy Explained, theory design and applications, Wiley publication
6. Leo J.M.J. Blomen and Michael N. Mugerwa, "Fuel Cell System", New York, Plenum Press, 1993.
7. Felix A. Farret and M. Godoy Simoes, Integration of Alternative Sources of Energy, 2006, John Wiley and Sons
8. M. Ehsani, Y. Gao, and Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, Second Edition, CRC Press.

Other Resources :

1. NPTEL Course: Renewable Energy Engineering by Prof. Vaibhav Vasant Goud, Prof. R. Anandalakshmi, IIT Guwahati :-Web link- https://nptel.ac.in/courses/103103206
2. NPTEL Course: Non-Conventional Energy Systems by Prof. L. Umanand, IISc-Bangalore :-Web link- https://nptel.ac.in/courses/108108078

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
   Think-pair-share worksheets/ Mind mapping/Flip classroom: 05 marks
   Regularity & 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% to 30% weightage, and the syllabus covered from MSE to ESE carrying 70% to 80% weightage.

Course Type	Course Code	Course Name	Credits
MDM	EEMDM301	ELECTRONIC COMPONENTS AND CIRCUITS	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. ESC204- Basic Electronics Engineering

Program Outcomes addressed :

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO3: Design/Development of Solutions
4. PO5: Modern Tool Usage
5. PO9: Individual and Teamwork

Course Objectives:

1. To impart knowledge on the working of analog and digital circuits to explore their applications in electronic circuits.
2. To design and analyse combinational and sequential digital circuits to implement digital systems.
3. To select appropriate engineering tool to simulate digital circuits as a group activity and present the results.

Module	Details	Hrs	CO
	Course Introduction This course provides the students with a comprehensive understanding of electronic circuits focusing on both analog and digital components. Electronic systems play a pivotal role in enhancing the efficiency, stability, and reliability of electrical power systems through the deployment of advanced control and monitoring technologies. This includes applications like smart grid systems, FACTS (Flexible AC Transmission Systems), HVDC (High-Voltage Direct Current) transmission, Digital control systems and protective relay systems. Electronics is also crucial in the development of precision instruments and measurement systems.	**01**	
01.	**Bipolar Junction Transistor and Field Effect Transistor**	**7-9**	CO1 CO2 CO3
	Learning Objective/s: *To apply the knowledge of electronics engineering fundamentals to model and analyze the performance of BJT and MOSFET amplifiers.*		
	Contents:		

	Bipolar Junction Transistor: Review of BJT Characteristics and DC Biasing, BJT as a switch, Common Emitter amplifier, Frequency Response, Amplifier gain calculation using h parameter model, Thermal Runaway, Applications. Field Effect Transistors: MOSFET construction, working and characteristics. MOSFET as a switch and amplifier, DC Biasing. ***Self-Learning Topics:*** *Applications of MOSFET amplifiers.* ***Learning Outcomes :*** *A learner will be able to* 1. *Apply the knowledge of transistor fundamentals to plot the V-I characteristics of BJT and MOSFET and identify the different regions of operation. (P.I.-1.4.1)* 2. *Use the core principles of engineering to understand the working of semiconductor devices. (P.I.-1.3.1)* 3. *Extract the knowledge of different operating regions to analyze the working and application of BJT and MOSFET amplifiers. (P.I.-2.4.4)* 4. *Use the modelling approach in BJT amplifiers to draw the h-parameter model and derive the expression of voltage gain. (P.I.-2.3.1)*		
02.	**Operational Amplifier** ***Learning Objective/s:*** *Use the knowledge of op-amp configurations to analyze the linear and non-linear applications.* **Contents:** Introduction, Properties of ideal and practical Op-amp, Gain, CMRR and Slew rate, Frequency Response. Open loop and Closed loop Configurations - Concept of virtual ground. Idealized Analysis of Inverting and Non-inverting amplifier, Adder, Subtractor (Numerical on the same), Schmitt trigger, Comparators, filters, Integrators. ***Self-Learning Topics:*** *Op-amp as instrumentation amplifier.* ***Learning Outcomes:*** *A learner will be able to* 1. *Use the basic knowledge of differential amplifiers in identifying the block diagram and parameters of operational amplifier. (P.I.-1.4.1)* 2. *Use the basic knowledge of semiconductor devices in identifying the different configurations of differential amplifiers. (P.I.-1.3.1)* 3. *Use the knowledge of op-amp fundamentals to formulate appropriate solution methods for analyzing open-loop and closed-loop configurations. (P.I.-2.2.3)* 4. *Extract the knowledge of op-amp configurations to analyze various linear and non-linear applications.(P.I.-2.4.4)*	**7-9**	CO1 CO3
03.	**Combinational Digital Circuits** ***Learning Objective/s:*** *1) Use the knowledge of logic gates to design and analyze combinational digital circuits for different applications.* *2) To select the appropriate software tool to design combinational circuit for real life applications. (Group Activity)*	**7-9**	CO1 CO3 CO4 CO5

	Contents: Combinational Digital Circuits: Review of logic gates, K-map representation, Simplification of logic functions using K-map, Design of combinational circuits: Half Adder, Full Adder, Encoders, Decoders, Multiplexers, Implementation in Open source Software. ***Self-Learning Topics:*** *Design of de-multiplexer circuit.* ***Learning Outcomes :*** *A learner will be able to* 1. *Apply the knowledge of digital electronics fundamentals to simplify logic functions. (P.I.-1.4.1)* 2. *Use the basic knowledge of semiconductor devices like transistors/diodes to recall the construction of logic gates. (P.I.-1.3.1)* 3. *Gain skill in identifying and using tools like K-map to simplify logic functions. (P.I.-2.1.3)* 4. *Use K-map tool to simplify and analyze combinational circuits for different applications. (P.I.-2.4.4)* 5. *Apply K-map to generate multiple design solutions for combinational digital circuits. (P.I.-3.2.1)* 6. *Use the design solution obtained to develop a prototype of combinational circuit. (P.I.-3.2.2)* 7. *Identify the software tool like MultiSim for analyzing combinational circuits. (P.I.-5.1.1)* 8. *Use the software tool to simulate any combinational circuit and validate the result. (P.I.-5.1.2)* 9. *Acquire skill in forming a group and working together to realize and implement one combinational circuit for real life applications. (P.I.-9.1.2)* 10. *Implement the circuit and produce valid results by taking individual contribution from all team members. (P.I.-9.3.1)*		
04.	**Sequential Digital Circuits** ***Learning Objective/s:*** *Use the knowledge of flip-flops to design and analyze sequential digital circuits for different applications.* **Contents:** Flip-flops- SR, JK, T, D, Counters: Synchronous and Asynchronous counters, Design, Shift Registers, Applications. ***Self-Learning Topics: Design of ring counter.*** ***Learning Outcomes:*** *A learner will be able to* 1. *Apply the knowledge of digital electronics fundamentals to examine the truth table and working of flip-flops (P.I.-1.4.1)* 2. *Use the basic knowledge of semiconductor devices like transistors/diodes to recall the construction of flip-flops. (P.I.-1.3.1)* 3. *Gain skill in identifying and using tools like K-map to simplify logic functions. (P.I.-2.1.3)* 4. *Use K-map tool to simplify and analyze sequential circuits for different applications. (P.I.-2.4.4)* 5. *Apply K-map to generate multiple design solutions for sequential digital circuits. (P.I.-3.2.1)* 6. *Use the design solution obtained to develop a prototype of sequential circuit. (P.I.-3.2.2)*	**7-9**	CO1 CO3 CO4

05.	**A/D and D/A converters** ***Learning Objective/s:*** *Use the knowledge of analog and digital electronics fundamentals to examine the working and types of A/D and D/A converters.* **Contents:** Weighted resistor converter, D/A converter ICs, Sample and hold circuit, Quantization and encoding, successive approximation A/D converter, specifications of A/D converters, A/D converter ICs, Applications. ***Self-Learning Topics:*** *R-2R D/A converter* ***Learning Outcomes :*** *A learner will be able to* 1. *Use core principles of engineering to understand the importance of A/D and D/A converters in real life applications (P.I.-1.3.1)* 2. *Use the knowledge of analog and digital electronics fundamentals to identify the specifications, working and types of A/D and D/A converters. (P.I.-1.4.1)* 3. *Extract the knowledge of converters to examine the working of A/D and D/A converter ICs. (P.I.-2.1.3)* 4. *Use the knowledge of these converters to analyze and select the appropriate one for various applications. (P.I.-2.4.4)*	**5-7**	CO1 CO3
06.	**Specialized IC Applications** ***Learning Objective/s:*** *To analyze the working and application of voltage regulator and 555 timer ICs.* **Contents:** Voltage Regulators: DC filters, ICs-78xx, 79xx, LM317, OPA2277, Buffer IC. IC-555: Functional block diagram, study of Astable Multivibrator, Applications. ***Self-Learning Topics:LC Filters.*** ***Learning Outcomes:*** *A learner will be able to* 1. *Use core principles of engineering to understand the importance of voltage regulator ICs in real life applications (P.I.-1.3.1)* 2. *Use the knowledge of analog electronics fundamentals to identify the working of voltage regulator and 555 timer ICs. (P.I.-1.4.1)* 3. *Extract the knowledge of these ICs to realize various applications. (P.I.-2.1.3)* 4. *Apply the knowledge of regulator and timer ICs to select the appropriate one for various applications. (P.I.-2.4.4)*	**4-6**	CO1 CO3

	Course Conclusion The course on Electronic Components and Circuits has provided a comprehensive overview of the working principles and applications of analog and digital circuits. Throughout this course, different topics such as BJT/MOSFET amplifiers, op-amps, A/D & D/A converters, Voltage regulators, 555 timer, combinational and sequential digital circuits have been dealt with. This understanding is a critical step towards being able to design new electronic circuits or use them appropriately as part of a larger engineering system. As the course is getting concluded, let us look forward with optimism to the future of electronic devices and the endless possibilities they hold for innovation and progress.	**01**	
	Total	**45**	

Course Outcomes:

1. Apply the knowledge of electronics engineering fundamentals to analyze the working and applications of analog and digital electronic circuits.
2. Identify, formulate and use the modelling approach to analyze the ac parameters of BJT amplifiers.
3. Execute appropriate solution methodology to analyse various analog and digital circuits.
4. Apply the knowledge of logic gates and flip-flops to design combinational and sequential digital circuits.
5. To identify and use appropriate engineering tools like PSpice to simulate different digital circuits and present the results as a team based activity.

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.
2.1.3	Identify the mathematical, engineering and other relevant knowledge that applies to a given problem
2.3.1	Combine scientific principles and electrical engineering concepts to formulate model of a system that is appropriate in terms of applicability and required accuracy.
2.4.4	Extract desired understanding and conclusions consistent with objectives and limitations of the analysis.
3.2.1	Apply formal idea generation tools to develop multiple engineering design solutions.
3.2.2	Build models/prototypes to develop a diverse set of design solutions.
5.1.1	Identify modern engineering tools such as computer-aided drafting, modelling and Analysis, techniques and resources for engineering activities.
5.1.2	Create/adapt/modify/extend tools and techniques to solve engineering problems.
9.1.2	Implement the norms of practice (e.g. rules, roles, charters, agendas, etc.) of effective team work, to accomplish a goal.
9.3.1	Present results as a team, with smooth integration of contributions from all individual efforts.

Text Books :

1. Electronic Devices and Circuit Theory, Robert Boylestad and Louis Nashelsky, 10th Edition, 2013, Pearson India Ltd.
2. Op-Amps and Linear Integrated Circuits, Ramakant A. Gayakwad, 4th Edition, 2015, Pearson India Ltd.
3. Integrated Electronics, Millman and Halkias, 2nd Edition, 2007, McGraw Hill
4. Modern Digital Electronics, R.P.Jain, 4th Edition, 2009, McGraw Hill

5. Digital principal and Applications, Malvino & Leach, 8th Edition, 2014, McGraw Hill Education.

Reference Books :

1. Electronic Devices and Circuits, David A Bell, 5th Edition, 2017, Oxford University Press
2. Electronic Devices, Thomas L.Floyd, 10th Edition, 2021, Pearson Education
3. Electronic Devices and Circuits, S. Salivahanan and N. Suresh Kumar, 4th Edition, 2017, McGraw Hill Education.
4. Introduction to Logic Design, Alan b. Marcovitz, 3rd Edition, 2009, McGraw Hill Education.

Other Resources :

1. NPTEL Course: Analog Electronic Circuits By Prof. Shanti Pavan , Department of Electrical Engineering, IIT Madras :-Web link- https://archive.nptel.ac.in/courses/108/106/108106188/
2. NPTEL Course: Digital Electronic Circuits By Prof. Goutam Saha, Department of Electrical Engineering, IIT Kharagpur. Web link- https://archive.nptel.ac.in/courses/108/105/108105132/

IN-SEMESTER ASSESSMENT (50 MARKS)

1. Continuous Assessment (20 Marks)

Suggested breakup of distribution

Numerical Assignment/s (min. 20 problems) covering the entire syllabus: 05 Marks

Class test based on above numerical assignment: 05 Marks

Postal Creation: 05 Marks

Regularity and active participation in class: 05 Marks

2. Mid Semester Exam (30 Marks)

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

END SEMESTER EXAMINATION (50 MARKS)

End semester examination will be based on syllabus coverage up to 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
LC	EELC301	ELECTRONICS LABORATORY	01

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

Pre-requisite :

1. ESC LC206- Basic Electronics Engineering Laboratory
2. EEMDM301 – Electronic Components and Circuits

Program Outcomes addressed :

1. PO2: Problem analysis
2. PO3: Design/Development of Solutions
3. PO4: Conduct investigations of complex problems
4. PO9: Individual and team work

Course Objectives :

1. To develop skill to select appropriate engineering tools to design and implement electronic circuits.
2. To develop skill to use/represent the collected data to analyse the performance of electronic circuits.
3. To demonstrate effective individual and team based performance in implementing electronic circuits.

Module	Details	Hrs	CO
01.	***Learning Objective/s:*** *Use various hardware tools to implement the BJT/MOSFET amplifier and analyze its performance as a team.*	**08**	CO1 CO3
	Theme for designing multiple experiments: 1. To conduct experiments on BJT/MOSFET amplifier to find gain and bandwidth by plotting the frequency response.		
	Self-Learning Topics: *Watch videos on the applications of BJT/MOSFET amplifiers.*		
	Learning Outcomes: *A learner will be able to* *1. Identify various parameters required for analyzing the performance of voltage amplifiers(P.I.-2.1.2)* *2. Use systematic techniques to implement the system and evaluate its operation as a team. (P.I.- 2.2.2, 9.2.1,.9.3.1)* *3. Use a systematic approach to gather data using the hardware tools to analyze the system's performance across various parametric variations. (P.I.- 4.3.1)* *4. Compare practical results with the theoretical one (P.I.-4.1.4)*		

02.	***Learning Objective/s:*** *To investigate the functioning of voltage regulator and 555 timer ICs and analyze its performance as a team.* **Theme for designing multiple experiments:** 2. Implement a fixed/adjustable voltage regulator circuit to get a fixed/adjustable DC with suitable AC-DC conversion stage. 3. Implement Astable /Monostable multivibrator circuits using 555 timer IC. ***Self-Learning Topics:*** *Watch videos on the applications of voltage regulator and 555 timer ICs.* ***Learning Outcomes:*** *A learner will be able to* *1. Implement the circuit as a team and use systematic procedures to gather the data using hardware tools for analyzing the performance of voltage regulator and timer ICs. (P.I.- 4.3.1, 9.2.1,.9.3.1)* *2. Identify various parameters required for analyzing the performance of regulator and timer ICs. (P.I.-2.1.2)* *3. Use the collected data to produce valid results. (P.I.- 2.2.2)* *4. Compare practical results with the theoretical one (P.I.-4.1.4)*	**08**	CO1 CO3
03.	***Learning Objective/s:*** *To investigate the functioning of op-amp 741IC and analyze its performance for linear and non-linear applications as a team.* **Theme for designing multiple experiments:** 4. Implement inverting/non-inverting amplifier, adder/Subtractor, and Schmitt trigger/comparator circuits using op-amp. ***Self-Learning Topics:*** *Watch videos on the applications of op-amp circuits.* ***Learning Outcomes:*** *A learner will be able to* *1. Implement the circuit as a team and use systematic procedures to gather the data using hardware tools for analyzing the applications of operational amplifiers. (P.I.- 4.3.1, 9.2.1,.9.3.1)* *2. Identify various parameters required for analyzing the performance of op-amps (P.I.-2.1.2)* *3. Use the collected data to evaluate its performance. (P.I.- 2.2.2)* *4. Compare the practical results with the theoretical results ((P.I.- 4.1.4)*	**08**	CO1 CO3
04.	***Learning Objective/s:*** *Use appropriate hardware tools to design and investigate the performance of combinational and sequential digital circuits as a team.* **Theme for designing multiple experiments:** 5. Design and implement Adder/ Subtractor /decoder/ demultiplexer /mod N counters using gates and flip-flops. ***Self-Learning Topics:*** *Watch videos on the applications of combinational circuits and sequential digital circuits.* ***Learning Outcomes:*** *A learner will be able to* *1. Implement the digital circuit as a team and use systematic procedures to gather the data using hardware tools for analyzing the performance. (P.I.-4.3.1, 9.2.1,.9.3.1)* *2. Identify various parameters required for analyzing the performance of op-amps. (P.I.-2.1.2)*	**06**	CO1 CO2 CO3

	3. *Use the collected data to evaluate its performance. (P.I.- 2.2.2)* 4. *Apply the K-map tool to simplify to design combinational and sequential circuit for various applications. (P.I.-3.2.1)* 5. *Develop the combinational circuit using the simplified result (P.I.-3.2.2)* 6. *Compare the practical results with the theoretical results ((P.I.- 4.1.4)*		
	Minimum 02 experiments from each module, and total at least 10 experiments	**30**	

Course Outcomes :

1. Use appropriate hardware tools and techniques to conduct experiments and collect data to analyse the performance of analog and digital circuits.
2. Apply the knowledge of logic gates and flip-flops to design combinational and sequential logic circuits.
3. To gain skill in demonstrating the performance as a team with individual contribution from all team members.

