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 Electronics & Telecommunication Engineering

Curriculum Structure FY to B.Tech

and

First Year & Second Year Syllabi

Prepared by : Board of Studies for Department of Electronics & Telecommunication Engineering

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

Revision: 2024

Effective from: AY 2024-25

PREAMBLE FROM DEAN (ACADEMICS)

Accelerating Towards Excellence: Unveiling a New Era in Education

Dear Students, Faculty, and Stakeholders,

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

1. **Purpose of Autonomy:** Our commitment to autonomy is rooted in the imperative to bridge the gap between academia and industry. We envision education as a catalyst for individual growth, fostering self-sustainability and enhancing employability. Through our curriculum, 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 future of engineering education. Together, let us strive towards excellence, innovation, and societal impact.

Sincerely,

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

PREAMBLE FROM CHAIRPERSON (BoS)

Dear Students and Stakeholders,

It is with great pleasure and anticipation that we introduce the newly designed curriculum for autonomy at the Department of Electronics & Telecommunication (EXTC) engineering, Agnel Charities' Fr. C. Rodrigues Institute of Technology. This pioneering initiative aims to adapt to changing needs of the society, foster excellence, and drive innovation, thereby contributing to the nation's technological advancement and global competitiveness.

The Department has followed a top-down approach, for curriculum design. The steps include consultation with stakeholders; mapping the program outcomes (as per the Self-Assessment Report provided by NBA-in January 2016) to courses; setting learning objectives which are clear and measurable; designing the content aligned with the learning objectives; selection of instructional material, activities, and assessment tools to support the alignment, integration of experiential learning through projects, skill laboratories, internships, and industry collaboration; and set the stage for continuous evaluation and improvement. The consultation with Industry partners has enabled to identify requirements of Industry and to introduce four Honours/minor tracks, namely, VLSI, IoT & Embedded Systems, AIML and Network Security. The current trends in Industry have been taken into consideration while designing the content of core courses, laboratory courses, program electives as well as Honours/minor courses. The recent impetus to the semiconductor program in India has motivated us to include courses like Electronic Devices & Circuits, CMOS Design, ASIC Design, System on Chip Design etc which will certainly make our graduates ready for the semiconductor industry.

In alignment with the transformative vision laid out in the National Education Policy (NEP) 2020, our curriculum is designed to empower students with a comprehensive understanding of core domains like electronics, communication, and signal processing. Through multi-disciplinary courses, skill laboratories and exclusively designed laboratory courses, students develop the skills required to address complex challenges. Practical engineering aspects like Image Processing & Machine Vision, Antenna Design, High Frequency Communication etc are introduced through stand-alone laboratory courses. The curriculum caters to diversity in learners' choices by offering program electives in different fields like Microwave engineering/ Optical Fiber Communication/ Satellite & nano-satellite Communication etc.

In the autonomous curriculum, teachers have numerous opportunities to innovate and enhance the educational experience for students. Teachers actively participate in designing the curriculum, they can engage in research and development activities and offer Internships to explore new areas. Teachers can foster partnerships with industry organizations to enrich the curriculum with industry-relevant projects, internships, and guest lectures. Overall, autonomy in curriculum aims to empower the teachers to play a central role in shaping the learning experiences of students, in the field of Electronics & Telecommunication Engineering.

Thus, by nurturing creativity, resilience, and a spirit of inquisitiveness, we aspire to empower our graduates to become leaders, innovators, and global ambassadors of excellence in the field of electronics and telecommunication engineering. As we embark on this transformative journey, we invite all stakeholders to join us in shaping the future of engineering education. Together, let us strive towards excellence, innovation, and societal impact.

Sincerely,

Chairperson, Board of Studies-Electronics & Telecommunication Engineering,

Agnel Charities' Fr. C. Rodrigues Institute of Technology

Contents

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
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
MJP	Major project
MP	Mini Project
OE	Open Elective Course
P	Practical
PCC	Program Core Course
PE	Program Elective Course
SBL	Skill Based Laboratory
SEC	Skill Enhancement Course
T	Tutorial
VEC	Value Education Course

B. Credit Structure

1. B. Tech in Electronics & Telecommunication 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 Electronics & Telecommunication 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 online either 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 on 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 on 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	ECPCC301	Engineering Mathematics-III	3	--	1	3	--	1	4
PCC	ECPCC302	Network Theory	3	--	1	3	--	1	4
PCC	ECPCC303	Electronic Devices and Circuits	3	--	--	3	--	--	3
PCC	ECPCC304	Digital Circuit Design	3	--	--	3	--	--	3
MDM	ECMDM301	Data Structures and Algorithms	3	--	--	3	--	--	3
LC	ECLC301	Electronic Devices and Circuits Laboratory	--	2	--	--	1	--	1
LC	ECLC302	Digital Circuit Design Laboratory	--	2	--	--	1	--	1
SBL	ECSBL301	Python Laboatory	--	4	--	--	2	--	2
MP	ECMP301	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	ECPCC301	Engineering Mathematics-III	20+25@	30	50	1.5	2	125
PCC	ECPCC302	Network Theory	20+25@	30	50	1.5	2	125
PCC	ECPCC303	Electronic Devices and Circuits	20	30	50	1.5	2	100
PCC	ECPCC304	Digital Circuit Design	20	30	50	1.5	2	100
MDM	ECMDM301	Data Structures and Algorithms	20	30	50	1.5	2	100
LC	ECLC301	Electronic Devices and Circuits Laboratory	25	--	25	--	--	50
LC	ECLC302	Digital Circuit Design Laboratory	25	--	25	--	--	50
SBL	ECSBL301	Python Laboatory	50	--	50	--	--	100
MP	ECMP301	Mini Project-1A	50	--	--	--	--	50
HSSM	HSSM301	Product Design	50	--	--	--	--	50
		Total	**350**	**150**	**350**	--	--	**850**

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

@For continuous assessment of tutorials.

Curriculum Structure – SY Semester-IV

Course Type	Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
			L	P	T	L	P	T	Total
PCC	ECPCC405	Engineering Mathematics-IV	3	--	1	3	--	1	4
PCC	ECPCC406	Linear Integrated Circuits	3		--	3	--	--	3
PCC	ECPCC407	Principles of Communication	3	--	--	3	--	--	3
PCC	ECPCC408	Microcontrollers & Embedded Systems	3	--	--	3	--	--	3
MDM	ECMDM402	Control Systems and PLC	3	--	--	3	--	--	3
LC	ECLC403	Linear Integrated Circuits Laboratory	--	2	--	--	1	--	1
LC	ECLC404	Principles of Communication Laboratory	--	2	--	--	1	--	1
LC	ECLC405	Microcontrollers and Embedded System Laboratory	--	2	--	--	1	--	1
SBL	ECSBL402	Simulation Laboratory	--	4	--	--	2	--	2
MP	ECMP402	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	ECPCC405	Engineering Mathematics-IV	20+25@	30	50	1.5	2	125
PCC	ECPCC406	Linear Integrated Circuits	20	30	50	1.5	2	100
PCC	ECPCC407	Principles of Communication	20	30	50	1.5	2	100
PCC	ECPCC408	Microcontrollers & Embedded Systems	20	30	50	1.5	2	100
MDM	ECMDM402	Control Systems and PLC	20	30	50	1.5	2	100
LC	ECLC403	Linear Integrated Circuits Laboratory	25	--	25	--	--	50
LC	ECLC404	Principles of Communication Laboratory	25	--	25	--	--	50
LC	ECLC405	Microcontroller and Embedded System Laboratory	25	--	25	--	--	50
SBL	ECSBL402	Simulation Laboratory	50	--	50	--	--	100
MP	ECMP402	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 on 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	ECPCC509	Signals and Systems	3	--	--	3	--	--	3
PCC	ECPCC510	Digital Communication	3	--	--	3	--	--	3
MDM	ECMDM503	Database Management Systems	3	--	--	3	--	--	3
PE	ECPE501X	Program Elective Course-I	3	--	--	3	--	--	3
LC	ECLC506	Machine Learning for Communication Laboratory	--	2	--	--	1	--	1
LC	ECLC507	Digital Communication Laboratory	--	2	--	--	1	--	1
LC	ECLC508	Electromagnetics & Antenna Laboratory	--	2	--	--	1	--	1
AEC	AEC502	Professional Communication and Ethics-II	1	2	--	1	1	--	2
MP	ECMP503	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 programmes.

List of Courses under Program Elective Course-I (ECPE501X)

Course Code	Course Name
ECPE5011	Electromagnetic Wave Theory
ECPE5012	Robotics
ECPE5013	Digital VLSI[#]

#: Students who have opted for VLSI as their Honours track, can not opt for Digital VLSI as Program Elective Course-I.

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	ECPCC509	Signals and Systems	20	30	50	1.5	2	100
PCC	ECPCC510	Digital Communication	20	30	50	1.5	2	100
MDM	ECMDM503	Database Management Systems	20	30	50	1.5	2	100
PE	ECPE501X	Program Elective Course-I	20	30	50	1.5	2	100
LC	ECLC506	Machine Learning for Communication Laboratory	25	--	25	--	--	50
LC	ECLC507	Digital Communication Laboratory	25	--	25	--	--	50
LC	ECLC508	Electromagnetics & Antenna Laboratory	25	--	25	--	--	50
AEC	AEC502	Professional Communication and Ethics-II	50	--	--	--	--	50
MP	ECMP503	Mini Project-2A	50	--	--	--	--	50
HSSM	HSSM502	Entrepreneurship	50	--	--	--	--	50
		Total	**305**	**120**	**275**	--	--	**700**

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

Curriculum Structure – TY Semester-VI

Course Type	Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
			L	P	T	L	P	T	Total
PCC	ECPCC611	Discrete Time signal Processing	3		--	3	--	--	3
MDM	ECMDM604	Computer Communication Networks	3		--	3	--	--	3
PE	ECPE602X	Program Elective Course-II	3	--	--	3	--	--	3
LC	ECLC609	Discrete Time signal Processing Lab	--	2	--	--	1	--	1
LC	ECLC610	Image Processing and Machine Vision Laboratory	--	2	--	--	1	--	1
SBL	ECSBL603	HDL Programming Laboratory	--	4	--	--	2	--	2
MP	ECMP604	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 programmes.

***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**

List of Courses under Program Elective Course-II (ECPE602X)

Course Code	Course Name
ECPE6021	Random Signal Analysis
ECPE6022	Optical Fiber Communication
ECPE6023	Analog VLSI[#]

#: Students who have opted for VLSI as their Honours track, can not opt for Digital VLSI as Program Elective Course-II.

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	ECPCC611	Discrete Time signal Processing	20	30	50	1.5	2	100
MDM	ECMDM604	Computer Communication Networks	20	30	50	1.5	2	100
PE	ECPE602X	Program Elective Course-II	20	30	50	1.5	2	100
LC	ECLC609	Discrete Time signal Processing Laboratory	25	--	25	--	--	50
LC	ECLC610	Image Processing and Machine Vision Laboratory	25	--	25	--	--	50
SBL	ECSBL603	HDL Programming Laboratory	50	--	50	--	--	100
MP	ECMP604	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 on 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	ECPCC712	Mobile Systems and Wireless Networks	3	--	--	3	--	--	3
PE	ECPE703X	Program Elective Course-III	3	--	--	3	--	--	3
PE	ECPE704X	Program Elective Course-IV	3	--	--	3	--	--	3
OE	ECOE701X	Open Elective Course –I	3	--	--	3	--	--	3
LC	ECLC711	High Frequency Laboratory	--	2	--	--	1	--	1
LC	ECLC712	Wireless Networks Laboratory	--	2	--	--	1	--	1
MJP	ECMJP701	Major Project-A	--	6	--	--	2	--	2
HSSM	HSSM703	Financial Planning	2	--	--	2	--	--	2
		Total	**14**	**10**	**--**	**14**	**4**	**--**	**18**

List of Courses under Program Eelctive Course-III) (ECPE703X)

& Program Elective Course-IV (ECPE704X)

Course Code	Course Name	Course Code	Course Name
ECPE7031	Advanced Digital Signal Prossing	**ECPE7041**	Internet of Things#
ECPE7032	Microwave Engineering	**ECPE7042**	Network Security#
ECPE7033	Computer Architecture in VLSI#	**ECPE7043**	Deep Learning#

#Students who have opted for Honours in VLSI/ IoT & Embedded Systems/Network Security/AIML, can not opt for respective Program Elective-III or IV in the same domain as Honours.

List of Open Elective Course –I (OE701X)

Course Code	Open Elective Course-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 or relevant domain need to select other Open Elective.

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	ECPCC712	Mobile Systems and Wireless Networks	20	30	50	1.5	2	100
PE	ECPE703X	Program Elective Course-III	20	30	50	1.5	2	100
PE	ECPE704X	Program Elective Course-IV	20	30	50	1.5	2	100
OE	ECOE701X	Open Elective Course –I	20	30	50	1.5	2	100
LC	ECLC711	High Frequency Laboratory	25	--	25	--	--	50
LC	ECLC712	Wireless Networks Laboratory	25	--	25	--	--	50
MJP	ECMJP701	Major Project-A	50	--	--	--	--	50
HSSM	HSSM703	Financial Planning	50	--	--	--	--	50
		Total	**230**	**120**	**250**	--	--	**600**

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

Curriculum Structure – B. Tech Semester-VIII

Course Type	Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
			L	P	T	L	P	T	Total
PE	ECPE805X	Program Elective Course-V	3	--	--	3	--	--	3
OE	OE802X	Open Elective Course-II	3	--	--	3	--	--	3
MJP	ECMJP802	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.									

NOTE: Please note that due to the internship requirement in the 8th semester, theory courses during this semester will be conducted online either synchronously or asynchronously.

Students can choose program Elective Course-V, from one of the domains listed below. The list of courses within the individual domains will be made available before the course registration

List of Course Domains under Program Elective Course-V (PE805X)

Course Code	Course Domain
ECPE8051	Advanced Communication Networks
ECPE8052	Cloud Technologies
ECPE8053	Satellite Communication

List of Courses under Open Elective Course-II (OE802X)

Course Code	Open Elective Course-II (OE802X)
OE8021	Project Management
OE8022	Finance Management
OE8023	Entrepreneurship Development and Management
OE8024	Human Resource Management
OE8025	Professional Ethics and CSR
OE8026	IPR and Patenting
OE8027	Digital Business Management
OE8028	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	ECPE805X	Program Elective Course-V	20	30	50	1.5	2	100
OE	OE802X	Open Elective Course-II	20	30	50	1.5	2	100
MJP	ECMJP802	Major Project-B	50	--	50	--	--	100
INTR	INTR801	Internship	50	--	50	--	--	100
		Total	**140**	**60**	**200**	--	--	**400**

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

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

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

E. First Year Syllabi

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 maximas and minimas of functions of two variables.* **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)*	**5-7**	**CO- 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.* **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)*	**4-6**	**CO-2**

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*. **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).*	**5-7**	**CO- 3**

05.	**Kinetics of Particle: D'Alembert's** ***Learning Objective/s:*** *To understand the concept of kinetics of particle and the different methods to solve the engineering problems.*	**9-11**	**CO- 4**
	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).*		
06.	**Centroid** ***Learning Objective/s:*** *To understand the importance of Centroid which can affect the stability of the objects in the real life situations.*	**3-5**	**CO- 5**
	Contents: First Moment of Area. Centroid of Composite Plane Lamina.		
	Self-Learning Topics: *Explore methods for calculating the First Moment of Area.* ***Learning Outcomes:*** *A learner will be able to* 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).*		
	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.
2.1.4	Identify existing processes/solution methods for solving the problem; including forming justified approximations and assumptions.
2.1.5	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** ***Learning Objective/s:*** *Learner is expected to recall one dimensional arrays and understand its usage and apply it to solve problems in C.*	**12**	**CO- 4**
	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.	Apply fundamental engineering concepts to solve 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.
2.2.5	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.*	**4-6**	**CO-1**
	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)*		
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*	**3-5**	**CO-1**
	Contents: Structure: order and disorder, importance of short range order, properties of non-crystalline solid; Classes: metals/metalloid glasses, alloys of transitions metals with rare earth atoms. Silica glasses and related alloys.		

	Self-Learning Topics: *Application of non-crystalline materials.* ***Learning Outcomes:*** *A learner will be able to* 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 Objectives:*** *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 tosolveengineering problems.
2.1.2	Identify engineering systems, variables, and parameters to solve the problems.
2.2.2	Identify/ assemble/integrate mathematical tools to information and resources.
2.2.3	Identify existing processes/solution methods for solving the problem, including forming justified approximations and assumptions.
2.2.4	Compare and contrast alternative solutions to select the best methodology.
3.1.6	Determine design objectives, functional requirements and arrive at specifications.
3.3.3	Identify relevant data from the given resources and arrive at an optimal design solution for particularspecifications.
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.* **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)*	**20**	**CO- 2**
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 concepts in Astadhyayi Importance of Verbs, Role of Sanskrit in Natural Language Processing, Number System and Units of Measurement, concept of zero and its importance, Large numbers & their representation, Place Value of Numerals, Decimal System, Measurements for time, distance and weight, Unique approaches to represent numbers (Bhūta Saṃkhya System, Kaṭapayādi System), Pingala and the Binary system, Knowledge Pyramid, Prameya – A Vaiśeṣikan approach to physical reality, constituents of the physical reality, Pramāṇa, Saṃśaya

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

Course Outcomes:

1. Explore the diverse realms of the Indian Knowledge System, spanning philosophy, literature, 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. Second Year Syllabi

Course Type	Course Code	Course Name	Credits
PCC	ECPCC301	ENGINEERING MATHEMATICS-III	03+01*

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

*For Tutorial

Pre-requisite:

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

Program Outcomes addressed:

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

Course Objectives:

1. To provide the basic knowledge on the concept of various Mathematical transforms.
2. To introduce the concept of Complex Variables and its applicability in the field of Engineering.

Module	Details	Hrs.	CO
	Course Introduction Engineering mathematics and transforms are indispensable tools in EXTC engineering, enabling engineers to analyze signals, systems, and data in various domains such as signal processing, communications, control systems, imaging, and data analysis. For example- 1. Application of Laplace Transforms in Engineering Problems. 2. Application of Fourier series and Transform in Spectrum analysis. 3. Application of Complex and Analytic functions in Control Theory.	**01**	
01.	**Laplace Transforms.**	**06-08**	CO- 1
	Learning Objective/s: *The learner will be able to analyze standard Laplace Transforms using basic definitions and apply its knowledge 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* *Interpret standard Laplace transforms and apply it for finding Laplace transform of mathematical problem. (P.I.- 1.1.2)* *Apply advanced techniques of factorization to solve Laplace Transform problems having higher order terms. (P.I.- 1.1.3)* *Identify discontinuous functions and apply Heaviside's unit step transform to compute the transforms. .(P.I-2.1.2)* *Identify whether shifting or scaling property is to be used based on the nature of mathematical problem. (P.I.-2.1.3)*		
02.	**Inverse Laplace Transform.** ***Learning Objective/s:*** *Learner will be able 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: Method of partial fraction, Differentiation Property. Convolution Theorem (without proof), Solution of Differential equations-initial value problem and Boundary Value Problem. ***Self-Learning Topics:*** *Application of Initial and Final Value Problem in EXTC Engineering.* **Learning Outcomes:**	**06-08**	CO- 1
	A learner will be able to 1. *Interpret standard Inverse Laplace transforms and its applicability to a given mathematical problem. (P.I.-1.1.2)* 2. *Apply advanced computation techniques to solve initial and boundary value problems of differential equations. (P.I.-1.1.3)* 3. *Identify whether differentiation property or Convolution theorem is to be applied based on the nature of the Inverse Laplace mathematical problem. (P.I.-2.1.3)* 4. *Identify whether linear, repeated or quadratic type of partial fraction method is to be used to find Inverse Laplace transform. (P.I.-2.1.2)*		
03.	**Fourier Series** ***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:**	**07-09**	CO- 2

	Dirichlet's conditions, Definition of 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* **Learning Outcomes:** *A learner will be able to* 1. *Apply mathematical techniques of algebra and calculus in determining Fourier coefficients. (P.I.-1.1.1)* 2. *Apply fundamental concept of Series and summation to find Fourier series expansion of the periodic function. (P.I.-1.3.1)* 3. *Articulate and interpret the basics of periodic functions and series. (P.I.-2.1.1)* 4. *Analyze waveforms and use this information to identify periodic functions. (P.I.-2.1.3)*		
04.	**Fourier Transform** ***Learning Objective/s:*** *Learner will be able to apply the concept of Fourier transform to convert and analyze a function in a form that describes frequencies present in the original function.* **Contents:** Fourier Integral Theorem, Definition of Fourier Transform, Fourier transform of even and odd function, Properties of Fourier Transform: Linearity, scaling and shifting. Fourier Transform of derivatives, Inverse Fourier Transform. ***Self-Learning Topics:*** *Convolution theorem. Fourier sine transform, Fourier cosine transform* ***Learning Outcomes:*** *A learner will be able to* 1. *Identify the correct properties of Fourier Transform applicable to a given problem and use it for solving advanced mathematical problems. (P.I.-2.1.3)* 2. *Apply the concept of calculus for finding frequencies present in a function using Fourier Transform. (P.I.-1.1.1)* 3. *Synthesize information about the waveform in terms of sine and cosine waveforms. (P.I.-2.2.3)* 4. *Apply fundamental concepts of product integration to compute inverse Fourier Transform. (P.I.-1.3.1)*	**07-10**	CO- 3
05.	**Complex Variables-I** ***Learning Objective/s:*** *To analyze if a given complex function is analytic or not by applying basic definitions and theorems of Complex Variables*	**05-07**	CO- 4

	Contents: Statement of D'Moivre's Theorem, Expansion of $\sin n\theta, \cos n\theta$ in terms of sines and cosines of multiples of θ and powers of$\sin\theta, \cos\theta$. Complex Variables, Calculus of Complex Variables. (Limit, Continuity, Differentiability) Analytic Functions, Necessary and sufficient conditions for $f(z)$to be analytic (Without proof), Cauchy-Riemann equations: Cartesian and Polar coordinates ***Self-Learning Topics:*** *Roots of a complex number, Conformal mapping* ***Learning Outcomes:*** *A learner will be able to* 1. *Interpret the real and imaginary part of complex function using the knowledge of complex variables. (P.I.-2.1.2)* 2. *Identify if a given complex function is analytic or not using Cauchy Riemann Equations. (P.I.-2.1.3)* 3. *Apply mathematical techniques of calculus and algebra to solve mathematical problems of complex variables and functions. (P.I.-1.1.1)* 4. *Apply advanced techniques of analytic functions for finding derivatives of a complex function. (P.I.-1.1.3)*		
06.	**Complex Variables-II** ***Learning Objective/s:*** *The learner is expected to analyze if a given function has its harmonic conjugate and apply it for finding the Orthogonal Trajectories of a given mathematical function.* **Contents:** Milne Thompson Formula. Milne-Thomson method: Determining analytic functions when real part (u) is given and when imaginary part (v) is given. Determining analytic functions using Cauchy Riemann Equations, Harmonic function, Harmonic conjugate, Orthogonal trajectories ***Self-Learning Topics:*** *Determining analytic function when the combination of Real and Imaginary part is given, linear mapping.* ***Learning Outcomes:*** *A learner will be able to* 1. *Identify harmonic conjugates and use its knowledge to find orthogonal trajectories and confirm it using Cauchy Riemann Equations. (P.I.-2.3.2)* 2. *Apply the mathematical techniques of calculus and algebra for determining the analytic functions using Milne Thomson Formula. (P.I.-1.1.1)* 3. *Apply advanced techniques of complex variable calculus and complex variable algebra for determining the orthogonal trajectories of a mathematical function. (P.I.-1.3.1)* 4. *Identify the existence of Laplace equations and use its knowledge for Harmonic functions. (P.I.-2.1.2)*	**05-07**	CO-5
	Course Conclusion	**01**	
	Total	**45**	

Course Outcomes:
Students will be able to -

1. Analyse standard Laplace and Inverse Laplace Transforms and apply it for finding solutions to Differential equations.
2. Analyse periodic functions and apply the concept of Fourier series to solve Engineering Problems.
3. Analyse Standard Fourier transforms and apply it to solve mathematical problems.
4. To analyse analytic functions by applying techniques of complex variables and complex calculus.
5. To apply complex variable theory in analysing harmonic conjugates and determine orthogonal trajectories used in engineering problems.

Performance Indicators:

P.I. No.	P.I. Statement
1.1.1	Apply mathematical techniques such as calculus, linear algebra, probability and statistics, Boolean algebra to solve problems.
1.1.2	Apply mathematical transforms to solve problems.
1.1.3	Apply advanced mathematical techniques such as integral and differential equations to describe/solve/construct a mathematical model of a system.
1.3.1	Apply fundamental Engineering concepts to solve Engineering problems.
2.1.1	Articulate problem statements and identify primary objectives and key constraints.
2.1.2	Identify engineering systems, variables, and parameters to solve the problems
2.1.3	Identify the mathematical, engineering and other relevant knowledge that applies to a given problem
2.2.3	Identify existing processes/solution methods for solving the problem, including forming justified approximations and assumptions.
2.3.2	Identify assumptions (mathematical and physical) necessary to allow modelling of a system at the level of accuracy required

Textbooks:

1. Advanced Engineering Mathematics, H. K. Dass, Twenty-first Revised Edition, 2013, S.Chand and Company Ltd.

Reference Books:

1. Advanced Engineering Mathematics, Erwin Kreyszig, Eight Edition, 2010, Wiley Eastern Limited
2. Complex Variables and Applications, S. Ponnusamy and Herb Silverman, First, 2006, Birkhauser Boston
3. Higher Engineering Mathematics, Dr. B. S. Grewal, Forty Second Edition, 2017, Khanna Publication
   Laplace Transforms, Murray R. Spiegel, First Edition, 2004, Tata McGraw-Hill Publishing Company Ltd
4. Linear Algebra, Seymour Lipchitz and Marc Lipson, Fourth Edition,2009, Tata McGraw-Hill Publishing Company Ltd.

Other Resources:

1. NPTEL Course: Laplace Transforms By Prof. Indrava Roy, Department of Mathematics, The Institute of Mathematical Science:-Web link https://youtube.com/playlist?list=PLyqSpQzTE6M8gnapvdLN92hs_4F75OSuH&feature=shared

2. NPTEL Course: Fourier Series by Prof. Priyanjali Pratap Singh, IIT Rorkee https://youtube.com/playlist?list=PLs7oDAL8_ouJ5w8wCPtKnK2I09MlKC6kP&feature=shared

   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

A. IN-SEMESTER ASSESSMENT (75 MARKS)

1. Continuous Assessment-Theory (20 Marks)

Suggested breakup of distribution

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

b) One Class test:05 Marks

c) One Team-Pair-Solo activity: 05 Marks

d) Regularity and active participation: 05 Marks

2. Continuous Assessment - Tutorial (25 Marks)

Suggested breakup of distribution

a) Tutorial Assignments and Class tests: 20 Marks

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

b) Regularity and active participation: 05 Marks

3. Mid Semester Examination (30 Marks)

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

B. END SEMESTER EXAMINATION (50 MARKS)

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

Course Type	Course Code	Course Name	Credits
PCC	ECPCC302	NETWORK THEORY	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 Tutorials

Pre-requisite:

1. ESC102- Basic Electrical Engineering

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO9: Individual and teamwork

Course Objectives:

1. To impart knowledge on the fundamentals of network analysis.
2. To analyse electrical network using graph theory.
3. To acquire analytical skills to solve the network circuits using mathematical techniques .

