SILVER HORIZONS 25 YEARS OF GLOBAL LEARNING

NEW HORIZON COLLEGE OF ENGINEERING

Department of Electronics and Communication Engineering

Academic Year: 2026-27

II Year

Scheme and Syllabus

Batch: 2025-29

Credits: 160

NEW HORIZON
COLLEGE OF ENGINEERING

Department of
Electronics and Communication Engineering

Academic Year 2026-27

3rd and 4th Semester Scheme & Syllabus

BATCH: 2025-29

CREDITS: 160

NEW HORIZON
COLLEGE OF ENGINEERING

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

3rd and 4th Semester Scheme & Syllabus

Academic Year 2026-27

BATCH: 2025-29 (CREDITS: 160)

NEW HORIZON COLLEGE OF ENGINEERING

INSTITUTION

Vision

To emerge as an institute of eminence in the fields of engineering, technology and management in serving the industry and the nation by empowering students with a high degree of technical, managerial and practical competence.

Mission

1. To strengthen the theoretical, practical and ethical dimensions of the learning process by fostering a culture of research and innovation among faculty members and students.
2. To encourage long-term interaction between the academia and industry through their involvement in the design of curriculum and its hands-on implementation.
3. To strengthen and mould students in professional, ethical, social and environmental dimensions by encouraging participation in co-curricular and extracurricular activities.

Quality Policy

To provide educational services of the highest quality both curricular and co-curricular to enable students integrate skills and serve the industry and society equally well at global level.

Values

- Academic Freedom
- Innovation
- Integrity
- Professionalism
- Inclusiveness
- Social Responsibility

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

VISION

To create high quality engineering professionals who can serve the society and earn global recognition.

MISSION

- To build strong foundation in Electronics and Communication Engineering aspects by exposing students to state of the art technology and research.
- To strengthen the curriculum through interaction with industry experts to equip the students with the required competency.
- To mould students to share technical knowledge and to practice professional and moral values.

Program Education objectives (PEOs)

PEO1	To produce graduates with understanding of fundamentals and applications of Electronics and Communication Engineering.
PEO2	To hone graduates with ability to apply, analyze, design and develop electronic systems.
PEO3	To enhance graduates with latest technologies to enable them to engineer products for real world problems in Electronics and Communication Engineering
PEO4	To build leadership qualities, management skills, communication skills, moral values, team spirit and lifelong learning ability for the graduates.

PEO to Mission Statement Mapping

Mission Statements	PEO1	PEO2	PEO3	PEO4
To build strong foundation in Electronics and Communication Engineering aspects by exposing students to state of the art technology and research.	3	3	3	2
To strengthen the curriculum through interaction with industry experts to equip the students with the required competency.	2	3	3	2
To mould students to share technical knowledge and to practice professional and moral values.	1	2	2	3

Correlation: 3- High, 2-Medium, 1-Low

KNOWLEDGE AND ATTITUDE PROFILE (WK)

S. No	Knowledge and Attitude Profile (WK)
1	WK1: A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.
2	WK2: Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.
3	WK3: A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline
4	WK4: Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.
5	WK5: Knowledge, including efficient resource use, environmental impacts, whole-life cost, re use of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.
6	WK6: Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.
7	WK7: Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.
8	WK8: Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.
9	WK9: Ethics, inclusive behaviour and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes.

PROGRAM OUTCOMES (POs)

S.No	Graduate Attributes	Program Outcomes (POs)
1	Engineering Knowledge	PO1: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.
2	Problem Analysis	PO2: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)
3	Design/Development of Solutions	PO3: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)

4	Conduct Investigations of Complex Problems	PO4: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).
5	Engineering Tool Usage	PO5: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)
6	The Engineer and The World	PO6: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).
7	Ethics	PO7: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)
8	Individual and Collaborative Team work	PO8: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
9	Communication	PO9: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences.
10	Project Management and Finance	PO10: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.
11	Life-Long Learning	PO11: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8).

Program Specific Outcomes

PSO1	To demonstrate the ability to design and develop complex systems in the areas of next generation Communication Systems, IoT based Embedded Systems, Advanced Signal and Image Processing, latest Semiconductor technologies, RF and Power Systems.
PSO2	To demonstrate the ability to solve complex Electronics and Communication Engineering problems using latest hardware and software tools along with analytical skills to contribute to useful, frugal and eco-friendly solutions.

Mapping of PEOs to POs & PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
PEO1	3	3	2	2	2	1	1	1	1	1	1	1	1	1
PEO2	3	3	3	3	3	2	2	2	2	2	2	2	3	2
PEO3	3	3	3	3	3	3	3	2	2	2	2	2	3	3
PEO4	1	1	1	1	1	2	2	3	3	3	3	3	1	1

Correlation: 3- High, 2-Medium, 1-Low

NEW HORIZON COLLEGE OF ENGINEERING

B. E. in Electronics and Communication Engineering

Scheme of Teaching and Examinations for 2025-2029 BATCH (2025 Scheme)

III Semester																
S. No.	**Course and Course Code**		**Course Title**	**BoS**	**Credit Distribution**				**Overall Credits**	**TLP Contact Hours / Sem**	**TW & SL / Sem**	**Total Hours /Sem**	**Exam Hrs**	**Marks**		
					L	**T**	**P**	**S**						**CIE**	**SEE**	**Total**
1	BSC	25MAE31	Numerical Methods, Vector Spaces and Transforms	BS	3	0	0	0	3	45	45	90	3	50	50	**100**
2	PCC	25ECE32	Analog Electronic Circuits	EC	3	0	0	0	3	45	45	90	3	50	50	**100**
3	PCCL	25ECL32	Analog Electronic Circuits Lab	EC	0	0	1	0	1	30	-	30	3	50	50	**100**
4	PCC	25ECE33	Digital Electronic Circuits	EC	3	0	0	0	3	45	45	90	3	50	50	**100**
5	PCCL	25ECL33	Digital Electronic Circuits Lab	EC	0	0	1	0	1	30	-	30	3	50	50	**100**
6	PCC	25ECE34	Signals and Systems	EC	3	0	0	0	3	45	45	90	3	50	50	**100**
7	PCC	25ECE35	Circuit Design and Analysis	EC	3	0	0	0	3	45	45	90	3	50	50	**100**
8	AEC	25ECE36X	Ability Enhancement Course – III	EC	0	0	1	0	1	30	-	30	3	50	50	**100**
9	PROJ	25CPD37	Community Project using Innovation and Design Thinking	Any Dept	0	0	1	0	1	-	30	30	3	50	50	**100**
10	NCMC	25NSS30	National Service Scheme	-	0	0	0	0	0	-	30	30	--	50	--	**50**
		25PED30	Physical Education and Sports	-												
		25YOG30	Yoga	-												
		25MUS30	Music	-												
								Total	**19**	**315**	**285**	**600**	**27**	**500**	**450**	**950**

11	NCMC	25DMAT31*	Basic Applied Mathematics -I	BS	0	0	0	0	0	15	15	30	--	50	--	**50**

BSC: Basic Science Course, **PCC**: Professional Core Course, **PCCL**: Professional Core Course laboratory, **UHV**: Universal Human Value Course, **NCMC:** Non-Credit Mandatory Course, **AEC**: Ability Enhancement Course, **PROJ**: Mini Project work, **L:** Lecture, **T**: Tutorial, **P**: Practical **S: SDA**: Skill Development Activity, **TW & SL-** Term Work & Self Learning, **K:** This letter in the course code indicates common to all the stream of engineering. **ESC:** Engineering Science Course, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation.

25DMAT31*: This non-credit mandatory course to be offered with only CIE and no SEE to Lateral entry students.

Ability Enhancement Course – III (1-0-0-0 or 0-0-1-0)			
25ECE361	Electronics System Design using Proteus	25ECE364	App Development using Google Flutter
25ECE362	Programming on Raspberry Pi using Python	25ECE365	Bio Inspired Design and Innovation (1-0-0-0)
25ECE363	Data Visualization with Scilab		

Community Project using Innovation and Design Thinking: A community is a social unit or group of people sharing socially-significant characteristics, such as place, set of norms, culture, religion, values, customs, or identity. The Community Project using Innovation and Design Thinking course involves addressing complex issues within such a community through a human-centered lens. By integrating design thinking methodologies, these projects move beyond traditional service to focus on empathy, iterative problem-solving, and the creation of sustainable, innovative solutions. Whether establishing welfare initiatives like orphanages, implementing renewable energy systems, or developing environmental technologies, the process begins with deep community engagement to uncover latent needs before defining specific challenges.

This experiential learning activity encourages students to identify, analyze, and address real-life problems by synthesizing engineering knowledge with creative strategy. The design thinking framework guides students through stages of empathy, ideation, and rapid prototyping, ensuring that the final interventions are not only technically sound but also culturally appropriate and user-validated. This approach promotes social responsibility and civic engagement while fostering interdisciplinary collaboration and the practical application of theoretical concepts. By navigating the ambiguity of real-world constraints through an innovative mindset, students contribute meaningfully to community welfare and sustainable development. Students may undertake these projects individually or in collaborative groups 2 to 4 members.

CIE:

The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide. The CIE marks awarded for the project work shall be based on the rubrics.

25XXX35(HSMS)- This course must be pertaining to economics and management of the concerned degree program. The course syllabus should have both economics and management topics and the course title should bear the word Management.
For IT allied Branches: Software Product/ Project Management
For Core Branches: Engineering Economics and Management / Industrial Management and Entrepreneurship.

National Service Scheme /Physical Education/Yoga/ Music: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PED) (Sports and Athletics), Yoga (YOG), and Music (MUS) with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semester and IV semester (for 2 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, Yoga and Music activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree. Students may opt for different activities/options across semesters. For instance, a student participating in PE during 3rd semester may choose NSS in the 4th semester or Yoga or Music.

NEW HORIZON COLLEGE OF ENGINEERING

B. E. in Electronics and Communication Engineering

Scheme of Teaching and Examinations for 2025-2029 BATCH (2025 Scheme)

IV Semester																
S. No.	**Course and Course Code**		**Course Title**	**BoS**	**Credit Distribution**				**Overall Credits**	**TLP Contact Hours / Sem**	**TW S SL / Sem**	**Total Hours /Sem**	**Exam Hrs**	**Marks**		
					L	**T**	**P**	**S**						**CIE**	**SEE**	**Total**
1	BSC	25MAE41	Complex Analysis, Optimization and Probability Distribution	BS	3	0	0	0	3	45	45	90	3	50	50	**100**
2	PCC	25ECE42	System Design using HDL	EC	3	0	0	0	3	45	45	90	3	50	50	**100**
3	PCCL	25ECL42	System Design using HDL Lab	EC	0	0	1	0	1	30	-	30	3	50	50	**100**
4	PCC	25ECE43	Digital Signal Processing	EC	3	0	0	0	3	45	45	90	3	50	50	**100**
5	PCCL	25ECL43	Digital Signal Processing Lab	EC	0	0	1	0	1	30	-	30	3	50	50	**100**
6	PCC	25ECE44	Microprocessors and Microcontrollers	EC	3	0	0	0	3	45	45	90	3	50	50	**100**
7	PCCL	25ECL44	Microprocessors and Microcontrollers Lab	EC	0	0	1	0	1	30	-	30	3	50	50	**100**
8	PEC	25ECE45X	Professional Elective Course-I	EC	3	0	0	0	3	45	45	90	3	50	50	**100**
9	AEC	25ECE46X	Ability Enhancement Course – IV	EC	0	0	1	0	1	30	-	30	3	50	50	**100**
10	PROJ	25EPP47	Environmental Science Project	EC	0	0	2	0	2	-	60	60	3	50	50	**100**
11	NCMC	25NSS40	National Service Scheme	-	0	0	0	0	0	-	30	30	--	50	--	**50**
		25PED40	Physical Education and Sports	-												
		25YOG40	Yoga	-												
		25MUS40	Music	-												
Total									**21**	**345**	**315**	**660**	**30**	**550**	**500**	**1050**

12	NCMC	25DMAT41*	Basic Applied Mathematics -II	BS	0	0	0	0	0	15	15	30	--	50	--	**50**

BSC: Basic Science Course, **PCC**: Professional Core Course, **PCCL**: Professional Core Course laboratory, **UHV**: Universal Human Value Course,

NCMC: Non-Credit Mandatory Course, **AEC**: Ability Enhancement Course, **PROJ**: Mini Project work, **L:** Lecture, **T**: Tutorial, **P**: Practical **S: SDA**: Skill Development Activity, **TW & SL-** Term Work & Self Learning, **K:** This letter in the course code indicates common to all the stream of engineering. **ESC:** Engineering Science Course, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation.

25DMAT41*: This non-credit mandatory course to be offered with only CIE and no SEE to Lateral entry students.

Professional Elective Course-I			
25ECE451	Control Systems	25ECE454	Biomedical Signal Processing
25ECE452	Linear Integrated Circuits	25ECE455	Competitive Coding
25ECE453	Electromagnetic Field Theory		

Ability Enhancement Course – IV (1-0-0-0 or 0-0-1-0)			
25ECE461	ALP with Microcontroller	25ECE464	Programming using RoboDK
25ECE462	PCB Design using OrCAD	25ECE465	Embedded Design using MPLAB
25ECE463	Virtual Instrumentation using LabVIEW		

Environmental Science Project: The Environmental Science Project is an applied learning component designed to develop students' awareness, understanding, and responsibility toward the environment. It provides an opportunity to study real-world environmental issues and apply scientific and engineering principles to design feasible and sustainable solutions. Central to this course is the alignment with the United Nations Sustainable Development Goals (SDGs), providing a global framework for students to address urgent environmental challenges through localized action.

The topics under environment include, but are not limited to, climate change, biodiversity, air and water pollution, land use, excess use of natural resources, earthquakes, rise in the earth's temperature, power generation, and soil erosion. By exploring these themes, students contribute to the realization of specific global targets, including Clean Water and Sanitation, Affordable and Clean Energy, Climate Action, Life Below Water, and Life on Land.

The project involves problem identification, field surveys, case studies, data collection, environmental audits, analysis, and the proposal of remedial or preventive measures. These interventions are aimed at improving biodiversity, air quality, and thermal

comfort while promoting Responsible Consumption and Production and Sustainable Cities and Communities. Students can take up the project individually or in a group not exceeding four members. Participants are also encouraged to opt for Interdisciplinary Projects, fostering the collaborative thinking essential for achieving a sustainable balance between human activity and the natural world.

CIE:

(i) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide.

(ii) Interdisciplinary: Continuous Internal Evaluation shall be group-wise at the college level with the participation of all the guides of the project.

The CIE marks awarded for the project work shall be based on the rubrics. The marks awarded for the project report shall be the same for all the batches mates.

National Service Scheme /Physical Education/Yoga/ Music: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PED) (Sports and Athletics), Yoga (YOG), and Music (MUS) with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semester and IV semester (for 2 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, Yoga and Music activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree. Students may opt for different activities/options across semesters. For instance, a student participating in PE during 3rd semester may choose NSS in the 4th semester or Yoga or Music.

Third Semester
(Syllabus)

NUMERICAL METHODS, VECTOR SPACES AND TRANSFORMS
(Common for ECE, EEE & ME)

Course Code	**25MAE31**	**Credits**	**03**
L:T:P:S	**3:0:0:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**45**	**SEE Marks**	**50**
TW & SL / Sem	**45**	**Total Marks**	**100**
Total Hours /Sem	**90**	**Exam Hours**	**03**

Course outcomes:
At the end of the course, the student will be able to:

25MAE31.1	Apply numerical techniques to solve engineering problems involving nonlinear equations and estimation of unknown data values.
25MAE31.2	Analyze engineering problems and select appropriate numerical techniques to obtain accurate approximate solutions.
25MAE31.3	Apply the concepts of vector spaces, inner product spaces, orthogonality, and linear transformations to represent and solve engineering and scientific problems.
25MAE31.4	Analyze harmonic components of periodic signals using Fourier series and interpret their significance in engineering systems.
25MAE31.5	Understand the concepts of Fourier transforms and their significance in the analysis of continuous-time engineering systems.
25MAE31.6	Apply the concepts of Z-transforms, their properties in the analysis of discrete-time engineering systems.

MODULE-1	**NUMERICAL SOLUTIONS AND INTERPOLATION**	**25MAE31.1**	**9 Hours**
Numerical solution of algebraic and transcendental equations - Newton-Raphson Method. Interpolation / Extrapolation: Newton's forward and backward formulae for equal intervals, Newton divided differences, Lagrange's formulae for unequal intervals.			
Self-study	Numerical solution of algebraic and transcendental equations using bisection method, Regula – Falsi method. Inverse Lagrange interpolation		
Text Book	Text Book 1: 28.2, 28.3, 29.6, 29.10, 29.11, 29.13, Text Book 2: 19.2, 19.3.		
MODULE-2	**NUMERICAL INTEGRATION, SOLUTION OF DIFFERENTIAL EQUATIONS**	**25MAE31.2**	**9 Hours**
Numerical integration by Simpson's 1/3rd, 3/8th & Weddle's rules. Application of numerical integration to velocity, area and volume. Numerical solution to 1st order & 1st degree ordinary differential equations by Taylor's series method, Modified Euler's method and Runge-Kutta method of 4th order.			
Self-study	Numerical differentiation, Numerical integration by Trapezoidal rule. Numerical solution to 1st order & 1st degree ordinary differential equations by Picard's method.		
Text Book	Text Book 1: 32.3, 32.5, 32.7, 32.9, 30.7, 30.8, 30.10, Text Book 2: 19.5, 21.1.		
MODULE-3	**VECTOR SPACES AND LINEAR TRANSFORMATIONS**	**25MAE31.3**	**9 Hours**
Vector Space examples, Subspaces, Linear dependence and Independence, Spanning Sets, Basis and dimension. Inner product space, Orthogonal and Orthonormal basis by Gram Schmidt orthogonalization process. Introduction to Linear Transformations, matrix of linear transformation, rank and nullity theorem			
Self-study	Verifying the given basis is Orthogonal and Orthonormal basis. Orthogonal compliment, projection mapping.		
Text Book	Text Book 3: 4.1, 4.2, 4.3, 4.4, 4.5.		
MODULE-4	**FOURIER SERIES**	**25MAE31.4**	**9 Hours**
Periodic function, Dirichlet's conditions, Fourier series of periodic functions of period 2π and arbitrary period 2l, Fourier series of full wave & half wave rectifiers, triangular wave, square wave and saw-toothed wave functions. Half range series-Problems. Practical harmonic analysis, variation of periodic current.			
Self-study	Complex Fourier Series, Half range practical harmonic analysis.		
Text Book	Text Book 1: 10.2, 10.4, 10.5, 10.6, 10.7, 10.11, Text Book 2: 11.1, 11.2,		

MODULE-5	FOURIER TRANSFORMS AND Z - TRANSFORMS	25MAE31.5 25MAE31.6	9 Hours

Fourier Transforms: Infinite Fourier transforms, Fourier Sine and Cosine transforms, Inverse Fourier sine and cosine transform. Convolution theorem.