Performance Indicators:

P.I. No.	P.I. Statement
2.1.2	Identify engineering systems, variables, and parameters to solve the problems.
2.2.2	Identify, assemble and evaluate information and resources.
4.1.4	Establish a relationship between measured data and underlying physical principles.
4.3.1	Use appropriate procedures, tools and techniques to conduct experiments and collect data.
3.2.1	Apply formal idea generation tools to develop multiple engineering design solutions.
3.2.2	Build models/prototypes to develop a diverse set of design solutions.
9.2.1	Demonstrate effective communication, problem solving, conflict resolution and leadership skills
9.3.1	Present results as a team, with smooth integration of contributions from all individual efforts

Text Books :

1. Electronic Devices and Circuit Theory, Robert Boylestad and Louis Nashelsky, 10th Edition, 2013, Pearson India Ltd.
2. Op-Amps and Linear Integrated Circuits, Ramakant A. Gayakwad, 4th Edition, 2015, Pearson India Ltd.
3. Integrated Electronics, Millman and Halkias, 2nd Edition, 2007, McGraw Hill
4. Modern Digital Electronics, R.P.Jain, 4th Edition, 2009, McGraw Hill
5. Digital principal and Applications, Malvino & Leach, 8th Edition, 2014, McGraw Hill Education.

Reference Books :

1. Electronic Devices and Circuits, David A Bell, 5th Edition, 2017, Oxford University Press
2. Electronic Devices, Thomas L.Floyd, 10th Edition, 2021, Pearson Education
3. Electronic Devices and Circuits, S. Salivahanan and N. Suresh Kumar, 4th Edition, 2017, McGraw Hill Education.
4. Introduction to Logic Design, Alan b. Marcovitz, 3rd Edition, 2009, McGraw Hill Education.

Other Resources :

1. NPTEL Course: Analog Electronic Circuits By Prof. Shanti Pavan , Department of Electrical Engineering, IIT Madras :-Web link- https://archive.nptel.ac.in/courses/108/106/108106188/

2. NPTEL Course: Digital Electronic Circuits By Prof. Goutam Saha, Department of Electrical Engineering, IIT Kharagpur. Web link- https://archive.nptel.ac.in/courses/108/105/108105132/

CONTINUOUS ASSESSMENT (25 Marks)

Suggested breakup of distribution

- Lab Experiments: 10 Marks
- Internal Assessment (10 marks)
  Evaluating proficiency in the field by assessing the candidate's capability to execute connections or circuits, conduct experiments, accurately record test data, and derive meaningful conclusions through data analysis during regular laboratory session.
- Observation & Active Participation: 5 marks

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

Practical and Oral Examination:

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

- Students will be randomly allocated an experiment from the list of laboratory exercises and will be asked to draw circuit diagram, observation table with relevant formula. It will be checked by the examiners and evaluated out of 05 Marks.
- Then the student will be allowed to start with the performance of the experiment.
- Students will be given 1 hour to complete the circuit connections and take readings. The connections and output are verified by the examiners. The weightage is 05 Marks
- 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.
- Students will then be appearing for Oral in front of both Internal and External examiners. The weightage of Oral will be of 10 Marks.

Course Type	Course Code	Course Name	Credits
PCC-LC	EELC302	ELECTRICAL SYSTEM LABORATORY	01

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

Pre-requisite:

1. ESC102-Basic Electrical Engineering

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO4: Conduct investigations of complex problems
4. PO5: Modern tool usage
5. PO9: Individual and team work

Course Objectives: To impart knowledge on

1. The choice of suitable tests to obtain performance curves of transformers, DC machines, and transmission lines.
2. Conduction of experiments on transformers, DC machines, and transmission lines to draw valid conclusions about the performance curves.
3. Derivation of steady state mathematical models of transformers and transmission lines based on the test data, and forecasting the performance curves.
4. Selection and usage of relevant hardware and software tools to analyse simple power system networks effectively.

Module	Details	Hrs.	CO
	Course Introduction This is a laboratory course covering the fundamentals of single phase transformers, DC motors, and transmission lines which will play a vital role in the education of electrical engineering students by providing hands-on experience, reinforcing theoretical concepts, developing practical skills, and fostering teamwork with an introduction to safety awareness when working with high voltage equipment.		
01.	**Single Phase Transformer**	**10**	**CO1** **CO2** **CO3**
	Learning Objective: *To develop skill in obtaining and analyzing the performance curves of a given single-phase transformer by conducting suitable tests.*		
	Content: Construction and operational principle of single-phase transformer, open-circuit (OC) and short-circuit (SC) tests, Sumpner's (back to back) test, equivalent circuit, parallel operation, and performance analysis of transformers		

	Theme for designing multiple experiments: 1. Analyze various parts of transformers and comprehend the operational principle. 2. Derive the steady-state equivalent circuit and predict the performance curves of single-phase transformers through relevant tests. **3.** Assess performance curves through direct load test on both isolated and parallel-connected single-phase transformers.		
	Self-Learning Topics: *Watch videos on constructional details and operational principle of single /three phase transformers to get valuable insight into their design and functionality.*		
	Learning Outcomes: *A learner will be able to* *1. As a team, analyze the importance of the different elements in the magnetic, electric, and thermal circuits of a transformer, by applying the fundamental principles of energy transfer (1.3.1, 9.2.2).* *2. Select suitable meters and perform open circuit (OC) and short circuit (SC) tests on single phase transformer (4.1.3).* *3. Develop the steady-state mathematical model of single phase transformers, outlining the underlying assumptions (2.3.1).* *4. Predetermine, plot and analyze the performance curves obtained from the OC & SC test data of transformer (4.3.3).* *5. Perform Sumpner's test on single-phase transformers taking care of safety aspects, then compare it with OC and SC tests to assess their applicability in various situations. (2.2.4, 6.1.1).* *6. Conduct load test on single phase transformer, analyze and interpret the results obtained and correlate them with theoretical principles) (4.1.4).* *7. Conduct polarity test to ensure safe connection when paralleling two transformers, highlighting its necessity for the proper functioning (1.4.1, 6.1.1).* ***8.** As a team, establish parallel connection between two single-phase transformers, ensuring all necessary conditions are met, and then individually analyze the power distribution between them (2.4.4, 9.2.1).*		
02.	**DC Motors**	**10**	**CO1** **CO3**
	Learning Objective: *To develop skill in analyzing the performance and speed control methods of a given DC motor by conducting suitable tests.*		
	Content: Electromechanical Energy Conversion, Principle, Energy stored in magnetic field, Field and co energy, Force and torque equations, Torque in singly and doubly excited systems. Construction of DC machine, Commutator and brushes, Back EMF, Torque equations, Types of DC machines, Armature reaction, Characteristics (Speed-Torque & Performance) of DC motors. Necessity of starter/soft starting, Speed control and braking methods, Swinburne's test.		

	Theme for designing multiple experiments: 5. Analyze various parts of DC motors and comprehend the operational principle. 6. Analyze the performance characteristics of DC motor by conducting direct and indirect tests. 7. Conduct various speed control methods and electrical braking methods of DC motors.		
	Self-Learning Topics: *Watch videos on constructional details and operational principle of DC motors to get valuable insight into their functionality.*		
	Learning Outcomes: *A learner will be able to* *1. As a team, identify the key components of DC machines and clarify the roles of each part. (1.3.1, 9.2.2).* *2. Ensure safety precautions, then demonstrate the conversion of electrical energy into linear mechanical motion using a basic electromechanical system (1.4.1, 6.1.1).* *3. Predetermine and plot the efficiency curve of a DC shunt/compound motor by conducting suitable test and compare the results with that of direct load test (2.2.3, 4.3.3).* *4. As a team, conduct load tests on different types of DC motors to gather their performance data and assess their suitability for diverse applications (2.2.3, 9.2.1).* *5. Use armature and field control to adjust the speed of a DC motor, analyze their speed ranges, and ensure safety precautions are followed. (2.4.4, 6.1.1).* ***6.** Test different electrical braking methods on a DC motor, assess the stopping time for each approach, and document safety precautions implemented throughout the testing process. (2.4.4, 6.1.1).*		
03.	**Transmission Lines**	**10**	**CO1** **CO2** **CO3** **CO4**
	Learning Objectives: *To analyze simple power system networks using hardware/software tools.*		
	Content: Classification and modelling of short, medium and long lines, regulation and efficiency of short and medium lines, Ferranti effect, estimation of generalized circuit constant (ABCD) for short and medium line, VAR compensation (only basics), Introduction to Power System Analyzer software (like ETAP, PSS Sincal).		
	Theme for designing multiple experiments: 8. Conduct suitable tests on the given transmission line model and obtain the ABCD parameters. 9. Predetermine the voltage regulation of transmission line for various power factor loads using the test data 10. Analyze the effect of basic VAR compensation on receiving end voltage profile. 11. Use power system analyzer software for simple basic power system analysis		

	Self-Learning Topics: *Watch videos on different software available for power system analysis to get valuable insight into their functionality.*		
	Learning Outcomes: *A learner will be able to* *1. Conduct tests on the given transmission line model to obtain the A, B, C, D parameters stating the assumptions made (2.3.1).* *2. Predetermine, plot and analyze the voltage regulation of transmission line for various power factor loads using the test data (4.3.3).* *3. Observe and analyze Ferranti effect in transmission line (2.2.2).* *4. Analyze the effect of basic VAR compensation on receiving end voltage profile of distribution line (2.2.3).* ***5.** Use power system analyzer software for simple basic power system analysis (5.1.1).*		
	Minimum 03 experiments from each module, and total at least 10 experiments	**30**	

Course Outcomes: Learner will be able to

1. Choose suitable tests, conduct experiments on transformers, DC machines, and transmission lines as a team, while prioritizing safety measures, and collect the necessary data to derive the performance curves.
2. Develop mathematical models for transformers and transmission lines in steady state to derive the performance curves.
3. Apply fundamental concepts of transformers, DC machines, and transmission lines to analyse the performance curves and draw valid conclusions.
4. Utilize appropriate hardware and software tools to analyse fundamental power system networks effectively.

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.
2.2.2	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.
2.3.1	Combine scientific principles and engineering concepts to formulate model/s (mathematical or otherwise) of a system or process that is appropriate in terms of applicability and required accuracy.
2.4.4	Extract desired understanding and conclusions consistent with objectives and limitations of the analysis
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.
4.3.3	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.
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
9.2.1	Demonstrate effective communication, problem-solving, conflict resolution and leadership skills.
9.2.2	Treat other team members respectfully

Text Books :

1. Electric Machinery, Bimbhra P.S., Seventh Edition, 1990, Reprint: 2018, Khanna Publisher
2. Power System Engineering, D. P. Kothari, I. J. Nagrath, Third Edition, 2019, Mc Graw Hill

Reference Books :

1. Performance and Design of Alternating Current Machines, M.G. Say, First Edition, 2002, CBS.
2. Electric Machines, Ashfaq Husain, Haroon Ashfaq, Third Edition, 2016, Dhanpat Rai and Co.
3. Electric Machinery, A.E. Fitzgerald, Kingsly, Stephen, Sixth Edition, 2002, McGraw-Hill Education
4. Elements of Power System, W. D. Stevenson, Fourth Edition, 1982, McGraw-Hill

Other Resources :

1. NPTEL Course: Electrical Machines by Prof. G. Bhuvaneshwari, Dept. of Electrical Engineering, IIT-Delhi. Weblink:- https://nptel.ac.in/courses/108/102/108102146/
2. Course: Power System Analysis by Prof. Debapriya Das, Dept. of Electrical Engineering, IIT, Kharagpur. Weblink: - https://swayam.gov.in/nd1_noc19_ee62/preview

CONTINUOUS ASSESSMENT (25 Marks)

Suggested breakup of distribution

- Practical Exercises - 10 Marks (Readiness to perform experiment (2 Marks), Performance (2 Marks), Report writing (2 Marks), Interpretation of result (2 Marks), Regularity in Submission (2 Marks))
- Internal Assessment - 10 Marks

  Evaluating proficiency in the field by assessing the candidate's capability to execute connections or circuits, conduct experiments, accurately record test data, and derive meaningful conclusions through data analysis during regular laboratory session.
- Regularity and active participation – 5 Marks

END SEMESTER EXAMINATION (25 Marks)

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

- Students will be randomly allocated an 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.
- Then the student will be allowed to start with the performance of the experiment.
- Students will be given 1 hour to complete the circuit connections and take readings. The connections and output are verified by the examiners. The weightage is 05 Marks
- 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.
- Students will then be appearing for Oral test in front of both Internal and External examiners. The weightage of Oral test will be of 10 Marks.

Course Type	Course Code	Course Name	Credits
SBL	EESBL301	PYTHON LABORATORY	02

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

Pre-requisite :

1. BSC101- Engineering Mathematics-I
2. ESC-LC103- C Programming Laboratory
3. ESC-LC205- Java Programming Lab
4. BSC204- Engineering Mathematics - II

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: Modern tool usage
6. PO9: Individual and team work

Course Objectives :

1. Tools used for Python programming and error debugging.
2. Fundamentals concepts of python operators, math functions, flow control instructions, libraries, GUI toolkits, database operations in different types of applications.
3. Fundamental concepts and applications of object oriented programming concepts using Python.
4. Representation, visualization and analysis of data using arrays and advanced Python libraries.
5. Development of GUI using Tkinter and database operations.