Module	Details	Range	CO
	Course Introduction This is foundation course which deals with fundamental concepts of dependent source based electrical network theorems, graph theory based circuit analysis, frequency and time domain analysis of electrical circuit, two-port network parameters and network functions for the complex circuit analysis in terms of pole-zero based system stability, and synthesis of the networks based on the network functions. Moreover, this course is essential for the courses like Electronics Devices and Circuits, Linear Integrated Circuits, etc.	**01**	
01.	**Network Theorems**	**06-08**	CO- 1
	Learning Objective/s: *Introduce students to independent and dependent sources, node and mesh techniques, superposition, Thevenin, Norton, and Maximum Power Transfer theorems.*		
	Contents:		
	Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Maximum power transfer theorem. Applications: Thevenin's theorem in potential divider bias.		

	Self-Learning Topics: *Application of maximum power transfer in communication system/power system.* ***Learning Outcomes:*** *A learner will be able to* 1. *Solve numerical based network theorem (P.I.1.1.1)* 2. *Apply the network theorems to find the voltage and current flowing through the network branch. (P.I.1.1.2)* 3. *Identify the dependent and independent sources present in network. (P.I.-2.1.2)* 4. *Apply maximum power transfer theorem and find the value of RL to deliver max. power (P.I.-2.2.3)*		
02.	**Graph Theory** ***Learning Objective/s:*** *Introduce students to objectives of graph theory, oriented and non-oriented graphs, graph terminologies, matrix representation of the graph such as incidence, reduced incidence, tieset/loop/circuit, cutset, fundamental cutset, and relationship between various matrices such as A, B, and Q.* **Contents:** Concept of network graphs, Tree, Link cut set, Network matrices, Node incidence matrix, Loop incidence matrix, Cutset incidence matrix, Network analysis using network incidence matrices. ***Self-Learning Topics:*** *Application of graph theory in electrical network* ***Learning Outcomes :*** *A learner will be able to* 1. *Convert a circuit into an oriented /non-oriented graph (PI:1.1.1).* 2. *Plot different forms (planar, non-planar, oriented, tree, co-tree) of a graph from a given circuit (PI:2.1.1).* 3. *Write/form the respective matrices from a graph obtained for a specific circuit (PI:2.1.3).* 4. *Solve KCL and KVL with the help of graph theory(P.I.-1.4.1)*	**05-07**	CO- 2
03.	**Time and frequency domain analysis** ***Learning Objective/s:*** *Introduce students to time domain analysis of R-L and R-C circuits in terms of forced and natural response, initial and final values, solution of circuits represented by first and second order differential equations, frequency domain analysis of R-L-C circuits in terms of natural and forced response, effect of damping factor, and solution of circuits representing the second order differential equations.* **Contents:** Time and frequency domain analysis: Forced and natural response, initial and final values, Solution using first order and second order differential equation with step signals, Frequency domain analysis of R-L-C Circuits: Forced and natural response, effect of damping factor, Analysis of electrical circuits using Laplace Transform for standard inputs, transformed network with initial conditions	**07-09**	CO- 3

	Self-Learning Topics: *Transient behavior of an air conditioner.* ***Learning Outcomes :*** *A learner will be able to* 1. *Apply Laplace transform to write current and voltage equations of R-L/R-C/R-L-C circuits (PI-:2.1.3)* 2. *Plot time/frequency domain response of given network. (PI:2.1.2).* 3. *Find the transfer function of step signal (P.I. 1.1.3)* 4. *Find the V and I of the RLC circuit using differential equations. (P.I.-1.1.1)* 5. *Work in a team of diverse students to learn on transient analysis in various ways (PI:9.2.1)* 6. *Solve the problems related to transient analysis in a group of students (PI:9.1.1).*		
04.	**Two-port Networks** ***Learning Objective/s:*** 1. *Introduce students to open and short circuit parameters, transmission and hybrid parameters, relationship among parameters and interconnections of two-port networks T and π representation*. **Contents:** Open circuit (Z-parameters), Short circuit (Y-Parameters), Hybrid and transmission parameters (h-parameters, ABCD-Parameters), Series, parallel connections of the two-port networks, Tandem connections of two-port networks ***Self-Learning Topics:*** *Analysis of common emitter amplifier using two-port parameters.* ***Learning Outcomes:*** *A learner will be able to* 1. *Identify open and short circuit parameters, transmission and hybrid parameters (PI:2.1.2).* 2. *Solve the numerical on two port network and relate various parameters (PI:1.1.2)* 3. *To perform interconnections of Two-Port Networks T & π representation (PI:2.1.4)* 4. *Define the open and short circuit parameters of the two port network (PI-1.1.4)*	**06-08**	CO- 4
05.	**Network Functions** ***Learning Objective/s:*** 1. *Introduce students to one port and two port network functions, driving point and transfer function, students to poles and zeroes of network functions, necessary conditions for driving point function and transfer function, calculation of residues by graphical method, and testing for Hurwitzs polynomial and the analysis of ladder and symmetrical lattice networks.*	**07-09**	CO- 4

	Contents: Introduction, Concept of complex frequency, Immittance functions, Poles and zeros of network functions, Necessary condition for driving point Immittance functions and transfer function ***Self-Learning Topics:*** *Stability analysis through network function* ***Learning Outcomes:*** *A learner will be able to* 1. *Identify one port and two port network functions, driving point and transfer functions (PI:2.1.3).* 2. *Apply mathematical techniques to find poles and zeros. (P.I.-1.1.1)* 3. *Identify, necessary conditions for driving point function and transfer function (P.I. 2.2.3)* 4. *Calculation of residues by graphical method, and testing for Hurwitzs polynomial (PI:1.4.1).*		
06.	**Network Synthesis** ***Learning Objective/s:*** *To formulate the state variable models to identify the Eigen values and use it to analyze the system behavior.* **Contents:** Positive real functions and their properties, Tests for positive real functions, Hurwitz polynomials, Driving-point synthesis of LC, RC and RL networks, Foster forms and Cauer forms. ***Self-Learning Topics:*** *Signal Processing Filters, Impedance Matching Networks* ***Learning Outcomes:*** *A learner will be able to* 1. *To test the polynomial by using fractional expansion (PI:1.1.1).* 2. *Identify Hurwitz polynomial (PI:1.3.1).* 3. *Identify the positive real functions (P.I. 2.1.2)* 4. *Compare and contrast types Foster forms P.I. (2.2.4)*	**06-08**	CO-5
	Course Conclusion	**01-02**	
	Total	**45**	

Course Outcomes:

Students will be able to

1. Apply techniques to analyze electric circuits having dependent sources.
2. Apply graph theory concepts to analyze the electric circuits
3. Perform the transient analysis using classical and Laplace Transform methods
4. Analyze the two-port network parameters and network functions-based circuits' behaviour
5. Synthesize R-L-C circuits in Cauer and Foster forms

Performance Indicators:

P.I. No.	P.I. Statement
1.1.1	Apply mathematical techniques such as calculus, linear algebra, probability and statistics, Boolean algebra to solve problems.
1.1.2	Apply mathematical transforms to solve problems.
1.1.3	Apply advanced mathematical techniques such as integral and differential equations to describe/solve/construct a mathematical model of a system.
1.4.1	Apply concepts of electronics and communication engineering and allied disciplines to solve engineering problems
2.1.1	Articulate problem statements and identify primary objectives and key constraints.
2.1.2	Identify engineering systems, variables, and parameters to solve the problems
2.1.3	Identify the mathematical, engineering and other relevant knowledge that applies to a given problem.
2.2.3	Identify existing processes/solution methods for solving the problem, including forming justified approximations and assumptions
2.2.4	Compare and contrast alternative solutions to select the best methodology.
9.1.1	Recognize a variety of working and learning preferences; appreciate the value of diversity on a team
9.2.1	Demonstrate effective communication, problem-solving, conflict resolution and leadership skills

Text Books :

1. Basic Circuit Theory, Desoer C. A. and Kuh E. S., McGraw Hill International Book Company.
2. Network Analysis, Valkenberg V, 3rd Ed., 2007 International Edition, Prentice Hall
3. Network Analysis and Synthesis, Franklin F Kuo, 2 nd ed, 1966, Wiley Toppan
4. Circuit Theory, A. Chakrabarti, 6th Edition, Dhanpat Rai & Co.Delhi
5. Network Analysis and Synthesis, K. M. Soni, S. K. Kataria and Sons

Reference Books:

1. Networks and Systems, D. Roy Choudhury, 1998, New Age International
2. Circuits and Networks, Sudhakar, Shyammohan, S. Palli, Tata McGraw-Hill education

Other Resources :

1. Course: Network Analysis by Prof. Tapan Kumar Bhatttacharya, IIT Kharagpur; Weblink - https://archive.nptel.ac.in/courses/108/105/108105159/

A. IN-SEMESTER ASSESSMENT (75 MARKS)

1. Continuous Assessment-Theory (20 Marks)

Suggested breakup of distribution

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

b) One Class test:05 Marks

c) Open book test/ Open notes test: 05 Marks

d) Regularity and active participation: 05 Marks

2. Continuous Assessment - Tutorial (25 Marks)

Suggested breakup of distribution

a) Tutorial Assignments and Class tests: 20 Marks

Students need to solve (in the class only during tutorial hour) 08 tutorials provided by the course coordinator on entire syllabus. Each tutorial carries 20 Marks. Average will be taken of all tutorial marks.

b) Regularity and active participation: 05 Marks

3. Mid Semester Examination (30 Marks)

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

B. END SEMESTER EXAMINATION (50 MARKS)

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

Course Type	Course Code	Course Name	Credits
PCC	ECPCC303	ELECTRONIC DEVICES 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. BSC205- Engineering Physics-II
2. ESC203- Basic Electronics Engineering

Program Outcomes addressed :

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO3: Design/Development of Solutions
4. PO9: Individual and teamwork

Course Objectives :

1. To impart the knowledge to analyse and design various amplifiers using bipolar and unipolar devices.
2. To introduce various types of power amplifier circuits.
3. To impart the knowledge to analyse MOSFET based differential amplifier.
4. To introduce advanced FETs like HEMT and MESFETS.

Module	Details	Hrs	CO
	Course Introduction Electronic devices and circuits play an indispensable role in both industry and daily life. In Industry, they enable automation, control systems, and data processing, enhancing efficiency and precision across manufacturing processes. Electronics also underpin vital communication networks, including the internet and mobile networks, connecting people globally. EDC is crucial for courses like Communication System, where it forms the basis for signal processing and modulation techniques. Moreover, in courses such as Microelectronics, EDC concepts are essential for designing and analysing integrated circuits and semiconductor devices.	**01**	

01.	**BJT Amplifiers**	**05-07**	CO- 1, CO-2
	Learning Objective/s:		
	To analyze and design BJT based amplifiers using concepts of low/high frequency modelling.		
	Contents:		
	Voltage amplifier, current amplifier, trans-conductance amplifier and trans-resistance amplifier, tuned amplifier, applications of each type of amplifier. Small signal analysis, low frequency models (Ebers-Moll model and hybrid-pi model), estimation of voltage gain, current gain, input resistance and output resistance. Design procedure for particular specifications, frequency analysis of multistage amplifiers. High frequency modelling and analysis of CE amplifiers.		
	Self-Learning Topics:		
	High frequency applications of BJT amplifiers. Read datasheet of high Frequency transistor BF 547.		
	Learning Outcomes :		
	A learner will be able to 1. *Apply fundamental engineering concepts to draw small signal models of BJT based amplifiers. (PI 1.3.1)* 2. *Identify engineering variables, and parameters of the amplifier circuit to draw the small signal model. (P.I 1.2.1)* 3. *Identify the mathematical electronics engineering knowledge that applies to analyzing amplifier circuits.(P.I 2.1.3)* 4. *Identify existing solution methods for solving the problem, including forming justified approximations on component values. (P.I 2.2.3)* 5. *By review of the state-of-the-art, synthesize an amplifier circuit that meets certain specifications.(P.I 3.1.3)* 6. *Identify relevant data from datasheets and arrive at an optimal design solution for particular specifications. (P.I 3.3.3)*		
02.	**Field Effect Devices: JFET**	**09-10**	CO- 1, CO-2
	Learning Objective/s:		
	To analyze and design JFET based amplifiers using concepts of low/high frequency modelling.		
	Contents:		
	Construction, Principle of Operation, device characteristics and applications. Biasing schemes for FET amplifiers, bias stability, various configurations (such as CS, CG, CD) and their features, small signal analysis, low frequency models, estimation of voltage gain, input resistance, output resistance etc., design procedure for CS configuration with particular specifications, frequency analysis of multistage amplifiers.		

	Self-Learning Topics: *High frequency analysis of JFET CS amplifier* ***Learning Outcomes :*** *A learner will be able to* 1. *Identify engineering variables, and parameters of the amplifier circuit to draw the small signal model. (P.I 1.2.1)* 2. *Apply concepts of electronics and communication engineering and allied disciplines to solve engineering problem on JFET amplifier. (P.I.-1.4.1)* 3. *Identify the mathematical electronics engineering knowledge that applies to analyzing amplifier circuits.(P.I 2.1.3)* 4. *Identify existing solution methods for solving the problem, including forming justified approximations on component values. (P.I 2.2.3)* 5. *By review of the state-of-the-art, synthesize an amplifier circuit that meets certain specifications.(P.I 3.1.3)* 6. *Identify relevant data from datasheets and arrive at an optimal design solution for particular specifications..(P.I 3.3.3)* 7. *Demonstrate effective communication, problem-solving skills during the activity based learning. (P.I 9.2.1)* 8. *Present results of the calculation as a team, with smooth integration of contributions from all individual efforts. (P.I 9.3.1)*		
03.	**Field Effect Devices: MOSFET** ***Learning Objective/s:*** *To analyze and design MOSFET based amplifiers using concepts of low/high frequency modelling.* **Contents:** Construction, Principle of Operation, device characteristics and applications. Small Signal Equivalent circuits of MOSFET. Introduction, Analysis and design of CS Amplifier, MOSFET based switch. High and low frequency analysis of CS (MOSFET) amplifier. ***Self-Learning Topics:*** *Study datasheet of Infineon's IRFZ44N MOSFET.* ***Learning Outcomes :*** *A learner will be able to* 1. *Identify engineering variables, and parameters of the amplifier circuit to draw the small signal model. (P.I 1.2.1)* 2. *Apply concepts of electronics and communication engineering and allied disciplines to solve engineering problem on MOSFET amplifier. (P.I.-1.4.1)* 3. *Identify the mathematical electronics engineering knowledge that applies to analyzing amplifier circuits. (P.I 2.1.3)* 4. *Identify existing solution methods for solving the problem, including forming justified approximations on component values. (P.I 2.2.3)* 5. *By review of the state-of-the-art, synthesize an amplifier circuit that meets certain specifications. (P.I 3.1.3)*	**09-10**	CO- 1, CO-2

	6. *Identify relevant data from datasheets and arrive at an optimal design solution for particular specifications. (P.I 3.3.3)* 7. *Demonstrate effective communication and problem-solving skills during the activity based learning. (P.I 9.2.1)* 8. *Present results of the calculation as a team, with smooth integration of contributions from all individual efforts. (P.I 9.3.1)*		
04.	**Large Signal Amplifiers** ***Learning Objective/s:*** *Classify and Analyze types of power amplifiers* **Contents:** Difference between small signal & large signal amplifiers, Classification and applications of Power amplifier. Working and analysis of Class A power amplifier (Series fed and transformer coupled), Class B power amplifier, Class AB with diode biasing. Thermal considerations and heat sinks. ***Self-Learning Topics:*** *Comprehending the implementation of audio power amplifier used in headphones drivers/cellphones/Televisions.* ***Learning Outcomes :*** *A learner will be able to* 1. *Apply fundamental engineering concepts to solve problem on power amplifiers. (P.I 1.3.1)* 2. *Apply concepts of Electronics and communication engineering and allied disciplines to solve problem power amplifiers. (P.I 1.4.1)* 3. *Identify engineering systems, variables, and parameters to compare power amplifiers. (P.I 2.1.2)* 4. *Identify the engineering knowledge that applies to given problems of incorrect biasing and heat dissipation. (P.I 2.1.3)*	**09-10**	CO- 3
05.	**Differential Amplifiers** ***Learning Objective/s:*** *Introduce the circuits of differential amplifiers and analyze the circuits.* **Contents:** Introduction to basic Differential amplifier, Need of Differential amplifier, parameters of diff. amplifiers, AC and DC analysis of MOSFET based Differential amplifier. ***Self-Learning Topics:*** *Read datasheet of INA592 from Texas Instruments.* ***Learning Outcomes :*** *A learner will be able to* 1. *Apply fundamental engineering concepts to solve problem on power amplifiers. (P.I 1.3.1)*	**06-07**	CO- 4

	2. *Apply concepts of Electronics and communication engineering and allied disciplines to solve problems on differential amplifier. (P.I 1.4.1)* 3. *Identify engineering systems, variables, and parameters to solve the problems on power amplifier analysis. (P.I 2.1.2)* 4. *Identify the mathematical and engineering knowledge that applies to given problem on analysis of differential amplifier. (P.I 2.1.3)* 5. *Demonstrate effective communication, problem-solving skills during the activity based learning. (P.I 9.2.1)* 6. *Present results of the given task as a team, with smooth integration of contributions from all individual efforts. (P.I 9.3.1)*		
06.	**Advanced FETs** ***Learning Objective/s:*** *To comprehend the principle and working of HEMT, MESFETS.* **Contents:** Device structure, principle of operation and V-I characteristics of MODFET (i.e. HEMT), MESFET and HBT, comparison of advanced FETs with MOSFETs. ***Self-Learning Topics:*** *Read about "MOSFETs based Memory Registers"* ***Learning Outcomes :*** *A learner will be able to* 1. *Apply fundamental engineering concepts to summarize the principle and working of HEMT, MESFETS. (P.I 1.4.1)* 2. *2. Apply concepts of electronics and communication engineering to analyze V-I characteristics of Advanced FETs. (P.I 1.3.1)*	**01-03**	CO- 5
	Course Conclusion	**01**	
	Total	**45**	

Course Outcomes:

Students will be able to

1. Analyse BJT and FET based amplifiers.
2. Design BJT and FET based amplifiers.
3. Compare different types of power amplifiers.
4. Analyse working and performance parameters of Differential Amplifier.
5. Comprehend principle of working of MESFETS, HEMT and HBT.

Performance Indicators:

P.I. No.	**P.I. Statement**
1.3.1	Apply fundamental engineering concepts to solve engineering problems.
1.4.1	Apply concepts of electronics and communication engineering and allied disciplines to solve engineering problems.

2.1.2	Identify engineering systems, variables, and parameters to solve the problems.
2.1.3	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.
3.1.3	Synthesize engineering requirements from a review of the state-of-the-art.
3.3.3	Identify relevant data from the given resources and arrive at an optimal design solution for particular specifications.
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", R. Boylestad and L. Nashelsky, 9th Edition, 2009, PHI.
2. "Electronic Circuit Analysis and Design", D. A. Neamen, 2nd Edition, 2012, Tata McGraw Hill.
3. "Electronic Devices and Circuits", J. Millman, C. Chalkias, and S. Millman, 3rd Edition, 2018, Tata McGraw Hill.
4. "Electronic Devices and Circuits", N. Salivahanan and N. Suresh Kumar, 3rd Edition, 2017, Tata McGraw Hill.
5. "Microelectronic Circuits", A. S. Sedra and K. C. Smith, 5th Edition, 2004, Oxford University Press.

Reference Books :

1. "Microelectronics Circuits Analysis and Design", Muhammad H. Rashid, 2nd Edition, Cengage Learning, 2012.
2. "Electronic Devices and Circuits", Allen Mottershed, 2nd Edition, 1979, PHI.

Other Resources :

1. NPTEL Course: Analog Electronic Circuits By Prof. Pradip Mandal, Department of Electronics and Electrical Engineering, IIT Kharagpur :-Web link- https://nptel.ac.in/courses/108105158
2. NPTEL Course: Analog Circuits By Prof. A.N. Chandorkar, Department of Electrical Engineering, IIT Bombay :-Web link- https://nptel.ac.in/courses/117101106

IN-SEMESTER ASSESSMENT (50 MARKS)

1. Continuous Assessment (20 Marks)

Suggested breakup of distribution

Numerical Assignments (min 20 problems) -05 marks

One Class test based on above numerical assignments-05 marks

Think-pair-share worksheets-05 Marks

Regularity and active participation- 05 marks

2. Mid Sem Exam (30 Marks)

Mid semester examination will be based on 40% to 50% of 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	ECPCC304	DIGITAL CIRCUIT DESIGN	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: Basics of Electrical Engineering
2. ESC203: 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

Course Objectives :

1. To learn the signed numbers representation and its arithmetic operations.
2. To construct the digital logic functions used for switching circuits.
3. To implement combinational and sequential circuits using MSI
4. To develop hardware construct of combinational and sequential circuits using Hardware descriptive language.

Module	Details	Hrs	CO
	Course Introduction Digital circuit design is the foundation course in digital design and main stream technology of today's digital system. The digital circuits are widely used in industrial machinery, computers, microprocessors, household appliances, medical equipment, internet and e-commerce. In fact, digital techniques have been increasing day by day in all applications. However, digital design engineer relies heavily on computer based aids i.e., hardware description language (HDL) in integrated circuits designs. The digital circuit design is also the prerequisite for microcontrollers, embedded system and VLSI courses.	**01**	
01.	**Signed Binary numbers and Codes** ***Learning Objective/s:*** *To formulate binary arithmetic operations used in computer environment by applying floating point standard, sign magnitude representation and binary codes on decimal number.*	**4 - 6**	CO1

	Contents: Digital system, Signed Binary numbers and its signed magnitude, 1's and 2's complement representation, Addition of signed numbers, Booth's multiplier algorithm, Floating point representation of binary numbers, Parity and 7-bit Hamming code. ***Self-Learning Topics:*** *Alphanumeric Codes* ***Learning Outcomes :*** *A learner will be able to* 1. *Represent the decimal numbers in binary by applying sign magnitude representation techniques. (P.I.-1.1.1)* 2. *Apply floating point standard to represent decimal number in binary to solve the engineering problem in computer environment. (P.I.-1.4.1)* 3. *Perform the arithmetic operations on signed binary numbers. (P.I.-2.4.1)* 4. *Identify the error in received binary information using 7-bit hamming code. (P.I.-2.4.3)*		
02.	**Logic Families and canonical and standard form** ***Learning Objective/s:*** *To design the switching circuit of Electrical appliances by applying basic logic gates with minimal gate count and summarize the characteristics of CMOS of TTL logic families of these logic gates ICs.* **Contents:** CMOS and TTL Logic families, Digital IC characteristics, Meta stability, skew, Realize switching circuits using gates, De Morgan and Duality Theorem, SOP, POS representation and canonical conversion, K-map up to 4 variables, Don't care terms. ***Self-Learning Topics:*** *Qunie McCluskey method* ***Learning Outcomes :*** *A learner will be able to* 1. *Apply the Boolean algebra/theorem to minimize standard canonical equations. (P.I.-1.1.1)* 2. *Differentiate CMOS and TTL Logic Family. (P.I.-1.2.1)* 3. *Design switching circuits using basic gates for given functions used in digital system (P.I.-3.1.6)* 4. *Build the logic design to operate electrical appliances. (P.I.-3.2.2)*	**6 - 8**	CO- 2
03.	**Combinational System design and MSI Circuits** ***Learning Objective/s:*** *To design combinational logic circuit i.e., adder, subtraction, code converter, used in arithmetic logic unit of the microprocessor/ controller using basic logic gates as well as MSI Chips.*	**6 -8**	CO- 3

	Contents: Half adder, full adder, half subtractor, full subtractor, 4-bit addition and subtraction using IC 7483, Design of binary multiplier and 4-bit magnitude comparator, MSI circuits: multiplexer, demultiplexer, decoder, encoder. ***Self-Learning Topics:*** *ALU 74181* ***Learning Outcomes :*** *A learner will be able to* 1. *Design full adder/subtractor using two half adder/subtractor. (P.I.-3.1.6)* 2. *Identify the MSI chips to implement the 4bit binary adder. (P.I.-3.3.3)* 3. *Identify fast binary multiplier algorithm and apply it to design the 4-bit multiplier. (P.I.-2.2.3)* 4. *Identify given combinational design and write its truth table. (P.I.-2.1.1)*		
04.	**Sequential logic** ***Learning Objective/s:*** *To analyze the build blocks of clocked sequential circuits i.e., flip flops and design the sequential circuits using MSI chips.* **Contents:** Introduction to 1-bit memory cell, Sequential circuits: SR, JK, D and T, MS JK Flip-flop , triggering methods, Excitation tables and conversion of flip-flop, Counter, modulus of counter, 4 bit asynchronous- counter using flip flops and MSI chips 7490, 7493, Shift registers using array of flip flops and MSI chip 7495. ***Self-Learning Topics:*** *Applications of flip flops: Bounce Elimination switches, Latch, memory* ***Learning Outcomes :*** *A learner will be able to* 1. *Tabulate the truth table of SR flip flops. Identify the constraints on applied inputs. (P.I.-2.2.3)* 2. *State the drawbacks of JK flip-flop. How it can be overcome? (P.I.-2.4.4)* 3. *Design mod-n counter using flips flops. (P.I.-3.1.6)* 4. *Identify the MSI chips to implement mod-n counter. (P.I.-3.3.3)*	**7 - 9**	CO- 4
05.	**Verilog Programming** ***Learning Objective/s:*** *To design the combinational and sequential circuits using hardware descriptive language used computer aided design tool.*	**7 - 9**	CO- 5

	Contents: Merits and demerits of HDL, Types of HDL: VHDL, Verilog and system Verilog, Verilog Constructs-Concurrent and Sequential, Developing a Verilog code for, adder/subtractor, decoder, Programmable logic devices: CPLD and FPGA. ***Self-Learning Topics:*** *VHDL and system Verilog constructs, Verilog constructs of basic gates.* ***Learning Outcomes :*** *A learner will be able to* 1. *Identify the strength and limitations of HDL. (P.I.-5.3.2)* 2. *Identify the Verilog constructs to design combinational as well as sequential circuits. (P.I.-5.1.1)* 3. *Design and optimize combinational circuits such as adder, subtractor and decoder using Verilog. (P.I.-3.3.1)* 4. *Elicit the architectural features of PLDs. (P.I.-3.1.2)*		
06.	**FSM: Moore and Mealy machines** ***Learning Objective/s:*** *To design and analyze finite state machines of clocked sequential circuits widely used in digital designs and programmable logics.* **Contents:** Introduction to Moore and Mealy machines, Counters using Moore and Mealy machines, Binary sequence detector and it application, Verilog codes of synchronous counter and sequence detector. ***Self-Learning Topics:*** *State reduction techniques* ***Learning Outcomes :*** *A learner will be able to* 1. *Differentiate synchronous and asynchronous counters and Mealy and Moore machines. (P.I.-2.4.4)* 2. *Design a synchronous counter using Moore Machines. (P.I.-3.1.6)* 3. *Design sequence detector using Mealy as well as Moore machines. (P.I.-3.1.6)* 4. *Identify the given state machine and analyse its states. (P.I.-2.1.1)* 5. *Design and optimize sequential circuits such as flip flops, counters, shift register and sequence detector using Verilog constructs. (P.I.-3.3.1)*	**7 - 9**	CO6
	Course Conclusion	**01**	
	Total	**45**	

Course Outcomes:

The students are able to

1. Perform arithmetic operations on signed binary numbers and illustrate the knowledge of binary codes used in digital circuits.
2. Illustrate the knowledge of digital logic families, characteristics of Digital ICs, Boolean algebra, digital switching circuits used in digital designs.
3. Designs combinational logic circuits and realizations using MSI circuits.
4. Illustrate the knowledge of flip –flops to construct counters and shift registers using MSI.
5. Design combinational and sequential circuits using Verilog.
6. Design sequence detector using Moore and Mealy machines.