Z-transform definition, Z-transforms of some standard functions, properties, damping rule, shifting rule, initial and final value theorems. Inverse Z- transforms by partial fractions method. Convolution theorem. Solution of difference equations using Z-transform

Self-study	Finite Fourier Transforms, Problems on initial and final value theorems of Z – transforms.
Text Book	Text Book 1: 22.4, 22.5, 23.3, 23.4, 23.5, 23.6, 23.9, 23.15, 23.16 Test Book 2: 11.7, 11.8

CIE Assessment Pattern (50 Marks – Theory) –

RBT Levels		Marks Distribution		
		Test (s)	AAT1	AAT2
		25	15	10
L1	Remember	-	-	-
L2	Understand	5	-	-
L3	Apply	10	5	5
L4	Analyze	10	5	5
L5	Evaluate	-	5	-
L6	Create			-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	10
L3	Apply	20
L4	Analyze	20
L5	Evaluate	-
L6	Create	-

Suggested Learning Resources:

Text Books:

1. B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, Forty fourth Edition, 2022, 9788193328491.
2. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley-India Publishers, Tenth Edition, Reprint ISBN: 9788126554232.
3. David C Lay, Linear Algebra and its applications, Addison-Wesley Publishers, Fourth Edition, 2012, ISBN: 9780321385178

Reference Books:

1. Glyn James, Advanced Modern Engineering Mathematics, Pearson Education, Fourth Edition, 2015, 9780273719236
2. B. V. Ramana, Higher Engineering Mathematics, McGraw Hill Education (India) Private Limited, 4th Edition ISBN: 9780070634190
3. H. K. Dass, Advanced Engineering Mathematics, S. Chand & Company Ltd., Twenty Second Edition, 2018 9789352533831
4. N. P. Bali and Manish Goyal, A Text Book of Engineering Mathematics, Laxmi Publications (P) Ltd., 9th Ed 2014, ISBN: 9788131808320

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=f_EqOpgRwRM&t=16s
- https://www.youtube.com/watch?v=Xb9Ypn77LBo&t=16s
- https://www.youtube.com/watch?v=csgvZol6Wfw
- https://www.youtube.com/watch?v=Atv3IsQsak8
- https://www.youtube.com/watch?v=aEF5PPbv8Oc

- https://www.youtube.com/watch?v=Pwk7p8WiCh0
- https://www.youtube.com/watch?v=LGxE_yZYigI
- https://www.youtube.com/watch?v=RFlAiEXRwoo
- https://www.youtube.com/watch?v=RFlAiEXRwoo&t=128s
- https://www.youtube.com/watch?v=sMYtHaSIXbU

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Problem solving Approach
- Organizing Group wise discussions on related topics
- Seminars

ANALOG ELECTRONIC CIRCUITS			
Course Code	**25ECE32**	**Credits**	**03**
L:T:P:S	**3:0:0:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**45**	**SEE Marks**	**50**
TW & SL / Sem	**45**	**Total Marks**	**100**
Total Hours /Sem	**90**	**Exam Hours**	**03**

Course outcomes: At the end of the course, the student will be able to:

25ECE32.1	Apply BJT operating principles, biasing techniques, load-line analysis, and DC and AC equivalent models to determine transistor operating characteristics
25ECE32.2	Evaluate the small-signal parameters of JFET amplifiers using DC and AC equivalent circuit models
25ECE32.3	Compare the frequency response characteristics of BJT and FET amplifier circuits under varying operating conditions
25ECE32.4	Analyze the effects of different feedback topologies on the gain, stability, and bandwidth of amplifier circuits
25ECE32.5	Design oscillator circuits using positive feedback principles and determine their oscillation frequencies for various BJT-based configurations
25ECE32.6	Interpret the operation and performance of power amplifiers and relate their applications to practical electronic systems

MODULE-1	**BJT BIASING AND AC ANALYSIS**	**25ECE32.1**	**9 Hours**
Transistor configurations (CE, CB, CC), Need for Biasing, Load Line (AC and DC) analysis for CE configuration and Q-point, Biasing Circuits- Fixed Bias, Emitter Bias, Voltage Divider bias. Analysis of various bias configurations using re transistor model. Numerical Examples.			
Self-study	Investigate the problems based on various bias configurations and solve using re transistor model.		
Text Book	Text Book 1 – 3.4, to 3.6, 4.1 to 4.5, 5.1 to 5.6		
MODULE-2	**JFET BIASING AND AC ANALYSIS**	**25ECE32.2**	**9 Hours**
Construction and characteristics of JFET, JFET configurations (CS, CG, CD), JFET Biasing (Fixed bias, Self-bias and Voltage divider bias), JFET small signal model for CS configuration. Numerical Examples.			
Self-study	Investigate and solve the problems for various JFET small signal model for CS configuration.		
Text Book	Text Book 1 –6.1 to 6.3, 7.1 to 7.4, 8.1 to 8.5		
MODULE-3	**BJT AND JFET FREQUENCY RESPONSE**	**25ECE32.3**	**9 Hours**
Introduction (Logarithms and Decibels), Low Frequency Analysis - Bode plot, Low Frequency Response of BJT and FET amplifiers, Miller Effect Capacitance, High frequency response of BJT and FET amplifiers.			
Case Study	Explore the Miller's Theorem and its various applications.		
Text Book	Text Book 1 – 9.1 to 9.10 Text Book 2:16.6.16.8.16.9		
MODULE-4	**FEEDBACK AND OSCILLATOR CIRCUITS**	**25ECE32.4 25ECE32.5**	**9 Hours**
The feedback concept, Feedback connection types, Practical Feedback Circuits, Theory of Sinusoidal Oscillation, Phase Shift Oscillator, Wien Bridge Oscillator, Tuned Oscillator Circuits (Colpitts, Hartley), and Crystal Oscillator (Only BJT version).			
Applications	Scrutinize the different types of oscillators and their applications.		
Text Book	Text Book 1 - 14.1 to 14.9		
MODULE-5	**POWER AMPLIFIERS**	**25ECE32.6**	**9 Hours**
Introduction (Amplifier Types and Efficiency), Class A amplifier (Series fed, Transformer coupled), Class B amplifier (Transformer coupled, push-pull), Class AB Complementary Symmetry, Amplifier Distortion, Power Transistor Heat Sinking, Class C and Class D amplifiers. AI applications in amplifiers.			
Applications	Survey on amplifier types and efficiency, design, applications and case studies of the same.		
Text Book	Text Book 1 - 12.1 to 12.8		

CIE Assessment Pattern (50 Marks – Theory) –

RBT Levels		Marks Distribution		
		Test (s)	AAT1	AAT2
		25	15	10
L1	Remember	5	-	-
L2	Understand	5	-	-
L3	Apply	10	10	5
L4	Analyze	5	5	5
L5	Evaluate	-	-	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	10
L2	Understand	10
L3	Apply	20
L4	Analyze	10
L5	Evaluate	--
L6	Create	--

Suggested Learning Resources:

Text Books:

1) Electronic Devices and Circuit Theory, Robert L. Boylestad and Louis Nashelsky, 11th edition, 2013, Pearson Education/PHI, ISBN 13: 978-0-13-262226-4.
2) Electronic Principles, Albert Malvino and David Bates, 7th edition, 2017, McGraw-Hill, ISBN-13: 978-0073373881.

Reference Books:

1) Electric Circuits, (Schaum's Outline Series) by M Nahvi, Joseph Edminister, K Rao, 5th edition, 2011, McGraw-Hill Education, ISBN-13: 978-0071633727.
2) Electronics Devices and Circuits, Millman J and Halkias C, 3rd edition,2008, TMH, ISBN-13: 978- 0070634558.

Web links and Video Lectures (e-Resources):

- https://archive.nptel.ac.in/courses/108/102/108102095/
- https://pages.uoregon.edu/rayfrey/AnalogNotes.pdf
- https://youtu.be/pkIxCmaxWFg
- https://www.youtube.com/watch?v=kWZVKszReLs

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Perform Load Line Analysis of BJT Circuits using simulation software (Multisim/LTspice) and identify the Q-point for different biasing methods
- Construct and Test a JFET Amplifier Circuit to measure voltage gain and compare the results with theoretical calculations.
- Plot the Frequency Response of BJT and FET Amplifiers and determine the lower and upper cut-off frequencies using a CRO/DSO.
- Design and Verify Oscillator Circuits such as RC Phase Shift, Wien Bridge, Hartley, or Colpitts oscillator and measure the oscillation frequency.
- Analyze the Performance of Power Amplifiers (Class A and Class B) by measuring efficiency, output power, and distortion characteristics.

ANALOG ELECTRONIC CIRCUITS LAB			
Course Code	**25ECL32**	**Credits**	**01**
L:T:P:S	**0:0:1:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**30**	**SEE Marks**	**50**
TW & SL / Sem	**-**	**Total Marks**	**100**
Total Hours /Sem	**30**	**Exam Hours**	**03**

Course outcomes: At the end of the course, the student will be able to:

25ECL32.1	Apply the knowledge of network theorems and device models to demonstrate the given analog electronic circuit
25ECL32.2	Model the applications of diode, BJT and FET circuits using discrete components and simulation tools
25ECL32.3	Construct analog circuits for the given design specification using suitable analog electronic components
25ECL32.4	Evaluate the performance of advanced analog circuit configurations

Exp. No. / Pgm. No.	List of Experiments	Hours	Cos
	Prerequisite Experiments		
	• **Knowledge of PN junction Diode** • **Basics of BJT and its applications**	2	NA
	PART-A		
1	To design and test single ended and double ended Clippers circuits and plot the input, output waveforms and transfer characteristics.	2	25ECL32.1
2	To design and test Clamper circuits and plot the corresponding input and output waveforms.	2	25ECL32.1
3	To design and analyze the following tuned oscillator circuits using BJT and determine the frequencies of oscillation a. Hartley Oscillator b. Colpitts Oscillator	2	25ECL32.1
4	Design and test a single-stage RC-coupled BJT amplifier, and determine its voltage gain and frequency response.	2	25ECL32.1
5	Design a BJT differential amplifier and determine its differential gain , common-mode gain and CMRR.	2	25ECL32.2
6	To design and test the active Integrators and Differentiators circuit using 741 IC. Plot the input and output waveforms	2	25ECL32.2
	PART-B		
7	Simulation of voltage multipliers: doublers, triplers, quadruplers	2	25ECL32.2
8	Simulation of RC phase shift oscillator for the given frequency using Lissajous patterns	2	25ECL32.2
9	Simulation of Common Source Amplifier using JFET	2	25ECL32.3
10	Simulation of current-series and voltage shunt feedback amplifier and to calculate the following parameters with and without feedback a. Mid band gain b. Bandwidth and cut-off frequencies c. Input and output impedance	2	25ECL32.3

11	Simulation of Darlington emitter follower circuit to calculate the Bandwidth	2	25ECL32.4

12	Simulation of Class B push pull amplifier and observe the crossover distortion	2	25ECL32.4

PART-C

Beyond Syllabus Virtual Lab Content (4 Hours)

(To be done during Lab but not to be included for CIE or SEE)

1. Familiarization with Oscilloscope and Function Generator
   http://vlabs.iitkgp.ac.in/aec/exp1/index.html
2. To design a regulated power supply.
   https://ade2-iitr.vlabs.ac.in/
3. To design a touch sensor circuit using BJT transistor.
   https://ade2-iitr.vlabs.ac.in/exp/bjt-transistor/
4. Frequency Response of CS Amplifier
   http://vlabs.iitkgp.ac.in/aec/exp6/index.html
5. Active Filter
   http://vlabs.iitkgp.ac.in/aec/exp2/index.html

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		30	20
L1	Remember	-	-
L2	Understand	05	05
L3	Apply	10	10
L4	Analyze	10	05
L5	Evaluate	05	-
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	05
L3	Apply	20
L4	Analyze	15
L5	Evaluate	10
L6	Create	-

Suggested Learning Resources:

Reference Books:

1) J Robert L. Boylestad Brian A. Olivari, "Introductory Circuit Analysis", 14th edition, Publisher: Pearson, October 25, 2024, ISBN- 978-0137594115

2) Richard C. Jaeger, Travis Blalock, "Microelectronic Circuit Design ISE", 6th Edition, Publisher: McGraw Hill, 2022, ISBN- 9781260597851

DIGITAL ELECTRONIC CIRCUITS			
Course Code	**25ECE33**	**Credits**	**03**
L:T:P:S	**3:0:0:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**45**	**SEE Marks**	**50**
TW & SL / Sem	**45**	**Total Marks**	**100**
Total Hours /Sem	**90**	**Exam Hours**	**03**

Course outcomes: At the end of the course, the student will be able to:

25ECE33.1	Apply the fundamental concepts of Digital logic to implement the functions using logic gates
25ECE33.2	Make use of standard methods to simplify the Boolean expressions
25ECE33.3	Employ the simplification methods for designing combinational logic circuits
25ECE33.4	Demonstrate the design of general sequential logic circuits
25ECE33.5	Design the circuits of standard Registers and Counters using flip flops
25ECE33.6	Examine the significance of state machines in Digital system design

MODULE-1	**PRINCIPLES OF COMBINATIONAL LOGIC**	**25ECE33.1, 25ECE33.2**	**9 Hours**

Binary Logic Gates, Definition of combinational logic, Canonical forms, problem statements to build truth tables and deriving Boolean equations, Karnaugh maps (3 & 4 variables), Incompletely specified functions (Don't care terms), Quine Mc Cluskey Minimization Technique, Map entered Variables (4 variables).

Text Book	Text Book 1 Chapter-3 :3.1,3.2,3.3,3.4,3.5,3.6(Page84-129)
Self-Study	Study how any Boolean expression can be realized using only NAND gates or only NOR gates.

MODULE-2	**ANALYSIS AND DESIGN OF COMBINATIONAL LOGIC**	**25ECE33.3**	**9 Hours**

Full Adder, Ripple carry Adder, Carry Look Ahead Adder, Full Subtractor, 8x3 Encoder, 3x8 Decoder, Binary Comparator(1BitS2Bit), Code Conversion (Binary to Gray vice versa), Multiplexer (4x1S 8x1), Implementation of different logics using Multiplexer.

Text Book	Text Book 1, Chapter- 4 :4.3,4.4,4.5,4.6,4.7,4.9(page171-215)
Self-Study	Real-world applications of multiplexers and decoders in communication and computer systems.

MODULE-3	**LATCHES AND FLIPFLOPS**	**25ECE33.4**	**9 Hours**

Basic Bistable Element, Latches-SR Latch, The gated SR Latch, The gated D Latch, Timing Considerations, Flip Flops –Clocked SR Flip Flop, JK Clocked Flip Flops, Clocked T Flip-flop, Clocked D Flip-flop, The Master Slave Flip-Flops, Flip-Flop Characteristic equations, Conversion of Flip-Flops.

Text Book	Text Book 2, Chapter -6 :6.1,6.26.3,6.4,6.5 .6.6(page302-329)
Self-Study	Applications of flip-flops in digital systems and memory devices.

MODULE-4	**SEQUENTIAL CIRCUITS**	**25ECE33.5**	**9 Hours**

Shift Registers: PIPO, SIPO, PISO, SISO, Universal Shift register. Counter: Design of synchronous counter (3 Bit Up/Down, Mod N), Ring counter, Johnson counter, Design of asynchronous counters – 4 bit asynchronous up/down counter.

Text Book	Text Book 2 `Chapter -6 :6.7,6.8,6.9(page332-347)
Self-study	Study the use of shift registers in data storage, data transfer, serial-to-parallel conversion, parallel-to-serial conversion, and communication systems.

MODULE-5	**FINITE STATE MACHINE**	**25ECE33.6**	**9 Hours**

Moore and Mealy State models, state machine notations, Synchronous Sequential Circuit Analysis, Construction of state diagrams, Sequence detector, Serial Ex-3 to BCD code converter, counter design, Applications of Mealy and Moore machines – Design Full adder.

Text Book	Text Book 1, Chapter-6:6.1,6.2,6.3,6.4,6.5(Page322-356)

Self-study	Compare the implementation of Mealy and Moore machines.

CIE Assessment Pattern (50 Marks – Theory) –

RBT Levels		Marks Distribution		
		Test (s)	AAT1	AAT2
		25	15	10
L1	Remember	5	-	-
L2	Understand	5	-	-
L3	Apply	10	10	5
L4	Analyze	5	5	5
L5	Evaluate	-	-	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	10
L2	Understand	10
L3	Apply	20
L4	Analyze	10
L5	Evaluate	-
L6	Create	-

Suggested Learning Resources:

Text Books:

1. John M. Yarbrough, "Digital Logic: Applications and Design", Cengage Learning, 2015 reprint, ISBN-10: 81-315-0058-6
2. Donald D. Givone, "Digital Principles and Design", 2003, Tata McGraw Hill Edition2002, ISBN-13: 978- \ 0072525038.

Reference Books:

1. R.P. Jain & Kishor Sarawadekar, "Modern Digital Electronics", TMH McGraw Hill, 5th Edition 2023, ISBN-10: 9355321775, ISBN-13: 978-9355321770
2. Thomas Floyd, "Digital Fundamentals", 11thedition,2014, Pearson Education, ISBN-13: 978-0132737968.
3. M. Morris Mano, "Digital Logic and Computer Design ", Pearson Education,2011,ISBN-13: 978-0130898968.
4. R.D. Sudhakar Samuel, "An Illustrative Approach to Logic Design", 2010, Pearson Education, ISBN-13: 978-8131732526.