Module	Details	Hrs	CO
	Course Introduction This is a foundation course on Python. Python is widely used across various industries and domains due to its versatility, simplicity, and the vast ecosystem of libraries and frameworks available. Here are some real-world applications of Python: Web Development, Data Science and Machine Learning, Artificial Intelligence, Scientific Computing, Automation and Scripting, Finance and Trading, Game Development, Education, Healthcare, Internet of Things (IoT) and many more. Python's versatility allows it to be applied in almost any domain where programming is involved. Its rich ecosystem and active community ensure that it remains a top choice for developers across various industries.		
01.	**Introduction to Python**	**4**	CO1

	Learning Objective: *To acquire knowledge and skill on adaption of suitable tool, fundamental concepts of variables and identifiers, and error debugging to develop a Python program*.		CO2
	Content: History, features and applications in electrical engineering, how to run Python programs. Identifiers, reserved keywords, variables, comments in Python. Indentation, multiline statements, quotes. Input, output, and import functions, Operators in Python.		
	Theme for designing multiple experiments: 1. Download and install software tools required for writing and executing Python programs. 2. Write and execute simple Python programs to understand different operators, variables, quotes, comments, indentation, input, and output functions in Python.		
	Learning Outcomes: *A learner will be able to* *1. Apply knowledge of mathematics and write Python programs to solve simple problems. (1.1.1, 9.2.1, 9.3.1)* *2. Apply fundamental concepts of Python programming to solve engineering problems. (1.3.1,9.2.1, 9.3.1)* *3. Identify keywords, operators, and software libraries to write/ execute Python programs to solve problems. (2.1.2,9.2.1, 9.3.1)* *4. Identify the mathematical and other relevant knowledge to write/execute Python programs and apply to a given problem. (2.1.3, 9.2.1, 9.3.1)* *5. Identify tools/techniques to build a Python code for solving engineering problem. (5.1.1, 9.2.1, 9.3.1)* *6. Adapt suitable programming techniques to build a Python code for engineering problem. (5.1.2, 9.2.1, 9.3.1)*		
02.	**Data Types, Operators, Flow Control Instructions**	**12**	CO1 CO2 CO4
	Learning Objective/s: *To acquire knowledge and skill on fundamentals concepts of data types, operators, math functions, flow control instructions, and representation/analysis of data to build a Python program.*		
	Content: Data types, number formats, basic math operations, built in math functions. Data Structures: Lists, Tuples, Sets, and Dictionaries. String operations: If-else, if-elif-else, for loop, while loop, Exception handling, try-except, break-continue, functions.		
	Theme for designing multiple experiments: 3. Perform math operations using built in functions. 4. Apply flow control instructions to write/execute Python programs for a specific application. 5. Write and execute Python programs to understand operational functionalities of Lists, Tuples, Sets, and Dictionaries.		

	Learning Outcomes: *A learner will be able to* 1. *Apply fundamentals concepts of math, cmath libraries, and flow control instructions to solve engineering problems and also execute error debugging. (1.3.1, 9.2.1, 9.3.1)* 2. *Apply mathematical techniques using Python to solve engineering problems. (1.1.1,9.2.1, 9.3.1)* 3. *Identify suitable function, parameters, and flow control instructions to write/execute and debug Python programs. (2.1.2, 9.2.1, 9.3.1)* 4. *Identity relevant knowledge of flow control instructions, exception handling, and data structures applicable to a given problem. (2.1.3, 9.2.1, 9.3.1)* 5. *Represent, analyze data using formats/tools such as lists, tuples, sets, and dictionaries. (4.3.3, 9.2.1, 9.3.1)* 6. *Synthesize information from raw data using data structures such as lists, tuples, dictionaries. (4.3.4, 9.2.1, 9.3.1)* 7. *Identify different libraries and resources for building a Python code to perform mathematical computations and data analysis. (5.1.1, 9.2.1, 9.3.1)* 8. *Create/adapt mathematical tools to solve engineering problems. (5.1.2, 9.2.1, 9.3.1)*		
03.	**Object Oriented Programming using Python:** ***Learning Objective/s:*** *To acquire knowledge and skill on fundamental OOP concepts and exception handling to create engineering application using Python programming.* **Content:** Creating class and objects, self-variables, constructors, methods. Inheritance and polymorphism, encapsulation. Assertion, types of exception and exception handling in Python. **Theme for designing multiple experiments:** 6. Develop a Python code to create an application using object oriented programming concepts. ***Learning Outcomes:*** *A learner will be able to* 1. *Apply knowledge of mathematics with object oriented programming to solve problems. (1.1.1, 9.2.1, 9.3.1)* 2. *Apply fundamental object oriented programming concepts and develop software tools to solve engineering problems. (1.3.1, 9.2.1, 9.3.1)* 3. *Identify variables, parameters, and adapt suitable software tools/techniques in OOP to solve engineering problem demonstrating effective communication, conflict resolution and leadership skills. (2.1.2, 9.2.1, 9.3.1)* 4. *Identify the mathematical, engineering knowledge to develop application using OOP. (2.1.3, 9.2.1, 9.3.1)* 5. *Build a software model using OOP Python with alternate design solutions. (3.2.2, 9.2.1, 9.3.1)* 6. *Identify suitable criteria to build a software model using Python. (3.2.3, 9.2.1, 9.3.1)* 7. *Use appropriate procedures, tools and techniques to build an application using OOP Python to conduct experiments and collect data. (4.3.1, 9.2.1, 9.3.1)* 8. *Represent and analyze data to create mathematical or engineering tools to solve engineering problems in a team. (4.3.2, 9.2.1, 9.3.1)*	**12**	CO1 CO2 CO3
04.	**Data Visualization, and Analysis using Advanced Python Libraries**	**20**	CO1

	Learning Objective/s: *To acquire knowledge and skill on advanced mathematical computation, representation, visualization, and analysis of data using Matplotlib and Pandas, Numpy, and SciPy libraries of Python to develop applications for solving engineering problem.*		CO2 CO3 CO4
	Content: Visualization using Matplotlib: working with plots (line plot, bar graph, histogram, scatter plot, area plot, pie chart etc.), working with multiple figures. Data manipulation and analysis using Pandas: Introduction to Pandas, importing data into Python, series, data frames, indexing data frames, basic operations with data frame, filtering, combining and merging data frames, Removing Duplicates. Introduction to Objects and Functions of Numpy - core library for scientific computing SciPy - ecosystem of open-source software for mathematics, science, and engineering		
	Theme for designing multiple experiments: 7. Perform computations and analyze statistical data by using functionalities of advanced Python libraries such as Matplotlib, Pandas, Numpy, and SciPy.		
	Learning Outcomes: *A learner will be able to* *1. Apply fundamental knowledge of mathematical techniques along with advanced Python libraries to develop data analysis tools. (1.1.1, 9.2.1, 9.3.1)* *2. Apply fundamental concepts of advanced Python libraries to solve engineering problems. (1.3.1, 9.2.1, 9.3.1)* *3. Identify/adapt suitable tool/library to build programs to develop diverse design solution. (2.1.2, 9.2.1, 9.3.1)* *4. Identify relevant knowledge of advanced Python libraries applicable to a given problem. (2.1.3, 9.2.1, 9.3.1)* *5. Build data models using advanced Python libraries satisfying suitable criteria. (3.2.2, 9.2.1, 9.3.1)* *6. Identify suitable criteria for visualization and analysis of data for evaluation of alternate design solutions. (3.2.3, 9.2.1, 9.3.1)* *7. Use appropriate library tools to collect and analyze data for a specific engineering application. (4.3.1, 9.2.1, 9.3.1)* *8. Represent, visualize, and analyze data using Matplotlib and Pandas, Numpy, and SciPy libraries. (4.3.3, 9.2.1, 9.3.1)* *9. Identify different libraries and resources for building a Python code to perform mathematical computations and data analysis. (5.1.1, 9.2.1, 9.3.1)* *10. Create applications using Python libraries to solve Engineering problem. (5.1.2, 9.2.1, 9.3.1)*		
05.	**GUI Programming and Database Operations.** ***Learning Objective/s:*** *To acquire knowledge and skill on creating an application/simulator using GUI programming to solve engineering problem and applying database operations to modify data in a particular application.*	**12**	CO1 CO2 CO3 CO5

	Content: GUI Programming - Writing a GUI with Python: GUI Programming Toolkits, Creating GUI Widgets with Tkinter, Creating Layouts, Radio Buttons and Checkboxes, Dialog Boxes. Creating a simulator for small electrical or electronic system. Database Access - Python's Database Connectivity, Types of Databases Used with Python, MySQL database Connectivity with Python, Performing Insert, Deleting & Update operations on database **Theme for designing multiple experiments:** 8. Write and execute simple Python programs to develop GUI and perform different database operations.		
	Learning Outcomes: *1. Apply knowledge of mathematical techniques to build a Python GUI to solve mathematical problems. (1.1.1, 9.2.1, 9.3.1)* *2. Apply fundamentals of GUI programming and database operations to solve engineering problems. (1.3.1, 9.2.1, 9.3.1)* *3. Build a Tkinter GUI program to develop diverse design solutions. (3.2.2, 9.2.1, 9.3.1)* *4. Identify criteria and develop alternate design solutions for GUI development. (3.2.3, 9.2.1, 9.3.1)* *5. Identify GUI library and its resources for engineering activities. (5.1.1, 9.2.1, 9.3.1)* *6. Create an application using Tkinter for particular application. (5.1.2, 9.2.1, 9.3.1)*		
	Minimum 2 experiments from each module, and total at least 10 experiments.	**60**	

Course Outcomes:

Learner will be able to

1. Identify tools and techniques to write/execute and debug Python programs.
2. Apply fundamental concepts of python operators, math functions, flow control instructions, libraries, GUI toolkits, database operations in specific application.
3. Create an application using concepts of Object Oriented Programming and database operations in Python.
4. Represent, visualize and analyze data using arrays and advanced Python libraries such as Matplotlib, Pandas, Numpy, and SciPy.
5. Develop a GUI using Tkinter and database operations in Python for a specific application.

Performance Indicators:

P.I. No.	**P.I. Statement**
1.1.1	Apply mathematical techniques such as calculus, linear algebra, and statistics to solve problems.
1.3.1	Apply fundamental 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.
3.2.2	Build models/prototypes to develop a diverse set of design solutions.
3.2.3	Identify suitable criteria for the evaluation of alternate design solutions.

4.3.1 Use appropriate procedures, tools and techniques to conduct experiments and collect data.

4.3.2 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.

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 such as computer aided drafting, modelling and analysis; techniques and resources for engineering activities.

5.1.2 Adapt the tools and techniques to solve engineering problems.

9.2.1 Demonstrate effective communication, problem solving, conflict resolution and leadership skills.

9.3.1 Present results as a team, with smooth integration of contributions from all individual efforts.

Text Books :

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

Reference Books :

1. "Learning Python", Mark Lutz, O Reily, 4thEdition, 2009.
2. "Programming Python", Mark Lutz, O Reily, 4thEdition, 2010.
3. "Python 3 for Absolute Beginners", Tim Hall and J-P Stacey, 2009.
4. "Beginning Python: From Novice to Professional", Magnus Lie Hetland, , 2nd Edition, 2009.
5. "Core Python Programming", Wesley J. Chun, Second Edition, Pearson.
6. "Taming Python by Programming", Jeeva Jose, Khanna Publishing House.
7. Introduction to Computing and Problem Solving with Python, J. Jose, Khanna Publications.
8. "Python Programming", Seema Thareja, Pearson.

Other Resources :

1. Python 3.4.3, By Prof Kannan Moudgalya, Indian Institute of Technology Bombay, Python 3.4.3 - Course (swayam2.ac.in)
2. Python Tutorial, Website link: https://www.w3schools.com/python/default.asp

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 as a team to inculcate teamwork. 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.

- **Regularity and active participation: 05 Marks**

- **Practical Test: (20 Marks)**
  The practical test will be conducted after completion of 50% of laboratory exercises.

  - The allocation of laboratory exercises for testing programming and problem-solving skills will be randomized, with each student receiving two or more programs from the exercise list.
  - Students will have a designated 2-hour timeframe for code development. After the first hour, an internal examiner will review the progress, offering suggestions for program enhancement to evaluate programming skill. Additionally, problem-solving skill will be assessed.
  - During the practical assessment or at its conclusion, students will be queried to evaluate their conceptual understanding, ensuring comprehension.

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

For the End semester exams, practical examination will be conducted. The detail of the end-sem evaluation is as follows. It will consist of three sections.

Practical Examination (20 Marks)

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

Debugging and Output Prediction Exercise (20 Marks)

The second 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.

Oral (10 Marks)

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

Course Type	Course Code	Course Name	Credits
MP	MP301	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 : Modern Tool Usage
6. PO6 : The Engineer & Society
7. PO7 : Environment & Sustainability
8. PO8 : Ethics
9. PO9 : Individual & team work
10. PO10: Communication
11. PO11: Project Management & Finance
12. PO12: Life-long learning

Course Objectives

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

Course Outcomes

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

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

Guidelines for the Mini Project

- At the beginning of semester-III, project guides are required to conduct around 4 hours' orientation sessions including following topics:
  - Familiarizing students about infrastructure available at Department/Institute level and how to use it.

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

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

In-Semester Continuous Assessment and End-Semester Examination Guidelines

- The Head of the Departments will assign a guide to each of the mini-projects and shall form a progress monitoring committee. The guide will carry out weekly monitoring of the project's progress. The committee shall carry out in-semester project evaluation based on presentations with a minimum of two evaluations per semester.
- Assessment will be based on individual contributions, understanding, and responses to questions asked.
- Continuous Assessment marks distribution in semester III (50 marks):
    - 10 marks for the Topic Approval Presentation in front of the progress monitoring committee
    - 15 marks for the Mid-Semester Progress Presentation in front of the progress monitoring committee
    - 25 marks for the Final Report & Presentation
- Continuous Assessment marks distribution in semester IV (50 marks):

- 15 marks for the In-Semester Two Presentations
- 10 marks for the Participation in Project Competitions, TPP, etc.
- 25 marks for the Final Report & Presentation

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

Semester III:

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

Semester IV:

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

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

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

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

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

Course Type	Course Code	Course Name	Credits
HSSM	HSSM301	PRODUCT DESIGN	02

Program Outcomes addressed:

1. PO2 : Problem Analysis
2. PO3 : Design/Development of Solutions
3. PO5 : Modern Tool Usage
4. PO6 : The Engineer & Society
5. PO7 : Environment & Sustainability
6. PO8 : Ethics
7. PO11: Project Management & Finance
8. PO12: 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 and visualization 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, Wire framing 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:

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 Mike Ashby and Kara Johnson, published by Butterworth-Heinemann; 3rd edition (October 10, 2014).
3. "The Design of Everyday Things" by Don Norman, published by Basic Books; 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	EEPCC405	ENGINEERING MATHEMATICS-IV	03+01*

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

Pre-requisite :

1. BSC101- Engineering Mathematics-I
2. BSC204- Engineering Mathematics-II
3. PCC301-Engineering Mathematics-III

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	CO
	Course Introduction Engineering Mathematics IV is often a foundational course designed to provide students with the mathematical tools and concepts essential for various engineering disciplines. Engineering Mathematics IV has many applications in Electrical engineering such as • Application of in Probability in control systems, communication system and power system. • Application of in Correlation and Regression in Deep learning. • Application of numerical methods used in optimization, simulation and modeling. • Concept of complex numbers and variables provides a knowledge to solve electrical engineering problems.	**01**	
01.	**Probability Theory and Random Variable**	**6-8**	CO1
	Learning Objective/s: *To analyze random variables using the basic theory of probability and will be able to apply various mathematical techniques in determining probability functions.*		
	Contents: Conditional Probability, Bayes Theorem, Total Probability Theorem, Definition of Random Variable. Types of Random Variable: Discrete and Continuous, Probability Mass and Density Function.		