Performance Indicators:

P.I. No.	P.I. Statement
1.1.1	Apply mathematical techniques such as calculus, linear algebra, probability and statistics, boolean algebra to solve problems
1.2.1	Apply laws of natural science to an engineering problem
1.4.1	Apply concepts of electronics and communication engineering and allied disciplines to solve engineering problems.
2.1.1	Articulate problem statements and identify primary objectives and key constraints.
2.2.3	Identify existing processes/solution methods for solving the problem, including forming justified approximations and assumptions
2.4.1	Apply engineering mathematics and computations to solve mathematical models
2.4.3	Identify sources of error in the solution process, and limitations of the solution.
2.4.4	Extract desired understanding and conclusions consistent with objectives and limitations of the analysis
3.1.2	Elicit and document, engineering requirements from stakeholders
3.1.6	Determine design objectives, functional requirements and arrive at specifications
3.2.2	Identify suitable criteria for evaluation of alternate design solutions
3.3.1	Apply formal decision-making tools to select optimal engineering design solutions for further development
3.3.3	Identify relevant data from the given resources and arrive at an optimal design solution for particular specifications.
5.1.1	Identify modern hardware and software engineering tools, techniques and resources for engineering activities.
5.3.2	Recognize the limitations of the capabilities of the tools used/created.

Text Books :

1. Modern Digital Electronics, R. P. Jain, , Fourth Edition, 2009, Tata McGraw Hill Education
2. Digital Design With an Introduction to the Verilog HDL, VHDL, and System Verilog, Morris Mano Michael D. Ciletti, Sixth Edition, Pearson

Reference Books :

1. Fundamentals of Digital Circuits, Anand Kumar, Fourth Edition, 2018, PHI learning
2. Digital Fundamentals, Thomas L. Floyd, Eleventh Global Edition, 2015, Pearson Prentice Hall
3. Digital Electronics Principles and Applications, Mandal, First Edition, 2010, McGraw Hill Education
4. A Verilog HDL Primer, J. Bhasker, Third Edition, 1997, Star Galaxy Press

Other Resources :

1. Virtual Labs, an initiative of Ministry of Education (MoE): https://da-iitb.vlabs.ac.in
2. "Using Practical Examples in Teaching Digital Logic Design", Dr. Joseph P Hoffbeck, University of Portland.

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 assignments:05 marks
Article reading & summarization/poster creation: 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	ECMDM301	DATA STRUCTURES AND ALGORITHMS	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. ESCLC103 - C programming Laboratory
2. BSC101- Engineering Mathematics

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem Analysis
3. PO3: Design / Development of Solutions
4. PO5: Modern Tools Usage
5. PO12: Lifelong Learning

Course Objectives:

1. Acquaint students with fundamental data structures like arrays, linked lists, and trees, graphs.
2. Familiarize students with algorithms and their complexities using asymptotic notations.
3. Introduce analytical and critical thinking skills for real-world problem-solving with modern tools.
4. Educate students on sorting and searching algorithms for implementation and analysis.

Module	Details	Hrs.	CO
	Course Introduction: The Data Structures and Algorithms (DSA) course offers a fundamental understanding of efficiently organizing and manipulating data. Learners will develop the analytical skills to choose the appropriate data structure for various applications. The course includes analysis of algorithms, code optimization, and tackling challenges in complex computations. Its goal is to develop skills for software development and problem-solving. Its aim is to build abilities for both software development and problem-solving. Furthermore, this subject serves as the prerequisite for disciplines like Database Management Systems (DBMS) and the Data Science stream, laying a solid foundation for future specialization.	**01**	

01.	**Introduction to Data structures and Algorithms**	**05–07**	**CO1, CO3**
	Learning Objective/s: *To familiarize with the fundamental principles of data structures and algorithms, recognizing their critical role in implementation, distinguishing between different types of data structures, and understanding the various asymptotic notations employed in analyzing algorithms.*		
	Contents: Data Structures– Basic Terminology, Importance. Types of Data structures, Operations on Data Structures. Abstract Data type (ADT), Advantages of Data structures. Algorithms and Analysis: Performance measures of algorithms, efficiency of algorithms, complexities- Time and Space complexity, importance of algorithm analysis. Asymptotic notations - Big O, Omega, Theta. Graphical and mathematical representations of Asymptotic Analysis.		
	Self-Learning Topics: *Amortized analysis for asymptotic analysis.*		
	Learning Outcomes: *A learner will be able to* 1. *Apply mathematical modeling techniques like set theory, boolean algebra, to represent data in suitable data structure. (P.I.-1.1.1)* 2. *Analyze algorithm complexities with asymptotic notations. (P.I.-1.4.1)* 3. *Evaluate data structures and algorithms, considering performance for real-life applications to select optimal solutions. (P.I.-2.2.4)* 4. *Perform arithmetic operations on data structures and analyze complexities using engineering mathematics. (P.I.-2.4.1)* 5. *Formulate Abstract Data Types (ADTs) for various data structures, integrating engineering principles. (P.I.-1.1.1)*		
02.	**Stack & Queue Data Structure**	**05–07**	**CO1**
	Learning Objective/s: *To facilitate understanding, implement, and compare Stack and Queue structures via linked lists and arrays, explore diverse queue types and applications, and apply them in real-world problem-solving.*		
	Contents: Introduction to Stack, definition of stack, array-based and linked list-based stack implementation, operations on stack. Applications of Stacks: Decimal to binary conversion, Algorithm to test a string for palindrome, solving a maze, backtracking, polish expressions- Prefix, Infix, Postfix expression and conversions, evaluations of polish expressions. Recursion: Common loops, Factorials, Fibonacci series, Towers of Hanoi. Introduction to Queue, definition, array-based and linked list-based queue implementation, operations on queue. Types of		

	Queue-Circular Queue, Priority Queue, Double Ended Queue. Implementation of multiple stack Queues, implementing a Deque with a circular array. Applications of Queue: Task scheduling examples, airline ticket counter.		
	Self-Learning Topics:		
	Applications of Queues in network packet scheduling		
	Learning Outcomes :		
	A learner will be able to 1. *Apply mathematical techniques to devise algorithms for stack and queue applications, such as decimal to binary conversion and infix expression evaluation. (P.I.-1.1.1)* 2. *Demonstrate the ability to differentiate between stack and queue data structures, identifying their key operations and properties.* *(P.I.-2.1.1)* 3. *Analyze various types of queues, including circular queues and priority queues and their applications such as task scheduling and breadth-first search. (P.I.-2.2.4)* 4. *Develop proficiency in implementing stack and queue data structures, along with their respective applications in real-world scenarios* *(P.I.-12.3.1)*		
03.	**Link list Data structure and Hashing Functions**	**07–09**	**CO1, CO2**
	Learning Objective/s:		
	To demonstrate differentiation between linked lists, execute operations on them along with hashing structures, and apply this knowledge to implement stack and queue data structures.		
	Contents: Linked Lists- Basic Terminologies, Linked Lists versus Arrays, Memory Allocation and De-allocation for a Linked List. Types of linked lists- Singly, Doubly, Circular, Circular Doubly Linked List. Operations on link lists: Node Creation, Node Insertion and Deletion from Beginning, End and Specified Position. Implementation of a stack and a queue using linked list. Applications of linked lists: Polynomial Representation using link list, polynomial arithmetic- Addition, Subtraction, Multiplication, Doubly Linked List Application. Introduction to Hashing and functions: Hashing-Concept, Hash Functions, Common hashing functions. Collision Resolution Techniques (CRT): Separate Chaining for Collision Handling, Open Addressing for Collision Handling. Link list use in implementation of anti-collision of hashing.		
	Self-Learning Topics:		
	Hashing quadratic probing		
	Learning Outcomes :		

	A learner will be able to 1. *Compare, differentiate, and execute operations on linked lists, demonstrating proficiency in data structure manipulation and understanding of linked list variations. (P.I.-2.2.4)* 2. *Apply linked list data structure to construct stack and queue and hashing data structures. (P.I.- 3.2.1)* 3. *Demonstrating practical applications of linked lists in mathematical contexts. (P.I.-3.3.1)* 4. *Develop an understanding of hash-based data structures, hash functions, and collision resolution methods (P.I.-12.3.1)*		
04.	**Trees & Graph data structures** ***Learning Objectives:*** *To acquire understanding of tree terminologies, proficiently perform fundamental Binary Search tree (BST) operations, and explore Adelson-Velsky and Landis (AVL) trees for efficient balance maintenance.* **Contents:** Tree Data structure Introduction, Tree Terminologies, Tree Height, Level and Depth, Representation of binary tree. Types of Binary Tree, Binary Tree Traversals (In-order, Post-order, Preorder). Operations on Binary Search Tree: Insertion, Deletion. Conversion of General Trees to Binary Trees. AVL Tree, height and weight balancing algorithm. Applications of Binary Tree- Expression Tree, Huffman Encoding, Graph Data structure Introduction, Graph Terminologies, Matrix Representation of Graphs. Concept of self-loop, Operations on Graph. Graph Traversals: Breadth First Search, Depth First Search. Applications of the Graph: Shortest Path Algorithms: Dijkstra's Algorithm, Minimum Spanning Tree: Kruskal and Prims Algorithm. ***Self-Learning Topics:*** *Red-Black trees and Graph Partitioning.* ***Learning Outcomes:*** *A learner will be able to* 1. *Compare, analyze and design algorithms for BST operations (insertion, deletion, conversion) to ensure optimal time complexity and memory usage. (P.I.-2.2.4)* 2. *Design and implement BFS and DFS algorithms for graph traversal, considering problem constraints and complexities for various applications. (P.I.-3.2.1)* 3. *Apply graph algorithms such as Dijkstra's and Kruskal's/Prim's algorithms using appropriate tools and resources to solve real-world problems efficiently(P.I.-5.1.1).* 4. *Source and comprehend technical literature and credible sources to deepen understanding of advanced tree and graph concepts. (P.I.-12.3.1)*	**07–09**	**CO2**

05.	**Searching & Sorting algorithms**	**08–10**	**CO3**
	Learning Objectives:		
	To implement, and analyze various searching and sorting methods to enable competent application in real-world scenarios.		
	Contents:		
	Searching algorithms: Sequential, Index Sequential, Binary search, comparison of various searching algorithms. Sorting algorithms: Bubble sort, Selection sort, Insertion Sort, Shell Sort. Divide and Conquer Sorting: Merge, Quick and Heap Sort, Choice of Pivot and Worst case, Time and Space analysis. Comparison of various sorting algorithms. Application of searching/sorting algorithms methods for practical cases like: Library catalog search optimization, E-commerce product sorting, profile searches in a social media platform, financial transactions, medical records sorting for efficient retrieval, locate specific DNA sequences in bioinformatics applications, smartphone contact search optimization.		
	Self-Learning Topics:		
	Parallel and Distributed Algorithms in Machine Learning		
	Learning Outcomes:		
	A learner will be able to 1. *Demonstrate proficiency in implementing searching algorithms. (P.I.-2.4.2)* 2. *Successfully implement various searching algorithms, considering their efficiency, and analyze scenarios to choose the most appropriate algorithm. (P.I.-2.2.4)* 3. *Showcase competence in implementing sorting algorithms. (P.I.-2.4.3)* 4. *Demonstrate practical application skills in Various Contexts-including media profile searches, financial transactions, medical records sorting, and smartphone contact optimization. (P.I.-5.1.2)* 5. *Source and comprehend technical literature and credible sources to deepen understanding of advanced searching and sorting algorithms. (P.I.-12.3.1)*		
06.	**Advanced Algorithms**	**05-07**	**CO4**
	Learning Objectives:		
	To familiarize with advanced algorithms, and apply representation techniques to solve diverse domain problems.		
	Contents:		
	Any two algorithms from the following. (Technical script writing for any one algorithm). a. PageRank Algorithm b. Strings and Pattern Matching Algorithms c. Rete Algorithm		

	Self-Learning Topics: *a. Expectation-Maximization (EM) Algorithm* *b. A priori Algorithm.* *c. Beam Search Algorithm.*		
	Learning Outcomes: *A learner will be able to* *1. Implement and analyze advanced algorithms to solve complex domain problems. (P.I.- 2.3.2)* *2. Apply representation techniques and analysis for diverse domain problems using advanced algorithms.(P.I.- 2.4.4)*		
	Course Conclusion	**01**	
	Total	**45**	

Course Outcomes:
Students will be able to

1. Demonstrate proficiency in selecting appropriate linear data structures, representations, analysis and operations for effective solving problem.
2. Demonstrate proficiency in selecting appropriate non-linear data structures, representations, analysis and operations for effective solving problem.
3. Apply algorithmic analysis techniques and modern tools to effectively utilize searching and sorting algorithms in real-world problem-solving.
4. Implement and analyse advanced algorithms to solve complex domain problems.

Performance Indicators:

P.I. No.	P.I. Statement
1.1.1	Apply mathematical techniques such as calculus, linear algebra, probability and statistics, boolean algebra to solve problems.
1.4.1	Apply concepts of electronics and communication engineering and allied disciplines to solve engineering problems.
2.1.1	Articulate problem statements and identify primary objectives and key constraints
2.2.4	Compare and contrast alternative solutions to select the best methodology.
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 techniques.
2.4.3	Identify sources of error in the solution process, and limitations of the solution.
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 build models/prototypes in order to develop multiple engineering design solutions.
3.3.1	Apply formal decision-making tools to select optimal engineering design solutions for further development.
5.1.1	Identify modern hardware and software engineering tools, techniques and resources for engineering activities.
5.1.2	Use/adapt/modify/create tools and techniques to solve engineering problems

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

12.1.3 Develop ability to learn independently through methods distinct from instructor provided materials.

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

Text Books:

1. Data Structures and Algorithm Analysis, Clifford A. Shaffer, Dover Publications, 3rd Edition, 2007.
2. Algorithm Design Manual, Steven S. Skiena, Springer, 2nd Edition, 2008.
3. Introduction to Algorithms, Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, The MIT Press, 3rd Edition, 2009.
4. Data Structures and Algorithms Made Easy, Narasimha Karumanchi, CareerMonk Publications, 1st Edition, 2011.
5. Introduction to the Design and Analysis of Algorithms, Anany Levitin, Pearson, 3rd Edition , 2011.
6. Data Structures using C and C++, Y Langsam, MJ Augenstein and A.M, Tanenbaum, Prentice Hall India, Second Edition 2015.

Reference Books:

1. Data Structures and Algorithms in Python, Michael T. Goodrich, Roberto Tamasin, and Michael H. Goldwasser, Wiley, 1st Edition 2013.
2. Algorithms in C++, Robert Sedgewick, Addison-Wesley, 3rd Edition 2001.
3. Data Structures and Algorithm Analysis in C++, Mark A. Weiss, Pearson,4th Edition 2013.
4. Algorithms, Robert Sedgewick and Kevin Wayne, Addison-Wesley, 4th Edition 2011.

Other Resources:

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

2. NPTEL Course: Design and Analysis of Algorithms. by Prof. Madhavan Mukund, Department of Computer Science and Engineering, Chennai Mathematical Institute.
   Web link-https://nptel.ac.in/courses/106/106/106106131/

A. IN-SEMESTER ASSESSMENT (50 MARKS)

1. Continuous Assessment (20 Marks)

Suggested breakup of distribution

a) Numerical Assignments (min 20 problems) -05 marks

b) One Class test based on above numerical assignments-05 marks

c) Script (Technical) writing -05 Marks

d) Regularity and active participation- 05 marks

2. Mid Semester Examination (30 Marks)

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

B. END SEMESTER EXAMINATION (50 MARKS)

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

Course Type	Course Code	Course Name	Credits
LC	ECLC301	ELECTRONIC DEVICES AND CIRCUIT LABORATORY	02

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

Pre-requisite :

1. BSC205- Engineering Physics-II
2. ESC203- Basic Electronics Engineering

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 and Society
7. PO9: Individual and Team Work
8. PO10: Communication
9. PO12: Life-long learning

Course Objectives:

1. To Design BJT/ FET based Amplifiers.
2. To measure the resonant frequency, bandwidth, and quality factor of an LC resonant circuit.
3. To design and implement a relay driver circuit using a Darlington pair configuration.
4. To design and develop a switches using BJT/ FETs.
5. To identify and rectify faults in each transistorized circuit.
6. To apply the knowledge and skills acquired throughout the course to complete a comprehensive project.

Module	Detailed Contents	Hrs	CO
	Course Introduction The Electronics Devices and Circuits lab will provide hands-on experience to students in designing, building and analysing electronic circuits. Through this lab, students will gain practical insights into the behaviour and characteristics of electronic components such as diodes, transistors. They will also gain experience in using instruments for generation of input and measurement of output. They will learn essential skills for circuit prototyping, troubleshooting and measurement techniques, which are fundamental for their understanding and application in real-world electronic systems.	**01**	

	Electronics devices and circuits find widespread application in industries for automation and control systems, powering machinery, and ensuring efficient production processes. In real life, they are integral to modern communication systems, including smartphones, Wi-Fi routers, and satellite communication. Moreover, electronics circuits are crucial components in transportation systems, facilitating navigation, vehicle control, and safety features in automobiles, trains and aircraft. The most basic and essential part of any electronic manufacturing is PCB design and development. PCB manufacturing is covered as a part of this course.		
01.	***Learning Objective/s:*** *To design and analyze the performance of CE Amplifier.* **Suggested Experiments:** 1. Design & Implement BJT CE Amplifier circuit for amplifying signal within audio frequency range. 2. Design & Implement BJT CE Amplifier circuit for amplifying signal within low frequency range. 3. Design & Implement BJT CE Amplifier circuit for amplifying signal within radio frequency range. ***Self-Learning Topics:*** *Simulate a CE Amplifier.* ***Learning Outcomes:*** *A learner will be able to* 1. *Determine objectives and requirements to design CE Amplifier. (P.I. -3.1.6)* 2. *Identify relevant data from the given resources and arrive at an optimal design solution of CE amplifier for particular specification. (P.I. -3.3.3)* 3. *Use appropriate procedure and components to implement amplifier on bread board (P.I.- 4.3.1)* 4. *Produce and validate the result theoretically and practically. (P.I. -2.4.2)* 5. *Extracts desired understanding and conclusions through analysis. (P.I. 2.4.4)* 6. *Read, understand and use transistor specifications from datasheet. (P.I. -10.1.1)* 7. *Create clear, well-constructed and well supported written document including design, result and conclusion.(P.I. -10.1.2)*	**02**	**CO- 1**
02.	***Learning Objective/s:*** *Design and analyze the performance LC tuned amplifier for a particular band of frequency.* **Suggested Experiments:** 1. Design & Implement of Parallel LC Tuned Amplifier for FM Band. 2. Design & Implement of Parallel LC Tuned Amplifier for AM Band. ***Self-Learning Topics:*** *Find out in which areas of communication LC Tuned Amplifiers are used.*	**02**	**CO- 1**

	Learning Outcomes : *A learner will be able to* 1. *Determine objectives and requirements to design LC tuned Amplifier. (P.I. - 3.1.6)* 2. *Identify relevant data from the given resources and arrive at an optimal design solution of parallel LC amplifier for particular specifications. (P.I. -3.3.3)* 3. *Use appropriate procedure and components to implement amplifier on bread board (P.I.- 4.3.1)* 4. *Produce and validate the result theoretically and practically. (P.I. -2.4.2)* 5. *Extracts desired understanding and conclusions through analysis. (P.I.- 2.4.4)* 6. *Read, understand and use transistor specifications from datasheet. (P.I. - 10.1.1)* 7. *Create clear, well-constructed and well supported written document including design, result and conclusion. (P.I.- 10.1.2)*		
03.	***Learning Objective/s:*** *Conduct Investigations and implement circuit for Smart Home using sensors and actuators.*	**02**	**CO- 2**
	Suggested Experiments: Implement a circuit for Smart Home. Examples: 1. Light sensing and Control: Use a light-dependent resistor (LDR) as a sensor to detect ambient light levels. Connect the LDR to a transistor-based switch circuit to control the lighting system, such as turning lights on/off automatically based on the detected light level. 2. Smoke/Fire Detection: Integrate smoke or fire sensors into the circuit to detect the presence of smoke or fire. When smoke or fire is detected, the sensor triggers a transistor-based alarm circuit, such as a siren or a flashing light, to alert occupants and prompt appropriate action. 3. Temperature Sensing and control: Utilize a temperature sensor, such as a thermistor or a temperature-dependent resistor (RTD), to monitor room temperature. Connect the temperature sensor to a transistor-based circuit that controls a fan or heating system based on the temperature readings.		
	Learning Outcomes : *A learner will be able to* 1. *Establish a relationship between measured data and physical phenomenon. (P.I.-4.1.4)* 2. *Use appropriate tools and techniques to conduct experiment and collect data.(P.I. - 4.3.1)* 3. *Use tools and techniques to implement a smart home. (P.I. -5.1.2)* 4. *Recognize the limitations of capabilities of sensors used (P.I -5.3.2)*		
04.	***Learning Objective/s:*** *To analyse the principle and working of Darlington pair configuration and establish relation between output of amplifier and speed of motor*		
	Suggested Experiments: 1. Speed control of motors using Darlington pair TIP120 2. Darlington pair as an Amplifier. 3. Touch sensor using Darlington pair	**02**	**CO-2**

	Self-Learning Topics: *Comprehend the principles behind relay operations and specify the types.* *Learning Outcomes:* *A learner will be able to* 1. *Identify need of motor and its parameters used for given problem. (P.I.- 2.1.3)* 2. *Use appropriate procedure and components to implement Darlington pair on bread board (P.I.- 4.3.1)* 3. *Establish a relationship between measured data and physical phenomenon. (P.I.-4.1.4)* 4. *Extracts desired understanding and conclusions through analysis. (P.I.-2.4.4)*		
05.	***Learning Objective/s:*** *Design and analysis of performance of FET based amplifier circuits for electronic applications.*		
	Suggested Experiments: 1. Design and Implementation of a MOSFET CS amplifier for LNA. 2. Analyse the frequency response of a MOSFET CS amplifier and determine its bandwidth and gain limitations.	**02**	**CO-1**
	Learning Outcomes: *A learner will be able to* 1. *Recognize the need to design MOSFET CS amplifier. (P.I. -3.1.1)* 2. *Determine objectives and requirements to design MOSFET CS Amplifier. (P.I. -3.1.6)* 3. *Produce and validate the result theoretically and practically. (P.I. -2.4.2)* 4. *Extracts desired understanding and conclusions through analysis. (P.I.- 2.4.4)* 5. *Read, understand and use transistor specifications from datasheet. (P.I. -10.1.1* 6. *Create clear, well-constructed and well supported written document including design, result and conclusion. (P.I. 10.1.2)*		
06.	***Learning Objective/s:*** *Design and implement MOSFET based circuits.*		
	Suggested Experiments: 1. Design & implement constant current source using MOSFET for current stabilizer circuits. 2. To study the switching characteristics of a MOSFET and understand its behaviour in different operating regions.	**02**	**CO-2**
	Self-Learning Topics: *Various techniques for creating constant current sources using transistors, operational amplifiers, and integrated circuits.* ***Learning Outcome:*** *A learner will be able to* 1. *Recognize the requirements of constant current source to design MOSFET current stabilizer circuits (P.I. -3.1.1)* 2. *Determine objectives and requirements to design current stabilizer circuit. (P.I. -3.1.6)* 3. *Produce and validate the result theoretically and practically. (P.I. -2.4.2)* 4. *Extracts desired understanding and conclusions through analysis. (P.I. -2.4.4)* 5. *Read, understand and use transistor specifications from datasheet. (P.I. -10.1.1* 6. *Create clear, well-constructed and well supported written document including design, result and conclusion. (P.I.- 10.1.2)*		

07.	***Learning Objective/s:*** *Design and implement MOSFET-based switching circuits for specific requirements.*		
	Suggested Experiments: 1. Simulate a BJT and MOSFET based switch. 2. Develop a MOSFET switch for turning on a staircase lamp.	**04**	**CO-2**
	Self-Learning Topics: *Learn about the differences in behaviour, characteristics and applications of BJTs and MOSFETs.* ***Learning Outcomes:*** *A learner will be able to* 1. *Identify relevant data from the given resources and arrive at an optimal design solution for particular specifications. (P.I -3.3.3)* 2. *Generate information through appropriate tests to improve or revise the design. (P.I 3.4.2)* 3. *Attain proficiency in circuit simulation techniques. (P.I.-5.2.2)* 4. *Utilize software tools to model, analyze, and troubleshoot electronic circuits effectively. (P.I.-5.1.2)*		
08.	***Learning Objective/s:*** *Identify errors in the given circuit, rectify it and produce accurate results.*		
	Suggested Experiment: Troubleshoot the given transistorized circuit assigned by lab instructor and rectify the errors.	**02**	**CO-3**
	Self-Learning Topics: *Read signal tracing techniques.* ***Learning Outcomes:*** *A learner will be able to* 1. *Identify sources of error in the solution process, and limitations of the solution. (P.I.- 2.4.3)* 2. *Produce and validate results through skillful use of contemporary engineering techniques. (P.I.- 2.4.2)*		
09.	***Learning Objective/s:*** *Design a PCB and analyse it for defects.*		
	Experiment: **Introduction to PCB fabrication** PCB design concepts, effects of ill-designed PCB	**04**	**CO-4**
	Self-Learning Topics: *Read types of PCB* ***Learning Outcomes:*** *A learner will be able to* 1. *Identify engineering systems, variables, and parameters to start the process of PCB designing. (P.I. -2.1.2)* 2. *Identify the mathematical, engineering and other relevant knowledge that applies to PCB designing. (P.I. - 2.1.3)* 3. *Determine design objectives, functional requirements and arrive at specifications in-order to develop a single sided PCB. (P.I.- 3.1.6)* 4. *Refine a conceptual design into a detailed design within the existing constraints (of the resources). (P.I.- 3.4.1)*		

10.	***Learning Objective/s:*** *Develop a need based project in groups, carry investigations on it.*		
	Experiment: **Course Project on a PCB.**	**07**	**CO-5**
	Self-Learning Topics: -- ***Learning Outcomes :*** *A learner will be able to* 1. *Identify suitable criteria for evaluation of alternate design solutions while selecting the components or tools for designing. (P.I. -3.2.3)* 2. *Apply formal decision-making tools like eagle, PCB-maker to select optimal engineering design solutions for further development. (P.I. - 3.3.1)* 3. *Define a problem, its scope, and importance for purposes of investigation while deciding the course project's scope. (P.I.- 4.1.1)* 4. *Use appropriate procedures, tools, and techniques to conduct investigations and collect data during the course project. (P.I. - 4.3.1)* 5. *Identify the possible social, cultural, environmental and human health-related impacts during PCB manufacturing process. (P.I.- 6.1.3)* 6. *Identify and evaluate the potential risks to human health and environment due to PCB manufacturing process. (P.I. -6.1.4)* 7. *Demonstrate effective communication, problem-solving, conflict resolution and leadership skills during the course project. (P.I.- 9.2.1)* 8. *Present results as a team, with smooth integration of contributions from all individual efforts. (P.I.- 9.3.1)* 9. *Develop the ability to identify and address challenges encountered during the project, applying troubleshooting and critical thinking skills .(P.I.- 12.1.3)* 10. *Source and comprehend technical literature and other credible sources of information (P.I.- 12.3.1)*		
	Total	**30**	
	Minimum one experiment from each module is mandatory.		