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=wk6O1OuAZn0
- https://www.youtube.com/watch?v=jm0PGDSSBkI
- https://www.youtube.com/watch?v=ApILP5WPZeE
- https://www.youtube.com/watch?v=O3If0Nr9to0
- https://www.youtube.com/watch?v=eZbGuv1lsrE

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Conduct group activities to compare different logic families and present their applications in real-world digital systems.
- Organize quiz activities and concept-based games to reinforce theoretical understanding.
- For active participation, instruct students to prepare flowcharts, handouts, and concept maps for digital electronic circuits and logic design concepts.
- Assign students to prepare comparison tables for different digital devices such as multiplexers, decoders, flip-flops, counters, and shift registers.

DIGITAL ELECTRONIC CIRCUITS LAB			
Course Code	**25ECL33**	**Credits**	**01**
L:T:P:S	**0:0:1:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**30**	**SEE Marks**	**50**
TW & SL / Sem	**-**	**Total Marks**	**100**
Total Hours /Sem	**30**	**Exam Hours**	**03**

Course outcomes:
At the end of the course, the student will be able to:

25ECL33.1	Apply logic gates to construct and interpret truth tables for various logical expressions and combinational circuits
25ECL33.2	Analyze digital combinational and sequential logic circuits to interpret their functionality and timing behavior
25ECL33.3	Design digital combinational and sequential logic circuits to meet specified functional requirements
25ECL33.4	Demonstrate various types of Shift registers, up/down counters, Mealy and Moore model

Exp. No. / Pgm. No.	List of Experiments	Hours	Cos
	Prerequisite Experiments		
	• Digital logic gates • Boolean algebra - basic theoretical background is required.	2	NA
	PART-A		
1	Simplification of Boolean expressions using K-map and realization of simplified expressions using basic and universal gates.	2	25ECL33.1 25ECL33.2
2	Realization of Half/Full adder and Half/Full Subtractor using Logic gates.	2	25ECL33.1 25ECL33.2
3	a) Realization of parallel adder/ Subtractors using7483chip b) BCD to Excess-3code conversion and vice versa.	2	25ECL33.1 25ECL33.2
4	Realization of Binary to Gray code conversion and vice versa.	2	25ECL33.1 25ECL33.2
5	MUX/DEMUX–use of 74153, 74139 for arithmetic circuits and code Converter.	2	25ECL33.1 25ECL33.2
6	Realization of One/Two bit comparator and study of 7485 Magnitude comparator.	2	25ECL33.1 25ECL33.2
	PART-B		
7	a) Use of Decoder chip to drive LED display b) Verifying the functionality of Priority encoder	2	25ECL33.2 25ECL33.3
8	Truth table verification of Flip-Flops: a) JK Master slave b) T type c) D type	2	25ECL33.2 25ECL33.3
9	Shift left; Shift right, SIPO, SISO, PISO, PIPO operations using 74S95.	2	25ECL33.2 25ECL33.3 25ECL33.4
10	Realization of Johnson and Ring counter.	2	25ECL33.2 25ECL33.3 25ECL33.4
11	Realization of synchronous and asynchronous counters.	2	25ECL33.2 25ECL33.3 25ECL33.4
12	Design and implementation of synchronous or clocked sequential	2	25ECL33.3

	circuits using Mealy and Moore model.		25ECL33.4

PART-C
Beyond Syllabus Virtual Lab Content (4 Hours)
(To be done during Lab but not to be included for CIE or SEE)

1. Interpretation of truth table for AND, OR, NOT, NAND, NOR, Ex-OR, Ex-NOR gates https://de-iitr.vlabs.ac.in/exp/truth-table-gates/
2. Seat belt warning system using basic AND and NOT gates https://da-iitb.vlabs.ac.in/exp/seat-belt-warning-system/
3. Universal NOR gate and its application in automobile alarm system https://da-iitb.vlabs.ac.in/exp/automobile-alarm-system/
4. Half and Full subtractor https://de-iitr.vlabs.ac.in/exp/half-full-subtractor/
5. DIY Build your own combinational logic circuit using generalized simulator https://da-iitb.vlabs.ac.in/exp/generalized-simulator/
6. Shift Register https://he-coep.vlabs.ac.in/exp/shift-registers/simulation.html

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		30	20
L1	Remember	-	-
L2	Understand	05	05
L3	Apply	10	10
L4	Analyze	10	05
L5	Evaluate	05	-
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	05
L3	Apply	20
L4	Analyze	15
L5	Evaluate	10
L6	Create	-

Suggested Learning Resources:
Reference Books:

1) Digital Fundamentals, Thomas Floyd, 11thedition, 2014, Pearson Education, ISBN-13: 978- 0132737968
2 An Illustrative Approach to Logic Design, R. D. Sudhakar Samuel, 2010, Pearson Education, ISBN-13: 978-0132737968

SIGNALS AND SYSTEMS			
Course Code	**25ECE34**	**Credits**	**03**
L:T:P:S	**3:0:0:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**45**	**SEE Marks**	**50**
TW & SL / Sem	**45**	**Total Marks**	**100**
Total Hours /Sem	**90**	**Exam Hours**	**03**

Course outcomes: At the end of the course, the student will be able to:

25ECE34.1	Classify continuous-time and discrete-time signals and systems, and analyze the properties and transformations of signals and systems
25ECE34.2	Apply convolution techniques and impulse/step responses to determine the output of continuous-time and discrete-time LTI systems
25ECE34.3	Solve the response and stability of continuous-time and discrete-time systems using differential and difference equation models
25ECE34.4	Analyze continuous-time signals using Fourier Transform techniques to obtain the spectral representation
25ECE34.5	Evaluate discrete-time signals and systems using Z-Transform techniques and Region of Convergence
25ECE34.6	Interpret the role of AI in signal processing to address modern engineering problems through analysis, case studies and technical presentation

MODULE-1	**INTRODUCTION TO SIGNALS AND SYSTEMS**	**25ECE34.1**	**9 Hours**
Signal Definition, Signal Classification, Elementary Signals, Signal Transformation of independent and Dependent variables (Amplitude scaling, addition, multiplication, time scaling, time shift and time reversal). System definition, Properties of Systems (Linear and non-linear systems, Time variant and invariant systems, causal and non-causal systems, Static system, BIBO system)			
Applications	Signal Processing in Smart Phones and Digital Camera.		
Text Book	Text Book 1: 1.1, 1.2, 1.3,1.4, 2.1,2.2,2.3,3.2.1 to 3.2.4,4.1.1 to 4.1.4		
MODULE-2	**TIME DOMAIN ANALYSIS OF LTI SYSTEMS**	**25ECE34.2 25ECE34.3**	**9 Hours**
Discrete time LTI system: Convolution Sum, Difference Equation Model, Continuous time LTI system: Convolution Integral. Differential Equation model, System response, system stability.			
Self-study	1. Convolution using MATLAB/Python, 2. Echo Removal in Audio Signals using Convolution		
Text Book	Text Book 1: 3.1,3.3,3.4,4.2,4.3,4.4,4.5		
MODULE-3	**ANALYSIS OF CONTINUOUS TIME SIGNALS**	**25ECE34.4**	**9 Hours**
Fourier Transform, Properties of Fourier Transform, Fourier transform of aperiodic signals, Fourier Transform of periodic signals, Magnitude Spectrum, Phase Spectrum, Energy Spectral Density, Power Spectral Density			
Applications	Frequency Analysis of Speech and Audio Signals		
Text Book	Text Book 1: 8.1, 8.2,8.3.1,8.3.4		
MODULE-4	**ANALYSIS OF DISCRETE TIME SIGNALS**	**25ECE34.5**	**9 Hours**
Z-Transform, Definition, ROC, Properties of Z Transform, Inverse Z-Transform, Transfer function, Poles and Zeros, Causality, Stability.			
Self-study	Pole-Zero Visualization using MATLAB/Python.		
Text Book	Text Book 1: 9.2,9.3,9.4,9.5.1, 9.5.2,9.5.3,9.5.5, 9.5.6		
MODULE-5	**AI ENABLED SIGNAL PROCESSING APPLICATION**	**25ECE34.6**	**9 Hours**
Overview of signal data in Biomedical, Radar, and Seismic (Earthquake) systems. Role of AI in Biomedical applications, Radar signal processing, and Earthquake monitoring systems. Overview of AI algorithms used for biomedical diagnosis, target detection in radar systems, and seismic event analysis.			
Case Study	Anomaly detection in signals (e.g., machinery vibration, ECG anomalies).		
Text Book	Text Book 2: 1.1,1.2,2.1.3,2.1.4,3.1, Weblink 4 and 5.		

CIE Assessment Pattern (50 Marks – Theory) –

RBT Levels		Marks Distribution		
		Test (s)	AAT1	AAT2
		25	15	10
L1	Remember	5	-	-
L2	Understand	5	-	-
L3	Apply	10	10	-
L4	Analyze	5	5	5
L5	Evaluate	-	-	5
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	10
L2	Understand	10
L3	Apply	20
L4	Analyze	10
L5	Evaluate	-
L6	Create	-

Suggested Learning Resources:

Text Books:

1) D Sundararajan, "Signals and Systems: A Practical Approach", Springer Nature Switzerland AG, 2nd edition 2023, ISBN: 978-3-031-19376-7.

2) Nishit Agarwal, "AI Driven Biomedical Data Science and Signal Processing", Deepmisti publication,2024, ISBN:9789360449261.

Reference Books:

1) Emiliano R. Martins, " Essentials of Signals and Systems", Publisher: Wiley 2023, ISBN: 978-1-119-90923-1.

2) Allen V. Oppenheim, Allen S. Willsiky, S. Hamid Nawab, "Signals and Systems", Publisher: PHI, 2015, 2023, ISBN: 0-13– 814757–4.

Web links and Video Lectures (e-Resources):

- https://ocw.mit.edu/courses/res-6-007-signals-and-systems-spring-2011/
- https://archive.nptel.ac.in/courses/108/106/108106163/
- https://www.youtube.com/watch?v=2znm6o8HUsA
- https://www.researchgate.net/publication/385393777_Artificial_Intelligence_AI-Based_Radar_Signal_Processing_and_Radar_Imaging
- https://theses.hal.science/tel-05006186v1/file/2024COAZ5083.pdf

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Demonstration of signal processing program using python.
- Video demonstration of Signal Processing application.
- For active participation of students, debate the advantage and limitation of different Analog signal Processing and digital Signal Processing.
- Assign pre-recorded video lectures or readings for students to review before class, freeing up class time for interactive discussions, problem-solving, and hands-on activities.
- Contents related activities (Activity-based discussions)
  - ➢ Problem based learning, Gallery walk, Case studies

CIRCUIT DESIGN AND ANALYSIS			
Course Code	**25ECE35**	**Credits**	**03**
L:T:P:S	**3:0:0:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**45**	**SEE Marks**	**50**
TW & SL / Sem	**45**	**Total Marks**	**100**
Total Hours /Sem	**90**	**Exam Hours**	**03**

Course outcomes: At the end of the course, the student will be able to:

25ECE35.1	Apply basic electrical laws and techniques such as mesh and nodal analysis for solving DC electrical circuits
25ECE35.2	Analyze electrical networks using circuit theorems and characterize two-port networks using various parameters
25ECE35.3	Evaluate transient response of first and second order RL, RC, and RLC circuits using Laplace transform methods
25ECE35.4	Analyze the behavior of electrical elements under switching conditions and evaluate initial/final conditions
25ECE35.5	Apply the fundamental characteristics and parameters of operational amplifiers to design and analyze basic DC amplifier configurations
25ECE35.6	Design Op-Amp based amplifier circuits and active filters for analog signal processing

MODULE-1	**BASIC LAWS AND NETWORK ANALYSIS TECHNIQUES**	**25ECE35.1**	**9 Hours**
Introduction to basic electrical laws, nodal analysis and mesh analysis using dependent and independent sources for DC networks and AC networks, nodal and mesh analysis by inspection, and concepts of super node and super mesh.			
Self-study	Additional Nodal and Mesh Analysis problems using dependent sources.		
Text Book	TextBook1:2.1,2.2,2.3,2.4,2.5,2.6,2.7,3.1,3.2,3.3,3.4,3.5,3.6,3.7(PgNo:30-56,80-102)		
MODULE-2	**NETWORK THEOREMS AND TWO-PORT NETWORK ANALYSIS**	**25ECE35.2**	**9 Hours**
Circuit Theorems - Superposition theorem, Thevenin's theorem, Norton's Theorem, Maximum Power transfer Theorem. Two-port networks: Characterization of two port networks, Z, Y, ABCD and h parameters, Reciprocity and symmetry. Inter-relationships between the parameters.			
Self-study	Parameter conversions and cascaded network examples.		
Text Book	Text book 1: 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8(PgNo:126-148) Text book 2:11.1,11.2,11.3,11.4,11.5.11.6.11.7(PgNo:325-338)		
MODULE-3	**TRANSIENT ANALYSIS AND LAPLACE TRANSFORM TECHNIQUES**	**25ECE35.3, 25ECE35.4**	**9 Hours**
Transient behavior and initial conditions: Behavior of circuit elements under switching condition and their Representation, evaluation of initial and final conditions in RL, RC and RLC circuits for DC excitations, concept of series and parallel resonance. Solutions of Networks Using Laplace Transformation: Step, ramp, and impulse responses of first-order circuits using Laplace Transform.			
Case Study	Step response of RLC circuits for switch-based DC applications.		
Text Book	TextBook1: 7.1,7.2,7.3,7.4,7.5,7.6(PgNo:252-282) , 14.5,14.6(627-634) Textbook2: 6.1,6,2,6.3,6.4, 7.1,7.2,7.3,7.5,8.1,8.2, (PgNo:139-158, 170-181,202-207)		
MODULE-4	**INTRODUCTION TO OPERATIONAL AMPLIFIER**	**25ECE35.5**	**9 Hours**
Op-Amp Fundamentals: Basic Op-Amp characteristics and parameters. Op-Amps as DC Amplifiers: Direct coupled (DC) Voltage Followers, Non-inverting Amplifiers, inverting amplifiers, Summing amplifiers, Difference amplifier, Instrumentation amplifier.			
Application	Signal conditioning using Instrumentation Amplifier.		
Text Book	Text book 3: 2.1 to 2.6,3.2,3.3,3.4,3.6,3.7,3.8(PgNo:13-34, PgNo:43-66)		
MODULE-5	**OP-AMP APPLICATIONS AND FILTERS**	**25ECE35.6**	**9 Hours**

OP-Amp Applications: Voltage sources, current sources, Log and antilog amplifiers, Integrator and differentiator.
Filters: Filter Types and characteristics, First Order Active Filters Design and Optimization of an Analog Filter Circuit using AI-based Techniques.

Application	Design of audio filters and waveform generators.
Text Book	Text book 3: 7.1,7.2,7.6,8.6,8.7,12.1,12.2(PgNo:148-163, PgNo:317-321) Reference Books: 4th link (Analog Filter Circuit using AI-based Techniques)

CIE Assessment Pattern (50 Marks – Theory) –

RBT Levels		Marks Distribution		
		Test (s)	AAT1	AAT2
		25	15	10
L1	Remember	5	-	-
L2	Understand	5	-	-
L3	Apply	10	10	5
L4	Analyze	5	5	5
L5	Evaluate	-	-	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	10
L2	Understand	10
L3	Apply	20
L4	Analyze	10
L5	Evaluate	-
L6	Create	-

Suggested Learning Resources:

Text Books:

1) Fundamentals of Electric Circuits, Charles K. Alexander and Matthew N. O. Sadiku, 7th Edition, McGraw Hill Education, 2021, ISBN-13: 978-93-5532-016-2
2) M.E. Van Valkenberg (2015), —Network analysis, Prentice Hall of India, 3rd edition, 2015, ISBN 97893-325-5013-1
3) Operational Amplifiers and Linear IC's, David A. Bell, 3rd edition, 2011, Oxford University Press, ISBN13: 978-0-19-569613-4

Reference Books:

1) Network Theory, K Channa Venkatesh, D Ganesh Rao, Pearson Education Limited, 2010, ISBN-13: 978-8131734070
2) Linear Integrated Circuits, D. Roy Choudhary and Shail B. Jain, 4th edition, 2015, New Age International, ISBN-13: 978-8122430677.
3) Ramakant A. Gayakwad, "Op-Amps and Linear Integrated Circuits", 4th edition, 2015, Pearson, ISBN13:978-0132808682.
4. https://arxiv.org/html/2505.03750v2

Web links and Video Lectures (e-Resources):

- **https://onlinecourses.nptel.ac.in/noc23_ee81/preview**
- **https://onlinecourses.nptel.ac.in/noc23_ee65/preview**

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- ➢ Solving network analysis problems using PSPICE
- ➢ Video demonstrations for network theorems
- ➢ Pre-class video lectures for flipped learning
- ➢ Breadboard-based Op-Amp circuit demonstrations
- ➢ Interactive seminars on amplifier/filter design

ELECTRONICS SYSTEM DESIGN USING PROTEUS			
Course Code	**25ECE361**	**Credits**	**01**
L:T:P:S	**0:0:1:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**30**	**SEE Marks**	**50**
TW & SL / Sem	**-**	**Total Marks**	**100**
Total Hours /Sem	**30**	**Exam Hours**	**03**

Course outcomes:
At the end of the course, the student will be able to:

25ECE361.1	Apply the fundamental concepts of analog and digital electronics to design and simulate basic electronic circuits using Proteus.
25ECE361.2	Simulate electronic circuits to study the behavior and characteristics of electronic components and circuits before hardware implementation.
25ECE361.3	Analyze the performance of analog and digital electronic circuits using virtual instruments and interpret the simulation results.
25ECE361.4	Design and verify electronic circuits involving semiconductor devices, logic circuits, oscillators, memory, and display systems to solve basic engineering problems.