	Self-Learning Topics: *Cumulative Distribution and Density Function.*		
	Learning Outcomes: *A learner will be able to* 1. *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)* 2. *Apply mathematical techniques of integration and summation for finding Expectation, Variance, Probability density function and Probability distribution function. (P.I.-1.1.2)* 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. *Identify independents sets and disjoint sets and use its knowledge in the context of conditional probability. (P.I.-2.1.3)*		
02.	**Probability Distribution**	**6-8**	CO2
	Learning Objective/s: *To analyze and identify standard probability distribution functions and apply the knowledge of distribution for finding probabilities of various events.*		
	Contents: Measures of Central Tendency and Dispersion, Binomial distribution, Poisson Distribution ,Fitting of a Poisson Curve, Gaussian Distribution, Normal Distribution (Standard Normal distribution, Reverse problem of Normal distribution)		
	Self-Learning Topics: *Joint Probability Distribution.*		
	Learning Outcomes: *A learner will be able to* 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.	**Numerical Methods-I**	**7-9**	CO3
	Learning Objective/s: *To analyze and apply the appropriate numerical method to solve Numerical differentiation and integration problems.*		
	Contents: Introduction to Difference Formula, Newton Backward Difference Formula and Newton Forward Difference Formula, Newton Cote Formula, Stirling's Formula, Trapezoidal Rule , Simpson's 1/3rd and Simpson's 3/8th rule		
	Self-Learning Topics: *Analysis of numerical errors in differentiation and integration.*		

	Learning Outcomes: *A learner will be able to* 1. *Apply the Numerical techniques to solve definite integral problems. (P.I.-1.1.1)* 2. *Apply analytical methods to solve the numerical problems. (P.I.-1.1.3)* 3. *Identify Analytical method to determine value of definite integral and determine error. (P.I.-2.2.4)* 4. *Identify the appropriate methods of difference formula to solve interpolation. (P.I.-2.1.3)* 5. *Identify the numerical differentiation and integration methods to solve various functions and data set in engineering field. (2.2.3)*		
04.	**Numerical Methods -II**	**7-9**	CO3
	Learning Objective/s: *To analyze and apply the appropriate numerical method to solve transcendental equation and system of simultaneous equations.*		
	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 using iterative method.(P.I.-2.4.3)*		
05.	**Correlation and Regression**	**5-7**	CO4
	Learning Objective/s: *To analyze the mathematical dataset given and apply techniques of correlation and regression to identify the relationships between variables from the dataset.*		
	Contents: Correlation, Karl Pearson's coefficients of correlation(r), Spearman's Rank correlation coefficient (R): Repeated Rank, Non-repeated rank, Regression, Line of regression, Curve fitting: Linear and Second-Degree Curves.		
	Self-Learning Topics: Fitting of an exponential Curve		
	Learning Outcomes: *A learner will be able to* 1. *Apply basic mathematical techniques from algebra in finding the lines of regression and regression coefficients. (P.I.-1.1.1)* 2. *Apply Least Square Method to fit a particular to the given data (P.I.-1.1.2)* 3. *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)*		

	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)		
06.	**Complex Variables-II**	**6-8**	CO5
	Learning Objective/s: *To analyze if a given function has its harmonic conjugate and apply it for finding the Orthogonal Trajectories of a given mathematical function using the concept of Complex Variables.*		
	Contents: Milne-Thomson method: Determine analytic function f(z) when real part (u) is given, Determine analytic function f(z) when imaginary part (v) is given, Determine the analytic function when the combination of Real and Imaginary part is given, Harmonic function , and Harmonic conjugate, Orthogonal trajectories.		
	Self-Learning Topics: *Linear mapping, bilinear mapping, cross ratio, fixed points.*		
	Learning Outcomes: *A learner will be able to* 1. *To apply the mathematical techniques of calculus and algebra for determining the analytic function using Milne Thomson Formula. (P.I.-1.1.1)* 2. *To apply the fundamental concept of complex Variables to solve engineering problems. (P.I.-1.3.1)* 3. *Identify the harmonic function and determine its harmonic conjugate. (P.I.-2.1.2)* 4. *Identify the analytic functions to solve orthogonal trajectory.(P.I.-2.1.3)*		
	Course Conclusion Engineering Mathematics provides the problem solving skills necessary for electrical engineering to design, analyze and optimize system and device across a wide range of applications.	**01**	
	Total	**45**	

Course Outcomes:

1. Analyse random variables and apply the concepts of probability for getting the spread of data.
2. Analyse the mathematical problem given and apply the concepts of distribution in finding probabilities.
3. Identify and apply appropriate numerical methods to solve numerical differentiation, integration and System of equations.
4. Analyse and interpret the data using Correlation and Regression.
5. Apply the concept of complex variables to analyze the function is Harmonic or not, and also determine orthogonal trajectory.

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 engineering problems
1.1.3	Apply advanced mathematical techniques such as integral and differential equations to describe/solve/construct a mathematical model.
1.3.1	Apply fundamental engineering concepts to solve engineering problems.
2.1.1	Articulate problem statements and identify objectives

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 solution/methods to solve the problem, including forming justified approximations and assumptions.

2.2.4 Compare and contrast alternative solutions to select the best methodology

2.4.3 Identify sources of error in the solution process, and limitations of the solution.

Text Books :

1. Higher Engineering Mathematics, Dr.B.S.Grewal, Khanna Publication
2. Advanced engineering mathematics, H.K. Das, S. Chand, Publications

Reference Books :

1. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Eastern Limited,
2. Complex Variables and Applications, Brown and Churchill, McGraw-Hill Education.
3. Higher Engineering Mathematics B.V. Ramana, McGraw Hill Education
4. Laplace transforms, Murray R. Spiegel, Schaum's Outline Series

Other Resources :

1. NPTEL Course: Probability and Statistics By Dr. Somesh Kumar, Department of Mathematics, IIT Kharagpur :-Web link- https://youtu.be/VVYLpmKRfQ8?si=Gh3EtQrLSrEFZMNo
2. NPTEL Course: Complex Analysis by Prof. P. A. S. Sree Krishna, Department of Mathematics, IIT Guwahati :-Web link https://youtu.be/Mwpz1zjPlzI?si=JU090YU2-MxJOXJD

IN-SEMESTER ASSESSMENT (75 Marks)

1. **Continuous Assessment (45 Marks)**

Continuous Internal Evaluation of Theory (20 Marks)
Numerical Assignments: 5 Marks
Class test based on above numerical Assignment: 5 Marks
Team-pair- Solo: 5 Marks
Regularity and attentiveness: 5 Marks
Continuous Internal Evaluation of Tutorial (25 Marks)
Minimum six Tutorials: 20 Marks
Regularity and attentiveness: 5 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.

2. **Mid Semester Exam (30 Marks)**
Mid semester examination will be based on 40% to 50% of the syllabus

END SEMESTER EXAMINATION (50 Marks)
End semester examination will be based on the syllabus coverage up to Mid Semester Examination (MSE) carrying 20% to 30% weightage, and the syllabus covered from MSE to ESE carrying 70% to 80% weightage.

Course Type	Course Code	Course Name	Credits
PCC	EEPCC406	CONTROL SYSTEM	03

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

Pre-requisite:

1. EEPCC301- Engineering Mathematics-III
2. EEPCC302-Circuit and Signal Analysis

Program Outcomes addressed:

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

Course Objectives:

1. To impart the knowledge to differentiate real-life applications as open loop or closed loop systems and to obtain mathematical models of the systems.
2. To impart the knowledge to perform time response analysis of the model to predict the system's behaviour.
3. To introduce root locus technique and use this tool to analyse systems for transient and stability.
4. To introduce various frequency-domain techniques to analyse the systems for stability.

Module	Details	Hrs	CO
	Course Introduction History, importance of control system, analysis and design objectives, control system design process.	**01**	
01.	**Fundamentals of Control System**	**2-4**	CO 1
	Learning Objective: *To apply the fundamentals of control system to identify suitable open loop or closed loop systems for real life applications.*		
	Contents: Concept of transient, steady state and stability, classifications of control system, concept of feedback, open loop and closed loop system properties. open loop and closed loop example with electrical systems.		
	Learning Outcomes: *A learner will be able to* 1. *Apply electrical engineering concepts to identify different components of control system with its significance. (P.I.-1.3.1)* 2. *Use core principles of engineering to understand the importance of Feedback in control system. (P.I.-1.4.1)* 3. *Differentiate open loop and closed loop systems, use this knowledge to identify a suitable system for real life applications. (P.I.-2.1.2)* 4. *Identify major performance criteria for the design of control system. (P.I.-2.1.3)*		

02.	**Mathematical Modelling**	**7-9**	CO 2
	Learning Objective: *To formulate transfer function models for complex electrical systems by breaking them down into smaller components or constructing signal flow graphs using electrical and mechanical engineering concepts.*		
	Contents: Mathematical modelling of electro-mechanical systems, transfer functions, block diagrams, block diagram reductions, signal flow graph, signal flow graphs of electrical circuits, conversion of block diagram to signal flow graph, Mason's gain formula.		
	Self-Learning Topics: *Mathematical modelling of mechanical system with and without gears and its Electric Circuit Analog.*		
	Learning Outcomes: *A learner will be able to* 1. *Formulate the transfer function model for electromechanical system by applying basic concepts in mechanical/electrical engineering. (P.I.-1.3.1)* 2. *Reframe the complex systems into interconnected subsystems, construct transfer function for each subsystem, then reduce to a single transfer function model for the entire system. (P.I.-1.4.1)* 3. *Use electrical engineering concepts to construct signal flow graphs for electrical systems and then to formulate the transfer function model using Mason's rule. (P.I.-2.3.1)* 4. *Apply fundamental engineering concepts to convert transfer function to SFG.(P.I.-2.2.1)*		
03.	**Time Response Analysis**	**10-12**	CO 3
	Learning Objective: *To analyze the transient, steady state and stability behavior of the system using the time domain specifications.*		
	Contents: Poles and zeros of the transfer function and their effects on response, step response of standard first order and second order systems, time-domain specifications, effect of addition of poles and zeros, static error coefficients, concept of stability, Bounded Input Bounded Output stability, Routh stability criterion.		
	Self-Learning Topics: *Derivation of closed loop transient parameter formula for the second order under damped system with ramp input.*		
	Learning Outcomes: ***A learner will be able to*** ***1.****Identify poles and zeros of a system from its transfer function and then analyze it to determine the time response. (P.I.-2.1.2)* *2.Solve the given transfer function to determine the damping ratio, natural frequency and static error coefficients of a system and use this information to analyze the transient and steady state behavior of the system. (P.I.-2.4.1)*		

	3.Construct and interpret a basic Routh array to analyze the system for its stability. (P.I.-2.4.2)		
04.	**Root Locus Technique**	**6-8**	CO 4
	Learning Objective: *Use the root locus tool to analyze the transient response and stability of the given systems.*		
	Contents: Definition and properties of root locus, rules for plotting root locus, impact of gain on root locus, stability analysis using root locus. active and passive compensators in control system. impact of different compensators through root-locus.		
	Self-Learning Topics: *Realization of active and passive compensators*		
	Learning Outcomes: *A learner will be able to* 1. *Use engineering mathematics and computations to sketch the root locus from the given transfer function model. (P.I.-2.1.2)* 2. *Identify the coordinates of points on the root locus alongside their corresponding gains to analyze the transient behavior and stability of the system. (P.I.-2.4.1)* 3. *Analyze the effect of adding active and passive compensators in control system using root locus. (P.I.-2.4.2)*		
05.	**Frequency Response Analysis**	**7-9**	CO 5
	Learning Objective: *To analyze the given system for its stability using various techniques in frequency domain such as Bode and Nyquist plots.*		
	Contents: Bode plot, asymptotic Bode plot, determination of steady state error coefficients, stability analysis using Bode plot, mapping theorem, Nyquist plot, stability analysis using Nyquist plot.		
	Self-Learning Topics: *Relation Between Closed-Loop Transient and Closed-Loop Frequency Responses, Relation Between Closed-Loop Transient and Open-Loop Frequency Responses*		
	Learning Outcomes: *A learner will be able to* 1. *Use engineering mathematics to sketch the Bode and Nyquist plot, from the given transfer function model. (P.I.-2.1.2)* 2. *Identify the gain, phase margins and cross over frequencies from the Bode and Nyquist plot to analyze the system stability. (P.I.-2.4.1)* 3. *Determine the steady-state error coefficients by sketching Bode plot to analyze the system's steady-state error characteristics. (P.I.-2.4.2)*		
06.	**State Variable Analysis**	**5-7**	CO 2 CO 3
	Learning Objective:		

	To formulate the state variable models, identify the eigen values and use it to analyze the system behaviour		
	Contents: State variable representation of electrical systems, different state space realizations. conversion of state variable models to transfer functions, conversion of transfer functions to state variable models, significance of eigen values, stability analysis.		
	Self-Learning Topics: *Solution of state equation using Laplace transform*		
	Learning Outcomes: *A learner will be able to* 1. *Formulate the state space model for electrical system by applying linear algebra and the basic concepts in electrical engineering. (P.I.-1.1.1)* 2. *Use engineering mathematics to determine various state space representations for the given system from its transfer function model. (P.I.-1.4.1)* 3. *Identify the Eigen values from the state space model to analyze the system for its stability. (P.I.-2.1.2)*		
	Course Conclusion The course will conclude with the importance of circuit and signal analysis, for understanding electric power systems, design of electrical system, their behavior, and optimization in various applications, emphasizing the fact that it is a foundation course in Electrical Engineering.	**01**	
	Total	**45**	

Course Outcomes:

1. Apply the fundamentals of engineering to identify a suitable control system for the given application.
2. Formulate mathematical models for control system using transfer function and state space techniques.
3. Apply engineering mathematics to identify the time domain specifications of the given control system, facilitating the analysis of its stability, transient and steady-state behaviour.
4. Analyse the transient behaviour and stability of the system for change in parameters using root locus.
5. Identify the steady state error and stability parameters from the Bode plot to analyse the system behaviour.

Performance Indicators:

P.I. No.	P.I. Statement
1.1.1	Apply mathematical techniques such as calculus, linear algebra, and statistics to solve problems
1.3.1	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

2.2.1 Reframe complex problems into interconnected sub problems

2.3.1 Combine scientific principles and electrical engineering concepts to formulate model of a system that is appropriate in terms of applicability and required accuracy.

2.4.1 Apply engineering mathematics and computations to solve mathematical models.

2.4.2 Produce and validate results through skilful use of contemporary engineering tools and models

Text Books:

1. Control Systems Engineering, Norman S. Nise, Seventh Edition, 2015, John Wiley & Sons
2. Control Systems Engineering, I. J. Nagrath. M. Gopal, Seventh Edition, 2021, New Age International Publisher
3. Modern Control System Engineering, K. Ogata, Fifth Edition, 2010, Prentice Hall.
4. Modern Control Systems, Richard C Dorf, Robert H Bishop, Twelfth edition, 2021, Pearson.
5. Feedback control of Dynamic System, G.F. Franklin, Eighth Edition, 2021, Pearson higher education

Reference Books:

1. Control System Engineering, Shivanagraju S. Devi L., 2010, New Age International
2. Control Systems Technology, Curtis Johnson, Heidar Malki, 2002, Pearson
3. Control Systems Engineering, S. K. Bhattacharya,Second Edition, 2015, Pearson.
4. Control Systems, Theory and applications, Smarajit Ghosh, 2013, Pearson

Other Resources:

1. NPTEL Course: Control Engineering By Prof. S.D. Agashe, Department of Electrical Engineering, IIT Bombay :-Web link- https://nptel.ac.in/courses/108/101/108101037/
2. NPTEL Course: Control Engineering By Prof. Ramkrishna Pasumarthy, Department of Electrical Engineering, IIT Madras :-Web link- https://nptel.ac.in/courses/108/106/108106098/
3. NPTEL Course: Control Systems By Prof. C.S. Shankar Ram, Department of Design Engineering, IIT Madras :- Web link- https://nptel.ac.in/courses/107/106/107106081/

IN-SEMESTER ASSESSMENT (50 MARKS)

1. Continuous Assessment (20 Marks)

Suggested breakup of distribution

01 MCQ test strictly as per GATE exam pattern / level: 05 Marks
01 Class test: 05 Marks
Open book test/ Open notes test: 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% to 30% weightage, and the syllabus covered from MSE to ESE carrying 70% to 80% weightage

Course Type	Course Code	Course Name	Credits
PCC	EEPCC407	POWER ELECTRONICS	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. EEMDM301-Electronic Components and Circuits
2. EEPCC302- Circuit & Signal Analysis

Program Outcomes addressed :

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO3: Design/development of solutions
4. PO4: Conduct investigations of complex problems
5. PO10: Communication

Course Objectives :

1. To learn the operation of various power electronic devices and auxiliary circuits needed for power conversion and select them for suitable application.
2. To analyse various power electronic converters and select for an application.
3. To build a strong foundation for further study and implementation of power electronic circuits and systems.

Module	Details	Hrs	CO
	Course Introduction: Concept of power electronics, power conversion & its significance, power electronics as an enabling technology in various applications of our day to day life.	**01**	
01.	**Power Semiconductor Devices**	**7-9**	CO1 CO5
	Learning Objective/s: *Learner will acquire knowledge of various power electronic devices and its features, analyze data sheet and its losses to select a suitable device for power conversion..*		
	Contents: Characteristics & features of power diode, SCR, power BJT, power MOSFET, IGBT, Safe Operation Area (SOA), understanding datasheet of devices. Wide band gap devices, SiC & GaN and its applications. Comparison & selection of devices. Device losses: Conduction & Switching losses.		