Course Outcomes:

Students will be able to

1. Design and implement BJT/FET amplifier circuits.
2. Implement and test BJT/FET based circuits for specific applications.
3. Troubleshoot a given circuit and rectify faults.
4. Comprehend the process of PCB manufacturing
5. Apply the knowledge and skills acquired throughout the course to complete a comprehensive project on PCB.

Performance Indicators:

P.I. No.	**P.I. Statement**
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.

2.4.2 Produce and validate results through skilful use of contemporary engineering techniques.

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

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

3.1.1 Recognize that need analysis is key to good problem definition.

3.1.6 Determine design objectives, functional requirements and arrive at specifications

3.2.3 Identify suitable criteria for evaluation of alternate design solutions

3.3.1 Apply formal decision-making tools to select optimal engineering design solutions for further development

3.3.3 Identify relevant data from the given resources and arrive at an optimal design solution for particular specifications.

3.4.1 Refine a conceptual design into a detailed design within the existing constraints (of the resources)

3.4.2 Generate information through appropriate tests to improve or revise the design

5.1.2 Use/adapt/modify/create tools and techniques to solve engineering problems

5.2.2 Demonstrate proficiency in using discipline-specific tools.

5.3.2 Recognize the limitations of the capabilities of the tools used/created.

6.1.2 Measure the impact of technological development on society at large and should be able to describe the role of an engineer to society.

6.1.3 Identify the possible social, cultural, environmental and human health-related impacts over the life-cycle of an engineering product or activity relevant to the student's discipline.

6.1.4 Identify and evaluate the potential risks to human health and environment due to an engineering product design or modelling technique

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.

10.1.1 Read, understand and interpret technical and/or non-technical information.

10.1.2 Create clear, well-constructed, and well-supported written engineering documents and/or presentation.

12.1.3 Develop ability to learn independently through methods distinct from instructor provided materials.

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

Books :

1. Electronic Devices and Circuits, J. Millman, Christos CHalkias and Satyabratatajit, 3rd edition, October 2017, Tata McGraw Hill.
2. Electronic Devices and Circuit Theory, R. Boylestad and L. Nashelsky, 9th edition,2009, PHI.
3. Electronic Circuit Analysis and Design, D. A. Neamen, 2nd edition,2012, Tata McGraw Hill.
4. Electronic Devices and Circuits, Salivahanan, N. Suresh Kumar, 3rd edition, June-2012, Tata McGraw Hill.
5. Microelectronic Circuits, A. S. Sedra and K. C. Smith, 5th edition, 2004, Oxford University Press.

6. Electronic Devices and Circuits, Dr. R. S. Sedha and B. L. Theraja, 2011, S. Chand Publication.

Reference Books :

1. Microelectronics Circuits Analysis and Design, Muhammad H. Rashid, 2nd edition, 2012, Cengage Learning.
2. Electronic Devices and Circuits, Allen Mottershed, 2nd edition, 1979, PHI.
3. Practical Electronics for Inventors, P. Scherz and S. Monk, McGraw-Hill Education, ISBN: 978-0071771337.
4. Troubleshooting Electronic Circuits: A Guide to Learning Analog Electronics, R. Quan, McGraw-Hill Education, ISBN: 978-0071830454.
5. Electronic troubleshooting, Daniel R. Tomal, 4th edition, 2014, McGraw Hill Education.

Other Resources:

1. Matlab support for amplifiers: https://www.mathworks.com/help/sps/amplifiers.html
2. Tinkercad, a free web app for electronics: https://www.tinkercad.com/things/hbUSKrp8XXl-resources
3. The Proteus Design Suit: https://www.labcenter.com/

A. CONTINUOUS ASSESSMENT (25 Marks)

Suggested breakup of distribution

a. Experiment execution: 10 Marks

Students will be given number of experiments as mentioned in the syllabus. Each experiment carries 10 Marks. Average will be taken of all experiments. Students are expected to complete the task assigned in the experiment description, record observations, interpret results/conclusion and prepare a brief report as per requirement.

b. Course project: 10 Marks.

Based upon the learnings from the experiments, students will be assigned a course project. They are expected to do the design, verification, simulation (if required) and implementation on PCB followed by testing for desired output.

c. Regularity and active participation: 5 marks.

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

Students will be assessed based on three parameters:

- Concept/circuit knowledge
- Accurate output
- Plotting of graphs
- Oral

- Students will be randomly allocated an experiment from the list of laboratory exercises and will be asked to draw the circuit diagram for the same. The circuit diagram is checked by the examiners (Internal and External) and evaluated out of 05 Marks.

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

- Students will be allocated 1 hour to complete the connections and observe the output. The output is then checked by both the examiners for its correctness. The weightage of the circuit implementation is 10 Marks.
- Students will then be appearing for Oral Examination 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	ECLC302	DIGITAL CIRCUIT DESIGN LABROTARY	02

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

Pre-requisite :

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

Program Outcomes addressed :

1. PO 3: Design/Development of Solutions
2. PO 4: Conduct investigations of complex problems
3. PO 5: Modern tool usage
4. PO 9: Individual and teamwork
5. PO10: Communication

Course Objectives :

1. To provide the learner the comprehension of logic gates and enable them to relate the logic to real world applications.
2. To handle the electronics devices i.e., power supply, multi-meter, function generator, Cathode ray oscilloscope to test and verify digital circuits.
3. To handle computer based aids (Tools) to develop, test and debug hardware descriptive language code

Module	Detailed Contents	Hrs	CO
	Course Introduction The control circuits in industrial machinery are based on digital logics. This course is developing the logic for digital controller and its prototyping. The digital design engineers are designing the circuits using computer based aids i.e., hardware description language (HDL) to reduce time to market. The digital circuit design lab is also the prerequisite for microcontrollers lab, embedded system design and VLSI designs.	**02**	
01.	***Learning Objective/s:*** *To build and verify the prototype of digital control switches widely used in electrical devices and appliances such as stair case lamp, washing machines, automatic sectors, polling devices and water level controller.* **Contents:** Digital Control logic used in electrical switches, electrical appliances, pilot devices, Functional requirement and safety features used in household equipment, Build and test the prototype of the design of digital controllers for switches, pilot devices, and house hold equipment using breadboard.	**08**	**CO- 1**

	Suggested list of Experiments: i. Realize the digital switch for stair case lamp. ii. To construct logic circuit of washing machine control using a basic. Washing Machine has three sensors for water level, door position and temperature. It has three output devices for control i.e., valve, heater and motor. iii. Realize the seat belt warning system using gates. iv. Realize the majority circuit using gates (Count of '1'). v. v. Realize the water level controller using AND and NOT gate. ***Self-Learning Topics:*** *Digital design on open source simulation tools / Virtual labs.* ***Learning Outcomes :*** *A learner will be able to* 1. *Identify functional requirement of house hold equipment, and automotive sector related to safety. (P.I.-3.1.5)* 2. *Build the prototype of digital switches used for staircase lamp, pilot devices of washing machines, seat belt motor vehicles, water tanks. (P.I.-3.2.2)* 3. *Build the prototype of polling count. (P.I.-3.2.2)* 4. *Select the electronics devices power supply, multi-meter, function generator. CRO to perform experiments(P.I.-4.1.3)* 5. *Test the prototype design using specified procedure and test vectors/pattern. (P.I.-4.2.1)*		
02.	***Learning Objectives:*** *To design the combinational circuits i.e., adder, subtractor, code converter and encoder using hardware descriptive language and validate it using computer aided design tool.* **Contents:** 2.1 Concurrent Verilog Construct for arithmetic operations, code converter, encoders and decoders. 2.2 Test bench for combinational circuits. 2.3 Verilog codes for arithmetic operations, code converter, priority encoders and decoders. 2.4 Simulation tool for functional verification of Verilog codes. **Suggested list of Experiments:** i. Simulate the Verilog code for 4-bit adder/subtractor. ii. Simulate the Verilog code for code converter i.e. BCD to ASCII. iii. Simulate the Verilog code for priority encoders. ***Self-Learning Topics:*** *Simulate the Verilog code for binary to gray code converter.* ***Learning Outcomes :*** *A learner will be able to* 1. *Identify the Verilog construct to design combinational circuits such as adder, subtractor, code converters and priority encoders. (P.I.-5.1.1)* 2. *Identify the modern tools to edit, debug, test the Verilog code of combinational circuits. (P.I.-5.2.1)* 3. *Generate test bench to verify the Verilog code of combinational circuits. (P.I.-4.2.1)* 4. *Simulate the Verilog codes using simulator. (P.I.-4.3.1)*	**06**	**CO- 2**

03.	***Learning Objectives:*** *To design the sequential circuits i.e., flip flops, counter, memory and sequence detector using hardware descriptive language and validate it using computer aided design tool.* **Contents:** 3.1 Sequential Verilog Construct for flip-flops, counter, memory and finite state machines. 3.2 Test bench for sequential circuits. 3.3 Verilog codes for flip flop , memory , counter, shift register **Suggested list of Experiments:** i. Simulate the Verilog code for D and T flip flops ii. Simulate the Verilog code for 4-bit binary counter. iii. Simulate the Verilog code for 16x8 Memory. iv. Simulate the Verilog codes for sequence detector. ***Self-Learning Topics:*** *Simulate the Verilog code for JK flip-flop.* ***Learning Outcomes :*** *A learner will be able to* 1. *Identify the Verilog construct to design sequential circuits such as flip-flops, counter and memory. (P.I.-5.1.1)* 2. *Identify the modern tools to edit, debug, test the Verilog code of sequential circuits. (P.I.-5.2.1)* 3. *Generate test bench to verify the Verilog code of sequential circuits. (P.I.-4.2.1)* 4. *Simulate the Verilog codes using simulator. (P.I.-4.3.1)*	**08**	**CO- 3**
04	**Learning Objectives:** *To design communication protocol using hardware descriptive language and validate it using computer aided design tool.* **Contents:** 4.1 Communication Protocols: I2C, SPI, UART. 4.2 Payload format. 4.3 Applications of protocol. **Suggested Experiment**: Verilog design of any one communication Protocols such as SPI, I2C, UART etc. *Self-Learning Topics:* *AMBA bus* ***Learning Outcomes:*** *A learner will be able to* ***Design serial communication protocol using Verilog constructs. (P.I.-5.1.1)*** 1. *Identify the modern tools to edit, debug, test the Verilog code of communication protocol. (P.I.-5.2.1)* 2. *Simulate the Verilog codes communication protocol using simulator. (P.I.-4.3.1)* 3. *Demonstrate the designed communication protocol in teams using test vectors. (P.I.-4.2.1) (P.I.-9.3.1)* 4. *Prepare a report containing methods, test results with conclusion (P.I.-10.1.2)*	**06**	**CO4**
	Total	**30**	

Note: Minimum four experiments from module 1, minimum two experiments from module 2, minimum two experiments from module 3 and one experiment in module 4 should be covered. Total number of experiments should be at least 9.

Course Outcomes:

1. Design digital control switches for electrical appliances.
2. Develop Verilog codes of combinational circuits and simulate them for functional verification.
3. Develop Verilog codes of sequential circuits and simulate them for functional verification.
4. Illustrate the knowledge of Verilog language to develop digital communication protocols.

Performance Indicators:

P.I. No.	P.I. Statement
3.1.5	Explore and synthesize engineering requirements considering health, safety risks, environmental, cultural and societal issues
3.2.2	Build models/prototypes to develop diverse set of design solutions
4.1.3	Apply appropriate instrumentation and/or software tools to make measurements of physical quantities
4.2.1	Design and develop an experimental approach, specify appropriate equipment and procedures, test vectors.
4.3.1	Use appropriate procedures, tools, and techniques to conduct experiments and collect data
5.1.1	Identify modern hardware and software engineering tools, techniques and resources for engineering activities.
5.2.1	Identify the strengths and limitations of tools for (i) acquiring information, (ii) modelling and simulating, (iii) monitoring system performance, and (iv) creating engineering designs.
9.3.1	Present results as a team, with smooth integration of contributions from all individual efforts
10.1.2	Create clear, well-constructed, and well-supported written engineering documents and/or presentation.

Books :

1. Modern Digital Electronics, R. P. Jain, , Fourth Edition, 2009, Tata McGraw Hill Education
2. Digital Design With an Introduction to the Verilog HDL, VHDL, and System Verilog, Morris Mano Michael D. Ciletti, Sixth Edition, Pearson

Reference Books :

1. Fundamentals of Digital Circuits, Anand Kumar, Fourth Edition, 2018, PHI learning
2. Digital Fundamentals, Thomas L. Floyd, Eleventh GlobalEdition,2015, Pearson Prentice Hall
3. Digital Electronics Principles and Applications, Mandal, First Edition, 2010, McGraw Hill Education
4. A Verilog HDL Primer, J. Bhasker, Third Edition, 1997, Star Galaxy Press
5. Embedded System, Raj Kamal , Fourth Edition,2020, McGraw Hill

Other Resources :

1. Virtual Lab: https://www.vlab.co.in/broad-area-electronics-and-communications
2. "Using Practical Examples in Teaching Digital Logic Design", Dr. Joseph P Hoffbeck, University of Portland

A. CONTINUOUS ASSESSMENT (25 MARKS)

Suggested breakup of distribution

a. Practical Exercises- 10 Marks

Students will be given number of experiments as mentioned in the syllabus. Each experiment carries 10 Marks. Average will be taken of all experiments. Students are expected to complete the task assigned in the experiment description, record observation, interpret results/conclusion and prepare a brief report as per requirement.

b. Practical Test1– 5 Marks

Students will be assigned an experiment based upon the first 50 % of the practical experiments from the list, which they have to perform. Students will be evaluated by lab instructor based on the parameters mentioned in (a).

c. Practical Test2– 5 Marks

Students will be assigned an experiment based upon the last 50 % of the practical experiments from the list, which they have to perform. Students will be evaluated by lab instructor based on the parameters mentioned in (a).

d. Regularity and active participation - 5 Marks

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

Students will be assessed based on three parameters:

- Interpretation of digital design
- Results obtained
- Oral
- Students will be randomly allocated a problem statement to base on digital system design laboratory work. The students will be asked to find the design solution of the given problem statement. The proposed solution 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 implementation/ verification of proposed digital design.
- Students will be allocated 1 hour to implement/ verify the digital design. The obtained result is verified by both the examiners for its correctness. The weightage of the implementation/verification is 10 Marks
- Students will then be appearing for Oral in front of both Internal and External examiners. The weightage of Oral will be of 10 Marks

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

Course Type	Course Code	Course Name	Credits
SBL	ECSBL301	PYTHON LABORATORY	02

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

Pre-requisite:

Program Outcomes addressed:

1. PO 1: Engineering knowledge
2. PO 2: Problem analysis
3. PO 3: Design/Development of Solutions
4. PO 4: Conduct investigations of complex problems
5. PO 5: Modern tool usage
6. PO 9: Individual and teamwork
7. PO 10: Communication
8. PO 12: Life-long learning

Course Objectives:

1. Describe the core syntax and semantics of Python programming language.
2. Explore file handling in Python.
3. Infer the Object-oriented Programming concepts in Python.
4. Formulate GUI Programming and Databases operations in Python.

Module	Detailed Contents	Hrs.	CO
	Course Introduction Python programming has a significant scope in the field of Electronics and Telecommunication (EXTC). It is widely used for tasks such as data analysis, signal processing, automation and control systems design. With its extensive libraries like NumPy and SciPy, Python facilitates efficient processing of signals and data in EXTC applications. It is a high-level programming language known for its simplicity. It has a huge library resource which is used for applications like web development and data analysis to machine learning and artificial intelligence. It has a community driven development model.	**02**	

01.	**Basics of Python programming**	**16**	**CO- 1**
	Learning Objective/s:		
	Apply knowledge of Python programming to analyze engineering problems using modern tools.		
	Content:		
	Introduction to Python, Installation and resources, Identifiers and Indentation, Variables (Local and Global), data types, Arithmetic, Comparative, Logical and Identity Operators, Bitwise Operators, Expressions, Print statement and Formats, Input statements in python. Data types (tuples, strings, dictionaries, lists), Operators in python (Arithmetic, relational, assignment, logical, bitwise, ternary), Decision Flow Control Statements, Methods and functions, Classes and objects, Files processing and handling functions.		
	Tasks: 1. Usage of Flow control statements. For example: **a.** Declare your Sem I SGPA value and Sem II SGPA value. Compute $CGPA = (SGPA1 * SGPA2)/2$ Display the result. Identify an appropriate flow control statement and display whether you are a distinction/1st class/second class holder. **b.** Accept user-defined values of distance between your institute and college canteen, write a program to convert and print this distance in meters, feet, inches and centimeters. Select an appropriate flow control statement and compute the following: If the walking speed of the student is 5Km/hr, calculate the time taken to reach the canteen. 2. Creation and Usage of Functions. For example: **a.** Write a function to generate the first 20 terms of the Fibonacci series. **b.** Use a list comprehension to convert temperatures in °C to Fahrenheit. **c.** Write a function that computes the volume of a sphere given its radius. **d.** Write a function to check if the given string is a Palindrome or not. 3. Creation and usage of classes For example: a. Create a Bank account class. The Class has two attributes: **1.** Owner **2.** Balance: **3.** And two methods:		

	4. Deposit **5.** Withdraw **6.** Add banking details of 10 customers, make multiple withdrawals and deposits and display the final bank balance. 4. Handling of Files For Example: **a.** Sort City Names from the given file alphabetically. **b.** Create a new text editor file. Enter the values of temperature in degree Celsius and Fahrenheit. **c.** Using RegEx, extract email and phone numbers from the given csv/text file.		
	Learning Outcomes: *A learner will be able to* 1. *Apply fundamental programming concepts to solve problems. (P.I.- 1.3.1)* 2. *Apply concepts of object-oriented programming to solve problems. (P.I.- 1.4.1)* 3. *Identify modern hardware and software engineering tools, techniques and resources for python programming. (P.I.-5.1.1)* 4. *Compare and contrast the looping methods to arrive at solutions. (P.I.-2.2.4)* 5. *Use tools like csv packages to handle files. (P.I.-5.1.2)* 6. *Demonstrate proficiency in using packages and tools of python library. (P.I.-5.2.2)* 7. *Identify existing processes for calling functions, creating classes and handling files. (P.I.- 2.2.3)*		
02.	**Usage of Packages and libraries in Python**	**20**	**CO-2,3**
	Learning Objective/s: *Identify the appropriate library and package for arithmetic analysis, data visualization, statistics, and development of GUI.*		
	Content:		
	Use of numpy for arithmetic operations, Use of pandas to access and analyze csv files, Use of Matplotlib library, Scipy library for data visualization and analysis (statistics), Seaborn library for linear and logistic regression, Tkinter library for development of GUI, OpenCV library for image processing.		
	Tasks: 1. GUI development For example: a. Develop a GUI based calculator which has features to execute mathematical operations on matrices. The calculator should be able to handle complex numbers too. b. Develop a user registration form to opt for railway concession from college. 2. Analysis of csv files. For example: Import the e-commerce purchases CSV file and report the		

following:

a. What are the highest and lowest Purchase Prices?

b. How many people have the job title 'Doctor'?

c. How many people made the purchase during AM and how many people made the purchase during PM?

d. What are the 5 most common job titles?

e. Identify the purchase made from Lot: "90 WT", what was the Purchase Price of the transaction?

f. Obtain the email-Id of the person with the following Credit Card Number: 4926535242672853.

g. Calculate the number of people having American Express as their Credit Card Provider and one who has made a purchase above $ 95.

h. How many people have a credit card that expires in 2025?

i. What are the top 5 most popular email providers/ hosts?

3. Perform linear regression on the given data.

For example:

Import and read the Ecommerce Customers csv file and execute the following tasks:

a. Display the heading and details of the file

b. Create a jointplot to compare any two parameters/ characteristics from the csv file.

c. Create a lmplot to predict on the correlation between any two parameters.

d. Create a pair plot on the dataset.

e. Import the training model and perform linear regression on the data.

f. Apply logistic regression and predict whether a person will default on his loan.

4. Image processing

For example:

a. Take your own image and print its shape, pixel intensity of a small section, overwrite the pixel values, crop the margin and also reverse the image in the y-direction and display the final output.

Self-Learning Topics:

Implementing logistic regression/ polynomial regression.

Learning Outcomes: A learner will be able to

1. *Identify the suitable criteria and user requirement to arrive at alternate design solutions for GUI development. (P.I.- 3.2.2)*
2. *Refine a conceptual design into a detailed design while developing a GUI application. (P.I.- 3.4.1)*
3. *Use Numpy and Pandas tools to solve mathematical problems. (P.I.- 5.1.2)*
4. *Demonstrate proficiency in using packages and tools of python library. (P.I.- 5.2.2)*

	5. *Identify existing method and select an appropriate package for a given task and use the inbuilt methods. (P.I.- 2.2.3)* 6. *Apply engineering mathematics and computations to solve regression models. (P.I.- 2.4.1)* 7. *Examine the packages and tools for image acquisition and analysis. (P.I.- 4.1.2)* 8. *Analyze data for trends and correlation while performing regression. (P.I.- 4.3.2)*		
03.	**Python for embedded systems**	**12**	**CO- 4**
	Learning Objective/s: *Develop a standalone embedded system for societal benefits using python.*		
	Content: Sensing (Data acquisition using Rpi), Storage (Uploading data to cloud), Actuation (Ringing of alarm based on threshold levels of the sensed parameter.)		
	Tasks: 1. Acquire data from the given sensor. For example: **a.** Write a code to capture and store images on an embedded system. **b.** Write a code to acquire data from LM35 sensor. **c.** Write a code to acquire data from DHT11 sensor. 2. Store the acquired data on a cloud. 3. Read data from the cloud and actuate an alarm on predetermined conditions.		
	Self-Learning Topics: *Introduction of data processing in Rpi, Architecture and Pinout diagram of Raspi 3.*		
	Learning Outcomes: *A learner will be able to* 1. *Identify relevant data from the given specification sheets and arrive at a design.* 2. *solution for the given system. (P.I.- 3.3.3)* 3. *Identify the suitable criteria for selection of components. (P.I.- 3.2.3)* 4. *Develop ability to learn independently, with respect to interfacing I-O peripherals. (P.I.- 12.1.3)* 5. *Adapt to current versions while selecting the microcontrollers. (P.I.- 12.2.2)*		
04.	**Course project**	**10**	**CO- 5**
	Learning Objective/s: *To develop a need-based application using python.*		
	Content: A python-based project.		
	Suggestive list of course projects:		
	1. A GUI based Personal expense tracker with authentication and currency converter feature. **2.** Prototype of biometrics with face recognition.		

	3. A GUI based To-Do list with Authentication and reminder feature. **4.** Number plate recognition using image processing. **5.** Real-time language translation application. **6.** Library management system with connection to database. **7.** Simple Web scraper for stock market analysis **8.** A To-do list with reminder feature.		
	Self-Learning Topics:		
	Product sheet of the embedded system and the I-O peripherals.		
	Learning Outcomes:		
	A learner will be able to 1. *Identify the suitable criteria and user requirement to arrive at alternate design solutions for a specific course project. (P.I.- 3.2.2)* 2. *Identify the suitable criteria for selection of components for building a course project. (P.I.- 3.2.3)* 3. *Demonstrate effective communication, problem-solving, conflict resolution and leadership skills during the course project. (P.I.- 9.2.1)* 4. *Present results as a team, with smooth integration of contributions from all individual efforts after completion of course project. (P.I.- 9.3.1)* 5. *Create a clear, well-constructed, and well-supported course project report. (P.I.- 10.1.2)* 6. *Create engineering-standard figures, reports, and tables to complement writing and presentations for the course project. (P.I.- 10.3.1)*		
	Total	**60**	
	Minimum 12 tasks and one course project to be performed.		

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

Course Outcomes:

Student will be able to

1. Execute flow control statements, functions and objects on different data types in python.
2. Demonstrate usage of libraries for computations and analysis.
3. Develop GUI Applications in Python.
4. Develop python programs, specifically for embedded system.
5. Develop a python-based application project.

Performance Indicators:

P.I. No.	**P.I. Statement**
1.3.1	Apply fundamental engineering concepts to solve engineering problems.
1.4.1	Apply concepts of electronics and communication engineering and allied disciplines to solve engineering problems.
2.2.3	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.
2.4.1	Apply engineering mathematics and computations to solve mathematical models.
3.2.2	Build models/prototypes to develop diverse set of design solutions.
3.2.3	Identify suitable criteria for evaluation of alternate design solutions.
3.3.3	Identify relevant data from the given resources and arrive at an optimal design solution for particular specifications.
3.4.1	Refine a conceptual design into a detailed design within the existing constraints (of the resources).
4.1.2	Examine the relevant methods, tools, and techniques of experiment, design, system calibration, data acquisition, analysis and presentation.
4.3.2	Analyse data for trends and correlations, stating possible errors and limitations.
5.1.1	Identify modern hardware and software engineering tools, techniques and resources for engineering activities.
5.1.2	Use/adapt/modify/create tools and techniques to solve engineering problems.
5.2.2	Demonstrate proficiency in using discipline specific tools.
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.
10.1.2	Create clear, well-constructed, and well-supported written engineering documents and/or presentation.
10.3.1	Create engineering-standard figures, reports and drawings to complement writing and presentations.
12.1.3	Develop ability to learn independently through methods distinct from instructor provided materials.
12.2.2	Adapt to the current technologies regarding new developments in relevant field.