Exp. No. / Pgm. No.	List of Experiments	Hours	Cos
	Prerequisite Demo		
	• Basic knowledge of **Electronic Components and Digital Logic Gates**. • Familiarity with **Proteus Design Suite** (schematic capture, component selection, and simulation). • **Understanding of Combinational and Sequential Logic Circuits** (Encoder, Decoder, Flip-Flops, Counters, and Registers).	2	NA
	PART-A		
1	To simulate of SPST and SPDT Switches with Electrical Loads.	2	25ECE361.1 25ECE361.2
2	Analysis of Capacitor and Inductor Characteristics in DC Circuits	2	25ECE361.1 25ECE361.2
3	To Simulate AC circuits and measure voltage waveforms using the virtual oscilloscope.	2	25ECE361.1 25ECE361.2 25ECE361.3
4	To design a 5 V regulated power supply using a Zener diode.	2	25ECE361.1 25ECE361.2 25ECE361.3
5	To design a JFET-based switching circuit to control an LED or lamp.	2	25ECE361.1 25ECE361.2
6	To design a 1 MHz crystal oscillator and verify its output frequency using the virtual oscilloscope.	2	25ECE361.2 25ECE361.3
	PART-B		
7	To design a tri-state buffer circuit and verify data transmission based on the Enable signal.	2	25ECE361.2 25ECE361.4
8	To design and simulate a 4-bit Magnitude Comparator and verify its operation.	2	25ECE361.2 25ECE361.4
9	To design and implement Binary to Gray and Gray to Binary Code Converters using logic gates.	2	25ECE361.2 25ECE361.4

10	To Investigate serial to parallel conversion using Shift register.	2	25ECE361.2 25ECE361.3 25ECE361.4
11	To display frequency of an input signal using 7-segment Display.	2	25ECE361.2 25ECE361.3 25ECE361.4
12	Design a memory circuit using the IC74LS189 RAM in Proteus.	2	25ECE361.2 25ECE361.3 25ECE361.4

PART-C

Beyond Syllabus Virtual Lab Content (4 Hours)

(To be done during Lab but not to be included for CIE or SEE)

1. Familiarization with Oscilloscope and Function Generator
   http://vlabs.iitkgp.ac.in/aec/exp1/index.html
2. Active Filter Design and Analysis
   http://vlabs.iitkgp.ac.in/aec/exp2/index.html
3. Interpretation of Truth Tables for Logic Gates
   https://de-iitr.vlabs.ac.in/exp/truth-table-gates/
4. Half and Full Subtractor
   https://de-iitr.vlabs.ac.in/exp/half-full-subtractor/
5. Shift Register Simulation
   https://he-coep.vlabs.ac.in/exp/shift-registers/simulation.html

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		30	20
L1	Remember	-	-
L2	Understand	05	05
L3	Apply	10	10
L4	Analyze	10	05
L5	Evaluate	05	-
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	05
L3	Apply	20
L4	Analyze	15
L5	Evaluate	10
L6	Create	-

Suggested Learning Resources:

Reference Books:

1) Farzin Asadi, Essential Circuit Analysis Using Proteus®, Springer Singapore, 2022, 978-981-19-4353-9, https://doi.org/10.1007/978-981-19-4353-9

2) Proteus Design Suite: https://www.labcenter.com/

PROGRAMMING ON RASPBERRY PI USING PYTHON			
Course Code	**25ECE362**	**Credits**	**01**
L:T:P:S	**0:0:1:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**30**	**SEE Marks**	**50**
TW & SL / Sem	**-**	**Total Marks**	**100**
Total Hours /Sem	**30**	**Exam Hours**	**03**

Course outcomes: At the end of the course, the student will be able to:

25ECE362.1	Understand the core concepts of Python Programming and Raspberry pi
25ECE362.2	Apply the basic Knowledge of Python Programming and system control to perform specific tasks
25ECE362.3	Conduct experiments to interface different I/O's to perform different tasks
25ECE362.4	Develop Programming skills in Embedded systems for various applications

Exp. No. / Pgm. No.	List of Programs	Hours	Cos
	Prerequisite Programs / Demo		
	• A Basic Understanding of Microprocessors and microcontrollers. • Basic Understanding of Python Programming.	2	NA
	PART-A		
1	Getting started with Raspberry Pi. • Introduction to Raspberry pi and supporting Operating systems	2	25ECE362.1
2	Basic programming in Python on Raspberry Pi. • Printing message	2	25ECE362.2
3	Write a Python program for understanding how to use the input() function to capture user name and age. Format output and convert input to integers for interactive programs.	2	25ECE362.2
4	Write a Python program to explore the operator precedence and asso-ciativity using real examples of +, *, parentheses, and brackets.	2	25ECE362.2
5	Write a Python program to explore the conditional flow with if-else and boolean expressions, showing how true conditions execute a block while false uses else, and how to control program behavior.	2	25ECE362.3
6	Write a Python program to implement the Fibonacci series in Python by iteratively summing the last two terms, starting from 0 and 1, and printing the first n terms with optional user input.	2	25ECE362.3
	PART-B		
7	Write a Python program to define functions with parameters, pass arguments, use default arguments, handle multiple parameters, and call with keyword arguments to control order.	2	25ECE362.3
8	Write a Python Program to explore tuples as immutable sequences, with zero-based indexing and iteration; use len to gauge length and learn that elements cannot be deleted, but the tuple can be deleted.	2	25ECE362.3
9	Write a Python script to Raise and handle exceptions explicitly using raise, except as, and finally, compare scenarios with zero and nonzero values, and apply finally for cleanup on Raspberry Pi.	2	25ECE362.3
10	Using a Python Script to Explore the Python math library by importing math and demonstrating functions like ceil, fabs, factorial, floor, trunc, and exp, and reveal constants pi, e, infinity, and not a number.	2	25ECE362.4
11	Develop a Python program to blink an LED with a Raspberry Pi GPIO	2	25ECE362.4

	output, wiring a 220 ohm resistor to pin 8 and ground, controlled by Python 3 and the GPIO library.		
12	Write a Python script to Explore the DHT humidity and temperature sensors, including DHT11 and DHT22, their pinouts (Vcc, data, ground), and the role of a 10k pull-up or built-in resistors.	2	25ECE362.4

PART-C
Beyond Syllabus Virtual Lab Content (4 Hours)
(To be done during Lab but not to be included for CIE or SEE)

1. **Introduction to Raspberry Pi**
   https://iot-amrt.vlabs.ac.in/exp/introduction-raspberry-pi/
2. **DHT11 sensor with Raspberry Pi Program**
   https://iot-amrt.vlabs.ac.in/exp/dht11-sensor-pi/
3. **Raspberry Pi Ultrasonic Sensor Interface Program**
   https://iot-amrt.vlabs.ac.in/exp/ultrasonic-sensor-pi/
4. **Raspberry Pi Motor Control with Relay**
   https://iot-amrt.vlabs.ac.in/exp/motor-relay-pi/
5. **Raspberry Pi Bluetooth Data Transfer to Smartphone**
   https://iot-amrt.vlabs.ac.in/exp/bluetooth-module-pi/
6. **Raspberry Pi Push Button LED Blink Program**
   https://iot-amrt.vlabs.ac.in/exp/interface-push-sensor-pi/

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		30	20
L1	Remember	-	-
L2	Understand	05	05
L3	Apply	10	10
L4	Analyze	10	05
L5	Evaluate	05	-
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	05
L3	Apply	20
L4	Analyze	15
L5	Evaluate	10
L6	Create	-

Suggested Learning Resources:
Reference Books:

1) Simon Monk, Programming the Raspberry Pi: Getting Started with Python, 3rd Edition, McGraw-Hill Education, 2021. ISBN: 9781260121736.
2) Simon Monk, Raspberry Pi Cookbook: Software and Hardware Problems & Solutions, 4th Edition, O'Reilly Media, 2023. ISBN: 9781098130923

DATA VISUALIZATION USING SCILAB

Course Code	**25ECE363**	**Credits**	**01**
L:T:P:S	**0:0:1:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**30**	**SEE Marks**	**50**
TW & SL / Sem	**-**	**Total Marks**	**100**
Total Hours /Sem	**30**	**Exam Hours**	**03**

Course outcomes:
At the end of the course, the student will be able to:

25ECE363.1	Apply the data visual tools of SCI Lab for data visualization
25ECE363.2	Analyze different types of data using plotting functions in Scilab software
25ECE363.3	Create 2D and 3D plots for analyzing different mathematical equations
25ECE363.4	Design applications with Scilab Xcos simulator and GUI toolbox

Exp. No. / Pgm. No.	List of Experiments / Programs	Hours	Cos
	Prerequisite Demo		
	• Mathematical modelling and analysis. • Graph theory and basics of charts.	2	NA
	PART-A		
1	To plot the function y = sin(x) using Scilab.	2	25ECE363.1
2	To plot y = sin(x) and y = cos(x) on the same graph.	2	25ECE363.1
3	To represent student marks using a bar chart & Pie chart.	2	25ECE363.1
4	Create Scatter plot to visualize correlation.	2	25ECE363.1
5	Implementing time series plot for temperature data over time	2	25ECE363.2
6	Create a Parametric plot to plot a Lissajous curve.	2	25ECE363.2
	PART-B		
7	Implementing Multi-Series 2D Plots in Scilab Using 2D to 2D4 Functions	2	25ECE363.2
8	Create a 3D surface plot for the equation z = sin(x)*cos(y).	2	25ECE363.2
9	To read and visualize data from a CSV file.	2	25ECE363.3
10	Create an interactive 3D plot to view and rotate a 3D surface interactively.	2	25ECE363.3
11	Design and Analysis of Basic Electrical Circuits Using Xcos Simulator.	2	25ECE363.4
12	Creating Basic Graphical User Interfaces in Scilab Using GUI Toolbox	2	25ECE363.4

PART-C
Beyond Syllabus Virtual Lab Content (4 Hours)
(To be done during Lab but not to be included for CIE or SEE)

1. Graphical-user-interface
   https://www.scilab.org/graphical-user-interface-1-plot-breakdown
2. Basic-tools-for-signal-processing
   https://www.scilab.org/basic-tools-for-signal-processing
3. Figures-in-scilab
   https://www.scilab.org/tutorials/figures-in-scilab
4. Non-linear-optimization-with-constraints-and-extra-arguments:
   https://www.scilab.org/non-linear-optimization-with-constraints-and-extra-arguments
5. ScilabAnimation:
   https://www.sky-engin.jp/en/ScilabAnimation/chap04/chap04.html

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		30	20
L1	Remember	-	-
L2	Understand	05	05
L3	Apply	10	10
L4	Analyze	10	05
L5	Evaluate	05	-
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	05
L3	Apply	20
L4	Analyze	15
L5	Evaluate	10
L6	Create	-

Suggested Learning Resources:

Reference Books:

1) Computing in Scilab - Chetana Jain, Publisher, Cambridge University Press, 2023 ; ISBN, 1009214195, 9781009214193 ;
2) Sandeep Nagar, Introduction to Scilab: For Engineers and Scientists. Apress publisher, New York, USA, 2017.
3) A.S.Nair, SCILAB (A free software to MATLAB), S. Chand Publishing, New Delhi, India, 2012.

Web References:

1. https://www.scilab.org/
2. https://onlinecourses.swayam2.ac.in/aic20_sp38/preview
3. https://www.udemy.com/course/scilab-the-first-course-beginners-to-intermediate/mediate/

APP DEVELOPMENT USING GOOGLE FLUTTER			
Course Code	**25ECE364**	**Credits**	**01**
L:T:P:S	**0:0:1:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**30**	**SEE Marks**	**50**
TW & SL / Sem	-	**Total Marks**	**100**
Total Hours /Sem	**30**	**Exam Hours**	**03**

Course outcomes:
At the end of the course, the student will be able to:

25ECE364.1	Understand Flutter framework, Dart programming concepts, widgets, and mobile application development environment
25ECE364.2	Design and develop user interfaces using Flutter widgets, layouts, forms, and event handling techniques
25ECE364.3	Implement navigation, validation, and data processing functionalities in mobile applications
25ECE364.4	Develop complete Flutter applications integrating multiple widgets, state management, and user interactions

Exp. No. / Pgm. No.	List of Experiments / Programs	Hours	COs
	Prerequisite Programs		
	Installation and configuration of Flutter SDK, Android Studio, Android Emulator, and execution of a basic Flutter application.	2	NA
	PART-A		
1	Design and develop a Student Profile Management Application using Text, Image, Icon, Container, Row, and Column widgets to display personal and academic information.	2	25ECE364.1
2	Develop a Student Information Management Application using Stateful Widgets, TextFields, Buttons, variables, conditional statements, and user inputs to store and display student details dynamically.	2	25ECE364.1
3	Design a College Dashboard Application using AppBar, Cards, GridView, Icons, and Containers to display academic departments, facilities, and student services.	2	25ECE364.1
4	Develop a Student Registration Form Application using Form Widgets, TextFields, Drop-down Menus, Radio Buttons, Checkboxes, and Validation techniques.	2	25ECE364.1
5	Design and implement a Scientific Calculator Application capable of performing arithmetic operations, percentage calculations, square, square root, and modulus operations.	2	25ECE364.2
6	Develop a CGPA Calculator Application to accept subject credits and grade points, calculate SGPA/CGPA, and display academic performance details.	2	25ECE364.2
	PART-B		
7	Develop a Student Attendance Tracker Application to maintain attendance records, calculate attendance percentage, and display attendance status.	2	25ECE364.2
8	Design an Electronics Component Catalog Application using ListView, Cards, Images, and ListTiles to display information about electronic components such as resistors, capacitors, diodes, transistors, and ICs.	2	25ECE364.2
9	Develop a Multi-Screen College Information Application implementing navigation using Navigator and Routes to display department, faculty, laboratory, and contact information.	2	25ECE364.3

10	Design and implement an Online Quiz Application with multiple-	2	25ECE364.3
	choice questions, answer validation, score calculation, and result display.		
11	Develop a To-Do Manager Application with functionalities to add, edit, delete, and mark tasks as completed using state management techniques.	2	25ECE364.4
12	Design and develop an Expense Tracker Application to record daily expenses, categorize transactions, calculate total expenditure, and display expense summaries.	2	25ECE364.4

PART-C

Beyond Syllabus Virtual Lab Content (4 Hours)

(To be done during Lab but not to be included for CIE or SEE)

1. Flutter Widget Catalog Exploration and Demonstration
   https://docs.flutter.dev/ui/widgets
2. Flutter Responsive UI Design using Layout Widgets
   https://docs.flutter.dev/ui/layout
3. Flutter Debugging and Hot Reload Techniques
   Hot Reload: https://docs.flutter.dev/tools/hot-reload
   DevTools: https://docs.flutter.dev/tools/devtools
   Debugging: https://docs.flutter.dev/testing/code-debugging
4. Flutter Package Management and Dependency Integration
   https://docs.flutter.dev/packages-and-plugins/using-packages
5. Android Application Build and APK Generation Process
   https://docs.flutter.dev/deployment/android
6. Flutter UI Design using Material Design Components
   https://docs.flutter.dev/ui/widgets/material

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		30	20
L1	Remember	-	-
L2	Understand	05	05
L3	Apply	10	10
L4	Analyze	10	05
L5	Evaluate	05	-
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	05
L3	Apply	20
L4	Analyze	15
L5	Evaluate	10
L6	Create	-

Suggested Learning Resources:

Reference Books:

1. Alberto Miola, "Flutter Complete Reference 2.0: The Ultimate Reference for Dart and Flutter", Independently Published, 2023, ISBN: 9798396549241.
2. Alessandro Biessek, "Flutter Cookbook – Over 100 Proven Techniques and Solutions for App Development with Flutter", Packt Publishing, 2023.
3. Kodeco Team, "Flutter Apprentice (4th Edition): Beginning Cross-Platform App Development with Flutter", Kodeco Publications, 2024.

BIO INSPIRED DESIGN AND INNOVATION			
Course Code	**25ECE365**	**Credits**	**01**
L:T:P:S	**1:0:0:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**15**	**SEE Marks**	**50**
TW & SL / Sem	**15**	**Total Marks**	**100**
Total Hours /Sem	**30**	**Exam Hours**	**03**

Course outcomes: At the end of the course, the student will be able to:

25ECE365.1	Understand the fundamentals and significance of bio-inspired design and engineering.
25ECE365.2	Apply biomaterials and bio-inspired healthcare systems for engineering applications.
25ECE365.3	Analyze bio-inspired optimization techniques to solve sustainable engineering and environmental management problems.
25ECE365.4	Apply bio-inspired AI innovations in manufacturing, automation, materials, and sustainable product development.

MODULE-1	**BIO-INSPIRED DESIGN AND ENGINEERING**	**25ECE365.1**	**3 Hours**

Bio-Inspired Engineering and design, History, Need for Bio-Inspired Designs. Bio inspired Additive manufacturing techniques, (self-healing, self-assembly).

Self-study	Investigate the Challenges of Bio inspired design, Compare with traditional areas of science and engineering
Text Book	Text Book 1: 1.2, 1.3, 1.4, 1.13, 1.15, 1.16

MODULE-2	**BIO MATERIALS AND BIO HEALTHCARE DESIGN**	**25ECE365.2**	**3 Hours**

Biomaterials, Design of Forms- (Hexagonal unit cells, Intrinsic disorder, anisotropy), Bio- Mechanics, Applications of Biomaterials and Bio systems in Health care design (Human Prosthetics, Parasitic, Wasp Inspired Needle)

Case Study	Investigate Bio-Compatible and health care applications.
Text Book	Text Book 1: 2.2, 2.3, 2.4 to 2.15

MODULE-3	**BIO SUSTAINABLE DEVELOPMENT**	**25ECE365.3**	**3Hours**

Innovations in Energy (Termite mound inspired shopping malls), Innovations in Resource-Air purification, filtration), Dew water collection systems, water purification, desalination.

Case Study	Explore the Bio inspired environmental constructions and development.
Text Book	Text Book 2: 3.1, 3.3, 3.5, 3.7, 3.10

MODULE-4	**BIO-OPTIMISATION TECHNIQUES**	**25ECE365.3**	**3 Hours**

No Free Lunch Theorem, Bat Algorithm, Flower Pollination Algorithm, Genetic Algorithm, Ant Colony Optimisation (ACO), Swam Intelligence- Particle Swam Optimisation (PSO).