	Self-Learning Topics: Solve simple sums to enhance the understanding.		
	Learning Outcomes : *A learner will be able to* 1. *Apply fundamental concepts to plot the characteristics and identify the features of switching devices to select a device (PI-1.3.1).* 2. *Apply electrical engineering concepts to find conduction and switching losses in devices(PI-1.4.1).* 3. *Identify parameters and compare devices to choose them based on the requirements demanded by application (PI-2.1.2).* 4. *Identify information from data sheets of switching devices to understand their operational limits(PI-2.2.2).*		
02.	**Auxiliary Circuits:**	**6-8**	CO2
	Learning Objective/s: *Learner will be able to demonstrate the ability to use and design various auxiliary circuits needed for the implementation of power electronic circuits..*		
	Contents: Need for gate driver circuits, design of Driver ICs, understanding its datasheets, floating power supply, level shifters, bootstrap drivers, isolated gate drivers, voltage & current sensing methods. Need for snubber circuits and its design, Heat sinks and EMI.		
	Self-Learning Topics: *Design of another other suitable driver ICs.*		
	Learning Outcomes : *A learner will be able to* 1. *Apply fundamental concepts to identify the functions of gate driver circuits to select suitable gate driver circuit (PI-1.3.1).* 2. *Apply electrical engineering concepts to select parameters of gate driver circuits and snubber circuits to meet the specific requirements (PI-1.4.1).* 3. *Identify parameters of sensing circuits for sensing voltage and current to select appropriate sensing circuit for an application (PI-2.1.2).* 4. *Identify and interpret data sheet parameters of driver ICs to select suitable driver IC (PI-2.2.2).*		
03.	**AC to DC Converters (Controlled Rectifiers)**	**6-8**	CO 3
	Learning Objective/s: *Learner will be able to demonstrate the ability to analyze AC to DC power conversion circuits.*		
	Contents: Single phase, fully controlled full wave bridge rectifiers for R and R-L load, derivation of output voltage, two quadrant operation, issues of harmonics & poor power factor, relevant standards, concept of freewheel diode, need for PWM rectifier, working principle and applications, PWM Rectifier in traction.		
	Self-Learning Topics*: Other applications of controlled rectifiers.*		

	Learning Outcomes : *A learner will be able to* 1. *Apply mathematical methods to derive the output voltage and current of controlled rectifiers (PI-1.1.1).* 2. *Apply electrical engineering concepts and describe the working and draw output waveforms of controlled rectifiers (PI-1.4.1).* 3. *Extract the requirements from relevant standards related to power factor and harmonics in the input current of controlled rectifier (PI-3.1.4).* 4. *Identify the criteria to improve to power factor and harmonics in line with the limits given by relevant standards (PI-3.2.3).*		
04.	**DC-DC Converters** ***Learning Objective/s:*** *Learner will be able to analyze DC to DC power conversion circuits and its applications.* **Contents:** Switched mode power supply and comparison with linear power supply, PWM operation, Buck, Boost, Buck-Boost dc to dc converters with resistive load and continuous conduction mode, Bidirectional dc to dc converters and its applications, DC-DC converter in power supply applications. ***Self-Learning Topics:*** *Synchronous dc-dc converters.* ***Learning Outcomes :*** *A learner will be able to* 1. *Apply fundamental engineering concepts to identify the working and features of dc-dc converters(PI-1.3.1).* 2. *Apply engineering concepts to derive the input to output voltage relation and understand various waveforms (PI-1.4.1).* 3. *Identify various parameters to select energy storage elements in DC-DC converter (PI-2.1.2).* 4. *Identify the features of DC-DC conversion to select them to meet the given requirements (PI-2.2.4).*	**7-9**	CO4
05.	**DC–AC Converters** ***Learning Objective/s:*** *Learner will be able to understand and analyze DC to AC power conversion circuits.* **Contents:** Single phase and Three phase voltage source Inverters, Square wave and sinusoidal PWM operation, concept of dead time, Harmonics in the inverter output voltage, Total Harmonic Distortion, relevant standards, Single phase current source inverters (CSI), comparison of VSI and CSI. Concept of multi-level inverter. Inverter in Uninterrupted Power supply. ***Self-Learning Topics:*** *Multiple pulse PWM technique and comparison with SPWM.*	**6-8**	CO3

	Learning Outcomes: *A learner will be able to* *1. Apply mathematical methods to derive the output voltage and current of controlled rectifiers (PI-1.1.1).* *2. Apply electrical engineering concepts and describe the working and draw output waveforms of controlled rectifiers (PI-1.4.1).* *3. Extract the requirements from relevant standards related to power factor and harmonics in the input current of controlled rectifier (PI-3.1.4).* *4. Identify the criteria to improve to power factor and harmonics in line with the limits given by relevant standards (PI-3.2.3).*		
06.	**Case Studies** ***Learning Objective/s:*** *To demonstrate the knowledge to analyse the given requirements, select suitable power electronic device and converter and communicate the selection to others effectively.* **Contents:** Assimilate the information obtained about devices, auxiliary circuits and converters to do a case study of Power Factor Correction Circuits, DC-DC converter in portable equipment, Solar Power Conditioning unit, LED lamp driver circuits, any other power electronic application. ***Self-Learning Topics:*** *Literature survey* ***Learning Outcomes :*** *A learner will be able to* *1. Examine the requirements of the problem and methods to suggest various techniques for the solution (PI-4.1.2).* *2. Analyse various techniques to conclude the solution for the problem (PI-4.3.4).* *3. Analyse related information to choose the converters and energy storage elements (PI-10.1.1)* *4. Create a presentation and present it with proper justification (PI-10.1.3).*	**5-7**	CO-5
	Course Conclusion Course will conclude with the understanding of various power electronic devices, converters, systems and case studies. Emphasizing the fact that how this is a foundation course for so many other courses in Electrical Engineering.	**01**	
	Total	**45**	

Course Outcomes :

1. Apply the knowledge of various switching devices and interpret datasheets to select a suitable device for an application.
2. Identify the requirements and select auxiliary circuits of power electronic systems such as gate driver circuit, snubber circuits and sensing circuits.
3. Analyse the working of various power conversion circuits from AC to DC and DC to AC and its applications.
4. Analyse the working of DC to DC power conversion and its applications.
5. Identify the requirements to select power electronic converters for various applications.

Performance Indicators:

P.I. No.	P.I. Statement
1.1.1	Apply mathematical techniques such as calculus, linear algebra, and statistics to solve problems
1.3.1	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
2.2.2	Identify, assemble and evaluate information and resources.
3.1.4	Extract engineering requirements from relevant engineering Codes and Standards such as IEEE,IEC etc.
3.2.3	Identify suitable criteria for the evaluation of alternate design solutions.
4.1.2	Examine the relevant methods, tools and techniques of experiment design, system calibration, data acquisition, analysis and presentation.
4.3.4	Synthesize information and knowledge about the problem from the raw data to reach appropriate conclusions.
10.1.1	Read, understand and interpret technical and non-technical information
10.1.3	Create flow in a document or presentation - a logical progression of ideas so that the main point is clear.

Text Books :

1. N. Mohan, T. M. Undeland, W.P Robbins, “Power Electronics, Converters, Applications & Design”, Wiley India.
2. Joseph Vithayathil, “Power Electronics: Principles & Applications”, McGraw Hill.
3. P.S. Bimbhra, “Power Electronics”, Khanna Publishers.
4. M. H. Rashid, “Power Electronic: Circuits, Devices & Applications”, Pearson education.
5. Daniel W. Hart, “Power Electronics”, Mc GrawHill.

Reference Books :

1. R. W. Erickson and D Maksimovic, “Fundamental of Power Electronics”, Springer, 2nd Edition.
2. P.C. Sen, “Power Electronics”, Mc GrawHill.
3. M. H. Rashid, “Hand book of Power Electronics”, PHI.
4. L. Umanand, “Power Electronics: Essentials & Applications”, Wiley.

Other Resources :

1. NPTEL Course on Power Electronics, , Prof. B.G. Fernandes, Prof. Kishore Chatterjee, IIT Bombay https://nptel.ac.in/courses/108101038
2. NPTEL Course on Power Electronics, Prof. G.Bhuvaneshwari, Department of Electrical Engineering IIT Delhi https://archive.nptel.ac.in/noc/courses/noc20/SEM2/noc20-ee97/

IN-SEMESTER ASSESSMENT (50 MARKS)

1. **Continuous Assessment (20 Marks)**
   Suggested breakup of distribution
   01 MCQ test strictly as per GATE exam pattern / level + 1 Class test **(10 Marks)**
   Seminar: 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% to 30% weightage, and the syllabus covered from MSE to ESE carrying 70% to 80% weightage.

Course Type	Course Code	Course Name	Credits
PCC	EEPCC408	POWER SYSTEM 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. EEPCC303- Elements of Power System

Program Outcomes addressed:

1. PO1-Engineering knowledge
2. PO2-Problem analysis
3. PO5-Modern tool usage
4. PO 6: The engineer and society

Course Objectives:

1. To impart knowledge on symmetrical and unsymmetrical faults in power system.
2. To impart knowledge on power system transients due to switching in transmission line.
3. To introduce Insulation coordination to decide the lightning arrestor rating.
4. To introduce corona in transmission line.

Module	Details	Hrs	CO
	Course Introduction Power Systems Engineering course deals with short circuit analysis, which provides currents and voltages in a power system during the fault condition. This information is needed to determine the required interrupting capacity of the circuit breakers and to design proper relaying system. It will ensure that personnel and equipment are protected from faults otherwise, it can be a serious threat to human life and is capable of causing injury, extensive equipment damage, and costly downtime. Hence, the fundamental concepts of this course are essential for designing the electrical systems.	**01**	
01.	**Symmetrical Fault Analysis**	**8-10**	CO1
	Learning Objective/s: *To apply knowledge of short circuit on synchronous machine and transmission line to analyse symmetrical faults in power system and perform simulation using modern tools*		
	Contents: Introduction to synchronous machine, basic construction, operation and equivalent circuit diagram, short circuit of synchronous machine: no load and loaded machine, transient on a transmission line, Selection of Circuit Breaker, short circuit MVA, Algorithm for short circuit studies, Z Bus formulation, symmetrical fault analysis using Z-bus.		
	Self-Learning Topics: Simulate symmetrical faults using software tools and analyze the results.		

	Learning Outcomes: *A learner will be able to* 1. *Apply electrical engineering concepts to obtain equivalent circuit of synchronous machine and Z-bus of given power system (PI-1.3.1)* 2. *Use basic principles of electrical engineering to solve short circuit problems in no-load and loaded condition of synchronous machine (PI-1.4.1)* 3. *Identify and analyse symmetrical faults for a given power system network (PI-2.1.2)* 4. *Formulate Z-bus model of power system to analyse symmetrical faults (PI-2.3.1)* 5. *Identify modern engineering tools for modeling and analysis of symmetrical faults in power system (PI-5.1.1)*		
02.	**Symmetrical Components**	**4-6**	CO2
	Learning Objective/s: *To derive sequence components and draw sequence networks of transmission line, synchronous machine and transformer using symmetrical component technique*		
	Contents: Introduction, Symmetrical component transformation, sequence impedances and sequence network of transmission line, synchronous machine and transformer, power invariance, construction of sequence network of a power system		
	Learning Outcomes: *A learner will be able to* 1. *Apply basic concepts in electrical engineering to formulate the symmetrical components of currents and voltages to solve problems in unbalanced power system (PI-1.3.1)* 2. *Apply principles of symmetrical components to construct sequence networks of transmission line, synchronous machine and transformer for solving the problems in unbalanced power system. (PI-1.4.1)*		
03.	**Unsymmetrical Fault Analysis**	**9-11**	CO3
	Learning Objective/s: *To derive sequence network model and analyse different types of unsymmetrical faults in power system and simulate using modern tools*		
	Contents: Types of unsymmetrical faults, Analysis of shunt type unsymmetrical faults: single line to ground (SLG) fault, line to line (L-L) fault, double line to ground (LLG) fault		
	Self-Learning Topics: Simulate unsymmetrical faults using software tools and analyse results.		
	Learning Outcomes: *A learner will be able to* 1. *Apply symmetrical components technique to solve problems of unsymmetrical faults in power system (PI-1.3.1)* 2. *Apply basic principles to solve problems of unsymmetrical faults in power system (PI-1.4.1)* 3. *Identify and analyse unsymmetrical faults in power system using symmetrical components (PI-2.1.2)*		

	4. *Formulate model and analyse unsymmetrical faults in power system (PI-2.3.1)* 5. *Identify modern engineering tools for modeling and analysis of unsymmetrical faults (PI-5.1.1)*		
04.	**Sources of Power System Transients**	**7-9**	CO4
	Learning Objective/s: *To apply concepts of transients in power system and analyse arcing grounds, capacitance switching, current chopping and travelling waves*		
	Contents: Review of transients in simple circuits, recovery transient due to removal of short circuit, arcing grounds, capacitance switching, current chopping phenomenon. Travelling waves on transmission lines, wave equation, reflection and refraction of waves, typical cases of line terminations, attenuation, Bewley lattice diagram		
	Self-Learning Topics: ABCD parameters of transmission line		
	Learning Outcomes: *A learner will be able to* 1. *Apply fundamental knowledge to solve problems due to transients in power system (PI-1.3.1)* 2. *Apply basic concepts of electrical engineering to derive travelling wave equation for obtaining reflection and refraction waves in transmission line (PI-1.4.1)* 3. *Identify and analyse arcing grounds, capacitance switching and current chopping in transmission line (PI-2.2.3)* 4. *Formulate models to analyse typical cases of line terminations in transmission line (PI-2.3.1)*		
05.	**Lightning and Insulation Coordination**	**5-7**	CO5
	Learning Objective/s: *To analyse over voltages due to lightning and to find the rating of surge arrester to protect against lightning surges using insulation coordination in power system.*		
	Contents: **Lightning:** Shape of Lightning voltage wave, over voltages due to Lightning, Lightning protection problem, significance of tower footing resistance in relation to Lightning, insulator flashover and withstand voltages, protection against surges, surge arresters, surge capacitor, surge reactor and surge absorber, Lightning arrestors and protective characteristics, dynamic voltage rise and arrester rating. **Insulation Coordination:** - Volt time curve, basic approach to insulation co-ordination in power system, over voltage protection, ground wires, insulation coordination based on lightning, surge protection of rotating machines and transformers.		
	Self-Learning Topics: *Lightning phenomenon- mechanism of Lightning stroke*		

	Learning Outcomes: *A learner will be able to* 1. *Identify and analyse over voltages due to lightning surge on transmission line (PI-2.2.3)* 2. *Determine the tower footing resistance and rating of surge arrestor using insulation coordination to analyse protection of transmission line (PI-2.4.4)* 3. *Identify tower footing resistance and rating of surge arrestor for public protection and safety. (PI-6.1.1)*		
06.	**Corona**	**4-6**	CO5
	Learning Objective/s: *To apply concept of electric discharge in air for understanding corona formation and calculate corona loss in transmission line*		
	Contents: Phenomenon of corona, Disruptive critical voltage, Visual critical voltage, corona loss, factors affecting corona loss, Radio interference due to corona, practical considerations of corona loss, corona in bundled conductor lines, corona ring		
	Self-Learning Topics: Nil		
	Learning Outcomes: *A learner will be able to* 1. *Apply basic laws of engineering to calculate disruptive critical voltage, visual critical voltage during corona formation (PI-1.2.1)* 2. *Use engineering concepts to calculate corona loss in transmission line and Identify factors affecting corona in transmission line (PI-1.4.1)*		
	Course Conclusion Calculation of symmetrical and unsymmetrical fault currents is important in selecting the circuit breaker rating in power system for protection. The knowledge of power system transients, insulation coordination and corona will be useful to build high voltage DC and AC transmission systems.	**01**	
	Total	**45**	

Course Outcomes:

1. Apply basic principles of electrical engineering to obtain equivalent circuit of synchronous machine and Z-bus for analysing symmetrical faults in power system.
2. Apply concepts of symmetrical components to construct sequence networks.
3. Analyse unsymmetrical faults in power system using sequence networks.
4. Apply basic concepts of electrical engineering to derive travelling wave equation for analysing line terminations in transmission line.
5. Apply principles of insulation coordination to determine the lightning arrestor rating for protection of transmission line and calculate corona loss.

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 electrical engineering concepts to solve engineering problems.

2.1.2 Identify engineering systems, variables, and parameters to solve the problems

2.3.1 Combine scientific principles and electrical engineering concepts to formulate model of a system that is appropriate in terms of applicability and required accuracy.