Books :

1. "Let us Python: Python is Future, Embrace it fast", Yashavant Kanetkar, 1st edition, 8 July 2019, BPB Publications.
2. "Python 3 object-oriented Programming", Dusty Phillips, 2nd Edition, August 2015, PACKT Publisher.
3. "Core Python Programming", Dr. R. Nageswara Rao, Dreamtech Press.
4. "Beginning Python: Using Python 2.6 and Python 3.1", James Payne, Wrox publication.
5. "Introduction to computing and problem-solving using python", E Balagurusamy, McGraw Hill Education.
6. "Learn Python the Hard Way: A Very Simple Introduction to the Terrifyingly Beautiful World of Computers and Code", Zed A. Shaw, 3rd edition, 1 October 2013, Addison Wesley.

Reference Books:

1. "Python Crash Course A hands-on, Project Based Introduction to programming", Eric Matthes, 1st edition, 8 December 2015, No Starch Press.
2. "Headfirst Python", Paul Barry, 2nd edition, 16 December 2016, O′Reilly.
3. "Introduction to Machine Learning with Python", Andreas C. Mueller, 1st edition, 7 October 2016, O′Reilly.
4. "Python Cookbook: Recipes for Mastering Python 3", David Beazley and Brian K. Jones, 3rd edition, 10 May 2013, O'Reilly Media.
5. "Tkinter GUI Application Development Blueprints: Master GUI programming in Tkinter as you design, implement, and deliver 10 real world application", Bhaskar Chaudhary, November 30, 2015, Packt Publishing.

Other Resources :

1. W3Schools Online Web Tutorials: https://www.w3schools.com/python/default.asp
2. Python 3 Documentation: https://docs.python.org/
3. Spoken tutorial: https://spoken-tutorial.org/watch/Python+3.4.3/Getting+started+with+IPython/English/
4. Numpy Documentation: https://numpy.org/doc/
5. Pandas Documentation: https://pandas.pydata.org/docs/
6. Matplotlib Documentation: https://matplotlib.org/3.2.1/contents.html
7. Scipy Documentation : https://www.scipy.org/docs.html
8. Machine Learning Algorithm Documentation: https://scikit-learn.org/stable/
9. Online course on Python: https://archive.nptel.ac.in/courses/106/106/106106182/

A. IN-SEMESTER ASSESSMENT (50 Marks)

1. Continuous assessment of Tasks Executed (30 Marks)

Students will be assigned tasks from the list given in syllabus. They have to perform the tasks, and get the desired output.

Students will be evaluated based on following:

i. Logic building for the given task (10 marks)

ii. Rectifying logical errors and syntax errors (06 marks)

iii. Well-structured and organized program (06 marks)

iv. Verification of experiment output for different inputs (08 marks)

2. **Practical Test (15 Marks)**

   Practical examination on first 50% of the practical list will be conducted for one-and-a-half-hour.

   Students will be randomly allocated a task from the list of tasks. Evaluation will be done by Internal Examiner as follows:

   Algorithm: 5 marks

   Program execution and presentation of results and their interpretation: 5 marks

   Oral Examination: 5 marks

3. **Regularity and active participation** - 5 Marks

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

Students will be assessed based on three parameters:

- Concept/Algorithmic knowledge
- Practical programming knowledge
- Oral

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

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

- Students will be allocated 1 hour to complete the execution. The program is then checked by both the examiners for its correctness. The weightage of the program implementation is 20 Marks.
- The weightage of Observations, Interpretation and Conclusion written on paper will carry 05 Marks.
- Students will then be appearing for Oral Examination in front of both Internal and External examiners. The weightage of Oral will be of 20 Marks.

Course Type	Course Code	Course Name	Credits
MP	ECMP301	Mini Project 1A	01

Examination Scheme	
Continuous Assessment	**Total**
50	50

Pre-requisite:

1. ESC203-Basic Electronics Engineering
2. ESCLC-203-Basic Electronics Engineering Laboratory

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem Analysis
3. PO3: Design/Development of Solutions
4. PO4: Conduct investigations of complex problems
5. PO5: 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.
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.

Guidelines for the Mini Project	Hrs
1. 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.	

2. 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. **3.** Students must form groups of 3 to 4 members either from the same or from different departments. **4.** Groups should conduct surveys to identify needs and develop problem statements in consultation with faculty. **5.** An implementation plan in Gantt/PERT/CPM chart format covering weekly activities must be submitted. **6.** Each group must maintain a logbook to record weekly progress, to be verified by the faculty supervisor. **7.** Faculty input should emphasize guiding by faculty and self-learning by group members. **8.** Groups should propose multiple solutions, select the best one in consultation with the supervisor, and develop a working model. **9.** 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. **10.** 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. **11.** 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.	
Total	**45**

Course Outcomes:
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.

A. IN-SEMESTER ASSESSMENT (50 MARKS)

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

Continuous Assessment Distribution

a) 10 marks for the Topic Approval Presentation in front of the progress monitoring committee
b) 15 marks for the Mid-Semester Progress Presentation in front of the progress monitoring committee
c) 25 marks for the Final Report & Presentation

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

Examination Scheme	
Continuous Assessment	**Total**
50	50

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 andvisualization techniques, Developing design briefs and specifications, Evaluating and selecting design concepts, Rapid prototyping methods(e.g., 3D printing, CNC machining)
04.	**Renewable energy & Energy efficiency** Detailed overview of the product development lifecycle, Design for manufacturability (DFM) considerations, Cost estimation and budgeting, Collaborative design tools and project management Regulatory and compliance requirements (e.g., safety standards)
05.	**User Experience (UX) Design**
	Understanding user needs and behaviour, Usability testing andfeedback gathering, Wireframing and prototyping for digital products, Iterative design process, Accessibility and inclusive design principles
06.	**Sustainability in Product Design** Environmental impact assessment in product design, Sustainable materials and manufacturing processes, Design for disassembly and recycling, Circular economy principles Case studies of eco-friendly product designs
Total No. of Hours: 30	

Course Outcomes:

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	ECPCC405	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

* For Tutorials

Pre-requisite:

1. 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 pertaining to the field of engineering.

2. To build a foundation to the methodology necessary for solving problems by applying the knowledge of mathematics in the field of Engineering

Module	Details	Hrs.	CO
	Course Introduction Engineering Mathematics forms the backbone of Electronics and Telecommunication Engineering. Mathematical concepts are essential for modelling, simulating, and implementing innovative solutions in areas such as signal processing, communication networks, control systems, and electronic circuits. For example- 1. Application of probability and statistics in Engineering design and analysis. 2. Application of complex integration in control systems and signal processing. 3. Application of correlation and regression in analysing signals and assessing system performance. 4. Application of vector space techniques in efficient transmission and reception strategies.	**01-02**	
01.	**Probability Theory and Random Variable** ***Learning Objective/s:*** *The learner will be able to analyze random variables using the basic theory of probability and will be able to apply various mathematical techniques in determining probability functions.* **Contents:** Conditional Probability, Bayes Theorem, Total Probability Theorem, Definition of Random Variable, Types of Random Variable: Discrete and	**06-08**	CO- 1

	Continuous, Probability Mass and Density Function, Measures of Central Tendency and Dispersion. ***Self-Learning Topics:*** *Cumulative Distribution and Density Function* ***Learning Outcomes:*** *A learner will be able to* 1. *Identify independent sets and disjoint sets and use its knowledge in the context of conditional probability. (P.I.-2.1.3)* 2. *Apply mathematical techniques of union, intersection and addition of sets, numbers for finding probabilities of events using Bayes' Theorem and Total Probability Theorem. (P.I.-1.1.1)* 3. *Identify if a given Random variable is Discrete or continuous in nature using existing definitions and formulas from Probability. (P.I.-2.1.2)* 4. *Apply advanced mathematical techniques for finding Expectation, Variance, Probability density function and Probability distribution function. (P.I.-1.1.3)*		
02.	**Probability Distribution** ***Learning Objective/s:*** *Learner will be able to analyze and identify standard probability distribution functions and apply the knowledge of distribution for finding probabilities of various events.* **Contents:** 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. *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)* 3. *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.-2.1.2)* 4. *Apply the advanced mathematical techniques of statistics to find the distribution of probabilities when percentile of area under the curve is given. (P.I. -1.1.3)* 5. *Articulate the problem statements in way such that either normal distribution or reverse normal distribution is to be applied. (P.I.-2.1.1)*	**06-09**	CO- 2
03.	**Complex Integration-I** ***Learning Objective/s:*** *Learner will be able to analyze complex power series and determine the value of complex integration using Cauchy's Integral theorem and Cauchy's Integral formula.*	**05-07**	CO- 3

	Contents: Line Integral, Cauchy's Integral theorem: Simple connected, multiply connected regions. Cauchy Integral formula (without proof). Taylor's and Laurent's series (without proof). ***Self-Learning Topics:*** *Winding Numbers* ***A learner will be able to*** 1. *Apply mathematical techniques from calculus to evaluate line and contour integrals. (P.I.-1.1.1)* 2. *Apply advanced mathematical techniques of analytical functions to rewrite the complex functions in a way that Cauchy Integral formula can be used. (P.I.-1.1.3)* 3. *Identify whether Cauchy Integral Theorem or Cauchy Integral Formula is to be used depending on the points where the function does not exist. (P.I.-2.1.3)* 4. *Identify the terms with negative powers in the power series expansion of complex functions and use this knowledge in understanding Taylor and Laurent Series. (P.I.-2.1.2)*		
04.	**Complex Integration-II** ***Learning Objective/s:*** *Learner will be able to analyze various types of singularities and apply its knowledge in finding contour integrals.* **Contents:** Definition of Singularity, Definition of Zeroes and Poles of $f(z)$. Residues, Cauchy's Residue Theorem (without proof), Application of Residue Theorem to evaluate real integrals. ***Self-Learning Topics:*** *Application of Residue Theorem to evaluate improper real integrals.* ***Learning Outcomes:*** 1. *A learner will be able to* 2. *Identify the existence of limits near the point of singularity and use this knowledge in classifying the types of singularities. (P.I.-2.1.2)* 3. *Apply mathematical techniques of calculus to evaluate contour integrals using the knowledge of residues. (P.I.-1.1.1)* 4. *Identify the order of poles and apply this knowledge for finding residues of complex function. (P.I.-2.1.3)* 5. *Apply fundamentals of distance in checking whether the singularities lie inside or outside the contour. (P.I.-1.3.1)*	**05-07**	CO- 3
05.	**Correlation and Regression** ***Learning Objective/s:*** *Learner will be able to analyze the mathematical dataset given and apply techniques of correlation and regression to identify the relationships between variables from the dataset.* **Contents:** Correlation, Karl Pearson's coefficients of correlation(r), Spearman's Rank correlation coefficient (R): Repeated Rank, Non-repeated rank,	**07-09**	CO- 4

	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. *Identify whether Karl Pearson's or Spearman's coefficient of correlation is to be used in establishing relationship between two variables depending on the dataset given. (P.I.- 2.1.3)* 2. *Apply basic mathematical techniques from algebra in finding the lines of regression and regression coefficients. (P.I.-1.1.1)* 3. *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)* 4. *Apply fundamental concepts of simultaneous equations and use it for curve fitting. (P.I.-1.3.1)* 5. *Identify whether step deviation method or direct correlation methods are to be applied to obtain Karl Person's coefficient of correlation accurately. (P.I.-2.3.2)*		
06.	**Vector Spaces** ***Learning Objective/s:*** *The learner is expected to analyze vectors and apply the concepts of vector algebra in identifying vector spaces and vector subspaces.* **Contents:** Vectors in n-dimensional vector space, norm, dot product, The Cauchy Schwarz inequality (with proof), Unit vector. Orthogonal projection, Orthogonal Basis, Gram-Schmidt orthogonalization process for vectors. Vector spaces over real field, subspaces, Linear combinations, Spanning Set, Linear Independence and Dependence. ***Self-Learning Topics:*** *Orthonormal basis, Basis and Dimension.* ***Learning Outcomes:*** 1. *A learner will be able to* 2. *Apply mathematical techniques of linear algebra and vector addition to find Orthogonal projections. (P.I.-1.1.1)* 3. *Identify if a given set is Linearly Independent or Dependent and use this knowledge to write vectors as linear combinations of each other. (P.I.-2.1.3)* 4. *Identify the axioms of closure, addition and scalar multiplication and use this knowledge for vector spaces (P.I.-2.1.2)* 5. *Apply advanced mathematical knowledge of vector spaces to identify and analyze vector subspaces. (P.I.-1.1.3)*	**07-09**	CO-5
	Course Conclusion	**01**	
	Total	**45**	

Course Outcomes:

Students will be able to -

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. Apply the concepts of Complex Integration for identifying and evaluating integrals, computing residues and evaluating various contour integrals
4. Analyse and interpret the data using Correlation and Regression.
5. Analyse vectors in a given space and apply the concept of vector spaces and orthogonalization process in Engineering Problems.

Performance Indicators:

P.I. No.	P.I. Statement
1.1.1	Apply mathematical techniques such as calculus, linear algebra, probability and statistics, Boolean algebra to solve problems.
1.1.3	Apply advanced mathematical techniques such as integral and differential equations to describe/solve/construct a mathematical model of a system.
1.3.1	Apply fundamental Engineering concepts to solve Engineering problems.
2.1.1	Articulate problem statements and identify primary objectives and key constraints.
2.1.2	Identify engineering systems, variables, and parameters to solve the problems
2.1.3	Identify the mathematical, engineering and other relevant knowledge that applies to a given problem
2.2.2	Identify/ assemble/integrate mathematical tools to information and resources.
2.3.2	Identify assumptions (mathematical and physical) necessary to allow modelling of a system at the level of accuracy required

Textbooks:

1. Advanced Engineering Mathematics, H. K. Dass, Twenty-first Revised Edition, 2013, S.Chand and Company Ltd.

Reference Books:

1. Probability, Statistics and Random Processes, T Veerarajan, Second Edition, 2004, Tata McGraw-Hill Publishing Company Ltd.
2. Advanced Engineering Mathematics, Erwin Kreyszig, Eight Edition, 2010, Wiley Eastern Limited
3. Complex Variables and Applications, S. Ponnusamy and Herb Silverman, First, 2006, Birkhauser Boston
4. Higher Engineering Mathematics, Dr. B. S. Grewal, Forty Second Edition, 2017, Khanna Publication
5. Linear Algebra, Seymour Lipschutz and Marc Lipson,Forth Edition,2009, Tata McGraw-Hill Publishing Company Ltd.

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

A. IN-SEMESTER ASSESSMENT (75 MARKS)

1. Continuous Assessment-Theory (20 Marks)

Suggested breakup of distribution

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

b) One Class test: 05 Marks

c) One Team-Pair-Solo activity: 05 Marks

d) Regularity and active participation: 05 Marks

2. Continuous Assessment - Tutorial (25 Marks)

Suggested breakup of distribution

a) Tutorial Assignments and Class tests: 20 Marks

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

b) Regularity and active participation: 05 Marks

3. Mid Semester Examination (30 Marks)

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

B. END SEMESTER EXAMINATION (50 MARKS)

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

Course Type	Course Code	Course Name	Credits
PCC	ECPCC406	LINEAR INTEGRATED 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. ESC102- Basic Electrical Engineering
2. ESC203-Basic Electronics Engineering
3. ECPCC303 -Electronic Devices and Circuits

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO3: Design/Development of Solutions
4. PO9: Individual and Team work

Course Objectives:

1. To impart the knowledge to demonstrate competence in comprehending the concepts of operational amplifiers and design operational amplifier based applications.
2. To impart the knowledge to demonstrate the ability to design filters, oscillators, waveform generators and precision rectifiers using operational amplifiers.
3. To demonstrate the ability to execute a solution process to design Team-based project using IC555.
4. To demonstrate the ability to execute a solution process to analyse voltage regulator integrated circuits
5. To introduce the special purpose integrated circuits like voltage-controlled oscillators and phase-locked loop.

Module	Details	Hrs	CO
	Course Introduction This course covers concept of operational amplifier which is an integrated circuit and its applications. Course also discusses some special purpose integrated circuits. Next Generation Integrated Circuit market is the growing preference for sustainable and eco-friendly products. It is escalating the integration of technology to enhance product quality and efficiency. The fundamental concepts of this subject are essential for designing operational amplifier (integrated circuit) based applications which are used extensively in mathematical computations, electronic systems such as audio communication, radio	**01**	

	communication, medical electronics instrumentation and in many signal processing applications.		
01.	**Introduction to Operational Amplifier** ***Learning Objective/s:*** *To demonstrate competence in engineering fundamentals and specialized engineering knowledge to comprehend the characteristics and configurations of operational amplifiers.* **Contents:** Block diagram of operational amplifier. Ideal and practical characteristics of operational amplifier, Configurations of operational amplifier: Open loop and closed loop configurations of operational amplifier, application of negative feedback in amplifiers, effect on gain, bandwidth, input resistance, and output resistance, CMRR, Slew rate, PSRR. ***Self-Learning Topics:*** *FET Amplifier.* ***Learning Outcomes:*** *A learner will be able to* 1. *Apply fundamental engineering concepts to comprehend the working principle and characteristics of an op-amp. (P.I.-1.3.1)* 2. *Apply concepts of electronics and communication engineering and allied disciplines to comprehend open and closed loop configurations of an op-amp. (P.I.-1.4.1)*	**6-8**	CO- 1
02.	**Applications of Operational Amplifier** ***Learning Objective/s:*** *To Demonstrate the ability to generate alternative design solutions using operational amplifiers.* **Contents:** Inverting and non-inverting configuration of operational amplifier, buffer, summing amplifier, difference amplifiers and Instrumentation amplifier using operational amplifier, Integrator & differentiator (ideal & practical), Comparators: Inverting comparator, non-inverting comparator, zero crossing detector, Schmitt Triggers: Inverting Schmitt trigger, non-inverting Schmitt trigger. ***Self-Learning Topics:*** *Audio amplifiers in a home stereo.* ***Learning Outcomes:*** *A learner will be able to* 1. *Determine design objectives, functional requirements and arrive at specifications using operational amplifiers. (P.I.-3.1.6)* 2. *Apply mathematical techniques and formal design principles to build op-amp based applications. (P.I.-3.3.3)*	**7-9**	CO- 1

03.	**Filters, Waveform Generators, Oscillators & Precision rectifiers using operational amplifier** ***Learning Objective/s:*** *To Demonstrate the ability to generate filters, oscillators, waveform generators and precision rectifiers using operational amplifier.* **Contents:** Active Filters: First and Second order active low pass, high pass, band pass, band reject and Notch filters. Concept of Positive feedback, Barkhausen's criteria, Sine Wave Oscillators: RC phase shift oscillator, Wien bridge oscillator. Waveform generators: Square wave generator and triangular wave generator, Basics of Precision Rectifiers: Half wave and full wave precision rectifiers. ***Self-Learning Topics:*** *Analog to Digital converters.* ***Learning Outcomes:*** *A learner will be able to* 1. *Determine functional requirements of negative feedback to design filters, waveform generators and rectifiers. (P.I.-3.1.6)* 2. *Apply formal design principles to make use of positive feedback to design op-amp based oscillators. (P.I.-3.3.3)*	**7-9**	CO- 2
04.	**Timer IC 555 and it's applications** ***Learning Objective/s:*** 1. *To demonstrate the ability to design multivibrators using IC 555.* 2. *Demonstrate effective individual and team operations--communication, problem-solving skills for implementing application of IC 555 in a team.* **Contents:** Functional block diagram and working of IC 555, Design of Astable and Monostable multivibrator using IC 555, Applications of Monostable multivibrator such as ramp genaration, frequency division and pulse – width modulation. Applications of Astable multivibrator such as FSK generator, Pulse position modulator and Schmitt trigger. ***Self-Learning Topics:*** *Bistable mode of IC 555.* ***Learning Outcomes:*** *A learner will be able to* 3. *Determine functional requirements of monostable multivibrators for ramp generation, frequency division and pulse width modulation. (P.I.-3.1.6)* 4. *Apply formal design principles to build FSK generator, Pulse position modulator and Schmitt trigger. (P.I.-3.3.3)* 5. *Demonstrate effective communication in implementing application in a team using IC 555. (P.I.-9.2.1)* 6. *Present results as a team, with smooth integration of contributions from all individual efforts. (P.I.-9.3.1)*	**7-9**	CO- 3

05.	**Voltage regulator integrated circuits** ***Learning Objective/s:*** *To identify the engineering systems, variables, and parameters for analyzing voltage regulator circuits.*	**5-7**	CO- 4
	Contents: Functional block diagram, working and design of three terminal fixed voltage regulators (78XX, 79XX series), LM317 Three terminal adjustable voltage regulator, Switched mode power supplies (SMPS).		
	Self-Learning Topics: *Switching voltage regulators.* ***Learning Outcomes:*** *A learner will be able to* 1. *Identify engineering systems to solve the problems of voltage regulators. (P.I.-2.1.2)* 2. *Compare and contrast alternative solutions to select best voltage regulator as per requirement. (P.I.-2.2.4)*		
06.	**Special Purpose Integrated Circuits** ***Learning Objective/s:*** 1. *Demonstrate competence in specialized engineering knowledge to implement applications of VCO IC 566.* 2. *To identify the engineering systems, variables, and parameters for analyzing PLL IC 565.*	**5-7**	CO- 5
	Contents: Functional block diagram and working of Voltage-controlled oscillator (VCO) IC 566 and application as frequency modulator, Functional block diagram and working of Phase-locked Loop (PLL) IC 565 and application as FSK Demodulator.		
	Self-Learning Topics: *PLL frequency synthesizer.* ***Learning Outcomes:*** *A learner will be able to* 1. *Apply fundamental engineering concepts to comprehend the functional block diagram and working principle of IC 566. (P.I.-1.3.1)* 2. *Apply concepts of electronics and communication engineering and allied disciplines to comprehend functional block diagram and working principle of PLL IC 565. (P.I.-1.4.1)* 3. *Apply engineering computations to analyze parameters of VCO IC 566 and PLL IC 565. (P.I.-2.1.2)* 4. *Combine engineering concepts to formulate VCO IC 566 and PLL IC 566 to build frequency modulator and FSK demodulator resp. (P.I.-2.3.1)*		
	Course Conclusion	**01**	
	Total	**45**	

Course Outcomes:

1. Apply the fundamentals of engineering to demonstrate the concepts of operational amplifiers and analyse its applications.
2. Apply the fundamentals of engineering to design filters, oscillators, waveform generators and precision rectifiers using operational amplifiers.
3. Apply fundamentals of engineering to analyse IC 555 applications and design Team-based project.
4. Identify engineering systems and parameters to solve the problems of voltage regulators.
5. Analyse the special purpose integrated circuits like voltage-controlled oscillators and phase-locked loop.

Performance Indicators:

P.I. No.	P.I. Statement
1.3.1	Apply fundamental engineering concepts to solve engineering problems.
1.4.1	Apply concepts of electronics and communication engineering and allied disciplines to solve engineering problems.
2.1.2	Identify engineering systems, variables, and parameters to solve the problems.
2.2.4	Compare and contrast alternative solutions to select the best methodology.
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.
3.1.6	Determine design objectives, functional requirements and arrive at specifications.
3.3.3	Combine scientific principles and electrical engineering concepts to formulate model of a system that is appropriate in terms of applicability and required accuracy.
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. Op-Amps and Linear Integrated Circuits, Ramakant A. Gayakwad, 4th Edition, Pearson Prentice Hall.
2. Linear Integrated Circuits, D. Roy Choudhury and S. B. Jain, 4th Edition, New Age International Publishers.
3. Integrated Circuits, K. R. Botkar, 2004, Khanna Publishers.
4. Design with operational amplifiers and analog integrated circuits, Sergio Franco, 3rd Edition, Tata McGraw Hill.

Reference Books:

1. Operation Amplifiers and Linear Integrated Circuits, David A. Bell, Indian Edition Oxford University Press.
2. Operation Amplifiers and Linear Integrated Circuits, R. F. Coughlin and F. F. Driscoll, 6th Edition, Prentice Hall.
3. Electronic Devices and Circuits, J. Millman, Christos C Halkias, and Satyabratatajit, Millman's, 3rd Edition, McGrawHill.

Other Resources:

1. NPTEL Course: Integrated Circuits and Applications by Prof. Prof. Shaik Rafi Ahamed, Department of Electrical Engineering IIT Guwahati: -
   Web link- https://onlinecourses.nptel.ac.in/noc24_ee73/preview
2. NPTEL Course: Analog Circuits, By Prof. Dr. Pramod Agarwal, IIT Roorkee:
   Web link- https://nptel.ac.in/courses/117107094 /

A. IN-SEMESTER ASSESSMENT (50 Marks)

1. Continuous Assessment (20 Marks)

Suggested breakup of distribution

a) Two Class tests: 10 marks
b) Open book test/ Open notes test: 05 Marks
c) Regularity and active participation:05 Marks

2. Mid Semester Exam (30 Marks)

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

B. END SEMESTER EXAMINATION (50 MARKS)

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

Course Type	Course Code	Course Name	Credits
PCC	ECPCC407	PRINCIPLES OF COMMUNICATION	03

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

Pre-requisite:

1. ESC203 - Basic Electronics Engineering
2. ECPCC303- Electronic Devices and Circuits

Program Outcomes addressed:

1. PO 1: Engineering knowledge
2. PO 2: Problem analysis
3. PO 3: Design/Development of Solutions
4. PO 12: Life-long learning

Course Objectives:

1. To impart the fundamentals of basic communication system and importance of noise.
2. To teach various analog modulation and demodulation techniques.
3. To introduce the concept of radio receivers.
4. To develop the key concepts of analog and digital pulse modulation and demodulation techniques.