Self-study	Scrutinize the Different types of Optimization techniques, genetic research.
Text Book	Text Book 1: 6.1, 6.3, 6.5, 6.7, Text Book 2: 10.1, 10.3, 10.5, 10.7

MODULE-5	**Applications of Bio-Inspired AI Innovations**	**25ECE365.4**	**3 Hours**

Bio-inspired innovations in AI Integrated automotive systems, automation and robotics, AI-driven Bio materials discovery and manufacturing, AI Driven predictive modeling, digital twins, and sustainable product design for addressing environmental and industrial challenges.

Case Study	Survey on Bio inspired Innovations, design, applications and case studies of the same.
Text Book	Text Book 2: 12.1 to 12.10

CIE Assessment Pattern (50 Marks – Theory) –

RBT Levels		Marks Distribution		
		Test (s)	AAT1	AAT2
		25	15	10
L1	Remember	5	-	-
L2	Understand	5	5	-
L3	Apply	10	5	5
L4	Analyze	5	5	5
L5	Evaluate	-	-	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	10
L2	Understand	10
L3	Apply	20
L4	Analyze	10
L5	Evaluate	-
L6	Create	-

Suggested Learning Resources:

Text Books:

1) Helena Hashemi Farzaneh, Udo Lindemann, "A Practical Guide to Bio-inspired Design", Springer Vieweg, 1st edition 2019, ISBN-10: 366257683X, ISBN-13: 978-3662576830.
2) Torben A. Lenau, Akhlesh Lakhtakia," Biologically Inspired Design: A Primer (Synthesis Lectures on Engineering, Science, and Technology)", Publisher: Morgan & Claypool Publishers, 2021, ISBN-10:1636390471, ISBN-13: 978-1636390475

Reference Books:

1) French M, "Invention and evolution: Design in nature and engineering", Publisher: Cambridge University Press, 2020, ISBN-13: 978-1108492263.
2) Pan L., Pang S., Song T. and Gong F. eds, "Bio-Inspired Computing: Theories and Applications", 15th International Conference, BIC-TA 2020, Qingdao, China, October 23-25, 2021, Revised Selected Papers (Vol. 1363). Springer Nature, 2021, ISBN: 978-981-16-1820-1.

Web links and Video Lectures (e-Resources)

- https://onlinecourses.nptel.ac.in/noc22_ge24/preview
- https://biodesign.berkeley.edu/bioinspired-design-course/
- https://nsf-gov-resources.nsf.gov/2023-03/Bio-inspired%20Design 20Workshop%20Report_2232327_October%202022_Final.508.pdf

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Bio Materials printing using 3D Printing
- Flipped class room
- Organizing Group wise discussions on sub topics
- Student presentations

COMMUNITY PROJECT USING INNOVATION AND DESIGN THINKING

Course Code	**25CPD37**	**Credits**	**01**
L:T:P:S	**0:0:1:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**-**	**SEE Marks**	**50**
TW & SL / Sem	**30**	**Total Marks**	**100**
Total Hours /Sem	**30**	**Exam Hours**	**03**

Course outcomes: At the end of the course, the student will be able to:

25CPD37.1	Identify environmental issues and their impact on ecosystems, natural resources, and sustainable development.
25CPD37.2	Evaluate environmental conditions using data obtained through field surveys, case studies, environmental audits, and related investigations
25CPD37.3	Develop skills in project planning, field survey, data collection, implementation, documentation and reporting
25CPD37.4	Formulate feasible environmental problem statements and solutions considering practical constraints and sustainability aspects

Community Project using Innovation and Design Thinking helps students to understand community problems, develop innovative solutions, and create sustainable positive impact through a structured problem-solving approach. Rapid urbanisation, population growth, environmental concerns, energy demand, water scarcity, waste management, transportation issues and rural development challenges have created practical problems affecting communities and public welfare. This course aims to integrate technical knowledge, field exposure and societal engagement so that students identify real community issues, frame problem statements and attempt appropriate, feasible and sustainable engineering responses.

Methods for project identification: Students may identify the project topic using one or more of the following methods: interaction with local rural or urban stakeholders such as local leaders, corporation/municipality personnel, NGOs, panchayat representatives, etc.; review of issues highlighted in print and electronic media, and social networks; and, after selecting a broad topic, collect data, conduct a feasibility survey, estimate timelines and resources, approximate expenditure, and define the problem statement and objectives clearly.

Restrictions and professional conduct:
Community / Societal Projects shall remain academic, socially responsible, technically focused, and politically neutral. Students and faculty must maintain professionalism, ethical conduct, and respect while working with communities and stakeholders, and avoid any political, ideological, commercial, or disruptive activities. Projects should also consider practical constraints such as cost, resources, safety, environmental impact, and stakeholder cooperation.

CIE Assessment Pattern (50 Marks)

RBT Levels		**Periodical Reviews and Evaluation (50M)**
L1	**Remember**	**-**
L2	**Understand**	**05**
L3	**Apply**	**15**
L4	**Analyze**	**10**
L5	**Evaluate**	**10**
L6	**Create**	**10**

SEE Assessment Pattern (50 Marks)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	05
L3	Apply	15
L4	Analyze	10
L5	Evaluate	10
L6	Create	10

Suggested Learning Resources:

Textbooks:

1. Phadke, N. D. Community Engagement and Social Innovation. 1st ed., Oxford University Press, New Delhi.
2. Garg, N. R. Project-Based Learning in Engineering Education. 1st ed., Pearson India Education Services, Noida.
3. Gupta, A. and P. Singh. Service Learning and Community Projects. 1st ed., McGraw-Hill Education (India), New Delhi.
4. Wilson, G. Practical Guide to Community Development Projects. 2nd ed., Routledge, London.

Reference books:

1. NPTEL courses on Project-Based Learning and Social Innovation.
2. SWAYAM courses on community engagement and sustainability.
3. UN Sustainable Development Goals portal: https://sdgs.un.org
4. MyGov India and local civic body portals for community initiatives.
5. YouTube resources on design thinking, social innovation, and community service learning.
6. NGO and government field-action case studies related to sanitation, water, health, education, and environment.

Web links and Video Lectures (e-Resources):

1. NPTEL courses on Engineering Geology (IIT Roorkee, IIT Kharagpur).
2. NPTEL courses on Soil Mechanics and Foundation Engineering (IIT Delhi, IIT Bombay).
3. Virtual Labs – Geotechnical Engineering Virtual Lab (IIT Kanpur): https://vlab.co.in
4. Geological Survey of India (GSI) – Maps, reports, and publications: https://www.gsi.gov.in
5. YouTube channels: Civil Engineering Essentials, The Engineering Classroom (soil mechanics experiments).
6. American Society of Civil Engineers (ASCE) – Geotechnical resources and standards

NATIONAL SERVICE SCHEME

Course Code	**25NSS30, 24NSS40**	**Credits**	**00**
L:T:P:S	**0:0:0:0**	**CIE Marks (each semester)**	**50**
TLP Contact Hours / Sem	**15**	**SEE Marks**	**--**
TW & SL / Sem	**15**	**Total Marks**	**50 x 2= 100**
Total Hours /Sem	**30**	**Exam Hours**	**02**

Course outcomes: At the end of the course, the student will be able to:

25NSSX0.1	Understand the importance of his / her responsibilities towards society.
25NSSX0.2	Analyse the environmental and societal problems/issues and will be able to design solutions for the same.
25NSSX0.3	Evaluate the existing system and to propose practical solutions for the same for sustainable development. Implement government or self-driven projects effectively in the field.
25NSSX0.4	Develop capacity to meet emergencies and natural disasters & practice national integration and social harmony in general.

Semester/ Course Code	CONTENT	COs	HOURS
3RD 25NSS30	1. Organic farming, Indian Agriculture (Past, Present and Future) Connectivity for marketing 2. Waste management–Public, Private and Govt organization, 5R's. 3. Developing Sustainable Water management system for rural areas and implementationapproaches. 4. Setting of the information imparting club for women leading to contribution in social and economic issues. 5. Preparing an actionable business proposal for enhancing the village income and approach for implementation.	25NSS30.1, 25NSS30.2, 25NSS30.3, 25NSS30.4	30 HRS
4TH 25NSS40	1. Helping local schools to achieve good results and enhance their enrolment in Higher/ technical/ vocational education. 2. Contribution to any national level initiative of Government of India. Digital India, Skill India, Swachh Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme, Skill developmentprograms etc. 3. Spreading public awareness under rural outreach programs. (minimum 5 programs). 4. Organize National integration and social harmony events / workshops / seminars. (Minimum TWO programs). 5. Govt. school Rejuvenation and helping them to achieve good infrastructure.	25NSS40.1, 25NSS40.2, 25NSS40.3, 25NSS40.4	30 HRS

CIE Assessment Pattern (50 Marks – Activity based) –

CIE component for every semester	Marks
Presentation - 1 Selection of topic, PHASE - 1	10
Commencement of activity and its progress - PHASE - 2	10
Case study-based Assessment Individual performance	10
Sector wise study and its consolidation	10
Video based seminar for 10 minutes by each student at the end of semester with Report.	10
Total marks for the course in each semester	**50**

- Implementation strategies of the project (NSS work).
- The last report should be signed by NSS Officer, the HOD and Principal.
- At last report should be evaluated by the NSS officer of the Institute.
- Finally, the consolidated marks sheet should be sent to the university and also to be made available at LIC visit.

Suggested Learning Resources:

Reference Books:

1. NSS Course Manual, Published by NSS Cell, VTU Belagavi.
2. Government of Karnataka, NSS cell, activities reports and its manual.
3. Government of India, NSS cell, Activities reports and its manual.

Pre-requisites to take this Course:

1. Students should have a service-oriented mindset and social concern.
2. Students should have dedication to work at any remote place, anytime with available resources and proper time management for the other works.
3. Students should be ready to sacrifice some of the time and wishes to achieve service-oriented targets on time.

Pedagogy:

- In every semester from 3rd semester to 4th semester, each student should do activities according to the scheme and syllabus.
- At the end of every semester student performance has to be evaluated by the NSS officer for the assigned activity progress and its completion.
- State the need for NSS activities and its present relevance in the society and provide real-life examples.
- Support and guide the students for self-planned activities.
- NSS coordinator will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress in real activities in the field.
- Encourage the students for group work to improve their creative and analytical skills.

Plan of Action:

- Student/s in individual or in a group Should select any one activity in the beginning of each semester till end of that respective semester for successful completion as per the instructions of NSS officer with the consent of HOD of the department.
- At the end of every semester, activity report should be submitted for evaluation.
- Practice Session Description:
    - Lecture session by NSS Officer
    - Students Presentation on Topics
    - Presentation - 1, Selection of topic, PHASE – 1
    - Commencement of activity and its progress - PHASE – 2
    - Execution of Activity
    - Case study-based Assessment, Individual performance
    - Sector/ Team wise study and its consolidation
    - Video based seminar for 10 minutes by each student at the end of semester with Report.

Sl No	Topic	Groupsize	Location	Activity execution	Reporting	Evaluation of the Topic
1.	Organic farming, IndianAgriculture (Past, Present and Future) Connectivity for marketing.	May be individual or team	Farmers land/Villages/ roadside / Community area / College campus	Site selection /proper consultation/ Continuous monitoring/ Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer

2.	Waste management– Public, Private and Govtorganization, 5 R's.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemes officers/ campus	Site selection /proper consultation/Continuous monitoring/ Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
3.	Developing SustainableWater management system for rural areas and implementation approaches.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemes officers/ campus	site selection/properconsultation/ Continuous monitoring/ Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
4.	Setting of the information imparting club for women leading to contributionin social and economic issues.	May be individual or team	Women empowerment groups/ Consulting NGOs & Govt Teams / College campus	Group selection/proper consultation/ Continuous monitoring/ Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
5.	Preparing an actionable business proposal for enhancing the village income and approach for implementation.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemes officers/ campus	Group selection/proper consultation/ Continuous monitoring/ Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
6.	Helping local schools toachieve good results and enhance their enrolment in Higher/ technical/ vocational education.	May be individual or team	Local government / private/ aided schools/Government Schemes officers	School selection/proper consultation/ Continuous monitoring/ Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer

7.	Contribution to any national level initiative of Government of India.For eg. Digital India, Skill India, Swachh Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme,Skill development programs etc.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemes officers/ campus	Group selection/proper consultation/ Continuous monitoring / Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
8.	Spreading public awareness under ruraloutreach programs. (minimum5 programs)	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemes officers/ campus	Group selection/proper consultation/ Continuous monitoring / Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
9.	Organize National integration and socialharmony events / Workshops / Seminars. (Minimum 02 programs).	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemes officers/ campus	Place selection/proper consultation/ Continuous monitoring / Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
10.	Govt. school Rejuvenation and helping them to achieve good infrastructure.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemes officers/ campus	Place selection/proper consultation/ Continuous monitoring / Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer

PHYSICAL EDUCATION AND SPORTS

Course Code	**25PED30, 25PED40**	**Credits**	**00**
L:T:P:S	**0:0:0:0**	**CIE Marks (each semester)**	**50**
TLP Contact Hours / Sem	**15**	**SEE Marks**	**--**
TW & SL / Sem	**15**	**Total Marks**	**50 x 2= 100**
Total Hours /Sem	**30**	**Exam Hours**	**02**

Course outcomes:

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

25PEDX0.1	Understand the fundamental concepts and skills of Physical Education, Health, Nutrition and Fitness
25PEDX0.2	Create consciousness among the students on Health, Fitness and Wellness in developing and maintaining a healthy lifestyle
25PEDX0.3	Perform in the selected sports or athletics of student's choice and participate in the competition at regional/state / national / international levels.
25PEDX0.4	Understand the roles and responsibilities of organization and administration of sports and games

Semester	CONTENT	COs	HOURS
3RD 25PED30	**Module 1: Orientation** A. Lifestyle B. Food & Nutrition C. Health & Wellness D. Pre-Fitness test. **Module 2: General Fitness & Components of Fitness** A. Warming up (Free Hand exercises) B. Strength – Push-up / Pull-ups C. Speed – 30 Mtr Dash **Module 3:** **Specific games (Any one to be selected by the student)** 1. Kabaddi – Hand touch, Toe Touch, Thigh Hold, Ankle hold and Bonus. 2. Kho-Kho – Giving Kho, Single Chain, Pole dive, Pole turning, 3-6 Up.	25PED30.1, 25PED30.2, 25PED30.3, 25PED30.4	30 HRS
4TH 25PED40	**Module 1: Ethics and Moral Values** A. Ethics in Sports B. Moral Values in Sports and Games **Module 2: Specific Games (Anyone to be selected by the student)** A. Volleyball – Attack, Block, Service, Upper Hand Pass and Lower hand Pass. B. Athletics (Track Events) – Any event as per availability of Ground. **Module 3: Role of Organization and administration**	25PED40.1, 25PED40.2, 25PED40.3, 25PED40.4	30 HRS

CIE Assessment Pattern (50 Marks – Practical) –

CIE to be evaluated every semester end based on practical demonstration of Sports and Athletics activities learnt in the semester.

CIE	Marks
Participation of student in all the modules	10
Quizzes – 2, each of 7.5 marks	15
Final presentation / exhibition / Participation in competitions/ practical on specific tasks assigned to the students	25

Total	**50**

Suggested Learning Resources:

Reference Books:

1. Saha, A.K. Sarir Siksher Ritiniti, Rana Publishing House, Kalyani.
2. Bandopadhyay, K. Sarir Siksha Parichay, Classic Publishers, Kolkata.
3. Petipus, et.al., Athlete's Guide to Career Planning, Human Kinetics.
4. Dharma, P.N. Fundamentals of Track and Field, Khel Sahitya Kendra, New Delhi.
5. Jain, R. Play and Learn Cricket, Khel Sahitya Kendra, New Delhi.
6. Vivek Thani, Coaching Cricket, Khel Sahitya Kendra, New Delhi.
7. Saha, A.K. Sarir Siksher Ritiniti, Rana Publishing House, Kalyani.
8. Bandopadhyay, K. Sarir Siksha Parichay, Classic Publishers, Kolkata
9. Naveen Jain, Play and Learn Basketball, Khel Sahitya Kendra, New Delhi.
10. Dubey H.C., Basketball, Discovery Publishing House, New Delhi.
11. Rachana Jain, Teach Yourself Basketball, Sports Publication.
12. Jack Nagle, Power Pattern Offences for Winning basketball, Parker Publishing Co., New York.
13. Renu Jain, Play and Learn Basketball, Khel Sahitya Kendra, New Delhi.
14. SallyKus, Coaching Volleyball Successfully, Human Kinetics.

YOGA			
Course Code	**25YOG30, 25YOG40**	**Credits**	**00**
L:T:P:S	**0:0:0:0**	**CIE Marks (each semester)**	**50**
TLP Contact Hours / Sem	**15**	**SEE Marks**	**--**
TW & SL / Sem	**15**	**Total Marks**	**50 x 2= 100**
Total Hours /Sem	**30**	**Exam Hours**	**02**

Course outcomes:
At the end of the course, the student will be able to:

25YOGX0.1	Understanding the origin, history, aim and objectives of Yoga
25YOGX0.2	Become familiar with an authentic foundation of Yogic practices
25YOGX0.3	Practice different Yogic methods such as Suryanamaskara, Pranayama and some of the Shat
25YOGX0.4	Use the teachings of Patanjali in daily life.