2.4.4 Extract desired understanding and conclusions consistent with objectives and limitations of the analysis

5.1.1 Identify modern engineering tools such as computer aided drafting, modeling and analysis; techniques and resources for engineering activities

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

Text Books:

1. D. P. Kothari, I. J. Nagrath, "Power System Engineering", 3e, Mc Graw Hill
2. Hadi Saadat, Power System Analysis, TMH publications
3. Stevenson and Grainger, Modern power system analysis, TMH publication, 1ed

Reference Books:

1. Turan Gonen, Modern power system analysis, Wiley
2. Power System Analysis by Arthur Bergen and Vijay Vittal
3. Power System Analysis and Design by J. Duncan Glover, M. S. Sarma and Thomas J. Overbye

Other Resources:

1. NPTEL Course on Power System Engineering by Prof. Debpriya Das, IIT Kharagpur, Link: https://nptel.ac.in/courses/108/105/108105104/
2. NPTEL Course on Power System Analysis by Dr. A.K. Sinha, IIT Kharagpur, Link: https://nptel.ac.in/courses/108/105/108105067/
3. NPTEL Course on Power System Generation, Transmission and Distribution by Prof. D.P. Kothari, IIT Delhi. Link: https://nptel.ac.in/courses/108102047

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
Technical report writing/open book test: 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% to 30% weightage, and the syllabus covered from MSE to ESE carrying 70% to 80% weightage.

Course Type	Course Code	Course Name	Credits
MDM	MDM402	INTERNET OF THINGS	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. EEESC102- Basic Electrical Engineering
2. EEESC203- Basic Electronics Engineering
3. EELC405-Measurement and Instruments Lab

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO 3: Design/Development of Solutions
4. PO 5: Modern tool usage

Course Objectives:

1. To provide overview of internet-of-things
2. To impart knowledge on IoT platform design methodology
3. To introduce Networking & Communication Protocols for IoT applications
4. To provide knowledge on online IoT Hardware Platforms
5. To introduce Mobile App platform for IoT
6. To impart knowledge on home and city automation IoT Applications

Module	Details	Hrs	CO
	Course Introduction Internet of Things is a foundation course which deals with fundamental concepts of IoT and its applications. The fundamental concepts of this subject are essential for designing Automation systems using IoT connectivity and communication technologies.	**01**	
01.	**Introduction to Internet of Things**	**7-9**	CO-1
	Learning Objective/s: *To apply fundamental and electrical engineering concepts for comprehending Internet of Things, building blocks of IoT, IoT enabling technologies, characteristics of IoT levels, IoT and M2M*		
	Contents: Introduction to IoT : Definition & Characteristics of IoT, Physical Design of IoT- Things in IoT, IoT protocol, Logical Design of IoT– IoT functional blocks, IoT Communication Models, IoT communication APIs, IoT Enabling Technologies – Wireless Sensor Networks, Cloud computing,		

	Big Data Analytics, Communication Protocols, Embedded Systems, IoT levels and Deployment Techniques, IoT and M2M		
	***Self-Learning Topics**: Sensing, actuation*		
	Learning Outcomes: *A learner will be able to* 1. *Apply fundamental engineering concepts to identify and understand IoT characteristics (P.I.-1.3.1)* 2. *Apply Electrical engineering concepts to understand Physical and logical design of IoT (P.I.-1.4.1)* 3. *Identify and comprehend IoT Enabling Technologies and IoT levels (P.I.-2.1.2)* 4. *Differentiate between IoT and M2M using mathematical, engineering and other relevant knowledge (P.I.-2.1.3)*		
02.	**IoT Platforms Design Methodology**	**7-9**	CO-2
	Learning Objective/s: *To identify and synthesize design methodology required in IoT application development*		
	Contents: IoT Platforms Design Methodology: Introduction, IoT design Methodology, Case Study on IoT system for Weather Monitoring		
	Learning Outcomes: *A learner will be able to* 1. *Identify information and resources related to IoT platforms design methodologies (P.I.-2.2.2)* 2. *Identify design methodology to specific IoT application using assembled information (P.I.-2.2.3)* 3. *Synthesize design requirements from review of various IoT platforms design methodologies (P.I.-3.1.3)* 4. *Determine design methodology based on IoT level, Functional view, operational view specification for specified application development (P.I.-3.1.6)*		
03.	**IoT Connectivity and Communication Technologies**	**7-9**	CO-3
	Learning Objective/s: *To identify and interpret IoT Connectivity, Communication protocols for selecting most appropriate connectivity protocol in IoT implementation.*		
	Contents: IoT Connectivity and Communication Technologies: IoT Connectivity technologies –IEEE 802.15.4, Zigbee, Zwave, RFID, LoRa, Wi-fi, Bluetooth, IoT Communication Technologies –Introduction, MQTT, CoAP, REST, HTTP RESTful, WebSocket		
	Learning Outcomes: *A learner will be able to* 1. *Identify IoT Connectivity and Communication Technologies for IoT applications (P.I.-2.1.2)* 2. *Identify the salient features and application scope of common connectivity protocols in IoT (P.I.-2.1.3)*		

	3. *Extract requirements from relevant connectivity protocols for IoT applications (P.I.-3.1.4)* 4. *Determine appropriate connectivity protocols for IoT applications (P.I.-3.1.6)*		
04.	**IoT Hardware Development Platforms**	**7-9**	CO-4
	Learning Objective/s: *To synthesize existing online IoT hardware development platforms and select specific platform for implementation of Home Automation IoT system*		
	Contents: IoT Hardware Development Platforms: Overview IoT hardware platforms, Design and implementation of Home Automation IoT System using online hardware platforms – Smart Lighting, Home intrusion detection.		
	Learning Outcomes: *A learner will be able to* 1. *Apply fundamental engineering concepts to execute specific Home Automation IoT system (P.I.-1.3.1)* 2. *Apply Electrical engineering concepts to execute specific Home Automation IoT system (P.I.-1.4.1)* 3. *Synthesize engineering requirements to solve design problem of Home Automation IoT system (P.I.-3.1.3)* 4. *Extract relevant protocols for executing the defined IoT system home automation problem (P.I.-3.1.4)* 5. *Adapt online IoT hardware platforms to execute Home Automation IoT system (P.I.-5.1.2)* 6. *Verify the credibility of results obtained from online IoT hardware platforms for Home Automation IoT system (P.I.-5.3.2)*		
05.	**Introduction to Mobile App platform**	**4-6**	CO-5
	Learning Objective/s: *To apply electrical /computer engineering concepts for understanding Mobile App platform required for Mobile to server integration using Mobile app protocol stack of IoT*		
	Contents: Introduction to Mobile App platform: Protocol stack of Mobile app for IoT, Mobile to server integration		
	Learning Outcomes: *A learner will be able to* 1. *Apply fundamental engineering concepts to understand Mobile to server integration system (P.I.-1.3.1)* 2. *Apply electrical/computer engineering concepts to comprehend Mobile to server integration using Mobile app platform (P.I.-1.4.1)* 3. *Identify existing Protocol stack of Mobile app for IoT (P.I.-2.2.3)* 4. *Extract desired understanding and conclusions required for executing mobile to server integration (P.I.-2.4.4)*		

06.	**IoT Applications**	**5-7**	CO-6
	Learning Objective/s: *To Identify and synthesize engineering system designs of different IoT applications*		
	Contents: IoT Applications: Case Studies illustrating IoT Design – Cities (Smart Parking, Garbage collection), Environment (Pollution detection, Forest Fire Detection), Power (Smart Grid)		
	Learning Outcomes: *A learner will be able to* *1. Identify and understand IoT designs in context to different case studies illustrating IoT design (P.I.-2.1.2)* *2. Extract desired understanding and conclusions in terms of IoT application designs (P.I.-2.4.4)* *3. Synthesize engineering requirements from a review of IoT designs (P.I.-3.1.3)* *4. Explore and synthesize engineering requirements considered in IoT applications including garbage collection, pollution detection, forest fire detection (P.I.-3.1.5)*		
	Course Conclusion This course has provided a comprehensive exploration of IoT technologies and their diverse applications. Through a blend of theoretical learning and practical implementation, students have gained insights into the interconnected world of IoT devices, sensors, networks, and data analytics.	**01**	
	Total	**45**	

Course Outcomes :

1. Apply fundamentals of IoT to understand characteristics of IoT system
2. Identify and determine IoT platform design methodology for given IoT application
3. Identify and select relevant communication protocol suitable for IoT implementation
4. Adapt online IoT hardware platforms to execute specific Home Automation IoT system and verify the credibility of results
5. Extract desired understanding and conclusions required for executing mobile to server integration using Mobile app protocol stack for IoT
6. Synthesize IoT designs through an understanding of case studies illustrating IoT implementation in home and city automation

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
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 Extract desired understanding and conclusions consistent with objectives and limitations of the analysis

3.1.3 Synthesize engineering requirements from a review of the state-of-the-art

3.1.4 Extract engineering requirements from relevant engineering Codes and Standards such as ASME, ASTM, BIS, ISO and ASHRAE

3.1.5 Explore and synthesize engineering requirements considering health, safety risks, environmental, cultural and societal issues

3.1.6 Determine design objectives, functional requirements and arrive at specifications

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

Text Books :

1. "Internet of Things (A Hands-on-Approach)", Vijay Madisetti and Arshdeep Bahga, 1st Edition, 2014, VPT
2. "Introduction to IoT", S. Misra, A. Mukherjee, and A. Roy, 2020, Cambridge University Press.
3. "Introduction to Industrial Internet of Things and Industry 4.0", S. Misra, C. Roy and A. Mukherjee, 2020, CRC Press
4. "Internet of Things: Architecture and Design Principles", Raj Kamal, First Edition, McGraw Hill Education.

Reference Books :

1. "Designing the Internet of Things", Adrian McEwen, Hakim Cassimally, 2014, John Wiley
2. "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", Francis daCosta, 1st Edition, 2013, Apress Publications.
3. "Getting Started with the Internet of Things", CunoPfister, 2011, OReilly Media.
4. "Internet of Things", Samuel Greenguard, 2015, MIT Press
5. "Internet of Things. IoT Infrastructures", Mandler, B., Barja, J., Mitre Campista, M.E., Cagáová, D., Chaouchi, H., Zeadally, S., Badra, M., Giordano, S., Fazio, M., Somov, A., Vieriu, R.-L., Springer International Publishing
6. "The Internet of Things: Key Applications and Protocols", Olivier Hersent, David Boswarthick, Omar Elloumi Wiley-Blackwell.
7. "Internet of things (IoT): Technologies, Applications, Challenges, and Solutions" Edited by B.K. Tripathy J. Anuradha, 2018, CRC Press,

Other Resources :

1. NPTEL Course: Introduction to Internet of Things By Prof. Sudip Misra, IIT Kharagpur:-Web link- https://nptel.ac.in/courses/106105166

IN-SEMESTER ASSESSMENT (50 MARKS)

1. **Continuous Assessment (20 Marks)**
   Suggested breakup of distribution
   Assignment on live problems/case studies:10 marks
   Technical Report Writing: 05 marks
   Attendance & 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% to 30% weightage, and the syllabus covered from MSE to ESE carrying 70% to 80% weightage

Course Type	Course Code	Course Name	Credits
LC	EELC403	POWER ELECTRONICS LABORATORY	01

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

Pre-requisite :

1. EELC301 - Electronics Lab
2. EEPCC407 - Power Electronics

Program Outcomes addressed:

1. PO2: Problem analysis
2. PO4: Conduct investigations of complex problems
3. PO9: Individual and teamwork

Course Objectives:

1. To impart knowledge on various parameters and characteristics of power electronic switching devices used for power conversion.
2. To provide skills to select parameters, implement and analyse the performance of auxiliary circuits needed for power electronic converters.
3. To provide skills to select parameters, implement and analyse the performance of various power electronic converters.

Module	Details	Hrs	CO
01.	***Learning Objective/s:*** *To identify various parameters from datasheets of power electronic switching devices, plot the characteristics and analyse the features.*	**6**	**CO-1** **CO-3**
	Theme for designing multiple experiments: 1. Test various power electronic switching devices, plot their characteristics and analyse their features.		
	Self-Learning Topics: *Watch videos on power electronic switching devices*		
	Learning Outcomes: *A learner will be able to* *1. Identify various parameters required for analyzing the performance of switching devices as a team (P.I.-2.1.2,9.2.2)* *2. Use systematic approach to implement the test circuit and evaluate its parameters as a team (PI-2.2.2, 9.2.2).* *3. Plot and analyze characteristics of switching devices such as power MOSFET, IGBT, WBG devices etc. (P.I.- 4.3.3)* *4. Compare the results obtained with the theoretical principles (P.I.-4.1.4)*		
02.	***Learning Objective/s:*** *To investigate the functioning of auxiliary circuits needed for the implementation of power electronic converters.*	**6**	**CO- 2** **CO- 3**
	Theme for designing multiple experiments: 2. Implement auxiliary circuits such as gate driver circuits, Snubber circuits etc.		
	Self-Learning Topics: *Watch videos on auxiliary circuits of power electronic converters*		

	Learning Outcomes: *A learner will be able to* 1. *Identify the parameters to meet the requirements of auxiliary circuits such as gate driver circuits and snubber circuits (P.I.-2.1.2).* 2. *Evaluate the requirements to select the parameters of the auxiliary circuit as a team (P.I.-2.2.2,9.3.1).* 3. *Implement auxiliary circuit as a team, analyze the performance and draw conclusions as a team (P.I.-4.3.3,9.3.1)* 4. *Compare the results obtained with the theoretical principles (P.I.-4.1.4)*		
03.	***Learning Objective/s:*** *To provide skills to implement and analyze the performance of various power electronic converters.*	**12**	**CO-2** **CO- 3**
	Theme for designing multiple experiments: 3. Implement power electronic converters to convert AC to DC and analyse the performance. 4. Implement power electronic converters to convert DC to AC and analyse the performance. 5. Implement power electronic converters to convert DC to DC and analyse the performance.		
	Self-Learning Topics: *Watch videos of different power electronic converters*		
	Learning Outcomes: *A learner will be able to* 1. *Identify the parameters to meet the requirements of AC to DC or DC to AC or DC to DC converter (P.I.- 2.2.2).* 2. *Evaluate the requirements to select the parameters of the converter (P.I.-2.2.2,9.3.1).* 3. *Implement the converter as a team and use systematic procedures for collecting the required data. (P.I.- 4.3.1,9.3.1)* 4. *Represent the collected data to evaluate its performance across parameter variations. (P.I.- 4.3.3).*		
04.	***Learning Objective/s:*** *To impart knowledge of a practical power electronic converter through demonstration of a hardware set up or simulate a power electronic converter.*	**06**	**CO-1** **CO-2** **CO- 3**
	Theme for designing multiple experiments: 6. Demonstration of hardware set up of any power electronic application and measurement of physical quantities. 7. 2. Simulation of any power electronic converter.		
	Learning Outcomes: *A learner will be able to* 1. *Identify parameters to solve the problem (PI-2.1.2).* 2. *Identify and evaluate information (PI-2.2.2)* 3. *Apply appropriate instrumentation to make measurements of practical power electronic application such as LED driver circuits, regulated power supply etc. (PI- 4.1.3)* 4. *Use an appropriate tool for the simulation of a power electronic converter and analyze its performance (PI- 4.1.3).*		
	Minimum 2 experiments/demo/simulation from each module, and total at least 10 experiments/demonstration/simulation.	**30**	

Course Outcomes: Learner will be able to

1. Use appropriate techniques to collect data to plot the characteristics and analyse the features of various power electronic switching devices.
2. Apply the knowledge of auxiliary circuits to implement and analyse auxiliary circuits needed for power electronic converters.
3. Analyse the requirements, select parameters and implement power electronic converters as a team.

Performance Indicators:

P.I. No.	P.I. Statement
2.1.2	Identify engineering systems, variables, and parameters to solve the problems.
2.2.2	Identify, assemble and evaluate information and resources.
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.
9.2.2	Treat other team members respectfully.
9.3.1	Present results as a team, with smooth integration of contributions from all individual efforts.

Text Books

1. Ned Mohan, Power Electronic Converters, John Wiley & sons.

2. P.S. Bimbhra, Power Electronics, Khanna Publishers.

Reference Books

1. Power Electronics Essentials and Applications, L. Umanand, Wiley
2. Data sheet of switching devices
3. Data sheet of ICs

Other Resources

1. Design and Simulation of Power Conversion Using Open Source Tools", Prof.L.Umanand, IISC, Bangalore https://archive.nptel.ac.in/noc/courses/noc20/SEM1/noc20-ee12/
2. Multisim software for simulation https://education.ni.com/teach/resources/967/power-electronics

CONTINUOUS ASSESSMENT (25 Marks)

Suggested breakup of distribution

- Lab Experiments: 10 Marks
- Internal Assessment: 10 marks

  Evaluating proficiency in the field by assessing the candidate's capability to execute connections or circuits, conduct experiments, accurately record test data, and derive meaningful conclusions through data analysis during regular laboratory session.
- Observation & Active Participation: 5 marks

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

Practical and Oral Examination:

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

- Students will be randomly allocated an experiment from the list of laboratory exercises and will be asked to draw circuit diagram, observation table with relevant formula. It will be checked by the examiners and evaluated out of 05 Marks.
- Then the student will be allowed to start with the performance of the experiment.
- Students will be given 1 hour to complete the circuit connections and take readings. The connections and output are verified by the examiners. The weightage is 05 Marks
- 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.
- Students will then be appearing for Oral in front of both Internal and External examiners. The weightage of Oral will be of 10 Marks.