Module	Details	Range	CO
	Course Introduction The Principles of Communication Engineering course provides a fundamental understanding of the principles, techniques, and technologies involved in communication systems. This course typically covers topics related to the design, analysis, and implementation of communication systems used for transmitting and receiving information.	**01**	
01.	**Basics of Communication System**	**03- 05**	CO- 1
	Learning Objectives: *To impart knowledge on different types of communication mode and understand need of modulation.*		
	Contents:		
	Block schematic of communication system, Simplex and duplex systems, Modes of communication: Broadcast and point to point communication, Necessity of modulation, Classification of		

	modulation, modulation index, bandwidth, voltage distribution and power calculations. Multiplexing: Time division multiplexing, Frequency division multiplexing. ***Self-Learning Topics:*** *Radio frequency spectrum with its wavelength and corresponding application.* ***Learning Outcomes:*** *A learner will be able to* 1. *Apply fundamental concepts of modulation to solve problems related to efficiency. (P.I.- 1.3.1)* 2. *Apply concepts of different mediums that influence communications in diverse scenarios. (P.I.- 1.4.1)* 3. *Identify the variables and parameters related to modulation to solve problems related to depth of modulation in communication system (P.I.- 2.1.2)* 4. *Breakdown communication system into interconnected sub systems to analyze transmitters and receivers. (P.I.- 2.2.1)* 5. *Recognize the need of multiplexing to reduce the overall bandwidth of a system. (P.I.- 3.1.1)* 6. *Identify relevant examples of multiplexing in practical scenarios and arrive at an optimal design solution for multiplexing multiple voice signals in communication systems. (P.I.- 3.3.3)*		
02.	**Noise in communication system** ***Learning Objectives:*** *To interpret how noise affects signal quality and system performance in communication systems.* **Contents:** Sources of noise, Types of noise: Thermal, Shot, Transition, Partition, Flicker, transit-time, and atmospheric noise; signal to noise ratio, noise figure, noise temperature, system sensitivity and Friis formula. ***Self-Learning Topics:*** *Importance of white noise and is spectrum*. ***Learning Outcomes:*** *A learner will be able to* 1. *Apply fundamental concepts of noise and its effect on communication systems. (P.I.- 1.3.1)* 2. *Compare and contrast different types of noise parameters that best define the noise in communication system. (P.I.- 2.2.4)* 3. *Identify sources of noise in the system and the limitations imposed due to its presence. (P.I.- 2.4.3)* 4. *Apply concepts of Friis formula to solve the problem in amplifiers. (P.I.- 1.4.1)*	**04- 06**	CO- 1
03.	**Amplitude Modulation and Demodulation** ***Learning Objectives:*** *To educate different terminology related to modulations and visualize the AM in time as well as frequency domain.*	**09-11**	CO- 2

	Contents: Amplitude modulation: Definition, expression, time and frequency domain, types: Double sideband full carrier (DSBFC), Double sideband suppressed. carrier (DSBSC), Single sideband suppressed carrier (SSBSC) and independent side band (ISB), Double sideband full carrier: Principles, low-level and high-level transmitters, Double sideband suppressed carrier: Balanced modulators and Single sideband systems: modulation schemes. Amplitude demodulation: Diode detector, practical diode detector, Standards amplitude modulation techniques. Concept of Vestigial sideband and independent sideband ***Self-Learning Topics:*** *Pilot carrier system and its importance in communication system.* ***Learning Outcomes:*** *A learner will be able to* 1. *Apply the concepts of AM to determine bandwidth and power efficiency. (P.I.-1.4.1)* 2. *Apply fundamental concepts of vestigial sideband AM to solve the problem of bandwidth utilization of audio and video signals efficiently. (P.I.-1.3.1)* 3. *Compare and contrast different AM techniques to select the best method. (P.I.- 2.2.4)* 4. *Breakdown and analyze AM system to obtain AM wave equation. (P.I.-2.2.1)* 5. *Adapt to the current technologies based on the development of AM systems in the communication field. (P.I.- 12.2.2)* 6. *Source and comprehend technical literature based on the Pilot carrier system and relate to the practical examples in AM receivers. (P.I.- 12.3.1)*		
04.	**Frequency Modulation and Demodulation** ***Learning Objectives:*** *Comprehend the concept of frequency and phase modulation and evaluate all three types of modulation.* **Contents:** Frequency and phase deviation. Narrow Band Frequency modulation, Wide Band Frequency modulation, Varactor diode modulator, FET reactance modulator, Direct and indirect FM transmitter, noise triangle, preemphasis and de-emphasis. FM demodulation: Balanced slope detector, Foster-Seely discriminator, Ratio detector, amplitude limiting and thresholding, Comparison of analog modulation schemes. ***Self-Learning Topics:*** *Phase modulation system to generate FM indirectly.* ***Learning Outcomes:*** *A learner will be able to* 1. *Apply the concepts of FM to determine bandwidth. (P.I.-1.4.1)* 2. *Apply fundamental concepts of noise triangle in FM to solve the problem of error by analyzing the degree of modulation. (P.I.-1.3.1)* 3. *Identify and integrate emphasis circuits to the FM systems. (P.I.-2.2.2)*	**09- 11**	CO- 2

	4. *Compare and contrast different analog modulation techniques to select the best method. (P.I.- 2.2.4)* 5. *Breakdown and analyze FM system for FM wave equation. (P.I.-2.2.1)*		
05.	**Radio Receivers** ***Learning Objective/s:*** *To instill knowledge on different receivers in communication systems and emphasize on the performance parameters of radio receivers.* **Contents:** TRF and Super-heterodyne receiver, Performance parameters: Image frequency rejection ratio (IFRR), sensitivity, selectivity, double spotting and fidelity; Choice of Intermediate Frequency, Image frequency, Automatic Gain Control, Automatic Frequency Control. Double conversion radio receiver. ***Self-Learning Topics:*** *Software defined radio and Amateur radio*. ***Learning Outcomes:*** *A learner will be able to* 1. *Apply the concepts of Radio receivers to determine parameters. (P.I.-1.4.1)* 2. *Apply fundamental concepts of automatic gain control in radio receivers to solve the problem of gain control. (P.I.-1.3.1)* 3. *Produce and validate different indices related to radio receivers. (P.I.-2.4.2)* 4. *Identify different receiver performance parameters and their impact on receiver operation. (P.I.- 3.3.3)* 5. *Recognize the need for double conversion receivers for the purpose of demodulation. (P.I.- 3.1.1)* 6. *Breakdown and analyze Radio receivers. (P.I.-2.2.1)*	**06- 08**	CO- 3
06.	**Pulse Modulation & Demodulation** ***Learning Objective/s:*** *Emphasize on the sampling theorem and its application in communication systems.* **Contents:** Sampling theorem for low pass signal, proof with spectrum, Nyquist criteria, Sampling techniques, aliasing and aperture effect. Pulse amplitude modulation (PAM), Pulse width modulation (PWM) and Pulse position modulation (PPM) systems: Modulation and demodulation, Applications. Basics of Pulse code modulation system and differential PCM system. Concepts of Delta modulation (DM) and Adaptive Delta Modulation (ADM). Applications of PCM. ***Self-Learning Topics:*** *Quantization error and its role in communication systems to overcome the step-size error. Applications of pulse modulation system.* ***Learning Outcomes:*** *A learner will be able to*	**06- 08**	CO- 4

	1. *Recognize the need of sampling at Nyquist rate and regenerate the modulating signal. (P.I.- 3.1.1)* 2. *Identify the type of pulse modulation system and analyze its use in communication. (P.I.- 2.1.2)* 3. *Extract understanding related to pulse modulation and its limitations. (P.I.- 2.4.4)* 4. *Compare and contrast different pulse modulation techniques to select the best method. (P.I.- 2.2.4)* 5. *Determine design objectives of digital pulse modulation and its requirement to obtain an output with minimum quantization error. (P.I.- 3.1.6)* 6. *Adapt to the current technologies based on the development of digital systems and the importance of error in the communication field. (P.I.- 12.2.2)* 7. *Source and comprehend technical literature based on the quantization error and relate to the practical examples. (P.I.- 12.3.1)*		
	Course Conclusion	**01**	
	Total	**45**	

Course Outcomes:

Student will be able to

1. Examine the performance of Communication System in presence as well as in absence of noise.
2. Analyse and compare types of analog modulation and demodulation.
3. Illustrate the working of analog communication transmitter and receiver systems.
4. Analyse the pulse modulation 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
2.2.1	Breakdown complex problem into interconnected sub systems and analyse by proper assumptions/ justification from information and resources.
2.2.2	Identify/ assemble/integrate mathematical tools to information and resources.
2.2.4	Compare and contrast alternative solutions to select the best methodology.
2.4.2	Produce and validate results through skilful use of contemporary engineering tools and models
2.4.3	Identify sources of error in the solution process, and limitations of the solution.
2.4.4	Extract desired understanding and conclusions consistent with objectives and limitations of the analysis
3.1.1	Recognize that need analysis is key to good problem definition.
3.1.6	Determine design objectives, functional requirements and arrive at specifications

3.3.3 Identify relevant data from the given resources and arrive at an optimal design solution for particular specifications.

12.2.2 Adapt to the current technologies regarding new developments in relevant field.

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

Textbooks:

1. Electronics Communication System, Kennedy and Davis, 4th edition, 2006, Tata McGraw Hill.
2. Modern Digital and Analog Communication system, B.P. Lathi, Zhi Ding, 4th edition, 2011, OxfordUniversity Press.
3. Electronics Communication Systems, Wayne Tomasi, 5th edition, 2003, Pearson education.

Reference Books:

1. Taub's Principles of Communication system, Taub, Schilling and Saha, 3rd edition, 2007, Tata McGraw Hill
2. Communication Systems: Analog and Digital, P. Sing and S.D. Sapre, 3rd edition, 2007, Tata McGraw Hill
3. Introduction to Analog and Digital Communication, Simon Haykin, Michel Moher, 2nd edition, 2012, Wiley.
4. Electronic Communication, Dennis Roddy and John Coolen, 4th edition, 2011, Pearson.
5. Communication Electronics, Louis Frenzel, 3rd Edition, 2004, Tata McGraw Hill.
6. Introduction to Radio Communication Systems, Jack Smith, 2nd edition, 1998, Tata McGraw Hill.

Other Resources:

1. NPTEL/ Swayam Course: Analog Communication by Prof. Goutam Das, IIT Kharagpur , Web Link: https://swayam.gov.in/nd1_noc20_ee69/preview

A. IN-SEMESTER ASSESSMENT (50 MARKS)

1. Continuous Assessment (20 Marks)

Suggested breakup of distribution

a) One MCQ test as per GATE exam pattern/ level: 05 marks
b) One Class test: 05 marks
c) Open notes test: 05 marks
d) Regularity and active participation: 05 marks

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

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

B. END SEMESTER EXAMINATION (50 MARKS)

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

Course Type	Course Code	Course Name	Credits
PCC	ECPCC408	MICROCONTROLLERS & EMBEDDED 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. ESCLC103- Programming Laboratory-1(C)
2. ECPCC304 - Digital Circuit Design

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO3: Design/Development of Solutions
4. PO5: Modern Tool Usage
5. PO6: The engineer and society
6. PO10: Communication

Course Objectives:

1. To learn the computer architectures, architectural comparison and its selection parameters.
2. To describe architectural building blocks of microcontrollers and its applications in microcontroller-based system.
3. To describe architectural building blocks of ARM, processing modes and low-level instruction set in ARM environment.
4. To describe the embedded system designs.

Module	Details	Hrs	CO
	Course Introduction Microcontrollers are widely used in embedded system designs such as mobile phones, medical equipment, entertaining gadgets and many more. Microcontrollers are employed in designing a system on chip (SoC) based around a microcontroller core and in designing microprocessor core itself. Microcontroller is also a foundation course for embedded systems, system on chip design and VLSI courses.	**01**	
01.	**Microcontrollers and Microprocessors**	**4 - 6**	CO- 1
	Learning Objectives: *To apply the knowledge of computer architecture, performance parameters and features of microprocessors and microcontrollers to design an embedded system.*		
	Contents: Overview of Microprocessors and microcontrollers, Overview of Computer Architecture- Memory Architecture -Van Numan & Harvard,		

	Core Architecture -Micro-coded & Hard-Wired Coded, Instruction Set Architecture- RISC & CISC, Multi Core, DSP, Indian Processors: Features of Ajit, Shakti Processors, Parameters to select a Microcontroller. ***Self-Learning Topics:*** *Course Architecture of 8-bit microprocessor -8085* ***Learning Outcomes :*** *A learner will be able to* 1. *Apply computer architectural concepts to identify components of different architectures. (P.I.-1.3.1)* 2. *Use core principles of engineering to differentiate microprocessors and microcontrollers. (P.I.-1.4.1)* 3. *Elicit the Indian microprocessors and there features suitable for embedded system applications. (P.I.-3.1.2)(P.I.-10.1.1)* 4. *Identify selection parameters of microcontroller for the design of embedded system. (P.I.-3.1.6)*		
02.	**ARM Microcontroller** ***Learning Objective/s:*** *To apply the knowledge of ARM and identify its applications in Medical field, entertaining gadget and communication devices.* **Contents:** Introduction to ARM, ARM Products, Intellectual properties of ARM, Applications of ARM cortex 'A', 'R' and 'M' series, architectural inheritance, ARM 7- Features, architecture- core data path, pipeline, Register Bank, Program Status Register, Program Counter, Exception Handling, Processor operating Modes and Register Set. ***Self-Learning Topics:*** *Find the role of ARM in Automobiles sector.* ***Learning Outcomes :*** *A learner will be able to* 1. *Identify the features of basic RISC machines for inclusion and exclusion from ARM architecture. (P.I.-2.2.4)* 2. *Identify and illustrate architectural component of ARM and ARM IP. (P.I.-2.2.2) (P.I.-6.1.1)* 3. *Identify the ARM cortex family used in featured rich OS, real time signal processing and low power applications. (P.I.-2.3.1)*	**8 - 10**	CO- 2
03.	**ARM 7 Instruction Set** ***Learning Objectives:*** *To analyze the assembly language instruction set of the ARM to select the appropriate instruction for data processing, flow control and data transfer used in assembly language environment.* **Contents:** Addressing Modes, BIG and Little Endian formats, Data Processing Instructions, Conditional Codes, Conditional execution and flag, Branch Instructions, Barral Shifter, Load and store: Pre and post	**8 - 10**	CO- 3

	indexing, Multiplication, Software interrupts, Integrated design environment for ARM. ***Self-Learning Topics:*** *High level language instructions used for ARM environment.* ***Learning Outcomes :*** *A learner will be able to* 1. *Select the appropriate assembly language instruction for logical, arithmetic shifts to solve mathematical equations. (P.I.-2.4.1)* 2. *Extract the result of ARM instruction. (P.I.-2.4.2)* 3. *Identify and describe the ARM instructions for data transfer. (P.I.-5.1.1)* 4. *Identify the strengths and limitations of IDE used in ARM development. .(P.I.-5.2.1)*		
04.	**ARM-32 bit Cortex M4** ***Learning Objective/s:*** *To apply the knowledge of architectural components of 32bit cortex M4 family and identify the components to communicate with external peripherals.* **Contents:** Functional overview, Memory protection unit, embedded Flash and SRAM, Clock, Reset and Supply Power Management, Interrupts, GPIO configuration, ADC/ DAC supports, DMA, Timers and Watchdog, Communication Interfaces –I2C, USART, SPI. ***Self-Learning Topics:*** *Serial communication protocol -Serial audio interface and CAN.* ***Learning Outcomes :*** *A learner will be able to* 1. *Apply the memory organization concept to avail the memory protection in RTOS environment. (P.I.-1.4.1)* 2. *Select timer configuration by applying PWM concept to obtain the desired triggering pulses for given applications. (P.I.-1.3.1)* 3. *Compare independent and windows watchdog timers present in ARM. (P.I.-2.2.4)* 4. *Identify the building blocks communication protocols used for serial communication. (P.I.-2.2.1)*	**6 - 8**	CO- 4
05.	**I/O interfacing with ARM and High-Level Programming** ***Learning Objectives:*** *To design ARM based system with I/O device interface and it's the high-level language program used by engineering tools for simulation.* **Contents:** Key interface – Static and Multiplexed, Display Devices- LCD, 7 segment in Multiplexed mode, ADC /DAC configuration, Interrupts, UART, Timers.	**6 -8**	CO- 5

	Self-Learning Topics: *Select any ARM development board and identify the I/O peripherals support available with board.* ***Learning Outcomes :*** *A learner will be able to* *1. Design ARM based system to measure the physical parameters. (P.I.-3.1.6)* *2. Design a serial communication interface by selecting appropriate mode. (P.I.-3.3.3)* *3. Identify the display devices to interface with identified GPIO lines of ARM processor. Display the decimal numbers on 7 it using 'c' language program. (P.I.-5.1.1)* 4. *Use multiplexed techniques to interface matrix key board with ARM. (P.I.-5.1.2)*		
06.	**Embedded Systems** ***Learning Objectives:*** *To apply the knowledge ARM architecture to design embedded system.* **Contents:** Role of microcontrollers in Embedded System, Characteristics of Embedded Systems, Development process, Criteria for selecting microcontrollers in embedded system design, Applications of embedded systems like Adaptive Cruise Control (ACC). ***Self-Learning Topics:*** *Overview of the building blocks of Embedded Systems* ***Learning Outcomes :*** *A learner will be able to* *1. Identify the characteristics of embedded system. (P.I.-2.1.2)* *2. Identify the role of /microcontroller in embedded system. (P.I.2.1.1)* *3. Identify selection parameters of microcontroller for the design of embedded system. (P.I.-3.3.3)* *4. Design embedded system based system for adaptive cruise control. (P.I.-3.1.6)*	**5 - 7**	CO- 6
	Course Conclusion	**01**	
	Total	**45**	

Course Outcomes:

The student will be able to

1. Illustrate the knowledge of Computer architectures used in microcontroller-based system.
2. Illustrate the knowledge of ARM architecture and its processing modes.
3. Summarize the data processing, flow control, data transfer instructions of ARM processor.
4. Summarize the functional blocks of ARM Cortex M4 series Microcontrollers.
5. Develop the high-level language programs to interface I/O devices and communication with external peripheral.
6. Design embedded system applications.

Performance Indicators:

P.I. No.	P.I. Statement
1.3.1	Apply fundamental engineering concepts to solve engineering problems.
1.4.1	Apply concepts of electronics and communication engineering and allied disciplines to solve engineering problems.
2.1.2	Identify engineering systems, variables, and parameters to solve the problems
2.2.1	Breakdown complex problem into interconnected sub systems and analyse by proper assumptions/ justification from information and resources.
2.2.2	Identify/ assemble/integrate mathematical tools to information and resources
2.2.4	Compare and contrast alternative solutions to select the best methodology.
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
2.4.2	Produce and validate results through skilful use of contemporary engineering techniques
3.1.2	Elicit and document, engineering requirements from stakeholders
3.1.6	Determine design objectives, functional requirements and arrive at specifications
3.3.3	Identify relevant data from the given resources and arrive at an optimal design solution for particular specifications.
5.1.1	Identify modern hardware and software engineering tools, techniques and resources for engineering activities.
5.1.2	Use/adapt/modify/create tools and techniques to solve engineering problems
5.2.1	Identify the strengths and limitations of tools for (i) acquiring information, (ii) modelling and simulating, (iii) monitoring system performance, and (iv) creating engineering designs.
6.1.1	Identify and describe various engineering roles; particularly as pertains to protection of the public and public interest at global, regional and local level.
10.1.1	Read, understand and interpret technical and/or non-technical information.

Text Books:

1. ARM System Developer's Guide: Designing and Optimizing System Software, Andrew N. Sloss, Dominic Symes and Chris Wright,2nd edition,2004, Morgan Kaufmann Publisher.
2. ARM system on-chip architecture, Steve Furber, Addison Wesley, second edition, 2000.
3. ARM Microcontroller Interfacing: Hardware and Software", Warwick A. Smith, 2010, Delmar Cengage Learning.

Reference Books :

1. Microcontroller Technology: The 68HC1, Peter Spasov,4th edition,1999, Prentice Hall
2. Embedded Systems: Introduction to Arm Cortex-M Microcontrollers, Jonathan Valvano,5th edition, 2012, Create Space Independent Publishing Platform.

3. Embedded Systems: Architecture, Programming, and Design, Raj Kamal, 3rd Edition, 2017, McGraw-Hill Education.
4. Microcontrollers, Ariel Lutenberg, Pablo Gomez, Eric Pernia,2022, Arm education Media.

Other Resources :

1. Forums and communities. (Microchip Forum, STM32 Community) Web link: https://academy.st.com/s/learning-catalogs
2. ARM Architecture Reference Manuals, keil Development tools -ARM Documentation. Web link: https://developer.arm.com/documentation/ddi0487/latest/
3. Web link for Indian Shakti processor: https://shakti.org.in/processors.html.

A. IN-SEMESTER ASSESSMENT (50 MARKS)

1. Continuous Assessment (20 Marks)

Suggested breakup of distribution

a) Design assignment*:10 Marks
b) Article reading & summarization/poster creation: 05 Marks
c) Regularity and active participation:05 Marks

2. Mid Semester Exam (30 Marks)

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

B. END SEMESTER EXAMINATION (50 MARKS)

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

* Topics: Embedded system application such as controlled rectifiers, speed control of industrial drives, choppers. However, students are free to select any application with prior approval from the course coordinator.

Course Type	Course Code	Course Name	Credits
MDM	ECMDM 402	CONTROL SYSTEMS AND PLC	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. ECPCC 302- Network Theory
2. ECPCC 304- Digital Circuit Design
3. BSCESC 102- Basics Electrical Engineering

Program Outcomes addressed:

1. PO 1: Engineering knowledge
2. PO 2: Problem analysis
3. PO 3: Design/Development of Solutions
4. PO 4: Conduct investigations of complex problems
5. PO 5: Modern tool usage
6. PO 10: Communication

Course Objectives:

1. To teach fundamentals of control system for mathematical modelling of a system.
2. To evaluate the system in time and frequency domain.
3. To impart knowledge on Process Controllers.
4. To develop the concept of industrial automation using PLC and SCADA.

Module	Details	Range	CO
	Course Introduction This course covers fundamentals of control systems, stability analysis in time and frequency domain, process controllers and PLC. Control systems play a vital role in maintaining stability, efficiency and safety in industrial applications. It deals with regulating operations within an industrial process to ensure optimal performance of system.	**01**	
01.	**Basics of Control systems and System Modelling**	**05-07**	CO- 1
	Learning Objectives:		
	To apply fundamentals of open and closed loop control systems to determine optimum transfer function.		

	Contents: Process control system: Block diagram with an example and function of each block (Both Open and closed loop systems), Modelling of electrical circuits. Analogy between electrical and mechanical system components, Block diagram reduction techniques and Signal Flow Graphs using Mason's Gain formula. ***Self-Learning Topics:*** *Rules of block diagram reduction.* ***Learning Outcomes:*** *A learner will be able to* 1. *Identify the difference between open and closed loop control system with block diagram. (P.I.-2.1.2)* 2. *Apply mathematical transforms to convert electrical circuits in specific domain. (P.I.-1.1.2)* 3. *Apply computations to solve electrical circuits. (P.I.- 2.4.1)* 4. *Identify electrical and mechanical system components. (P.I.- 2.1.3)* 5. *Apply fundamental engineering concepts related to block diagram reduction and signal flow graph techniques. (P.I- 1.3.1)* 6. *Determine and validate an optimal transfer function for a system. (P.I.- 2.4.2)*		
02.	**Stability Analysis in Time Domain** ***Learning Objectives:*** *To analyze the transient, steady state error and stability of the system in time domain.* **Contents:** Analysis of First and Second Order Control System: First Order System: Analysis for inputs of Unit Step, Unit Ramp and Unit Parabolic, Concept of Time Constant, Steady State Error and types of error constants. Second Order System: Analysis for inputs of Unit Step, Unit Ramp and Unit Parabolic, Effect of Damping, Time Response Specifications: Delay time, Rise time, Peak Time, Peak Overshoot, settling time, Numerical Problems, Routh's Stability Criterion, Root locus Analysis: General rules for constructing root-locus and analysis of given root locus plot. ***Self-Learning Topics:*** *Time Response: Transient and Steady State Response, Standard Test Inputs: Unit Step, Unit Ramp, Unit Parabolic, Unit Impulse functions and their corresponding Laplace Transform, Stability: Concept of Stability based on location of roots in s-plane and Analysis of Stable, Unstable, Critically Stable and Conditionally Stable System.* ***Learning Outcomes:*** *A learner will be able to* 1. *Apply Laplace transforms of various input signals to obtain the output. (P.I.- 1.1.2)*	**08- 10**	CO- 2

	2. *Apply fundamental concepts to calculate steady state errors for inputs such as Unit Step, Unit Ramp and Unit Parabolic. (P.I.- 1.3.1)* 3. *Apply engineering mathematics and computations to determine the given transfer function. (P.I.- 2.4.1).* 4. *Define time response specifications and its importance in control system. (P.I- 4.1.1)* 5. *Analyze time response specification from graphical representation. (P.I.- 4.3.3).* 6. *Identify type of a system to obtain static error coefficients. (P.I.- 2.1.2)* 7. *Analyze the stability from the given Root locus plot and Routh's array. (P.I.- 4.3.3)*		
03.	**Stability Analysis in frequency domain** ***Learning Objectives:*** *To illustrate the system parameters and analyze the stability in frequency domain.* **Contents:** Bode Plot: Magnitude and phase plot, Stability margins and analysis of a given plot, practical example- filter circuits, Nyquist stability Criterion: Concept of Polar and Nyquist plot, gain and phase margin and stability analysis of a given plot, Concept of Lead, Lag compensator and design of lead lag compensator using bode plot. ***Self-Learning Topics:*** *Fundamentals of optimal control theory.* ***Learning Outcomes:*** *A learner will be able to* 1. *Produce the transfer function for a given Bode plot. (P.I.-2.4.2)* 2. *Define the gain margin, phase margin and cross over frequencies and its importance to analyze the system stability. (P.I.- 4.1.1)* 3. *Synthesize the gain margin, phase margin and cross over frequencies from a given plot to analyze the system stability. (P.I.-4.3.4)* 4. *Recognize the need for compensators in a system. (P.I- 3.1.1)* 5. *Identify the effect of adding compensators in control system. (P.I.- 3.3.3)* 6. *Compare and contrast the solutions of Polar and Nyquist plot to select the best method. (P.I.- 2.2.4)*	**08- 10**	CO- 3
04.	**Process Controllers** ***Learning Objectives:*** *To examine a process using controllers to determine a desired output.* **Contents:** Control Actions: Discontinuous Mode: ON-OFF Controllers, Neutral Zone. Continuous Modes: a) Proportional Controller - Offset, Proportional Band, b) Proportional, Integral and Derivative Controllers-Output Equation, Response, Characteristics, c) Composite Controllers: PI, PD, PID Controllers - Output Equation, Response Characteristics.	**05- 07**	CO- 4

	Self-Learning Topics: *Controller tuning* ***Learning Outcomes:*** *A learner will be able to* 1. *Recognize the need for Process Controllers. (P.I.- 3.1.1)* 2. *Determine the specifications of Process Controllers. (P.I.- 3.1.6)* 3. *Identify the controllers and obtain output equation, response characteristics. (P.I.- 2.1.2)* 4. *Compare PI, PD, PID controllers (P.I.- 2.2.4)*		
05.	**Fundamentals of PLC** ***Learning Objective/s:*** *To develop concepts of industrial automation using PLC.* **Contents:** Advantages of PLC Based Control over Conventional Relay Based Control, Classification of PLC (Fixed and Modular PLCs), Architectural Details of PLC: Block Diagram of PLC, CPU and Program Scan, Input- Output Modules (Discrete and Analog), Memory (its organization and addressing), Power Supply and Programming Devices, Ladder Logic Diagram: Elements of Ladder Diagram with examples. ***Self-Learning Topics:*** *Case study: PLC application in industries.* ***Learning Outcomes:*** *A learner will be able to* 1. *Articulate the need of PLC in industry. (P.I.- 2.1.1)* 2. *Break-down the architectural details of PLC and analyze the information. (P.I.- 2.2.1)* 3. *Use tools and techniques of ladder logic diagram to solve engineering problems. (P.I.- 5.1.2)* 4. *Demonstrate ladder logic diagram using tools. (P.I.- 5.2.2)* 5. *Create flow of ladder logic in rungs and document the logical progression of execution. (P.I.- 10.1.3)* 6. *Create the design steps as report for the ladder diagram. (P.I.- 10.3.1)*	**05- 07**	CO- 5
06.	**Role of control systems in Industrial Automation** ***Learning Objectives:*** *To formulate the concepts of industrial automation using PLC and SCADA.* **Contents:** Architecture of a typical SCADA system: Human-Machine Interface (HMI), Remote Terminal Units (RTUs), Communication in SCADA, PLC Instruction Set: Relay Instructions, Logical Instructions, Program	**06- 08**	CO- 5

	Control instructions, Timer and Counter Instructions, Data Handling Instructions.		
	Self-Learning Topics**:* *Use of SCADA in automation.* ***Learning Outcomes: *A learner will be able to* *1.Articulate the need of SCADA system. (P.I.- 2.1.1)* *2. Break-down the architectural details of SCADA system and analyze the information. (P.I.- 2.2.1)* *3. Define importance of control systems in Industrial Automation. (P.I.- 4.1.1)* *4. Examine relevant tools or techniques for data acquisition using SCADA system. (P.I.- 4.1.2)* *5. Use tools and techniques with PLC instruction set. (P.I.- 5.1.2)* *6. Demonstrate PLC instruction set using tools. (P.I.- 5.2.2)*		
	Course Conclusion	**01**	
	Total	**45**	

Course Outcomes:

Students will be able to:

1. Determine the mathematical models of a given system using block diagram reduction rules and Mason's gain formula.
2. Analyze a given system in Time domain with respect to stability
3. Analyze a given system in Frequency domain with respect to stability
4. Obtain the Transfer Functions and Reponses characteristics for Process Controllers
5. Illustrate the concept of industrial automation using PLC and SCADA.