Semester / Course Code	CONTENT	COs	HOURS
3rd 25YOG30	**Introduction of Yoga:** Aim and Objectives of yoga, Prayer: Yoga, its origin, history and development. Yoga, its meaning, definitions. Different schools of yoga, importance of prayer **Brief introduction of yogic practices for common man:** Yogic practices for common man to promote positive health **Rules and regulations:** Rules to be followed during yogic practices by practitioner **Misconceptions of yoga:** Yoga its misconceptions, Difference between yogic and non-yogic practices. **Suryanamaskara:** 1. Suryanamaskar prayer and its meaning, Need, importance and benefits of Suryanamaskar. 2. Suryanamaskar 12 count,2rounds **Kapalabhati:** Revision of Kapalabhati -40strokes/min 3rounds **Different types of Asanas with Brief introduction and importance:** 1. Sitting: Padmasana, Vajrasana, Sukhasana 2. Standing: Vrikshana, Trikonasana, Ardhakati Chakrasana 3. Prone line: Bhujangasana, Shalabhasana 4. Supineline: Utthitadvipadasana, Ardhahalasana, Halasana	25YOG30.1, 25YOG30.2, 25YOG30.3, 25YOG30.4	30 Hrs
4TH 25YOG40	**Suryanamaskara:** Suryanamaskar 12 count,4rounds **Kapalabhati:** Revision of Kapalabhati - 60strokes/min3rounds **Different types of Asanas with Brief introduction and importance:** 1. Sitting: Paschimottanasana, Ardha Ushtrasana, Vakrasana, Aakarna Dhanurasana 2. Standing: Parshva Chakrasana, Urdhva Hastothanasana, Hastapadasana 3. Prone line: Dhanurasana 4. Supine line: Karna Peedasana, Sarvangasana, Chakraasana 5. Balancing: Sheershasana **Patanjali's Ashtanga Yoga**: Asana, Pranayama **Pranayama:** Chandra Bhedana, Nadishodhana, Surya Bhedana **Shat Kriyas:** Jalaneti and sutraneti, Sheetkarma Kapalabhati	25YOG40.1, 25YOG40.2, 25YOG40.3, 25YOG40.4	30 Hrs

CIE Assessment Pattern (50 Marks – Practical)

CIE to be evaluated every semester based on practical demonstration of Yogasana learnt in the semester and internal tests (objective type)

CIE	Marks
Avg of Test 1 and Test 2	25
Demonstration of Yogasana	25
Total	**50**

Suggested Learning Resources:

Reference Books:

1. Swami Kuvulyananda: Asma (Kavalyadhama, Lonavala)
2. Tiwari, O P: Asana Why and How
3. Ajitkumar: Yoga Pravesha (Kannada)
4. Swami Satyananda Saraswati: Asana Pranayama, Mudra, Bandha (Bihar School of yoga, Munger)
5. Swami Satyananda Saraswati: Surya Namaskar (Bihar School of yoga, Munger)
6. Nagendra H R: The art and science of Pranayama
7. Tiruka: Shatkriyegalu (Kannada)
8. Iyengar B K S: Yoga Pradipika (Kannada)
9. Iyengar B K S: Light on Yoga (English)

Web links and Video Lectures (e-Resources):

- **https://youtu.be/KB-TYlgd1wE**
- **https://youtu.be/aa-TG0Wg1Ls**

MUSIC			
Course Code	**25MUS30, 25MUS40**	**Credits**	**00**
L:T:P:S	**0:0:0:0**	**CIE Marks (each semester)**	**50**
TLP Contact Hours / Sem	**15**	**SEE Marks**	**--**
TW & SL / Sem	**15**	**Total Marks**	**50 x 2= 100**
Total Hours /Sem	**30**	**Exam Hours**	**02**

Course outcomes:
At the end of the course, the student will be able to:

25MUSX0.1	Identify and understand the origins and evolution of the Indian music system and its fundamental concepts
25MUSX0.2	Analyse and practice various types of compositions in Carnatic music and relate to different musical traditions
25MUSX0.3	Demonstrate knowledge of major composers and their contributions to Indian classical music
25MUSX0.4	Classify and understand various musical instruments and their construction

Mapping of Course Outcomes to Program Outcomes:

Semester / Course Code	CONTENT	COs	HOURS
3rd 25MUS30	**Origin of Indian Music** - Evolution of the Indian music system, Understanding of Shruthi, Nada, Swara, Taya, Raga, Tala, and Mla. Study of the fundamental concepts that form the foundation of Carnatic music. **Compositions in Carnatic Music** - Introduction to types of compositions including Geethe, Jathi, Swara, Swarajathi, Varna, Krithi, and Thillana. Understanding of notation systems and their application in musical compositions. **Composers and Their Contributions** - Biography and musical contributions of Purandaradasa (founder of Carnatic music pedagogy), Thyagaraja (prolific composer and saint), and Mysoro Vasudevacharya. Study of their impact on Indian classical music traditions. **Abhyasa Gana - Practical Training**- Singing of Sarale Varase exercises and notation writing. Introduction to Suladi Sapthatala. Singing of 2 Geethe in Malahiri. Foundation for practical music experience.	25MUS30.1, 25MUS30.2, 25MUS30.3, 25MUS30.4	30 Hrs
4TH 25MUS40	**Classification of Musical Instruments** - Classification and construction of string instruments (Veena, Sitar), wind instruments (Flute, Shehnai), percussion instruments (Mridangam, Tabla), and Idiophones (Ghana Vaadya - Gongs, Cymbals). Examples and characteristics of each class of instruments. **Abhyasa Gana - Practical Training**- Continuation of singing exercises including Sarale Varase at varying speeds. Complete notation writing for Sarale Varase and Suladi Sapthatala in Mayamalavagowla Raga. Singing of 2 additional Geethe in Malahiri, one Jathi Swara, and one Krithi in a Mela raga. Advanced practical music training.	25MUS40.1, 25MUS40.2, 25MUS40.3, 25MUS40.4	30 Hrs

CIE Assessment Pattern (50 Marks – Practical)

CIE to be evaluated every semester based on practical demonstration of Singing/Playing learnt in the semester and internal tests (MCQ type)

CIE	Marks
Avg of Test 1 and Test 2	20
Practical test on: a. Recite one Sarale Varase mentioned by the examiner in three speeds. b. Sing/Play the Geethe in Malahari. c. Singing/Playing Jathi Swara/Krithi.	30
Total	**50**

Textbooks:

1. Vidushi Vasantha Madhavi, "Theory of Music", Prism Publication, 2007.
2. T Sachidevi and T Sharadha (Thirumalai Sisters), Karnataka Sangeetha Dharpana - Vol.1 (English), Shreenivaas Prakaashana, 2018.

References:

1. Lakshminarayana Subramiam, Viji Subramaniam, "Classical Music of India: A Practical Guide", Tranqueber 2018.

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=ihFDT8ZBPxE
- https://www.youtube.com/watch?v=4XXl5tTXa0I
- **https://www.youtube.com/watch?v=n-60gfzGa1E**
- **https://www.youtube.com/watch?v=Vv_K7J7gx6M**
- **https://www.youtube.com/watch?v=BovAAPumYUo**
- **https://www.youtube.com/watch?v=F_aWPATb8V4**
- **https://www.youtube.com/watch?v=DPPCRWA3hXo**
- **https://www.youtube.com/watch?v=TuP00NK9eTM**
- **https://www.youtube.com/watch?v=LlolyBzZtdg**

BASIC APPLIED MATHEMATICS - I
(Common for All Branches)

Course Code	**25DMAT31**	**Credits**	**0**
L:T:P:S	**0:0:0:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**15**	**SEE Marks**	**--**
TW & SL / Sem	**15**	**Total Marks**	**50**
Total Hours /Sem	**30**	**Exam Hours**	**--**

Course outcomes:
At the end of the course, the student will be able to:

25DMAT31.1	Understand the concepts of elementary transformations to the rank of a matrix, and apply the consistency and solutions of systems of linear equations
25DMAT31.2	Apply eigenvalues and eigenvectors of square matrices for matrix diagonalization, and compute the powers of matrices for engineering and computational applications
25DMAT31.3	Analyze curves represented in Cartesian, polar coordinate systems, determine tangents, angles between polar curves, and derive pedal equations for scientific modeling.
25DMAT31.4	Apply techniques of partial differentiation, chain rule, Euler's theorem for homogeneous functions, Jacobians of functions to solve multivariable engineering problems
25DMAT31.5	Analyze the motion of particles using velocity and acceleration vectors, and evaluate gradient and directional derivatives to interpret rates of change in scalar fields.
25DMAT31.6	Apply vector differential operators—gradient, divergence, and curl—to investigate scalar and vector fields

MODULE-1	**LINEAR ALGEBRA - 1**	**25DMAT31.1**	**3 Hours**
Elementary transformations, Reduction of the given matrix to echelon form, Rank of a Matrix, Consistency of a system of linear equations, Solution of a system of non-homogeneous linear equations.			
Self-study	Rank of a matrix by normal form, Solution of a system of homogeneous linear equations		
Text Book	Text Book 1: 2.7, 28.6, Text Book 2: 7.3, 7.4		
MODULE-2	**LINEAR ALGEBRA - 2**	**25DMAT31.2**	**3 Hours**
Linear transform, Eigen values and Eigen vectors of a square matrix, Diagonalization of a square matrix and Power of matrices using Diagonalization.			
Self-study	Reduction of quadratic expression to canonical form.		
Text Book	Text Book 1: 2.11, 2.13, Text Book 2: 7.9, 8.1.		
MODULE-3	**DIFFERENTIAL CALCULUS**	**25DMAT31.3**	**3 Hours**
Importance of cartesian and polar coordinate systems, Angle between the radius vector and tangent to a polar curve, angle between two polar curves, Pedal equation of a polar curve.			
Self-study	Radius of curvature in cartesian, parametric, polar forms		
Text Book	Text Book 1: 4.4, 4.7, 4.8		
MODULE-4	**MULTIVARIABLE CALCULUS**	**25DMAT31.4**	**3 Hours**
Introduction to partial differentiation, total differentiation, chain rule, Euler's theorem for Homogeneous functions, Jacobians, Extreme values of the functions with two variables.			
Self-study	Basic problems on partial differentiation		
Text Book	Text Book 1: 5.4, 5.7		
MODULE-5	**VECTOR CALCULUS**	**25DMAT31.5 25DMAT31.6**	**3 Hours**
Velocity and Acceleration of a particle, Gradient of scalar function, directional derivative, Divergence and Curl of vector functions, Solenoidal and Irrotational vector fields.			
Self-study	Vector identities		
Text Book	Text Book 1: 8.3, 8.5, 8.7, 8.18 Text Book 2: 9.7, 9.8, 9.9		

CIE Assessment Pattern (50 Marks – Theory) –

RBT Levels	**Marks Distribution**		
	Test (s)	**AAT1**	**AAT2**

		25	15	10
L1	**Remember**	-	**-**	**-**
L2	**Understand**	5	**-**	**-**
L3	**Apply**	10	**5**	5
L4	**Analyze**	10	5	5
L5	**Evaluate**	-	5	-
L6	**Create**			**-**

Suggested Learning Resources:

Text Books:

1) B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, Forty fourth Edition, 2022, 9788193328491.
2) Erwin Kreyszig, Advanced Engineering Mathematics, Wiley-India Publishers, Tenth Edition, Reprint ISBN: 9788126554232.

Reference Books:

1) Glyn James, Advanced Modern Engineering Mathematics, Pearson Education, Fourth Edition, 2015, 9780273719236
2) B. V. Ramana, Higher Engineering Mathematics, McGraw Hill Education (India) Private Limited, 4th Edition ISBN: 9780070634190
3) H. K. Dass, Advanced Engineering Mathematics, S. Chand & Company Ltd., Twenty Second Edition, 2018 9789352533831
4) N. P. Bali and Manish Goyal, A Text Book of Engineering Mathematics, Laxmi Publications (P) Ltd., 9th Ed 2014, ISBN: 9788131808320

Web links and Video Lectures (e-Resources):

- https://youtu.be/IUV0_Nj4d1s?si=eO3s7keCbCO1_jcz
- https://youtu.be/VzUcs7aiqgg?si=YLtTUGr4Xp88KGY3
- https://youtu.be/LDBnS4c7YbA?si=udUOdJ-u0ZxFmBAW
- https://youtu.be/palSdK9P-ns?si=7A8_VSxEI4lGvksB
- https://youtu.be/Bw5yEqwMjQU?si=jzbklZmVev1w8K2S
- https://youtu.be/LBqdGn1r_fQ?si=DWcAIiFnosT7zikY
- https://youtu.be/N5YCGOyTSuU?si=Wsf75V5fkUpfVVxr
- https://youtu.be/gd1FYn86P0c?si=7drzBEqVFSv6sQeZ
- https://youtu.be/cSj82GG6MX4?si=4QN1DFXEqaJoUBn7
- https://youtu.be/0c3yq9btr3A?si=jIoz8eu5TgV7mh8G
- https://youtu.be/PhfbEr2btGQ?si=HVK1uk65oHph0t8G

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Problem solving Approach
- Organizing Group wise discussions on related topics
- Seminars

Fourth Semester
(Syllabus)

COMPLEX ANALYSIS, OPTIMIZATION AND PROBABILITY DISTRIBUTIONS
(Common for ECE, EEE & ME)

Course Code	**25MAE41**	**Credits**	**03**
L:T:P:S	**3:0:0:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**45**	**SEE Marks**	**50**
TW & SL / Sem	**45**	**Total Marks**	**100**
Total Hours /Sem	**90**	**Exam Hours**	**03**

Course outcomes:
At the end of the course, the student will be able to:

25MAE41.1	Analyze two-dimensional potential flow problems using velocity potential, stream functions, and complex potential functions in engineering applications.
25MAE41.2	Apply Operations Research techniques to analyze and optimize engineering systems involving production planning, scheduling, logistics, network optimization, and resource management.
25MAE41.3	Analyze engineering problems involving uncertainty and random processes and select appropriate probability distributions.
25MAE41.4	Analyze sample data by selecting appropriate statistical tests, interpreting hypothesis test results, evaluating confidence limits, and applying the Central Limit Theorem for engineering applications.
25MAE41.5	Apply Markov chain models to solve engineering problems involving state transitions and compute higher transition probabilities using matrix methods
25MAE41.6	Apply the queueing models to determine key performance measures such as system utilization, average queue length, average waiting time, and probability of system states

MODULE-1	**COMPLEX ANALYSIS**	**25MAE41.1**	**9 Hours**

Functions of complex variables, Analytical functions, Cauchy-Riemann Equations in Cartesian and Polar forms, Harmonic functions and Construction of analytic functions using Milne-Thompson's method. Applications of Flow Problems-Velocity potential, Stream functions and complex potential functions. Conformal Transformations of $W = z^2$ and $W = e^z$. Cauchy's Theorem, Generalized Cauchy's integral formula

Self-study	Bilinear transformation, conformal transformation of $w = z + \frac{1}{z}$, complex line integration.
Text Book	Text Book 1: 20.3, 20.4, 20.5, 20.6, 20.9, 20.13, 20.14. Text Book 2: 13.3, 13.4, 14.2, 14.3

MODULE-2	**OPTIMIZATION TECHNIQUES**	**25MAE41.2**	**9 Hours**

Introduction to optimization techniques, Objectives and Characteristics of Operation Research. Introduction to Linear programming, solution by simplex and Big M methods. Formulation of transportation problem, Initial Basic feasible solution by North-West Corner method, least cost method, Vogel's approximation method. Optimal solutions-Problems. Formulation of assignment problems, Hungarian method.

Self-study	Linear programming, solution by graphical method, two phase simplex method
Text Book	Text Book 1: 34.1, 34.2, 34.7, 34.8, 34.9, 34.14, 34.15, 34.17, 34.18 Text Book 2: 22.3, 22.4

MODULE-3	**PROBABILITY DISTRIBUTIONS**	**25MAE41.3**	**9 Hours**

Random variables, discrete and continuous random variables, probability density functions, Expectation and Standard deviation. Discrete Probability distribution, Binomial and Poisson Distributions. Continuous Probability distribution, Normal distribution. Joint probability distribution - dependent and independent Random variables, Covariance, Correlation coefficient.

Self-study	Basic probability theory, Baye's theorem, Bernoulli distribution, uniform distribution, exponential distribution
Text Book	Text Book 1: 25.12, 25.13, 26.8, 26.9, 26.10, 26.11, 26.12, 26.14, 26.15, 26.16.

MODULE-4	**SAMPLING THEORY**	**25MAE41.4**	**9 Hours**

Sampling, Sampling distributions, Level of significance, Type-I & Type-II errors, one tail and two tail tests, test of hypothesis of large samples for means and proportions, Inferences for variance and proportion. Central

limit theorem, confidence limits for means, Student's t-distribution, F-distribution and Chi-square distribution for test of goodness of fit for small samples.