Course Type	Course Code	Course Name	Credits
LC	EELC404	CONTROL SYSTEM LABORATORY	01

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

Pre-requisite:

1. EEPCC301- Engineering Mathematics-III
2. EEPCC302-Circuit and Signal Analysis

Program Outcomes addressed:

1. PO2: Problem analysis
2. PO4: Conduct investigations of complex problems
3. PO5: Modern tool usage
4. PO9: Individual and team work

Course Objectives:

1. To impart the knowledge on various components of closed loop control systems.
2. To impart the knowledge on modelling and transient and steady state analysis of closed loop control systems.
3. To impart the knowledge on the analysis of control system using Root-locus and Bode-plot technique with simulation platform.

Module	Details	Hrs	CO
	Course Introduction This foundation course provides a comprehensive understanding of the basic principles and methodologies essential for designing, analyzing, and implementing control systems in various engineering applications.		
01.	***Learning Objective:*** *To investigate the functioning of various components of the given control system as a team.*	**06**	**CO- 1**
	Theme for designing multiple experiments: 1. Analyze the functioning of various components of the given open loop or closed loop control system		
	Learning Outcomes: *A learner will be able to* *1. Identify various components required for a control system, use systematic techniques to implement the system and evaluate its operation as a team. (P.I.-2.1.2, 2.2.2, 9.2.1,.9.3.1)* *2. Use a systematic approach as a team to gather data and analyze the system's performance across various parametric variations. (P.I.-4.1.4, 4.3.1)* *3. Formulate a mathematical model by observing and plotting the response with various inputs. (P.I.-4.1.4)*		

02.	***Learning Objective:*** *To investigate the behavior of the given control system as a team and to formulate an appropriate model of the system by examining its response.*	**10**	**CO- 1** **CO- 2**
	Theme for designing multiple experiments: 2. Implement the given electrical system and analyze the transient and steady state behavior for various test input		
	Learning Outcomes: *A learner will be able to* *1. Implement the circuit and use systematic procedures to determine the transient and steady state parameters from the response as a team. (P.I.-4.3.1, 9.2.1,.9.3.1)* *2. Formulate the transfer function model from the response and compare the transfer function with the transfer function constructed from the circuit.(P.I.-2.3.1, 2.4.1, 4.1.4)* *3. Systematically analyze the response with change in parameters. (P.I.-4.1.4, 4.3.1)*		
03.	***Learning Objective:*** *To identify computational tool to sketch root locus and frequency response plots for the given system and analyze its behavior.*	**14**	**CO- 3**
	Theme for designing multiple experiments: 3. Use a simulation software to analyze the behavior of the given system utilizing various system models and computational tools, including analysis with and without compensator.		
	Learning Outcomes: *A learner will be able to* *1. Use suitable simulation software to implement transfer function model for the given system and analyze its behavior for change in pole location, addition of poles and zeros, change in time domain specifications etc. (P.I.-2.4.1,5.1.1, 5.1.2)* *2. Develop a program algorithm to plot root locus, Bode plot, or Nyquist plot by coding the transfer function of the provided system directly, allowing for thorough system analysis. (P.I.-2.4.2)* *3. Construct state space model from transfer function, determine the eigen values and analyze the system for stability. (P.I.-2.4.1)* *4. Formulate transfer function model for the given electrical system, implement the transfer function, include a suitable compensator and analyze the performance using a suitable simulation tool. (P.I.-2.4.1, 2.4.2, 5.1.1, 5.1.2)*		
	Minimum 2 experiments from each module, and total at least 10 experiments	**30**	

Course Outcomes:

1. Investigate the given system, employ systematic data collection methods, and analyze the functioning of various components of the control system for the specific application as a team.
2. Analyze the transient and steady state behavior of physical systems to standard test inputs.

3. Use an appropriate simulation tool to analyze the behavior of the specified system, employing root locus and frequency response plots.

Performance Indicators:

P.I. No.	P.I. Statement
2.1.2	Identify engineering systems, variables, and parameters to solve the problems.
2.2.2	Identify, assemble and evaluate information and resources.
2.3.1	Combine scientific principles and electrical engineering concepts to formulate model of a system that is appropriate in terms of applicability and required accuracy.
2.4.1	Apply engineering mathematics and computations to solve mathematical models.
2.4.2	Produce and validate results through skillful use of contemporary engineering tools and models
4.1.4	Establish a relationship between measured data and underlying physical principles
4.3.1	Use appropriate procedures, tools and techniques to conduct experiments and collect data
5.1.1	Identify modern engineering tools such as computer aided drafting, modeling and analysis; techniques and resources for engineering activities
5.1.2	Adapt the tools and techniques to solve engineering problems
9.2.1	Demonstrate effective communication, problem solving, conflict resolution and leadership skills
9.3.1	Present results as a team, with smooth integration of contributions from all individual efforts

Text Books:

1. Control Systems Engineering, Norman S. Nise, Seventh Edition, 2015, John Wiley & Sons
2. Control Systems Engineering, I. J. Nagrath. M. Gopal, Seventh Edition, 2021, New Age International Publisher
3. Control Systems Engineering, Norman S. Nise, Seventh Edition, 2015, John Wiley & Sons

Reference Books:

1. Control Systems Engineering, S. K. Bhattacharya,Second Edition, 2015, Pearson.
2. Control Systems, Theory and applications, Smarajit Ghosh, 2013, Pearson

Other Resources:

1. NPTEL Course: Control Engineering By Prof. S.D. Agashe, Department of Electrical Engineering, IIT Bombay :-Web link- https://nptel.ac.in/courses/108/101/108101037/
2. Control Engineering By Prof. Ramkrishna Pasumarthy, Department of Electrical Engineering, IIT Madras :-Web link- https://nptel.ac.in/courses/108/106/108106098/

CONTINUOUS ASSESSMENT (25 Marks)

Suggested breakup of distribution

- Lab Experiments: 10 Marks
- Internal Assessment (10 marks)
  Evaluating proficiency in the field by assessing the candidate's capability to execute connections or circuits, conduct experiments, accurately record test data, and derive meaningful conclusions through data analysis during regular laboratory session.
- Observation & Active Participation: 5 marks

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

Students will be randomly allocated an experiment from the list of laboratory exercises and will be asked to draw circuit/block diagram, observation table and write relevant formula. It will be checked by the examiners (Internal and External) and evaluated out of 05 Marks.

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

- Students will be allocated 1 hour to complete the circuit connections and take readings. The connections and output is then checked by both the examiners for its correctness. The weightage is 05 Marks
- Students will do sample calculations, draw graph if required and write conclusion of the experiment. It will be checked by the examiners (Internal and External) and evaluated out of 05 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
LC	EELC405	MEASUREMENT AND INSTRUMENTS LABORATORY	01

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

Pre-requisite :

1. ESC102-Basic Electrical Engineering
2. ESC203- Basic Electronics Engineering

Program Outcomes addressed:

1. PO2: Problem Analysis
2. PO4: Conduct investigations of complex problems
3. PO9: Individual and teamwork

Course Objectives:

1. To select and use sensors/transducers for testing and measurement.
2. To select and use measuring instruments for testing and measurement.
3. To implement instrumentation for a selected application.

Module	Details	Hrs	CO
	Course Introduction Sensors, transducers, and measuring instruments are indispensable tools for electrical engineers, enabling them to acquire data, control systems, ensure safety, improve efficiency, conduct research, maintain quality, and monitor the environment across a wide range of applications.	**02**	**CO1** **CO2**
01.	**Sensors/ Transducers**	**08**	**CO1** **CO2** **CO3**
	Learning Objective/s: *To identify the various types of sensors/ transducers commonly used in practice based on their specifications, analyse and select the suitable one for specific application.*		
	Content: **Sensors/ transducers** Types of Sensors/ transducers for measurement of various electrical/ non electrical parameters used in practice. Datasheet of sensors/ transducers, Understanding the specifications, Characterization / calibration of sensors/ transducers. Types / variants in sensors/ transducers for any parametric measurements, Selection and suitability of sensors/ transducers for given application(Sensors / Transducers used for Current (AC/DC), Voltage (AC/DC), L/C/R/Q, Temperature, Speed, Pressure etc.)		

	Theme for designing multiple experiments: 1. Demonstration of various sensors/ transducers, applications based on them, characterization of the sensor using measuring lab instruments. 2. Testing of sensors/ transducers for a given application. 3. Characterization / calibration of sensors/ transducers 4. Selection of sensors/ transducers for a given application		
	Learning Outcomes: *A learner will be able to* *1. Identify different sensors/ transducers for an application. (2.1.2,9.2.1)* *2. Select sensors/ transducers for an application. (2.2.2,9.2.1)* *3. Interpret the specifications, datasheet parameters of sensors/ (4.1.3,9.2.2)* *4. Characterize/calibrate of sensors/ transducers for given application using measuring laboratory instruments (4.1.4,9.2.2)*		
02.	**Measuring Instruments**	**08**	**CO1** **CO3**
	Learning Objective/s: *To identify the various types of measuring instruments commonly used in practice based on their specifications, analyze and select the suitable one for specific application.*		
	Content: **Use of Lab Equipment:** Standard Lab Instruments: Multi-meter, Power Supply, Function Generator, Tachometer, thermometer, clamp-on meter, DSO etc. (Study at least 2 such equipment) Special Measuring Instruments: True RMS multi-meter, Lux meter, Megger, LCRQ meter, Power Meter, Thermal Analyzer, Anemometer, Humidity Meter, Earthling Resistance meter, Insulation Resistance meter etc. (Study at least 2 such equipment) Special Lab Equipment: High Power DC Supply, Isolated DSO, Power Analyzer, Emulators etc. (Study at least one of such equipment) Students should be trained to use these classes of lab equipment with good expertise achieved. Students should clearly understand and differentiate the situations in which use of each of these equipment is best suitable. Identify, use and practice the measurement instruments using Standard Lab Equipment, Special Measuring Instruments and Special Lab Equipment. **Theme for designing multiple experiments:** 5. Identify, use and practice the measurement using Standard Lab Equipment. 6. Identify, use and practice the measurement using Special Measuring Instruments. 7. Identify, use and practice the measurement using Special Lab Equipment.		
	Learning Outcomes: *A learner will be able to* *1. Select measuring instruments for an application. (2.1.2,9.2.1)* *2. Use measuring instruments for laboratory experiments (2.2.2,9.2.1* *3. Measure electrical parameters using appropriate instruments. (4.1.3,9.2.2)* *4. Compare the same parameter using different measuring instruments. (4.1.4,9.2.2)*		
03.	**Instrumentation**	**12**	**CO- 3**

	Learning Objective/s: *To demonstrate the skill to identify suitable instrumentation for the given application and analyse its performance.*		
	Content: Voltage /Current (AC/DC) measurement with suitable sensor/ transducer and signal processing circuits with measurement of temperature/pressure /speed using with suitable sensor/ transducer and signal processing circuits and measurement of R/L/C using a bridge technique **Theme for designing multiple experiments:** 8. Measurement Voltage /Current (AC/DC) with suitable sensor/ transducer and signal processing circuits. 9. Measurement of temperature/pressure /speed with suitable sensor/ transducer and signal processing circuits. 10. Measurement of R/L/C using a bridge technique 11. Measurement of any one selected parameter of above experiments to implements in an application using sensors and measuring instruments.		
	Learning Outcomes: *A learner will be able to* *1. Identify the required sensor/ transducer from datasheet parameters for an application. (4.1.3,9.2.2)* *2. Select suitable sensor/ transducer and measuring instruments for an application. (2.1.2,9.2.1)* *3. Implement the circuit and measure the parameters using appropriate measuring instruments. (2.2.2,9.2.1)* *4. Collect, characterize and analyze the result observed. (4.1.4,9.2.2)*		
	Minimum 03 experiments from each module and total at least 10 experiments	**30**	

Course Outcomes: Learner will be able to

1. To provide hands on experience to use sensors, transducers and laboratory instruments for testing and measurement.
2. To develop the ability to identify, select and integrate suitable sensor/ transducers for any given applications.
3. To impart knowledge of measurements based on the sensors / transducers and the relevant instrumentation for practical purpose.

Performance Indicators:

P.I. No.	P.I. Statement
2.1.2	Identify engineering systems, variables, and parameters to solve the problems
2.2.2	Identify, assemble and evaluate information and resources.
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
9.2.1	Demonstrate effective communication, problem-solving, conflict resolution and leadership skills
9.2.2	Treat other team members respectfully

Text Books:

1. Electrical & Electronic Measurements and Instrumentation, AK Sawhney,18th edition,2001, Dhanpat Rai & Sons
2. Modern Electronic Instrumentation and Measurement Techniques, Helfric and Cooper,3rd edition,1985, PHI
3. Electronic Instrumentation, H.S.Kalsi,Third Edition, 2006, Tata McGraw Hill

Reference Books:

1. Principle of Measurement & Instrumentation, Alan.S.Moris,3rd edition,2001,Prentice Hall of India
2. Electrical Measurement & Instrumentation, RS Sirohi & Radhakrisnan,4th edition,2005, New Age International
3. Sensors Handbook, Second Edition, RS Sirohi & Radhakrisnan, 2nd edition,2008, McGraw Hill

Other Resources :

1. Virtual Lab An Initiative of Ministry of Education Under the National Mission on Education through ICT http://vlab.co.in/broad-area-electronics-and-communications

CONTINUOUS ASSESSMENT (25 Marks)

Suggested breakup of distribution

- Lab Experiments: 10 Marks
- Internal Assessment (10 marks)
  Evaluating proficiency in the field by assessing the candidate's capability to execute connections or circuits, conduct experiments, accurately record test data, and derive meaningful conclusions through data analysis during regular laboratory session.
- Observation & Active Participation: 5 marks

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

- Students will be randomly allocated an experiment from the list of laboratory exercises and will be asked to draw circuit diagram, observation table and write relevant formula. It will be checked by the examiners (Internal and External) and evaluated out of 05 Marks.

  Then the student will be allowed to start with the performance of the experiment.
- Students will be allocated 1 hour to complete the circuit connections and take readings. The connections and output is then checked by both the examiners for its correctness. The weightage is 05 Marks
- Students will do sample calculations, draw graph if required and write conclusion of the experiment. It will be checked by the examiners (Internal and External) and evaluated out of 05 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
SBL	EESBL402	PCB FABRICATION AND CIRCUIT TESTING LABORATORY	02

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

Pre-requisite:

1. EEESC102- Basic Electrical Engineering
2. EEESC203- Basic Electronics Engineering
3. EEPCC407- Power Electronics

Program Outcomes addressed:

1. PO2: Problem analysis
2. PO3: Design solutions for complex engineering problems
3. PO4: Conduct investigations of complex problems
4. PO5: Modern tool usage

Course Objectives:

1. To develop the skill set to work on real-life projects and its design.
2. To develop the required skill set to design, develop and assemble the PCB using the CAD tools.

Module	Detailed Contents	Hrs.	CO
	Course Introduction This course is designed to provide a comprehensive understanding of the principles and practices involved in the design and fabrication of Printed Circuit Boards (PCBs). Through a combination of theoretical lectures, hands-on laboratory sessions, and practical projects, students will gain proficiency in using CAD software tools for design and simulation. Additionally, through project work, students will have an opportunity to apply their knowledge to different scenarios, fostering creativity, innovation, and problem-solving abilities.		
01.	**Types of PCB**	**10**	**CO 1**
	Learning Objective/s: *To compare the characteristics and applications of common PCB materials and difference between single-sided and multi-layer PCBs.*		
	Content: Types of PCBs: Single Sided (Single Layer), Multi-Layer (Double Layer) PCB Materials: Standard FR-4 Epoxy Glass, Multifunctional FR-4, Tetra Functional FR-4, NelcoN400-6, BT Epoxy Glass, Teflon , IPC Standard for PCB Materials		
	Theme for designing multiple experiments: 1. Demonstration of PCB fabrication facility.		