Performance Indicators:

P.I. No.	P.I. Statement
1.1.2	Apply mathematical transforms to solve problems.
1.3.1	Apply fundamental engineering concepts to solve engineering problems.
2.1.1	Articulate problem statements and identify primary objectives and key constraints.
2.1.2	Identify engineering systems, variables, and parameters to solve the problems.
2.1.3	Identify the mathematical, engineering and other relevant knowledge that applies to a given problem.
2.2.1	Breakdown complex problem into interconnected sub systems and analyse by proper assumptions/ justification from information and resources.
2.2.4	Compare and contrast alternative solutions to select the best methodology.
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
3.1.1	Recognize that need analysis is key to good problem definition.

3.1.6 Determine design objectives, functional requirements and arrive at specifications.

3.3.3 Identify relevant data from the given resources and arrive at an optimal design solution for particular specifications.

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.

4.3.3 Represent data (in tabular and/or graphical forms) to facilitate analysis and explanation of the data and drawing of conclusions.

4.3.4 Synthesize information and knowledge about the problem from the data to reach appropriate conclusions.

5.1.2 Use/adapt/modify/create tools and techniques to solve engineering problems

5.2.2 Demonstrate proficiency in using discipline-specific tools.

10.1.3 Create flow in a document or presentation - a logical progression of ideas so that the main point is clear

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

Textbooks:

1. Modern Control Engineering, Ogata K, Yang Y., 3rd Edition, 2002 Prentice hall.
2. Control System Engineering, Nagrath, M.Gopal , 7th Edition, 2021, New Age International Private Limited.
3. Control Systems Principles and Design, Gopal M , 4th Edition, 2012, Tata McGraw Hill Publishing Co. Ltd.New Delhi.
4. Programmable logic controllers, Petruzella, Frank , 4th Edition, 2017, McGraw-Hill, Inc..
5. Industrial automation: hands-on, Lamb, Frank, 1st Edition, 2013, McGraw-Hill Education.

Reference Books:

1. Control System Engineering, Norman,, 3rd edition, 2004, John Wiley & sons.
2. Automatic Control Systems, Benjamin C.Kuo, 7th edition, 1995, Pearson education.
3. Programmable Logic Controllers: Industrial Control, Khaled Kamel and Eman Kamel , 1st Edition, 2013, Tata McGraw Hill Publishing Co. Ltd.
4. Supervisory Control and Data Acquisition (SCADA) Systems, Stuart A. Boyer, 4th edition, 2016, International Society of Automation.

Other Resources:

1. Course: Control Systems By Prof. C. S. Shankar Ram (IIT Madras);
   Web Link: https://swayam.gov.in/nd1_noc20_ee90/preview
2. 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/

A. IN-SEMESTER ASSESSMENT (50 MARKS)

1. Continuous Assessment (20 Marks)

Suggested breakup of distribution

a) One MCQ test (As per GATE exam pattern / level) will be conducted for 5 Marks.
b) One Class test will be conducted for 5 Marks.
c) One Think-pair-share Activity for PLCs: Students will be asked to select a real-world application*****, discuss and build a ladder diagram for PLC based automation of this system. They will submit the ladder diagram and the design steps as a report: 05 Marks
d) Regularity and active participation: 05 Marks

2. Mid Semester Exam (30 Marks)

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

B. END SEMESTER EXAMINATION (50 MARKS)

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

*** Suggested List for Continuous Assessment (c):**

1. Motor Control Circuit: A ladder diagram to control the start and stop of a motor using a start button, stop button, and motor contactor.

2. Traffic Light Control: A ladder diagram to control a traffic light system with multiple stages using timers and outputs for signal control.

3. Conveyor Belt Control: A ladder diagram to control the movement of a conveyor belt with start, stop, and emergency stop buttons.

4. Water Tank Level Control: A ladder diagram to control the level of water in a tank using level sensors, motorized valves, and alarms.

5. Temperature Control: A ladder diagram to control the temperature of a room using a temperature sensor, heater, and fan.

6. Pump Control: A ladder diagram to control the operation of a pump based on the level of a liquid in a tank using level sensors and pump control relays.

7. Sequential Process Control: A ladder diagram to control a sequential process with multiple steps, such as a filling station or a production line.

8. Elevator Control: A ladder diagram to control the operation of an elevator system with floor selection buttons, door control, and safety mechanisms.

9. Batch Mixing Control: A ladder diagram to control the mixing process of different ingredients in a batch using timers, valves, and pumps.

10. Vending Machine Control: A ladder diagram to control the operation of a vending machine, including coin input, product selection, and dispensing.

Course Type	Course Code	Course Name	Credits
LC	ECLC403	LINEAR INTEGRATED CIRCUITS LABORATORY	01

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

Pre-requisite:

1. ESCLC206 -Basic Electronics Engineering Laboratory
2. ECLC301- Electronic Devices and Circuits Lab

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 :

1. To analyse open and closed loop configurations of operational amplifier
2. To summarize various linear and non-linear applications of operational amplifier
3. To develop design skills related operational amplifier and IC-555 Timer IC.

Module	Detailed Contents	Hrs	CO
	Course Introduction This course covers concept of operational amplifier which is an integrated circuit and its applications. operational amplifier are used extensively in mathematical computations, electronic systems such as audio communication, radio communication, medical electronics instrumentation and in many signal processing applications. Course also discusses some special purpose integrated circuits.	**01**	
01.	**Introduction to Operational Amplifier** ***Learning Objective/s:*** *Comprehend various configurations of operational amplifier, circuits associated with closed loop configurations and derive suitable conclusion and relate it with theoretical concepts.*	**06**	**CO- 1**
	Suggested Experiments: 1. Proof of concept: Inverting Amplifier 2. Proof Concept: Non-inverting amplifier 3. Proof of Concept: Buffer Design of an analog calculator using operational amplifier		
	Self-Learning Topics: *Learn the various applications based on inverting and non-inverting operational amplifier*		

	Learning Outcomes: *A learner will be able to* 4. *Comprehend and realize the various closed loop configuration of operational amplifier (P.I.-1.3.1)* 5. *Compare the results obtained and derive suitable conclusions (2.2.4, 9.3.1)* 6. *Tabulate the results and draw suitable graphs (PI: -4.3.3).* 7. *Simulate results for correlation with theoretical concepts (PI-:5.1.1).* 8. *Prepare a brief report based on the obtained results and conclusions (PI-: 10.1.2)*		
02.	**Applications of Operational Amplifier** ***Learning Objectives:*** *Design and implement the circuit based on various parameters its operation along with its output.* **Suggested Experiments:** 1. Design of function generator using operational amplifier based differentiator. 2. Design of function generator using operational amplifier based integrator. 3. Design of a comparator using operational amplifier. 4. Design of Oscillator and switch debouncing using Schmitt trigger ***Self-Learning Topics:*** *Applications of Schmitt trigger.* ***Learning Outcomes :*** *A learner will be able to* 1. *Demonstrate various circuits related to applications of operational amplifier (PI: -4.2.1)* 2. *Compare the results obtained and derive suitable conclusions (PI: -2.2.4, 9.3.1)* 3. *Tabulate the results and draw suitable graphs (PI: -4.3.3).* 4. *Simulate results for correlation with theoretical concepts (PI: -5.1.1).* 5. *Prepare a brief report based on the obtained results and conclusions (PI-: 10.1.2)*	**04**	**CO- 1**
03.	**Filters, Waveform Generators, Oscillators & Precision rectifiers using operational amplifiers** ***Learning Objectives:*** *1) Design* and implement *the circuit based on various parameters its operation along with its output* **Suggested Experiments:** 1. Design Wein bridge and RC phase shift Oscillator for audio and radio frequency generation 2. Design and analyse Low pass, band pass and band reject filter for various applications 3. Design of a square wave generator 4. Design of a precision rectifier ***Self-Learning Topics:*** *Applications of Precision Rectifiers* ***Learning Outcomes:*** *A learner will be able to* *1. Compare the results obtained and derive suitable conclusions (PI: -2.2.4)* *2. Tabulate the results and draw suitable graphs (PI: -4.3.3)* 3. *Simulate results for correlation with theoretical concepts (PI: -5.1.1).*	**06**	**CO- 2** **CO- 3**

04.	**Timer IC 555 and its applications** ***Learning Objective/s:*** *1) Design the circuit based on various parameters* *2) Implement the circuits on breadboard and demonstrate its operation along with its output.* *3) Compare results and observation to derive suitable conclusion and relate it with theoretical concepts.* **Suggested Experiments:** 1. Blinking LED using Timer IC 555 2. Monostable multivibrators using Timer IC 555 3. Astable multivibrators using Timer IC 555 4. Pulse width modulation using IC 555. ***Learning Outcomes****:* *A learner will be able to* 1. *Analyze linear application using operational amplifier and modes of timer IC 555 (PI: -4.3.1).* 2. *Design various circuits related to applications of operational amplifier and timer IC 555 (PI: -4.2.1)* 3. *Compare the results obtained and derive suitable conclusions (PI:2.2.4, 9.3.1)* 4. *Tabulate the results and draw suitable graphs (PI: 4.3.3).* 5. *Simulate results for correlation with theoretical concepts (PI:5.1.1).* 6. *Prepare a brief report based on the obtained results and conclusions (PI-:10.1.2)*	**06**	**CO3**
05.	**Voltage regulator integrated circuits** ***Learning Objective/s:*** *Design* and implement *the circuit based on various parameters its operation along with its output.* **Suggested Experiments*:*** 1. Design regulated power supply using IC 723 2. Voltage regulation using IC LM317 3. Design of switched mode power supply. ***Learning Outcomes:*** *A learner will be able to* 1. *Comprehend the basics fundamentals of voltage regulation and its working (PI: 1.3.1)* 2. *Implement the circuits using software tool (PI: -4.3.3).* 3. *Compare the results obtained and derive suitable conclusions (PI:2.2.4, 9.3.1)* 4. *Tabulate the results and draw suitable graphs (PI: 4.3.3).* 5. *correlate simulated results with theoretical concepts (2.2.4)* 6. *Prepare a brief report based on the obtained results and conclusions (PI-: 10.1.2)*	**04**	**CO4**
06.	**Special Purpose Integrated Circuits** ***Learning Objectives:*** *Design* and *implement the circuit based on various parameters its operation along with its output.* ***Suggested Experiments:*** 1. *Design frequency modulator using IC 566* 2. *Design of Modulator using IC 565*	**04**	**CO4**

	Learning Outcomes: *A learner will be able to* *1. Compare the results obtained and derive suitable conclusions (PI:2.2.4)* *2. Tabulate the results and draw suitable graphs (PI: 4.3.3).*		
	Total	**30**	
Minimum two experiments from modules 1 to 4, one experiment from modules 5 and 6, and total at least 10 experiments.			

Course Outcomes:

Student will be able to

1. Realize various closed loop configurations of operational amplifier
2. Demonstrate various linear and non-linear applications of operational amplifier
3. Design and implement circuits related to operational amplifier and Timer IC-555
4. Simulate various integrated circuits using suitable software tools.

Performance Indicators:

P.I. No.	**P.I. Statement**
1.3.1	Apply fundamental engineering concepts to solve engineering problems.
2.2.4	Compare and contrast alternative solutions to select the best methodology.
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.
4.2.1	Design and develop an experimental approach, specify appropriate equipment and procedures, test vectors.
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) to facilitate analysis and explanation of the data, and drawing of conclusions
5.1.1	Identify modern hardware and software engineering tools, techniques and resources for engineering activities.
9.3.1	Present results as a team, with smooth integration of contributions from all individual efforts
10.1.2	Create clear, well-constructed, and well-supported written engineering documents and/or presentation.

Books:

1. Operational amplifier and Linear Integrated Circuits, Ramakant A. Gayakwad, 4th Edition, Pearson Prentice Hall
2. Linear Integrated Circuits, D. Roy Choudhury and S. B. Jain, 4th Edition, New Age.International Publishers

Reference Books:

1. Integrated Circuits, K. R. Botkar, 2004, Khanna Publishers
2. Design with operational amplifiers and analog integrated circuits, sergio Franco, 3rd edition, Oxford University Press
3. Operation Amplifiers and Linear Integrated Circuits, David A. Bell, Indian Edition, , Oxford University Press

4. Operation Amplifiers and Linear Integrated Circuits, R. F. Coughlin and F. F. Driscoll, 6th Edition, Prentice Hall.
5. Electronic Devices and Circuits, Millman, Christos CHalkias, and Satyabratatajit, , 3rd Edition, McGrawHill.

Other Resources:

1. NPTEL online course: Integrated Circuits, MOSFETs, OP-Amps, and their Applications: Web Link : https://archive.nptel.ac.in/courses/108/108/108108111/

A. CONTINUOUS ASSESSMENT (25 MARKS)

Suggested breakup of distribution

a. Practical Exercises- 10 Marks

Students will be given number of experiments as mentioned in the syllabus. Each experiment carries 10 Marks. Average will be taken of all experiments. Students are expected to complete the task assigned in the experiment description, record observation, interpret results/conclusion and prepare a brief report as per requirement.

b. Practical Test1– 5 Marks

Students will be assigned an experiment based upon the first 50 % of the practical experiments from the list, which they have to perform. Students will be evaluated by lab instructor based on the parameters mentioned in (a).

c. Practical Test2– 5 Marks

Students will be assigned an experiment based upon the last 50 % of the practical experiments from the list, which they have to perform. Students will be evaluated by lab instructor based on the parameters mentioned in (a).

d. Regularity and active participation - 5 Marks

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

Students will be assessed based on three parameters:

- Concept/Theoretical knowledge
- Practical knowledge
- Oral

- Students will be randomly allocated an experiment from the list of laboratory exercises and will be asked to perform the same. The students will be asked to write the theory related to the experiment. The write-up is checked by the examiners (Internal and External) and evaluated out of 05 Marks.

  Then the student will be allowed to perform the experiment.

- Students will be allocated 1 hour to perform the experiment. The results are then checked by both the examiners for its correctness. The weightage of the successful done experiment is 10 Marks

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

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

Course Type	Course Code	Course Name	Credits
LC	ECLC404	PRINCIPLES OF COMMUNICATION LABORATORY	01

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

Pre-requisite:

1. ESC203- Basic Electronics
2. ECPCC303- Electronics Circuits and Devices
3. ECPCC302- Network Theory

Program Outcomes addressed:

1. PO 1: Engineering knowledge
2. PO 2: Problem analysis
3. PO 3: Design/Development of Solutions
4. PO 4: Conduct investigations of complex problems
5. PO 5: Modern tool usage
6. PO 12: Life-long learning

Course Objectives:

1. To impart the conceptual knowledge on modulation and demodulation in time and Frequency domain.
2. To evaluate the performance parameters of receivers.
3. To develop the concept and need of pulse modulations.

Module	Detailed Contents	Hrs.	CO
	Course Introduction The Principles of Communication Engineering lab course provides a fundamental understanding of the principles, techniques, and technologies involved in communication systems. This lab course typically covers a wide range of topics related to the design, analysis, and implementation of communication systems used for transmitting and receiving information. It equips students with the knowledge and skills necessary to analyse, design, and optimize communication systems for various applications in industries such as telecommunications, broadcasting and networking.	**02**	
01.	**Analog modulation & demodulation:** ***Learning Objectives:*** *Analyze experimental results to validate theoretical concepts and understand practical implications to evaluate desired performance characteristics.*	**08**	**CO-1, 3**
	Suggested list of experiments: 1. Design envelope detector for amplitude modulated (AM) signal and comment on the peak diagonal clipping.		

	2. Perform frequency modulation and demodulation and analyze the response based on different modulation indexes. 3. Design and implement Pre-emphasis and De-emphasis circuits for analog audio recording and playback systems. 4. Analysis of aliasing effect on pulse amplitude modulated signals ***Self-Learning Topics:*** *Analysis of Analog communication systems.* ***Learning Outcomes:*** *A learner will be able to* **1.** *Apply fundamental engineering concepts to solve problems based on communication links. (P.I.-1.3.1)* **2.** *Breakdown FM system into interconnected sub systems to analyze the demodulation of modulating signal at the receiver. (P.I.- 2.2.1)* **3.** *Recognize the need of sampling theorem to reconstruct the original modulating signal. (P.I.- 3.1.1)* **4.** *Define an unsampled pulse amplitude modulated signal and its scope to obtain an original signal from it. (P.I.- 4.1.1)* **5.** *Apply concepts of modulation schemes to solve problems related to modulator circuits. (P.I.-1.4.1)* **6.** *Identify relevant data from the given circuit and obtain an optimal design solution for generating an appropriate modulated frequency. (P.I.- 3.3.3)* **7.** *Identify existing process of modulation and demodulation to solve the problem of bandwidth to be utilized efficiently. (P.I.- 2.2.3)* **8.** *Establish a relationship between variable frequency and fixed frequency signal to produce a modulated signal. (P.I.- 4.1.4)*		
02.	**Radio receivers and multiplexing in pulse modulated systems:** ***Learning Objective/s:*** *Analyze experimental results to validate theoretical concepts of multiplexing signals from different sources and understand practical implications to evaluate desired performance characteristics.* **Suggested list of experiments:** 1. Comparison of ideal and practical characteristics of radio receivers. 2. Design a mixer circuit to generate the intermediate frequency for amplitude modulated broadcast receiver. 3. Analyze a Time Division Multiplexing (TDM)- Pulse Width Modulation (PWM) system for transmitting multiple analog signals over a single communication channel. 4. Design and implement a sample-and-hold circuit for analog signal sampling used in analog to digital converter (ADC). ***Self-Learning Topics:*** *Analysis of Analog pulse communication systems.* ***Learning Outcomes:*** *A learner will be able to* **1.** *Apply fundamental engineering concepts to solve problems based on radio receivers. (P.I.-1.3.1)* **2.** *Breakdown pulse modulation system into interconnected sub systems to analyze the demodulation of modulating signal at the receiver. (P.I.- 2.2.1)* **3.** *Recognize the effect of aliasing to reconstruct the original modulating signal. (P.I.- 3.1.1)* **4.** *Define the scope of sample and hold circuit to obtain an original signal from it. (P.I.- 4.1.1)*	**08**	**CO-1, 2, 3**

	5. *Apply concepts of radio receiver characteristics to solve problems related to tuning circuits. (P.I.-1.4.1)* **6.** *Identify relevant data from the given mixer circuit and obtain an optimal design solution for generating an appropriate intermediate frequency. (P.I.-3.3.3)* **7.** *Identify existing process of multiplexing to solve the problem of bandwidth to be utilized efficiently. (P.I.- 2.2.3)* **8.** *Establish a relationship between variable frequency and fixed frequency signal to produce a time division multiplexed signal. (P.I.- 4.1.4)*		
03.	**Analysis of communication systems:** ***Learning Objectives:*** *To Assemble and connect the components according to the transmitter-receiver architecture.* **Suggested list of experiments:** 1. Design and implement an amplitude modulation (AM) detector for receiving broadcasts in medium- wave (MW) band. 2. Investigation of signal to noise ratio for the given signal. 3. TV based experiment: to analyze the Vestigial sideband modulator of a TV. ***Self-Learning Topics:*** *TV signal transmission and reception.* ***Learning Outcomes:*** *A learner will be able to* **1.** *Recognize the need of detector stage to extract the modulating audio signal from the output. (P.I.- 3.1.1)* **2.** *Use tools and techniques to analyze errors due to noise in communication systems. (P.I.- 5.1.2)* **3.** *Adapt to the current technologies based on the development of AM bands in the communication field. (P.I.- 12.2.2)* **4.** *Demonstrate proficiency in using tools to implement an AM based application. (P.I.- 5.2.2)* **5.** *Identify suitable criteria for TV signals and interpret the role of vestige. (P.I.-3.2.3)* **6.** *Source and comprehend technical literature based on the TV signals and relate to the practical examples. (P.I.- 12.3.1)*	**06**	**CO-1, 2, 4**
04	**Applications of Communication Systems:** ***Learning Objectives:*** *To build a circuit according to the transmitter-receiver architecture according to the given specifications.* **Suggested list of experiments:** **1.** Implement simple FM walkie-talkie with the given data specification and evaluate noise performance. 2. Design an FM Radio circuit that can be tuned to a required frequency and evaluate noise performance. 3. Implement a synchronous clock generator using Phase locked loop (PLL) technique to generate pulse amplitude modulated (PAM) signal. 4. Implement and monitor the control of light intensity of LED's based on PWM technique.	**08**	**CO-1, 2, 3, 4**

	Self-Learning Topics:		
	TV signal transmission and reception.		
	Learning Outcomes:		
	A learner will be able to **1.** *Apply fundamental engineering concepts to solve problems based on FM radio. (P.I.-1.3.1)* **2.** *Apply concepts of phase locked loop to solve problems related to pulse amplitude modulated (PAM) signal. (P.I.-1.4.1)* **3.** *Identify the need of detector stage to extract the modulating audio signal from the modulated output. (P.I.- 3.1.1)* **4.** *Use tools and techniques to analyze noise related errors in communication systems. (P.I.- 5.1.2)* **5.** *Adapt to the current technologies based on the development of FM bands in the communication field. (P.I.- 12.2.2)* **6.** *Demonstrate proficiency in using tools to implement an FM based application. (P.I.- 5.2.2)* **7.** *Identify suitable criteria for PWM signals and interpret the role of duty cycle. (P.I.- 3.2.3)* **8.** *Source and comprehend technical literature based on the FM Walkie- talkie and relate to the practical examples. (P.I.- 12.3.1)*		
	Total	**30**	
	Minimum two experiments from each module, and total at least 10 experiments covering all COs.		

Course Outcomes:

Student will be able to

1. Demonstrate modulation, demodulation, and multiplexing schemes.
2. Analyse the characteristics of a radio receiver.
3. Implement and analyse the pulse modulation circuits.
4. Evaluate the communication system for the noise parameters.

Performance Indicators:

P.I. No.	P.I. Statement
1.3.1	Apply fundamental engineering concepts to solve engineering problems.
1.4.1	Apply concepts of electronics and communication engineering and allied disciplines to solve engineering problems.
2.2.1	Breakdown complex problem into interconnected sub systems and analyse by proper assumptions/ justification from information and resources.
2.2.3	Identify existing processes/solution methods for solving the problem, including forming justified approximations and assumptions.
3.1.1	Recognize that need analysis is key to good problem definition.
3.2.3	Identify suitable criteria for evaluation of alternate design solutions
3.3.3	Identify relevant data from the given resources and arrive at an optimal design solution for particular specifications.
4.1.1	Define a problem, its scope, and importance for purposes of investigation
4.1.4	Establish a relationship between measured data and underlying physical principles.
5.1.2	Use/adapt/modify/create tools and techniques to solve engineering problems

5.2.2 Demonstrate proficiency in using discipline-specific tools.

12.2.2 Adapt to the current technologies regarding new developments in relevant field

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

Text Books:

1. Communication Systems, S. Haykin, 4th edition, 2001, John Wiley & Sons.
2. Introduction to Analog and Digital Communications, S. Haykin and M. Moher, 2nd edition., 2007, Wiley.
3. Modern Digital and Analog Communication Systems, B.P. Lathi, 3rd edition, 1998, Oxford University Press.

Reference Books:

1. Communication Electronics, Louis Frenzel, 3rd Edition,2017, Tata McGraw Hill.
2. Electronic Communication Systems, Roy Blake, 2nd edition, 2001, Delmar publication.
3. Lab Manual:
   a. https://www.etti.unibw.de/labalive/manual/
   b. Experiment 3 and 8 of the manual can be referred to perform the experiment based on noise and multiplexing: ECC305 Communication System Lab.pdf (iitism.ac.in)

Other Resources:

1. NPTEL online course: Simulation of Communication Systems Using Matlab:
   Web Link: https://onlinecourses.nptel.ac.in/noc23_ee136/preview
2. Online course by NI (part of Emerson's group)
   Web Link: https://education.ni.com/teach/resources/16/introductory-communications-systems

A. CONTINUOUS ASSESSMENT (25 MARKS)

Suggested breakup of distribution

a. Practical Exercises- 10 Marks

Students will be given number of experiments as mentioned in the syllabus. Each experiment carries 10 Marks. Average will be taken of all experiments. Students are expected to complete the task assigned in the experiment description, record observations, interpret results/conclusion and prepare a brief report as per requirement.

b. Practical Test1– 5 Marks

Students will be assigned an experiment based upon the first 50 % of the practical experiments from the list, which they have to perform. Students will be evaluated by lab instructor based on the parameters mentioned in (a).

c. Practical Test2– 5 Marks

Students will be assigned an experiment based upon the last 50 % of the practical experiments from the list, which they have to perform. Students will be evaluated by lab instructor based on the parameters mentioned in (a).

d. Regularity and active participation - 5 Marks

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

Students will be assessed based on three parameters:

- Conceptual knowledge
- Practical knowledge
- Oral

- Students will be randomly allocated a problem statement from the list of laboratory exercises and will be asked to draw the circuit diagram / block diagram along with the expected results and observations. The written content is checked by the examiners (Internal and External) and evaluated out of 05 Marks.