Self-study	Confidence limits problems.
Text Book	Text Book 1: 27.2, 27.4, 27.6, 27.8, 27.10, 27.12, 27.14, 27.16, 27.18, 27.20,

MODULE-5	**MARKOV CHAIN AND QUEUEING THEORY**	**25MAE41.5 25MAE41.6**	**9 Hours**

Stochastic Process: Stochastic processes, probability vector, stochastic matrices, fixed probability vector, regular stochastic matrices, Markov chains, higher transition probability problems.
Queueing Theory: Problems on Queueing model with M/M/1 and M/M/C

Self-study	Queueing model with M/G/1 and M/D/1
Text Book	Text Book 3: 9.1, 9.2, 9.3, 9.4, 9.5, 9.6, 11.1, 11.2, 11.3, 11.4, 11.5, 11.6, 11.7

CIE Assessment Pattern (50 Marks – Theory) –

RBT Levels		Marks Distribution		
		Test (s)	AAT1	AAT2
		25	15	10
L1	Remember	-	-	-
L2	Understand	5	-	-
L3	Apply	10	5	5
L4	Analyze	10	5	5
L5	Evaluate	-	5	-
L6	Create			-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	--
L2	Understand	10
L3	Apply	20
L4	Analyze	20
L5	Evaluate	--
L6	Create	--

Suggested Learning Resources:

Text Books:

1) B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, Forty fourth Edition, 2022, 9788193328491.
2) Erwin Kreyszig, Advanced Engineering Mathematics, Wiley-India Publishers, Tenth Edition, Reprint ISBN: 9788126554232.
3) William J. Stewart, Probability, Markov Chains, Queues, and Simulation: The Mathematical Basis of Performance Modeling, Princeton University Press, ISBN 9780691140629

Reference Books:

1) Glyn James, Advanced Modern Engineering Mathematics, Pearson Education, Fourth Edition, 2015, 9780273719236
2) B. V. Ramana, Higher Engineering Mathematics, McGraw Hill Education (India) Private Limited, 4th Edition ISBN: 9780070634190
3) H. K. Dass, Advanced Engineering Mathematics, S. Chand & Company Ltd., Twenty Second Edition, 2018 9789352533831
4) N. P. Bali and Manish Goyal, A Text Book of Engineering Mathematics, Laxmi Publications (P) Ltd., 9th Ed 2014, ISBN: 9788131808320

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=f_EqOpgRwRM&t=16s
- https://www.youtube.com/watch?v=Xb9Ypn77LBo&t=16s
- https://www.youtube.com/watch?v=csgvZol6Wfw
- https://www.youtube.com/watch?v=Atv3IsQsak8

- https://www.youtube.com/watch?v=aEF5PPbv8Oc
- https://www.youtube.com/watch?v=Pwk7p8WiCh0
- https://www.youtube.com/watch?v=LGxE_yZYigI
- https://www.youtube.com/watch?v=RFlAiEXRwoo
- https://www.youtube.com/watch?v=RFlAiEXRwoo&t=128s
- https://www.youtube.com/watch?v=sMYtHaSIXbU

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Problem solving Approach
- Organizing Group wise discussions on related topics
- Seminars

SYSTEM DESIGN USING HDL			
Course Code	**25ECE42**	**Credits**	**03**
L:T:P:S	**3:0:0:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**45**	**SEE Marks**	**50**
TW & SL / Sem	**45**	**Total Marks**	**100**
Total Hours /Sem	**90**	**Exam Hours**	**03**

Course outcomes:
At the end of the course, the student will be able to:

25ECE42.1	Understand the role of Hardware Description Languages (HDLs) in automating the VLSI design process
25ECE42.2	Apply Verilog HDL data types, operators, and constructs to model digital hardware systems
25ECE42.3	Design combinational and sequential digital circuits using Verilog HDL
25ECE42.4	Analyze simulation, verification, and synthesis processes involved in HDL-based digital design
25ECE42.5	Differentiate between various Programmable Logic Devices (PLDs) and their applications
25ECE42.6	Design and implement FPGA-based digital systems using Verilog HDL and synthesis tools

MODULE-1	**INTRODUCTION TO VHDL AND VERILOG**	**25ECE42.1, 25ECE42.2, 25ECE42.3**	**9 Hours**

A brief history of HDL, Computer-Aided Design, Hardware Description Languages, Structure of VHDL module and Verilog module, Types of Descriptions (Behavioral, structural, Data-flow), Verilog Data Types and Operators, Comparison of VHDL and Verilog, Verilog Description of Combinational Circuits, Verilog Modules

Case Study	Design of combinational circuits using VHDL and Verilog
Text Book	Text Book 1: 1.1,1.2,1.3(Pg. No:1-6,31-33), Text book 2:2.1,2.2,2.3,2.4,2.11(Pg No. 58-72,93-98)

MODULE-2	**ASSIGNMENTS IN VERILOG**	**25ECE42.1, 25ECE42.2, 25ECE42.3**	**9 Hours**

Verilog Assignments, Procedural Assignments, Modeling Flip-Flops Using Always Block, Always Blocks Using Event Control Statements, Verilog Models for Multiplexers, Modeling Registers and Counters Using Verilog Always Statements, Behavioral and Structural Verilog, SRAM model.

Case Study	Design of sequential circuits using Verilog
Text Book	Text book 2: 2.5,2.6,2.7,2.8,2.13,2.14,2.15,8.6(Pg No:73-83,102-124,445-446)

MODULE-3	**SIMULATION AND SYNTHESIS**	**25ECE42.3, 25ECE42.4**	**9 Hours**

Delays in Verilog, Compilation, Simulation and Synthesis of Verilog Code, Simple Synthesis Examples. Constants, Arrays, Loops in Verilog, Testing Verilog Model, Verilog functions, Verilog Tasks, System functions.
DESIGN EXAMPLES: BCD to 7-segment display, BCD Adder, Array Multiplier.

Applications	Perform Simulation and synthesis of digital circuits
Text Book	Text Book 2: 2.9,2.10,2.12,2.16,2.17,2.18,2.19, 8.1,8.2,8.11,4.1,4.2,4.3,4.9(Pg No: 84-93, 98-102,124-132,431-437,455-456,211-219,238-241)

MODULE-4	**INTRODUCTION TO PROGRAMMABLE LOGIC DEVICES**	**25ECE42.5, 25ECE42.6**	**9 Hours**

Brief Overview of Programmable Logic Devices. Simple Programmable Logic Devices (SPLDs)- Read Only Memories, Programmable Logic Arrays, Programmable array Logic. Complex Programmable Logic Devices (CPLDs). Field Programmable Gate Arrays (FPGAs) - Organization of FPGAs, FPGA Programming techniques

Case Study /	Design of digital circuits using Programmable devices

Text Book	Text Book 2: 3.1,3.2,3.3,3.4.1,3.4.2(Pg No: 158-189)		
MODULE-5	**Field Programmable Gate Arrays (FPGAs) and Emerging Applications in Artificial Intelligence**	**25ECE42.5, 25ECE42.6**	**9 Hours**
Fiel Field Programmable Gate Arrays (FPGAs) -, Programmable Logic block Architecture, Programmable interconnects, Programmable I/O blocks in FPGAs, Design flow of FPGAs, Implementing Functions in FPGAs, implementing functions using Shannon's decomposition, Design Translation (synthesis), Mapping, Placement and Routing FPGA applications in AI: hardware acceleration of neural-network inference (CNNs/edge AI) on FPGA fabric. AI-enabled design automation in VLSI systems			
Self-study	Interfacing with FPGA.		
Text Book	Text Book 2: 3.4.3,3.4.4,3.4.5,3.4.6,3.4.7,3.4.8, 6.1,6.2, 6.11,6.12(Pg No: 189-204, 341-352, 375-389		

CIE Assessment Pattern (50 Marks – Theory) –

RBT Levels		Marks Distribution		
		Test (s)	AAT1	AAT2
		25	15	10
L1	Remember	5	-	-
L2	Understand	5	-	-
L3	Apply	10	5	5
L4	Analyze	5	5	5
L5	Evaluate	-	5	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	10
L3	Apply	20
L4	Analyze	10
L5	Evaluate	10
L6	Create	--

Suggested Learning Resources:

Text Books:

1) HDL Programming (VHDL and Verilog), Nazeih M. Botros, 2015, John-Weily India Pvt. Ltd, ISBN13: 978-8126554782

2) Digital System design using Verilog, Charles H. Roth Jr., Lizy Kurian John, Byeong Kil Lee, 1st Edition, 2015, CL Engineering, ISBN-13: 978-1305635157

Reference Books:

1) Digital Systems Design using VHDL, Charles H Roth, Jr., 2007, Thomson, ISBN-13: 978- 0495244700.

2) Digital Design: An Embedded Systems Approach Using VERILOG, Peter J. Ashenden, 2014, Elesvier, ISBN-13: 978-0123852221

3) J Bhaskar, "A Verilog HDL Primer (3/e)", Kluwer, 2005, ISBN-13: 978-0790613271.

4) https://www.intel.com/content/www/us/en/learn/fpga-for-ai.html

Web links and Video Lectures (e-Resources):

- https://onlinecourses.nptel.ac.in/noc20_cs63/preview
- https://onlinecourses.nptel.ac.in/noc21_ee97/preview
- https://www.youtube.com/watch?v=PJGvZSlsLK
- https://www.youtube.com/watch?v=bwoyQ_RnaiA

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Video demonstration on FPGA architectures and applications
- Student presentations on HDL concepts and real-time design challenges

- Interactive discussions on circuit modeling techniques and HDL coding styles
- Hands-on Verilog programming sessions (e.g., counters, FSMs, ALU)
- Design thinking activity to solve real-world problems using HDL (e.g., traffic controller)
- Seminars on emerging topics like FPGA in AI, HDL in ASIC/IoT
- Mini-projects or case studies using simulation tools (Vivado/ModelSim)

SYSTEM DESIGN USING HDL LAB			
Course Code	**25ECL42**	**Credits**	**01**
L:T:P:S	**0:0:1:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**30**	**SEE Marks**	**50**
TW & SL / Sem	**-**	**Total Marks**	**100**
Total Hours /Sem	**30**	**Exam Hours**	**03**

Course outcomes:
At the end of the course, the student will be able to:

25ECL42.1	Design Combinational digital circuits using HDL in different levels of Abstractions
25ECL42.2	Design sequential circuits like flip flops and counters using HDL in Behavioral description
25ECL42.3	Develop Verilog/VHDL testbenches for functional verification and simulation of digital designs
25ECL42.4	Perform logic synthesis and implement synthesized designs on hardware platforms

Exp. No. / Pgm. No.	List of Programs	Hours	Cos
	Prerequisite Experiments / Programs / Demo		
	Digital electronics circuits, combinational and sequential circuits, state diagrams	2	NA
	PART-A		
1	Software tool flow and write an HDL code for logic gates.	2	25ECL42.1 25ECL42.3 25ECL42.4
2	Write an HDL code to describe the functions of a Full Adder using three modeling styles.	2	25ECL42.1 25ECL42.3 25ECL42.4
3	Write an HDL code for 16bit ALU using the 4bit opcodes; the requisite functions can be defined for the chosen opcodes	2	25ECL42.1 25ECL42.3 25ECL42.4
4	Write an HDL program for the following designs: a) 4-bit Binary to Gray converter b) 4-bit Binary Comparator	2	25ECL42.1 25ECL42.3 25ECL42.4
5	Write an HDL code for the following designs: a) Decoder b) Encoder	2	25ECL42.1 25ECL42.3 25ECL42.4
6	Write an HDL code for the following designs: a) Multiplexer b) Demultiplexer	2	25ECL42.1 25ECL42.3 25ECL42.4
	PART-B		
7	Write an HDL code for the following designs: a) SR and JK flipflops b) T and D flipflops	2	25ECL42.2 25ECL42.3 25ECL42.4
8	Design 4-bit Binary and BCD counters (Synchronous reset and Asynchronous reset and “any sequence” counters).	2	25ECL42.2 25ECL42.3 25ECL42.4
9	Implement a finite state machine (FSM) that recognizes two specific sequences of applied input symbols, namely four consecutive 1s or four consecutive 0s.	2	25ECL42.2 25ECL42.3 25ECL42.4
10	Write an HDL code to display messages on the given seven segment display	2	25ECL42.2 25ECL42.3 25ECL42.4

11	Write the HDL code to control speed, direction of stepper motor	2	25ECL42.2 25ECL42.3 25ECL42.4
12	Write the HDL code to generate different waveforms (sawtooth, sine wave, square, triangle, ramp etc) using DAC and FPGA kit.	2	25ECL42.2 25ECL42.3 25ECL42.4

PART-C
Beyond Syllabus Virtual Lab Content (4 Hours)
(To be done during Lab but not to be included for CIE or SEE)

1. **Synthesis of Boolean relations using Digital Comparator of two binary numbers**
   https://dec-iitkgp.vlabs.ac.in/exp/digital-comparators/
2. **To design multiplexers etc. using vhdl coding**
   https://vlab.amrita.edu/?sub=3Sbrch=66Ssim=531Scnt=862
3. **To build an FSM that would detect the pattern 101**
   https://mddliitb.vlabs.ac.in/sequence_detector/index.htm
4. **Simple Processor**
   https://www.intel.com/content/www/us/en/developer/topictechnology/fpgaacademic/materials-digital-logic.html

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		30	20
L1	Remember	-	-
L2	Understand	05	05
L3	Apply	10	10
L4	Analyze	10	05
L5	Evaluate	05	-
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	05
L3	Apply	20
L4	Analyze	15
L5	Evaluate	10
L6	Create	-

Suggested Learning Resources:
Reference Books:

1) Shirshendu Roy, *Advanced Digital System Design: A Practical Guide to Verilog Based FPGA and ASIC Implementation*, Ane Books, 2021, ISBN: 978-81-948918-8-8.
2) Nazeih M. Botros, *HDL Programming: VHDL and Verilog*, Dreamtech Press, 2009, ISBN: 978-81-7722-697-3.
3) Charles H. Roth Jr., Lizy Kurian John and Byeong Kil Lee, *Digital Systems Design Using Verilog*, 1st Edition, Cengage Learning, 2016, ISBN: 978-93-86650-37-5.
4) Charles H. Roth Jr. and Lizy Kurian John, *Digital Systems Design Using VHDL*, 2nd Edition, Cengage Learning, 2007, ISBN: 978-0-534-38462-3.
5) Peter J. Ashenden, *Digital Design: An Embedded Systems Approach Using Verilog*, Morgan Kaufmann/Elsevier, 2014, ISBN: 978-0-12-369527-7.
6) Samir Palnitkar, *Verilog HDL: A Guide to Digital Design and Synthesis*, 2nd Edition, Prentice Hall/Pearson Education, 2003, ISBN: 978-0-13-044911-5

DIGITAL SIGNAL PROCESSING

Course Code	**25ECE43**	**Credits**	**03**
L:T:P:S	**3:0:0:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**45**	**SEE Marks**	**50**
TW & SL / Sem	**45**	**Total Marks**	**100**
Total Hours /Sem	**90**	**Exam Hours**	**03**

Course outcomes:
At the end of the course, the student will be able to:

25ECE43.1	Apply Fourier analysis techniques to compute and analyze the Discrete Fourier Transform (DFT) of discrete-time signals
25ECE43.2	Utilize convolution principles to perform linear filtering of discrete-time signals
25ECE43.3	Compute DFT and inverse DFT using decimation in time (DIT) and decimation in frequency (DIF) FFT algorithms
25ECE43.4	Design the digital filters to obtain the desired magnitude-frequency response
25ECE43.5	Examine the key architectural features and functional capabilities of programmable Digital Signal Processors
25ECE43.6	Analyze multirate DSP techniques and their applications in communication, audio, speech, and image processing

MODULE-1	**INTRODUCTION TO SIGNAL PROCESSING AND DISCRETE FOURIER TRANSFORMS**	**25ECE43.1**	**9 Hours**

Frequency domain sampling and reconstruction of discrete time signals, DFT as a linear transformation, its relationship with other transforms, Computation of N - point DFT and IDFT, Properties of DFT.

Self-study	Investigate the various characteristics of LTI System
Text Book	Text Book 1: 7.1, 7.2

MODULE-2	**DSP ALGORITHMS**	**25ECE43.2, 25ECE43.3**	**9 Hours**

Convolution: Linear Convolution, Circular convolution, Stockham Method.
Fast Convolution: overlap-save and overlap-add method.
FFT algorithm: Need for efficient computation of the DFT, Radix-2 FFT algorithm for the computation of DFT and IDFT, decimation-in time and decimation-in-frequency algorithms.

Case Study	Case study on Designing wind speeds using fast Fourier transform
Text Book	Text Book 1: 8.1,8.2, 8.3

MODULE-3	**FIR AND IIR FILTERS**	**25ECE43.4**	**9 Hours**

Design of FIR filter: Need, types and characteristics of window, design of FIR filters using Rectangular and Hamming window, Structures of FIR Filter: Direct form I & II, Cascade form.
Design of IIR Filter: Analog to analog frequency transformations, Impulse Invariance method, Bilinear Transformation, Digital Butterworth filter design, Structures of IIR Filter: Direct form I & II, Cascade form.

Self-study	Realization of Parallel ,Lattice and Polyphase structures.
Text Book	TextBook1:9.2.1, 10.2.1, 10.2.2 Text Book1: 9.3.1, 9.3.3, 9.3.4, 10.3.2, 10.3.3, 10.3.4, 10.4.1

MODULE-4	**PROGRAMMABLE DIGITAL SIGNAL PROCESSOR**	**25ECE43.5**	**9 Hours**

Number Formats: Features of fixed point and floating point processors.
TMS320C67x Processor: Introduction, Features, Internal architecture, CPU, General purpose Register files, Functional units and operations, Data paths, control Register file.

Applications	Interfacing FIR LPF of order 5 and cut off frequency of 1000 HZ. Audio application using C/C++
Text Book	Text Book 2: 6.1, 6.2, 6.3, Text Book 3: 2.1,2.2,2.3,2.4,2.5,2.6

MODULE-5	**MULTI-RATE DIGITAL SIGNAL PROCESSING AND ITS APPLICATIONS**	**25ECE43.6**	**9 Hours**

Multi rate Digital Signal Processing: Decimation by a factor D, Interpolation by a factor I, Sampling conversion by a Rational factor I/D.

Applications: FIR Wiener filter, linear prediction-forward and backward predictions, Adaptive filters, LMS Algorithm.

Application	Radar signal Processing, DSP based measurement system.
Text Book	Text Book 1: 11.1 , 11.2, 11.3, 11.4, Text Book 4: 2.10.3, 3.1, 3.2, 3.3,3.4,3.5

CIE Assessment Pattern (50 Marks – Theory) –

RBT Levels		Marks Distribution		
		Test (s)	AAT1	AAT2
		25	15	10
L1	Remember	5	-	-
L2	Understand	5	-	-
L3	Apply	10	10	5
L4	Analyze	5	5	5
L5	Evaluate	-	-	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	10
L3	Apply	10
L4	Analyze	20
L5	Evaluate	10
L6	Create	--

Suggested Learning Resources:

Text Books:

1) Digital signal processing: Principles, Algorithms & Applications, Proakis & Monalakis, 5th Edition, 2021, Pearson education, ISBN-13: 978-0137348657.

2) Real-Time Digital Signal Processing: Fundamentals, Implementations and Applications, Sen M. Kuo, Bob H. Lee, Wenshun Tian, 4th Edition, Wiley, 2023, ISBN-13: 978-1119806097

3) TMS320C67x/C67x+ DSP CPU and Instruction Set Reference Guide (Rev. A)

4) Adaptive Filtering: Algorithms and Practical Implementation, Paulo S. R. Diniz, 5th Edition, Springer, ISBN-13: 978-3-030-29059-7 (Softcover, 2021)

Reference Books:

1) Discrete Time Signal Processing, Alan V. Oppenheim & Ronald W. Schafer, 3rd Edition, Pearson 2021, ISBN-13: 9780137549771

2) Principles of Digital Signal Processing, S Palani, 2nd Edition, Springer 2022, 978-3030963217 (Print), 978-3030963224 (eBook)

3) Digital Signal Processing, S. K. Mitra, 4thEdition, 2014, Tata Mc-GrawHill, ISBN-13: 978-0073380490.