	Learning Outcomes: *A learner will be able to* 1. *Identify different PCB materials such as FR-4 epoxy glass, Teflon, and NelcoN400-6 etc. (PI 3.1.5)* 2. *Evaluate the advantages and limitations of each PCB material in specific applications. (PI. 3.1.6)* 3. *Identify and differentiate between various types of PCB: single-sided, double-sided, and multi-layer PCBs, based on their structural characteristics and layout complexities. (PI 4.1.1)* 4. *Analyze the design requirements and constraints associated with different PCB types (PI 4.1.2)*		
02.	**Components and its Categories**	**10**	**CO 2**
	Learning Objective/s: *To identify and categorize electronic components based on their functionality and application.*		
	Content: Types of Components: Active Components: Diode, Transistor, MOSFET/IGBT, LED, SCR, Integrated Circuits (IC's) Passive Components: Resistor, Capacitor, Inductor, Transformer, Speaker/Buzzer Component Package Types: Through Hole Packages, Axial lead, Radial Lead, Single Inline Package (SIP), Dual Inline Package (DIP), Transistor Outline (TO), Pin Grid Array (PGA), Metal Electrode Face (MELF), Leadless Chip Carrier (LCC), Small Outline Integrated Circuit (SOIC), Quad Flat Pack (QPF) and Thin QFP (TQFP), Ball Grid Array (BGA), Plastic Leaded Chip Carrier (PLCC).		
	Theme for designing multiple experiments: 2. Use of videos/ photographs & actual components to show electrical/ electronic components used in practice. 3. Identification of components, reading data sheets and handling components.		
	Learning Outcomes: *A learner will be able to* 5. *Identify and classify electronic components, such as passive components, active components, and electromechanical components. (PI 2.3.1)* 6. *Demonstrate the ability to select appropriate electronic components based on circuit requirements and compatibility. (PI 2.3.2)*		
03.	**Introduction to CAD Tools**	**08**	**CO 3**
	Learning Objective/s: *To gain proficiency in utilizing both open-source and commercial software for PCB design and simulation.*		
	Content: Introduction to open source and commercial software like: Proteus, Altium, Eagle, OrCAD, KiCAD, easy EDA etc.		
	Theme for designing multiple experiments: 4. Demonstration of CAD software tool for PCB design.		

	Learning Outcomes: *A learner will be able to* 1. *Gain proficiency in utilizing modern CAD software tools for PCB design. (PI 5.1.1)* *Demonstrate the ability to create and modify schematic diagrams and PCB layouts using the CAD software tool. (PI 5.1.2)*		
04.	**PCB Basic Artwork Designing**	**16**	**CO 4**
	Learning Objective/s: *To develop the ability to create precise and optimized PCB layouts, incorporating component placement, routing techniques, and other design considerations.*		
	Content: Keywords & Their Description: Footprint, Vias, Tracks, PCB Track width/ size calculation formula, Schematic Entry, Net listing, PCB Layout Designing Description of PCB Layers: Electrical Layers: Top Layer, Bottom Layer Mechanical Layers: Board Outlines and Cutouts, Drill Details Documentation Layers: Components Outlines, Reference Designation, Text Prototype Designing: Design Rule Check (DRC), Electronic rule checking (ERC) Rules for Track: Track Length, Track Angle, Vias, Track Size.		
	Theme for designing multiple experiments: 5. Create a simple schematic layout to glow an LED using CAD software. 6. Create a schematic layout to achieve the desired voltage at the output using CAD software. (voltage divider network). 7. Draw a schematic & board layout of a low pass filter circuit using CAD software. 8. Design a 2-layer schematic & board layout for gate driver circuit using CAD software**.**		
	Learning Outcomes: *A learner will be able to* 1. *Identify and interpret specific features and elements present in each PCB layer for optimized circuit designs. (PI 2.4.2)* 2. *Utilize knowledge of routing techniques, trace routing, vias, and signal integrity considerations, to create PCB schematic/board layouts. (PI 2.4.4)* 3. *Understand and apply design considerations such as EMC/EMI compliance, power distribution, and manufacturability constraints in PCB layout design. (PI 3.1.4)* 4. *Demonstrate the ability to optimize PCB layouts for space efficiency, minimizing signal interference, and meeting design specifications and requirements. (PI 3.1.6)*		
05.	**Advanced PCB Artwork Design, Fabrication and Testing**	**16**	**CO 5**

	Learning Objective/s: *To gain proficiency in advanced PCB design concepts and fabrication techniques adhering to IPC standards.*		
	Content: Creating Library & Components. Auto routing: Setting up Rules, Defining Constraints, Auto router Setup Post Designing & PCB. Fabrication Process: Printing the Design, Etching, Drilling, Interconnecting and Packaging Electronic Circuits (IPC) Standards, Gerber file Generation, Soldering and De-soldering, Component Mounting PCB and Hardware Testing. IPC Standard for PCB Fabrication.		
	Theme for designing multiple experiments: 9. Create a component library (any one component mentioned by the subject In Charge) 10. Design a schematic & board layout of a 15 V regulator circuit using LM317. 11. Design a schematic & board layout of a DC-DC buck/ boost converter circuit. 12. Design, fabrication, and testing of a 12V dual power supply circuit using 7812 & 7912 voltage regulators. 13. Use the given components to design a PCB board for the given microcontroller/ DSP Board. (any other design details to be given by subject in charge)		
	Learning Outcomes: *A learner will be able to* *1. Create custom components and libraries tailored to project specifications. (P.I.-3.2.1)* *2. Acquire skills in soldering, de-soldering, and component mounting techniques for assembling PCBs (PI 3.2.2)* *3. Demonstrate a comprehensive understanding of IPC standards relevant to PCB design and fabrication, to ensure compliance with industry practices. (PI 3.1.4)* *4. Employ design verification techniques such as electrical simulation to identify and rectify potential issues early in the design process. (PI 3.1.6)*		
	Minimum 03 experiments from 3, 4, 5 modules, and total at least 10 experiments	**60**	

Course Outcomes:

1. Identify various types of Printed Circuit Boards (PCBs) and materials based on fundamentals of PCB design.
2. Identify various electrical/electronic components and their packages/ footprints.
3. Demonstrate the ability to use of CAD tools for schematic design layout.
4. Ability to create precise and optimized PCB layouts adhering to IPC standards.
5. Develop skill in PCB fabrication, testing and debugging.

Performance Indicators:

P.I. No.	**P.I. Statement**
2.4.2	Produce and validate results through skilful use of contemporary engineering tools and models

2.4.4 Extract desired understanding and conclusions consistent with objectives and limitations of the analysis
3.1.4 Extract engineering requirements from relevant engineering Codes and Standards such as ASME, ASTM, BIS, ISO and ASHRAE.
3.1.5 Explore and synthesize engineering requirements considering health, safety risks, environmental, cultural and societal issues
3.1.6 Determine design objectives, functional requirements and arrive at specifications
3.2.1 Apply formal idea generation tools to develop multiple engineering design solutions
3.2.2 Build models/prototypes to develop a diverse set of design solutions
4.1.1 Define a problem, its scope and importance for purposes of investigation
4.1.2 Examine the relevant methods, tools and techniques of experiment design, system calibration, data acquisition, analysis and presentation
5.1.1 Identify modern engineering tools such as computer-aided drafting, modelling and analysis; techniques and resources for engineering activities
5.1.2 Create/adapt/modify/extend tools and techniques to solve engineering problems

Text Books:

1. Simon Monk, Make Your Own PCBs with EAGLE: From Schematic Designs to Finished Boards, 1st Edition, McGraw-Hill Education
2. Matthew Scarpino, Designing Circuit Boards with EAGLE: Make High-Quality PCBs at Low Cost, 1st Edition Prentice Hall.
3. Archambeault and Drewniak James, PCB Design for Real-World EMI Control, Springer Publications

Reference Books:

1. P. Horowitz and W. Hill, The Art of Electronics, 3 Edition, Cambridge University Press.

Other Resources:

1. Electronic Packaging and Manufacturing By Prof. A Bhattacharya, Prof. Goutam Chakraborty, IIT Kharagpur :-Web link- https://nptel.ac.in/courses/112105267

CONTINUOUS ASSESSMENT (50)

1. Continuous Assessment (20 Marks)

Suggested breakup of distribution

Task assigned during Lab session: 5 Marks

Internal Assessment: 10 marks

To develop schematic circuit design, wherein the basic circuit details will be given prior. Students are expected to research and collect required resources. They can use the resources and complete the assigned work on the given date and time within the Institute premises in presence of faculty member.

Regularity and active participation: 5 marks

2. Practical Test (30 Marks)

- Identify type of PCB single sided (single layer), multi-layer (double layer) /different materials (standard FR-4 epoxy glass, NelcoN400-6). (10 marks)
- Identify various electrical/electronic components and their packages/ footprints. (10 marks): split up of marks is mentioned below
    a. Active components (4 marks)
    b. Passive components (3 marks)
    c. Component package type (3 marks)

- Demonstrate component selection from libraries in schematic editor/ CAD software tool and its interconnection. (10 marks): split up of marks is mentioned below
    a. Selection of appropriate components and their packages/ footprints. (5 marks)
    b. Connection of component with other circuit elements. (5 marks)

3. END SEMESTER ASSESSMENT (Pract. / Oral Exam) (50 Marks)

(Pract. (25 marks) + Oral (25 marks) = 50 marks

1. Practical (25 marks)

For the End semester exams, practical examination will be conducted. The detail of the end-sem evaluation is as follows.

a. Design Task

Students will be provided with the circuit requirement. They will be asked to create a detailed PCB design including schematic, component placement, and routing using software tools like Eagle **(15 marks).**

b. Simulation and Analysis

To evaluate their ability to interpret simulation results, identify potential issues, and optimize the design, they will be asked to create a PCB Layout using the given circuit diagram based on following instructions. **(10 marks)**

i. Use dimensions as 4x3 inches.
ii. Calculate the track width and then proceed with routing.
iii. Avoid jumper wires
iv. Observe proper placement of components.
v. Label each component.

2. Oral (25 marks)

a. Conceptual Understanding (15 marks)

To evaluate the conceptual understanding, questions based on topics such as PCB materials, layers, routing techniques and other such design considerations will be asked. Also their ability to explain complex concepts clearly and connect theoretical knowledge to practical applications will be tested

b. Problem-solving Scenarios (10 marks)

Problem solving approach is evaluated based on critical thinking skills, and ability to propose effective solutions for the given problem.

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

Course Type	Course Code	Course Name	Credits
MP	MP402	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 : Modern Tool Usage
6. PO6 : The Engineer & Society
7. PO7 : Environment & Sustainability
8. PO8 : Ethics
9. PO9 : Individual & team work
10. PO10: Communication
11. PO11: Project Management & Finance
12. PO12: Life-long learning

Course Objectives

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

Course Outcomes

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

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

Guidelines for the Mini Project

- At the beginning of semester-III, project guides are required to conduct around 4 hours' orientation sessions including following topics:
  - Familiarizing students about infrastructure available at Department/Institute level and how to use it.

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

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

In-Semester Continuous Assessment and End-Semester Examination Guidelines

- The Head of the Departments will assign a guide to each of the mini-projects and shall form a progress monitoring committee. The guide will carry out weekly monitoring of the project's progress. The committee shall carry out in-semester project evaluation based on presentations with a minimum of two evaluations per semester.
- Assessment will be based on individual contributions, understanding, and responses to questions asked.
- Continuous Assessment marks distribution in semester III (50 marks):
    - 10 marks for the Topic Approval Presentation in front of the progress monitoring committee
    - 15 marks for the Mid-Semester Progress Presentation in front of the progress monitoring committee
    - 25 marks for the Final Report & Presentation
- Continuous Assessment marks distribution in semester IV (50 marks):

- 15 marks for the In-Semester Two Presentations
- 10 marks for the Participation in Project Competitions, TPP, etc.
- 25 marks for the Final Report & Presentation

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

Semester III:

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

Semester IV:

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

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

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

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

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

Course Type	Course Code	Course Name	Credits
VEC	VEC402	ENVIRONMENT & SUSTAINABILITY	02

Program Outcomes addressed:

1. PO2 : Problem Analysis
2. PO6 : The Engineer & Society
3. PO7 : Environment & Sustainability
4. PO8 : Ethics
5. PO12: Life-long learning

Course Objectives :

1. To provide students with foundational knowledge and understanding of environmental science principles and concepts.
2. To explore the principles of sustainability and their applications in various domains of engineering and technology.
3. To familiarize students with the legal and ethical considerations associated with environmental management and sustainability practices.
4. To equip students with practical skills and strategies for promoting renewable energy, energy efficiency, waste management, and environmental impact assessment.

Module	Details
01.	**Foundations of Environmental Sciences** Introduction to Environmental Science, Earth's Systems: Atmosphere, Hydrosphere, Lithosphere, Biosphere, Ecological Principles: Energy flow, Nutrient cycling, Biodiversity, Environmental Degradation: Pollution, Deforestation, Habitat loss, Environmental Monitoring and Data Analysis
02.	**Sustainability Basics** Concepts of Sustainability and Sustainable Development, Sustainable Resource Management: Water, Air, Land, Sustainable Agriculture and Food Systems, Sustainable Transportation and Urban Planning, Sustainable Business Practices and Corporate Social Responsibility
03.	**Legal & Ethical Considerations** Environmental Laws and Regulations: National and International Perspectives, Environmental Policies and Governance Frameworks, Ethical Issues in Environmental Decision Making, Environmental Justice and Equity, Corporate Ethics and Environmental Responsibility
04.	**Renewable energy & Energy efficiency** Introduction to Renewable Energy Sources: Solar, Wind, Hydro, Biomass, Geothermal, Energy Conversion Technologies and Systems Energy Efficiency Measures and Strategies, Policy Support for Renewable Energy Deployment, Economic and Environmental Impacts of Renewable Energy
05.	**Waste management & recycling** Solid Waste Management: Collection, Treatment, Disposal, Recycling Processes and Technologies, E-waste Management and Hazardous Waste Handling, Circular Economy Principles, Waste Reduction Strategies: Source Reduction, Reuse, Repair

06.	**Environmental Impact Assessment** Introduction to Environmental Impact Assessment (EIA), EIA Process: Screening, Scoping, Impact Assessment, Mitigation, Monitoring, Methods and Tools for Impact Assessment: GIS, LCA, Risk Assessment, Case Studies of EIA in Various Sectors: Infrastructure, Energy, Mining, Construction, Role of Stakeholders in EIA Process
Total no. of hours: **30**	

Course Outcomes :

1. Gain a comprehensive understanding of key environmental science principles and their relevance to engineering disciplines.
2. Apply principles of sustainability to analyze and address environmental challenges in engineering projects and processes.
3. Demonstrate awareness of legal and ethical considerations in environmental decision-making and management practices.
4. Develop proficiency in implementing renewable energy technologies and energy-efficient practices in engineering designs and operations.
5. Acquire knowledge and skills in waste management, recycling, and circular economy principles for sustainable resource utilization.
6. Apply environmental impact assessment methods to evaluate and mitigate the environmental impacts of engineering projects and activities.

Text Books :

1. Environmental Science: Toward a Sustainable Future by Richard T. Wright and Dorothy F. Boorse (Publisher: Pearson Education)
2. Introduction to Environmental Engineering and Science by Gilbert M. Masters and Wendell P. Ela (Publisher: Pearson Education)
3. Renewable and Efficient Electric Power Systems by Gilbert M. Masters (Publisher: Wiley)

Reference Books :

1. Environmental Law Handbook by Thomas F. P. Sullivan, David R. Buente Jr., and Sally Fairfax, Bernan Press
2. Sustainability Science by Bert J. M. de Vries, Springer
3. Environmental Impact Assessment: Theory and Practice by Peter Wathern, Routledge

Other Resources:

1. NPTEL Course: Introduction to Environmetal Engineering & Science- Fundamental & Sustainability Concepts, Prof.Brajesh Kumar Dubey, Department of Multidisciplinary IIT Kharagpur :-Web link https://archive.nptel.ac.in/courses/127/105/127105018/
2. NPTEL Course: Environment And Development, By Prof. Ngamjahao Kipgen, IIT Guwahati, Web link- https://onlinecourses.nptel.ac.in/noc23_hs133/preview