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

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

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

Course Type	Course Code	Course Name	Credits
PCC	ECLC405	Microcontrollers and Embedded System Laboratory	01

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

Pre-requisite:

1. ESCLC103- Programming Laboratory-I (C)
2. ECPCC304- Digital Circuit Design
3. ESC204- Basic Electronics Engineering

Program Outcomes addressed:

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

Course Objectives:

1. To impart the fundamental concepts of microcontroller peripheral interfaces to solve complex problems.
2. To analyse and troubleshoot microcontroller-based systems efficiently.
3. To acquire proficiency in sensor and actuator interfacing with microcontrollers for diverse real-world applications, prioritizing safety and utilizing modern tools.

Module	Detailed Contents	Hrs	CO
	Course Introduction: This foundational course covers microcontroller peripheral interfaces, focusing on designing responsive systems, considering technical, economic, and societal factors, using modern tools and programming in embedded C and assembly. Its aim is to build abilities for both microcontroller–based system development and problem-solving opportunities in IoT, Embedded Systems, and various industries. Skills acquired enable contribution to innovative projects in automation, robotics, wearable technology, and adaptability for further education, entrepreneurship, or careers in technology.	**02**	
01.	**Microcontroller GPIO Programming** ***Learning Objectives:*** *To equip students with the necessary skills to program microcontroller, to configure GPIO pins using IDE tools effectively.*	**04**	CO1

Suggested List of Experiments

1. Write a program to flash any port GPIO pin.
2. Two switches are connected to P0.1 and P0.2. Write a program to monitor the status of two switches and perform a task as mentioned in the following table.

P0.2	P0.1	Task
0	0	P3 = P2 ^ P1
0	1	Send the ASCII of A to P1
1	0	Read port P1 and send its complement on P3
1	1	P2.1 = 1, P2.2 =0

3. Develop an embedded C program incorporating an interrupt service routine (ISR) to control a staircase lamp using staircase switch.
4. Write a program to control sequence of an LEDs connected to GPIO using delays.
5. A Light Emitting Diode (LED) is connected to port pin P1.1 of the microcontroller. The task is to control the LED by turning it ON for 2 milliseconds and OFF for 3 milliseconds. This cycle repeats for 'n' iterations, where the value of 'n' is input through Port 2. Write an embedded C language program to perform this operation.
6. Design a microcontroller-based interrupt driven road traffic signaling system.
7. Design a microcontroller-based interrupt driven counter to count the number of bottles filled in one second and display it the output

Self-Learning Topics:

Conduct a comparative analysis of latest IDE tools for microcontrollers.

Learning Outcomes:

A learner will be able to

1. *Demonstrate proficiency in analyzing various GPIO pins and its driving circuits, programming and debugging using an IDE tool (P.I.-5.2.2).*
2. *Identify suitable I/O pins, interrupt driven approach for implementing a certain application (P.I.-3.1.6)*
3. *Analyze the given I/O interfacing circuits and extract valid conclusions from the results. (P.I.- 2.4.4)*

02.	**Microcontroller Peripheral Interface Programming**	**06**	CO2

Learning Objectives:

Develop proficiency in designing and implementing microcontroller-based systems with diverse peripherals and effective peripheral interfacing and collaborative troubleshooting for various applications.

Suggested List of Experiments:

1. The 8-bit ADC is used to measure temperature of a water heater. The output of ADC is connected to Port 1 of a microcontroller. Write a program to serially transmit the message "LOW TEMP" if

	the temperature falls below the defined threshold limit (assume 30H), and "HIGH TEMP" otherwise. 2. Implement a digital thermometer using ADC and display the temperature on an LCD 3. The 8-bit ADC is used to measure temperature of a water heater. The output of ADC is connected to Port 1 of a microcontroller. Write a program to display message “LOW TEMP” else “HIGH TEMP” on LCD, when the temperature falls below the defined threshold limit (assume 30H), and "HIGH TEMP" otherwise. 4. Design a system which contains a 4*4 key pad and 8 LEDs interfaced with a microcontroller. Develop a program to identify the pressed key and display the binary code of the pressed key on the connected LEDs 5. Implement a function generator using DAC to produce different types of waveforms. 6. Configure a microcontroller system equipped with multiple programmable I/O pins, including open-drain, internal passive pull-up, and tri-stated pins, to interface with various peripherals such as LEDs, keypads, ADCs, and DACs and perform the following task: The microcontroller is to be used in a system consisting of the following peripherals: (i) Two status indicator LEDs (L1, L2), (ii) 16 keys (K1, K2, ..., K16) capable of 0/1/2 key presses, and 3 keys (K17, K18, K19) allowing any combination of key presses, (iii) Two 8-bit ADCs (ADC1, ADC2), each with internal latch and 8-bit parallel tri-stated outputs, featuring two control inputs: Start and Output Enable, (iv) Two 6-bit DACs (DAC1, DAC2), each having internal latch and 6-bit parallel inputs, and a single control input: Latch Enable. 7. Design a microcontroller-based system to execute the following task: The two ADC's convert analog inputs simultaneously and periodically at a rate set by the internal programmable timer. The two DAC outputs are to require to produce data periodically but at different rates. Employ software debouncing for all keys within the system.		
	Self-Learning Topics: *Implement a decimal counter and display the count on seven segment display.*		
	Learning Outcomes: *A learner will be able to* 1. *Accurately model complex interfacing circuits, including preprocessing and compatibility circuits, using IDE tools. (P.I.- 2.3.1)* 2. *Demonstrate proficiency in understanding interfacing sequences, timing and the effects of various input conditions on system output. (P.I.-2.4.4)*		

	3. *Troubleshoot the interfacing devices, circuits, program and identify the sources of errors if any (P.I.-2.4.3)* 4. *Select appropriate Peripheral devices based on the design requirements. (P.I.-3.1.6)* 5. *Interface various peripherals devices with a selected microcontroller for a given application. (P.I.-3.2.2)*		
03.	**Microcontroller Programming with Sensors and Actuators** *Learning Objective/s:* *Acquire microcontroller programming skills for sensor and actuator interfacing, utilizing timer/PWM techniques to control electrical appliances and motors for real-world applications, including robotics.*	**06**	CO3
	Suggested List of Experiments		
	1. Write a program to control electrical appliances based on temperature using simple ON/OFF relay. 2. Write a program to generate a siren alarm after every t time. Siren need to be connected through relay for isolation. 3. Design a microcontroller-based system to regulate the speed of a DC motor using PWM method- a) manual mode b) based on temperature. (Temperature-Controlled Fan System) 4. A DC motor is used to operate a sliding gate and operated with the switch. Develop a C language program to control the operation of a sliding gate using a DC motor, which is interfaced with a microcontroller through an H-bridge (LD293). 5. A turn table is rotated manually by a foreman at desired angle. Design an automated control system using stepper/Servo motor interfaced with microcontroller. 6. Design and implement using microcontroller-based Fire-alarm system. 7. Design and Implementation of microcontroller-based Firefighting water extinguisher system with sensor-activated motor pump control. 8. Design and Implementation of a microcontroller-based water level control system with sensor-activated motor pump control. 9. Design a line-following robot using infrared sensors and motor control. 10. Design a microcontroller-based system for a. Smart Lighting System with Motion Detection b. Automated Plant Watering System c. Smart Door Lock System		
	Self-Learning Topics: *Implementation of control algorithms (e.g. PID, fuzzy logic) in embedded systems.*		
	Learning Outcomes: *A learner will be able to* 1. *Visualize and process various sensors data and actuate the output devices for a specific real time application using appropriate tools. (P.I.-5.2.2)* 2. *Design and implement microcontroller-based systems with sensors and actuators for a specified engineering application (P.I.-3.2.1)* 3. *Demonstrate the effective use of an IDE for programming a microcontroller and independently learn to develop microcontroller-based applications (P.I.-5.1.2),* 4. *Troubleshoot the circuit and identify the sources of errors if any (P.I.-2.4.3)*		

	5. *Determine design objectives, functional requirements and arrive at specifications ((P.I.-3.1.6)*		
04	**Microcontroller Interfacing using Communication Techniques** ***Learning Objectives:*** *Develop proficiency in microcontroller-based communication protocols for controlling various peripherals and analyze/troubleshoot communication issues effectively*. **Suggested List of Experiments** 1. Implement USART-based communication to display sensor data on a serial terminal. 2. Design UART-controlled DC motor system for speed and direction control, communicating with a PC. 3. Develop USART communication between microcontroller and LCD display for data transmission 4. Setup I2C communication for analog-to-digital conversion with microcontroller and ADC. 5. Setup SPI communication for digital-to-analog conversion between microcontroller and DAC. ***Self-Learning Topics****:* *Explore advanced communication protocols and comparison.* ***Learning Outcomes:*** *A learner will be able to* 1. *Select appropriate communication protocols based on the design requirements. (P.I.-3.1.6)* 2. *Demonstrate proficiency in understanding protocol timings, sequential flow for controlling peripheral devices and the effects of various handshaking signals on communication process (USART, I2C/SPI). to get desired output. (P.I.-2.4.4)* 3. *Troubleshoot the communication interfacing circuit, program, baud rate and identify the sources of errors if any (P.I.-2.4.3)* 4. *Use the modern simulation tools to implement communication protocols for a given task. (P.I.-5.1.2)*	**06**	CO1, CO2
05	**Microcontroller Applications in Power Systems** ***Learning Objectives:*** *To provide students with the essential skills and knowledge to proficiently use microcontroller-based systems for efficient power management using modern tools for analysis. By mastering power technology, they can implement precise control over power requirements of machinery and excel in various industrial power automation and control environments.* **Suggested List of Experiments** 1. Design a microcontroller-based system to regulate the brightness of an LED lamp using PWM signals. 2. Design ARM-based firing system for IGBT-triggered full-wave controlled rectifier. 3. Develop high-level language program to generate triggering pulses for chopper applications.	**06**	CO4

	4. Develop high-level language program to use power savings features (Sleeping Modes) of microcontroller in Battery-Operated Microcontroller Systems. 5. Develop a microcontroller program to monitor and control the charging of a lithium-ion battery. 6. Design a microcontroller-controlled relay system to switch power sources based on predefined conditions (e.g., voltage thresholds, time schedules). 7. Develop a program to measure and display the real-time power consumption of electrical appliances using a microcontroller and energy metering IC. 8. Create a microcontroller-based system to detect and respond to overcurrent or short circuit faults in a power circuit. 9. Resource Utilization Assessment in Microcontroller-Driven Power Systems 10. Risk Analysis in designing microcontroller-based power systems.		
	Self-Learning Topics: *Exploring emerging trends, safety, and regulations in microcontroller-driven power systems.*		
	Learning Outcomes:		
	A learner will be able to *1. Gain an understanding of the integration of power devices with other automation technologies and systems, promoting interdisciplinary knowledge and collaboration in the field of industrial power systems. (P.I.-3.1.6)* *2. Create and troubleshoot power control circuity and programs for implementing real world societal / industrial problems/ application using microcontroller-based power systems, understand input/output demands, configurations, implement control strategies (P.I.- 3.2.2)* *3. Select open-source Simulation tools for power system-based applications. (P.I.-5.1.2)* *4. Develop problem-solving skills to troubleshoot microcontroller-driven power systems., fostering their adaptability in real-world industrial environments (P.I.-5.2.2)*		
	Total	**30**	
Minimum 2 experiments from each module, and total at least 10 experiments.			

Course Outcomes:

Students will be able to

1. Develop proficiency in using GPIO pins of microcontrollers and IDE tools for solving given tasks.
2. Apply microcontroller interfacing and programming skills for various peripherals to solve engineering problems with societal and environmental considerations.
3. Develop proficiency in sensor and actuator interfacing with microcontrollers, prioritizing safety and utilizing modern tools.
4. Design, implement, and evaluate microcontroller-based power management system

Performance Indicators:

P.I. No.	P.I. Statement
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.
2.4.3	Identify sources of error in the solution process, and limitations of the solution.
2.4.4	Extract desired understanding and conclusions consistent with objectives and limitations of the analysis
3.1.6	Determine design objectives, functional requirements and arrive at specifications
3.2.1	Apply mathematical techniques and formal design principles to generate multiple engineering solutions for complex problems, incorporating higher-order thinking skills
3.2.2	Build models/prototypes to develop diverse set of design solutions
5.1.2	Use/adapt/modify/create tools and techniques to solve engineering problems
5.2.2	Demonstrate proficiency in using discipline-specific tools.

Books:

1. "Embedded Systems: Real-Time Interfacing to ARM Cortex-M Microcontrollers" by Jonathan W. Valvano, 1st Edition, 2014, CreateSpace Independent Publishing Platform
2. ARM System Developer's Guide: Designing and Optimizing System Software", Andrew N. Sloss, Dominic Symes and Chris Wright, Morgan Kaufmann,2nd edition,2004.
3. "ARM system on-chip architecture", Steve Furber, Addison Wesley, second edition, 2000.
4. "ARM Microcontroller Interfacing: Hardware and Software", Warwick A. Smith, 2010, Delmar Cengage Learning.

Reference Books:

1. "Microcontroller Theory and Applications with the PIC18F" by M. Rafiquzzaman, 1st Edition, 2011, Wiley
2. "Embedded Systems: Architecture, Programming, and Design", Raj Kamal, 3rd Edition, 2017, McGraw-Hill Education.

Other Resources:

1. NPTEL Course: Introduction to Embedded System Design, by Prof. Dhananjay V. Gadre, Prof. Badri Subudhi, Netaji Subhas University of Technology, IIT Jammu.
   Web link- https://onlinecourses.nptel.ac.in/noc24_cs33/preview
2. NPTEL Course: Embedded Systems, by Prof. Santanu Chaudhary Prof. Santanu Chaudhary, Department of Electrical Engineering, IIT Delhi
   Web link-https://nptel.ac.in/courses/108102045
3. Forums and communities. (Microchip Forum, STM32 Community)
4. ARM Architecture Reference Manuals, Keil Development tools - ARM Documentation

A. CONTINUOUS ASSESSMENT (25 Marks)

Suggested breakup of distribution

a. Experiment execution: 10 Marks

   Students will be given number of experiments as mentioned in the syllabus. Each experiment carries 10 Marks. Average will be taken of all experiments. Students are expected to complete the task assigned in the experiment description, record observations, interpret results/conclusion and prepare a brief report as per requirement.

b. Course project: 10 Marks.

   Based upon the learnings from the experiments, students will be assigned a course project. They are expected to do the design, verification, simulation (if required) and implementation followed by testing for desired output.

c. Regularity and active participation: 5 marks.

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

Students will be assessed based on three parameters:

- Concept/Theoretical knowledge
- Practical knowledge
- Oral

- Students will be randomly allocated an experiment from the list of laboratory exercises and will be asked to perform the same. The students will be asked to write the theory related to the experiment. The write-up is checked by the examiners (Internal and External) and evaluated out of 05 Marks.

  Then the student will be allowed to perform the experiment.

- Students will be allocated 1 hour to perform the experiment. The results are then checked by both the examiners for its correctness. The weightage of the successful done experiment is 10 Marks
- Students will then be appearing for Oral in front of both Internal and External examiners. The weightage of Oral will be of 10 Marks

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

Course Type	Course Code	Course Name	Credits
SBL	ECSBL402	SIMULATION LAB	02

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

Pre-requisite :

1. ESC203- Basic Electronics Engineering
2. ESCLC 206- Basic Electronics Engineering Laboratory
3. ECPCC 303- Electronics Devices and Circuits
4. ECMDM 402- Control system and PLC

Program Outcomes addressed :

1. PO 2: Problem analysis
2. PO 3: Design/Development of Solutions
3. PO 5: Modern tool usage
4. PO 12: Life-long learning

Course Objectives :

1. To familiarize students with Simulation software for building and analysing electronic and pulsed circuits.
2. To provide practical exposure to interfacing of sensors and output devices with controller boards.
3. To introduce ladder diagram programming for PLC simulation and provide students with hands-on experience in designing ladder logic circuits.

Module	Detailed Contents	Hrs	CO
	Course Introduction The Simulation Lab provides a platform for students to bridge theory with practical application, promoting hands-on experience. Simulation helps in enhancing understanding of complex electronic concepts through virtual experimentation.	**01**	
01.	**Electronic Circuits using Suitable Simulation tool**	**15**	**CO- 1**
	Learning Objective/s: *To develop deeper understanding of electronic circuits and their applications, improve their problem-solving abilities, and gain hands-on experience in working with various electronic devices and circuits.*		
	Content: Use of simulation tools to perform experiments based on analog electronics.		

	Suggested List of Experiments **1.** Motor direction Control using H-Bridge **2.** Trouble shooting **3.** Transient Analysis of RL and RC circuits **4.** Function generators using IC 555 and IC 741. **5.** Electronic Stop Watch / Digital Clock **6.** Data logger **7.** Analog IC Tester **8.** Amplitude modulator and Demodulator **9.** Pattern generators using LEDS **10.** DC-DC convertors 11. BPSK Generator ***Self-Learning Topics:*** --- ***Learning Outcomes :*** *A learner will be able to* 1. *Analyse the given electronic circuit and extract valid conclusions from the results. (2.4.4)* 2. *Troubleshoot the circuit and Identify the sources of errors if any (2.4.3)* 3. *Design and implement electronics circuits for a specified engineering application (3.2.1)* 4. *Use the modern simulation tools to implement an electronic circuit for a given task. (5.1.2)* 5. *Demonstrate proficiency in analyzing various electronic circuits and devices using a modern simulation tool (5.2.2)*		
02.	**Pulsed Circuits** ***Learning Objective/s:*** *To design pulsed circuits which form an integral part of modern automated systems and explore the capabilities of simulation software to build and analyze prototypes of such systems.* **Content:** Use of simulation tools to perform experiments based on digital electronics. **Suggested List of Experiments** 1. Simulation of ADC **2.** Simulation of DAC **3.** Electronic Password Lock for Appliances **4.** Mixing of Audio signals using Mux **5.** Digital IC tester	**16**	**CO- 2**

	6. Multi Status Indicator **7.** Memory address decoding / chip selection in 8086. ***Learning Outcomes :*** *A learner will be able to* *1. Accurately model complex digital circuits, including combinational and sequential logic elements, using simulation software. (2.3.1)* *2. Demonstrate proficiency in understanding circuit timing, propagation delays, and the effects of various inputs on circuit output. (2.4.4)* *3. Troubleshoot the circuit and Identify the sources of errors if any (2.4.3)* *4. Select appropriate components and digital ICs based on the design requirements. (3.1.6)* *5. Design and implement digital circuits for a specified engineering application (3.2.2)* *6. Determine design objectives, functional requirements and arrive at specifications* *7. Use the modern simulation tools to implement a digital circuit for a given task. (5.1.2)* *8. Demonstrate proficiency in analyzing various digital circuits and devices using a modern simulation tool (5.2.2)*		
03.	**Embed C for Arduino/ STM / ESP32** ***Learning Objective/s:*** *To equip students with the necessary skills to program microcontroller-based systems effectively so as to enable them to create smart and automated systems* **Content:** IDE alternatives for experiments based on embedded systems. **Suggested List of Experiments** 1. Interfacing Temperature Sensor: and LCD display 2. Ultrasonic Distance Sensor: 3. Light Intensity Meter: 4. Servo Motor Control: 5. Sound Detection: Use a sound sensor module (like the KY-038) to detect sound levels. ***Learning Outcomes :*** *A learner will be able to* *1. Identify suitable I/O devices for implementing a certain application (3.1.6)* *2. Select appropriate sensors and components based on the design requirements. (3.1.6)* *3. Interface various I/o devices with a selected microcontroller for a given application. (3.2.2),* *4. Demonstrate the effective use of an IDE for programming a certain microcontroller and Independently learn to develop and troubleshoot various controller based applications (5.1.2), (12.1.3)* *5. Visualize and process the sensor reading and actuate the output devices for a specific real time application. (5.2.2)*	**16**	**CO- 3**
04.	**PLC Simulators using Online Simulators** ***Learning Objective/s:*** *To provide students with the essential skills and knowledge to proficiently utilize Programmable Logic Controllers (PLCs) in modern industrial automation settings. By* *mastering PLC technology, they can implement precise control over machinery and excel in various industrial automation and control environments.*	**12**	**CO- 4**

	Content:		
	Use of simulation tools to perform ladder diagram based experiments for PLC.		
	Suggested List of Experiments		
	1. Water Tank Level Control: A ladder diagram to control the level of water in a tank using level sensors, motorized valves, and alarms. **2.** Temperature Control: A ladder diagram to control the temperature of a room using a temperature sensor, heater, and fan. **3.** Pump Control: A ladder diagram to control the operation of a pump based on the level of a liquid in a tank using level sensors and pump control relays. **4.** Sequential Process Control: Bottle filling station **5.** Elevator Control: A ladder diagram to control the operation of an elevator system with floor selection buttons, door control, and safety mechanisms. **6.** Batch Mixing Control: A ladder diagram to control the mixing process of different ingredients in a batch using timers, valves, and pumps. **7.** Vending Machine Control: A ladder diagram to control the operation of a vending machine, including coin input, product selection, and dispensing. **8.** PLC based Automatic Packaging System		
	Learning Outcomes :		
	A learner will be able to *1. Gain an understanding of the integration of PLCs with other automation technologies and systems, promoting interdisciplinary knowledge and collaboration in the field of industrial automation. (3.1.6)* *2. Create and troubleshoot ladder logic programs for implementing real world societal / industrial problems/ application using PLC based systems, understand input/output configurations, implement control strategies (3.2.2), (6.1.2)* *3. Select open source Simulation tools for PLC based applications. (5.1.2)* *4. Develop problem-solving skills to troubleshoot PLC-based systems, fostering their adaptability in real-world industrial environments (5.2.2)*		
	Total	**60**	
Minimum 02 experiments from each module, and total at least 10 experiments.			

Course Outcomes : Student will be able to

1. Develop proficiency in using simulation software for electronic circuit design.
2. Analyze operation of pulsed circuits, using simulation software

3. Interface various sensors, such as temperature sensors, ultrasonic distance sensors, and light intensity meters, with microcontrollers like Arduino, STM, or ESP32.

4. Write programs for PLC Simulation using ladder diagrams

Performance Indicators:

P.I. No.	P.I. Statement
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.
2.4.3	Identify sources of error in the solution process, and limitations of the solution.
2.4.4	Extract desired understanding and conclusions consistent with objectives and limitations of the analysis
3.1.6	Determine design objectives, functional requirements and arrive at specifications
3.2.1	Apply mathematical techniques and formal design principles to generate multiple engineering solutions for complex problems, incorporating higher-order thinking skills
3.2.2	Build models/prototypes to develop diverse set of design solutions
5.1.2	Use/adapt/modify/create tools and techniques to solve engineering problems
5.2.2	Demonstrate proficiency in using discipline-specific tools.
6.1.2	Measure the impact of technological development on society at large and describe the role of an engineer to society.
12.1.3	Develop ability to learn independently through methods distinct from instructor provided materials.

Text Books :

1. Multisim for Circuit Analysis, Electronics, and Power Electronics by James M. Fiore.
2. Multisim Simulation and Circuit Analysis: A Beginner's Guide by Amarpreet Singh and Raj Kumar Bansal.
3. Beginning C for Arduino, Jack Purdum, 2nd Edition, 2015.
4. Embedded Controllers Using C and Arduino, James M. Fiore, Laboratory Manual.
5. Industrial automation: hands-on, Lamb, Frank, 2013, McGraw-Hill Education.

Reference Books :

1. Circuit analysis with Multisim, Báez-López, David, and Felix Guerrero-Castro, 2nd Edition, 2022, Springer Nature.
2. Embedded Controllers Using C and Arduino, James M. Fiore, 2nd edition, 2018, Dissidents publisher.
3. Arduino for Beginners: Step-by-Step Guide to Arduino (Arduino Hardware & Software), Simon Knight, 3rd edition, 2018
4. Arduino: 2 Books In 1: The Comprehensive Beginner's Guide to Take Control of Arduino Programming & Best Practices to Excel While Learning Arduino Programming, Miles Price, 2018.

Other Resources :

1. Guide to mastering KiCad for the successful development of sophisticated electronic printed circuit board
https://docs.kicad.org/4.0/en/getting_started_in_kicad/getting_started_in_kicad.pdf

A. IN-SEMESTER ASSESSMENT (50 marks)

1. Continuous assessment of Experiments (30 Marks)

Suggested breakup of distribution

Students will be assigned experiments from the list given in syllabus. They have to perform the laboratory tasks, and get the desired output.

Students will be evaluated based on following:

i. Design – 10 Marks
ii. Execution of Simulation - 10 Marks
iii. Interpretation of results - 5 Marks
iv. Troubleshooting - 5 Marks

2. Practical Test (15 Marks)

Practical examination on first 50% of the practical list will be conducted for one-and-a-half-hour.

Students will be randomly allocated a task from the list of laboratory exercises. Evaluation will be done by Internal Examiner as follows:

Design: 5 marks

Simulation execution and presentation of results and their interpretation: 5 marks

Oral Examination: 5 marks

3. **Regularity and active participation** - 5 Marks

B. END SEMESTER ASSESSMENT (Practical/Oral Examination) (50 Marks)

Students will be assessed based on three parameters:

- Selection of appropriate Simulation tool
- Design of circuit / Algorithm / Ladder diagram
- Simulation of the circuit and Analysis of the results
- Oral

Students will be randomly allocated a task for designing and implementing Electronic/ Digital/ Controller based / PLC based system for the given application and implement using an appropriate simulation tool from the list of laboratory exercises and will be asked to design the circuit / Algorithm / Ladder diagram. The circuit / Algorithm / Ladder diagram is checked by the examiners (Internal and External) and evaluated out of 10 Marks.

- Students will be allocated 1 and half hour to complete the execution. The program is then checked by both the examiners for its correctness. The weightage of the program implementation is 20 Marks
- Students will then be appearing for Oral in front of both Internal and External examiners. The weightage of Oral will be of 20 Marks

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

Course Type	Course Code	Course Name	Credits
MP	ECMP402	Mini Project 1B	01

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

Pre-requisite:

1. ECMP301- Mini Project 1A

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 1B.
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.

Guidelines for the Mini Project	Hrs
1. 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 1B. **2.** 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. **3.** Students must form groups of 3 to 4 members either from the same or from different departments. **4.** Groups should conduct surveys to identify needs and develop problem statements in consultation with faculty. **5.** An implementation plan in Gantt/PERT/CPM chart format covering weekly activities must be submitted. **6.** Each group must maintain a logbook to record weekly progress, to be verified by the faculty supervisor. **7.** Faculty input should emphasize guiding by faculty and self-learning by group members. **8.** Groups should propose multiple solutions, select the best one in consultation with the supervisor, and develop a working model. **9.** 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. **10.** 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. **11.** 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.	
Total	**45**

Course Outcomes:
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.

A. IN-SEMESTER ASSESSMENT (50 MARKS)

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

Continuous Assessment Distribution (50 marks):

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

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.

B. 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

Examination Scheme	
Continuous Assessment	**Total**
50	50

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