4) Digital Signal Processing, Avtar Singh S S. Srinivasan, Thomson Brooks /Cole, 2004, ISBN-13: 978-0534401042.

5) Digital Signal Processing, P. Ramesh Babu, 6th Edition, 2014, Scitech Publications, ISBN-13: 978-8183714630

Web links and Video Lectures (e-Resources)

- https://youtu.be/QcuIYJZ4RRE
- https://www.youtube.com/watch?v=rwENxNH0zdA
- https://www.youtube.com/watch?v=Bdw3XcXgHa8
- https://www.youtube.com/watch?v=HVGW85eGPQQSlist=PLyqSpQzTE6M_h5UgZWpybzBVDGmHGhQQb
- https://www.youtube.com/watch?v=MQzY8cIBiFsSlist=PLgMDNELGJ1CYvviJ_ZHrHy5TKLbVn7-r
- https://www.youtube.com/watch?v=Iw77CYUT74cSt=17s
- https://www.youtube.com/watch?v=ADnSkJnprBY
- https://www.ti.com/lit/ug/spru733a/spru733a.pdf

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Video demonstration of latest trends in Digital Signal Processing
- Contents related activities (Activity-based discussions)
- For active participation of students, conduct problem solving sessions
- Organizing Group wise discussions on applications of different types of filters
- Class presentations
- Practical orientation on Design Thinking, Creativity Innovation

DIGITAL SIGNAL PROCESSING LAB

Course Code	**25ECL43**	**Credits**	**01**
L:T:P:S	**0:0:1:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**30**	**SEE Marks**	**50**
TW & SL / Sem	**-**	**Total Marks**	**100**
Total Hours /Sem	**30**	**Exam Hours**	**03**

Course outcomes:
At the end of the course, the student will be able to:

25ECL43.1	Conduct time and frequency domain analyses of signals processed by different DSP techniques
25ECL43.2	Design FIR and IIR filters for the desired frequency response
25ECL43.3	Execute discrete computations with a DSP processor
25ECL43.4	Analyze the behavior of digital filters with a simulation tool

Exp. No. / Pgm. No.	List of Programs	Hours	Cos
	Prerequisite Experiments / Programs / Demo		
	• **LTI System and its properties, Signals and Systems** • **Basic Programming (MATLAB/C)** • **Fourier and Z-Transforms** • **Fundamentals of Digital Communication**	2	NA
	PART-A		
1	Computation of N-point DFT of a given sequence and plotting of Magnitude and phase spectrum.	2	25ECL43.1
2	Linear convolution and Circular convolution of two sequences using both time and frequency domain	2	25ECL43.1
3	Auto correlation and cross correlation of given signals in time domain and frequency domain.	2	25ECL43.1
4	Design and implementation of FIR filters of different types using windowing techniques to meet given specifications.	2	25ECL43.2
5	Design and implementation of IIR filters of different types (Butter worth: low pass, high pass, band pass and band reject) to meet given specifications	2	25ECL43.2
6	Perform decimation and interpolation of signals using MATLAB	2	25ECL43.1
	PART-B		
7	Computation of N-Point DFT of a given sequence using DSP Processor	2	25ECL43.3
8	Impulse response of first order and second order system using DSP Processor.	2	25ECL43.3
9	Linear convolution and circular convolution of two given sequences using DSP Processor.	2	25ECL43.3
10	Sampling of a signal using MATLAB Simulink	2	25ECL43.4
11	Design of FIR filter of different types (Butter worth): low pass, high pass, band pass and band reject) and IIR filters to meet given specifications using MATLAB Simulink.	2	25ECL43.4
12	Implement LMS Adaptive Filter for noise cancellation using DSP toolbox	2	25ECL43.4

PART-C
Beyond Syllabus Virtual Lab Content (4 Hours)
(To be done during Lab but not to be included for CIE or SEE)

1. Study of sampling theorem, effect of undersampling.
   http://vlabs.iitkgp.ernet.in/dsp/exp1/index.html

2. Study of properties of Linear time-invariant system.
   http://vlabs.iitkgp.ernet.in/dsp/exp4/index.html
3. Study of convolution: series and parallel system.
   http://vlabs.iitkgp.ernet.in/dsp/exp5/index.html
4. Study of Transform domain properties and its use.
   http://vlabs.iitkgp.ernet.in/dsp/exp7/index.html

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		30	**20**
L1	**Remember**	**-**	**-**
L2	**Understand**	05	05
L3	**Apply**	10	10
L4	**Analyze**	10	05
L5	**Evaluate**	05	-
L6	**Create**	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	**Remember**	-
L2	**Understand**	05
L3	**Apply**	20
L4	**Analyze**	15
L5	**Evaluate**	10
L6	**Create**	**-**

Suggested Learning Resources:

Reference Books:

1). Digital signal processing: Principles, Algorithms & Applications, Proakis & Monalakis, 4th Edition, 2014, Pearson education, ISBN-13: 978-0131873742.
2) Digital Signal Processing. Ramesh Babu, 6thEdition, 2014, Scitech Publications, ISBN-13: 978- 8183713425.
3) Discrete Time Signal Processing, Oppenheim & Schaffer, 7thEdition, 2010, TMH, ISBN-13: 978- 0131988422.
4) Digital Signal Processing, S. K. Mitra, 4thEdition, 2014, Tata Mc-Graw Hill, ISBN-13: 978-0077366766.

MICROPROCESSORS AND MICROCONTROLLERS			
Course Code	**25ECE44**	**Credits**	**03**
L:T:P:S	**3:0:0:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**45**	**SEE Marks**	**50**
TW & SL / Sem	**45**	**Total Marks**	**100**
Total Hours /Sem	**90**	**Exam Hours**	**03**

Course outcomes:
At the end of the course, the student will be able to:

25ECE44.1	Understand the functional features of 8086 Microprocessor
25ECE44.2	Apply the knowledge of addressing modes to write assembly language program in 8086
25ECE44.3	Analyze different assembler directives and interrupt methods in 8086 programming
25ECE44.4	Understand MSP430 architecture and write embedded C code
25ECE44.5	Implement timers, interrupts, and communication interfaces in MSP430
25ECE44.6	Design and interface MSP430 with peripherals and sensors for embedded applications

MODULE-1	**ARCHITECTURE OF 8086**	**25ECE44.1**	**9 Hours**

Introduction: Basic Microprocessor architecture, Harvard and Von Neumann architectures with examples 8086 Architecture: Main features, pin diagram/description, 8086 microprocessor family, internal architecture, bus interfacing unit, execution unit, 8086 system timing, minimum mode and maximum mode configuration.

Self-Study	Investigate the pipeline architecture of the 8086 microprocessor, focusing on how instructions are fetched, decoded, and executed in assembly language
Text Book	Text Book 1: 2.11, 2.12,2.13,2.14,2.15, 2.16 Text Book-2: 1.3, 2.1, 2.2, 2.3

MODULE-2	**ASSEMBLY LANGUAGE PROGRAMMING**	**25ECE44.2, 25ECE44.3**	**9 Hours**

Program development steps, instructions, addressing modes, assembler directives, writing simple programs with an assembler, assembly language program development tools. Procedures , interrupts and interrupt response and Macros.

Case Study	Explore the use of 8086 assembly language instructions for string manipulation, including operations like string copying, reversing, and comparing, leveraging the processor's instruction set and data registers.
Text Book	Text Book 1: 6.30-6.36 Text Book-2: 2.4, 3.4, 4.3, 4.4, 4.5, 4.6, 4.7

MODULE-3	**MSP430 ARCHITECTURE AND PROGRAMMING BASICS**	**25ECE44.4**	**9 Hours**

Micro Controllers introduction, Differences between Microcontrollers and MicroprocessorsMSP430 Overview: Block diagram, CPU, memory organization, low power modes, Addressing Modes, Constant Generator and Emulated Instructions, Instruction Set.Simple Programs.Reflections on the CPU and instruction set,Low power Modes of operation

Text Book	Text Book 3: 1.3,1.4,2.1,2.2,2.3,2.45.1,5.2,5.3,5.4, 5.5,6.10

MODULE-4	MSP430 PERIPHERALS-1	25ECE44.5	9 Hours
Clocks in MSP 430,Timers-Watchdog Timer,Timer_A, Timer_B modes, Timer-based delay and PWM generation, External interrupts and ISR configuration			
Case Study	Automatic Street Light Controller with PWM		
Text Book	Text Book 3:8.1,8.2,8.3,8.4,8.5,8.6,8,7,8.8,8.9,8.10,6.6,6.7,6.8,10.1,10.2,		
MODULE-5	MSP430 PERIPHERALS -2 AND INTERFACING WITH SENSORS	25ECE44.6	9 Hours
Communication peripherals in MSP430- Serial peripheral interfacing, UART. ADC10/ADC12 overview and channel selection, Reading analog sensors -LCD interfacing in 4-bit mode, Real-world applications: temperature sensor,weighing machine Processors for AI(GPU,NPU,QPU concepts only)			
Applications	Battery-operated thermometer with MSP430, LCD, and sleep mode after inactivity		
Text Book	Text Book 3: 9.2,9.3,9.4,9.5,9.7,7.7.7.8,7.9,9.5,9.11		

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	AAT1	AAT2
		25	15	10
L1	Remember	5	-	5
L2	Understand	5	5	5
L3	Apply	10	5	-
L4	Analyze	5	5	-
L5	Evaluate	-	-	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	10
L2	Understand	10
L3	Apply	20
L4	Analyze	10
L5	Evaluate	-
L6	Create	--

Suggested Learning Resources:

Text Books:

1) Microprocessor and Interfacing- Douglas V Hall, SSSP Rao, 3rd edition, TMH, 2012, ISBN-13: 978-1259006150.
2) Advanced Microprocessors and Peripherals- A.K. Ray and K.M. Bhurchandi, TMH, 3rd Edition,2015, ISBN-13: 978-1259006136.
3) MSP430 Microcontroller Basics-John H. Davies

Reference Books:

1) Microcomputer systems-The 8086 / 8088 Family – Y.C. Liu and A. Gibson, 2nd edition, PHI -2003, ISBN-13: 978-0130930811.
2) The 8086 Microprocessor: Programming & Interfacing the PC – Kenneth J Ayala, ENGAGE Learning, 2011, ISBN-13: 978-1401861582.
3) T I Documentation – MSP430 Family User Guide
4) The Intel Microprocessor, Architecture, Programming and Interfacing - Barry B. Brey, 6e,

Pearson Education / PHI, 2003, ISBN-13: 978-0130607140.
Web links and Video Lectures (e-Resources): • **https://onlinecourses.nptel.ac.in/noc22_ee09/preview** • **https://www.tutorialspoint.com/microprocessor/microprocessor_io_interfacing_overview.htm** • **https://onlinecourses.nptel.ac.in/noc20_ee98/preview**
Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning • Industrial Visit to Electronics Based Companies • Demonstration of Manufacturing/Fabrication of ICs • Video demonstration of latest trends in Processors

MICROPROCESSORS AND MICROCONTROLLERS LAB			
Course Code	**25ECL44**	**Credits**	**01**
L:T:P:S	**0:0:1:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**30**	**SEE Marks**	**50**
TW & SL / Sem	**-**	**Total Marks**	**100**
Total Hours /Sem	**30**	**Exam Hours**	**03**

Course outcomes:
At the end of the course, the student will be able to:

25ECL44.1	Develop assembly level programs using 8086 to perform arithmetic and logical operations
25ECL44.2	Build assembly code for string operations, sorting of numbers and branch instructions of 8086
25ECL44.3	Understand Programming of MSP430 using Embedded C
25ECL44.4	Demonstrate the performance of the various interfacing devices using MSP430

Exp. No. / Pgm. No.	List of Experiments / Programs	Hours	COs
	Prerequisite Experiments / Programs / Demo		
	• Basic knowledge of Digital System • Design Basic structure of a processor- instructions, registers and memory Introduction to microcontroller MSP430 • Embedded system applications. • Digital Electronics Fundamentals	2	NA
	PART-A		
1	Write an assembly level programs for basic arithmetic operations using 8086 a. To perform 16-bit addition b. To perform 16-bit Subtraction	2	25ECL44.1
2	Write an assembly level programs for basic arithmetic and Logical operations using 8086 a. To perform 16-bit multiplication b. To perform 16-bit division c. To perform logical operations	2	25ECL44.1
3	Write an assembly level programs for String operations using 8086 a. To move a block of data from source to destination b. To reverse a given string using c. To compare two strings using d. To check whether the string is palindrome or not	2	25ECL44.2
4	Write an assembly level program using 8086 for sorting operations like, smallest, largest, ascending and descending.	2	25ECL44.2
5	Write an assembly level program using procedures and Macros a. To find factorial of a number using procedure and macro b. To find whether the given number is prime or not using procedure / macro.	2	25ECL44.2
6	Interfacing and programming of ports of MSP430 To blink the RED LED using C language.		25ECL44.3, 25ECL44.4
	PART-B		
7	Interfacing and programming of ports of MSP430 To control the on-board LED by taking the input from switch	2	25ECL44.3, 25ECL44.4

8	a) Interrupt programming through GPIOs OF MSP430 b) PWM generation using Timer on MSP430 GPIO	2	25ECL44.3, 25ECL44.4
9	Program for Counters using timers a) Up counting b) Down counting	2	25ECL44.3, 25ECL44.4
10	Interfacing Potentiometer with MSP430.	2	25ECL44.3, 25ECL44.4
11	PWM based Speed Control of Motor by Potentiometer	2	25ECL44.3, 25ECL44.4
12	Serial Communication using MSP430.	2	25ECL44.3, 25ECL44.4

PART-C

Beyond Syllabus Virtual Lab Content (4 Hours)

(To be done during Lab but not to be included for CIE or SEE)

1) **Design of Arithmetic Logic Unit**
   http://vlabs.iitkgp.ac.in/coa/exp8/index.html
2) **CPU Design http://vlabs.iitkgp.ac.in/coa/exp12/index.html#**
3) **Traffic light Controller using 8086 https://www.youtube.com/watch?v=t3thKRqMK2M**
4) **Optimized MSP Programming Across Active and Low Power Modes**
   https://www.youtube.com/watch?v=CsV2LrdAyaw
5) **Energy Trace: MSP430™ Real-time Monitoring of Power Consume.**
   https://www.youtube.com/watch?v=oo3NnQ7cyg
6) **QCockpit warning light control using basic logic gates**
   https://da-iitb.vlabs.ac.in/exp/cockpit-warning-light-control/

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		30	20
L1	Remember	-	-
L2	Understand	05	05
L3	Apply	10	10
L4	Analyze	10	05
L5	Evaluate	05	-
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	05
L3	Apply	20
L4	Analyze	15
L5	Evaluate	10
L6	Create	-

Suggested Learning Resources:

Reference Books:

1) Microprocessor and Interfacing- Douglas V Hall, SSSP Rao, 3rd edition, TMH, 2012, ISBN-13: 978-1259006150.

2) Advanced Microprocessors and Peripherals- A.K. Ray and K.M. Bhurchandi, TMH, 3rd Edition,2015, ISBN-13: 978-1259006136.

3) The Intel Microprocessor, Architecture, Programming and Interfacing - Barry B.Brey, 6e, Pearson Education PHI, 2003, ISBN-13: 978-0130607140.

CONTROL SYSTEMS			
Course Code	**25ECE451**	**Credits**	**03**
L:T:P:S	**3:0:0:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**45**	**SEE Marks**	**50**
TW & SL / Sem	**45**	**Total Marks**	**100**
Total Hours /Sem	**90**	**Exam Hours**	**03**

Course outcomes:
At the end of the course, the student will be able to:

25ECE451.1	Apply the fundamentals of control systems and develop mathematical models of physical systems using transfer functions and block diagram reduction techniques
25ECE451.2	Analyze the time response characteristics and steady-state performance of first- and second-order control systems
25ECE451.3	Examine the stability of control systems using algebraic techniques such as Hurwitz and Routh stability criteria
25ECE451.4	Evaluate the stability and dynamic behavior of control systems using the Root Locus technique
25ECE451.5	Analyze the frequency response and state variable representation of control systems for performance assessment
25ECE451.6	Apply state variable analysis techniques to represent and solve linear continuous-time control systems

MODULE-1	**INTRODUCTION TO CONTROL SYSTEMS**	**25ECE451.1**	**9 Hours**

The control system, Concept of Open loop and Closed loop systems, Feedback Characteristics: Feedback and non-Feedback System, Mathematical modeling of Physical systems: Transfer function, Representation of physical systems by differential equations, Modeling of Electric systems, Translational and rotational mechanical systems, Analogous systems, Determination of transfer function by block diagram reduction techniques.

Self-study	Investigate real-world applications of open-loop and closed-loop control systems and compare their performance.
Text Book	Textbook 1: 1.1, 2.2,2.4,2.5, 2.6, 3.1 Text book 2: 2.5, 2.6

MODULE-2	**TIME RESPONSE ANALYSIS**	**25ECE451.2**	**9 Hours**

Standard test signals, Time response of first order system, Time response of second order system, Steady state analysis: steady state error and error constants, design specification of second order systems, Design consideration for higher order system, signal flow method using Mason's gain formula

Case study	Analyze the time response characteristics of a DC motor speed control system and evaluate the effect of system parameters on transient and steady-state performance
Text Book	Textbook1: 5.2-5.5, 5.7, 5.8 Textbook 2: 5.4- 5.6

MODULE-3	**STABILITY ANALYSIS**	**25ECE451.3, 25ECE451.4**	**9 Hours**

Stability Analysis in S-Domain: The concept of stability, Necessary conditions for stability, Hurwitz stability criterion, Routh stability criterion and its applications, Relative stability analysis.
The Root Locus Technique: Introduction to Root-Locus Techniques, The root locus concepts - construction of root loci.

Self-study	Study the influence of pole movement on system response using Root Locus.
Text Book	Textbook 1: 6.1, 6.2,6.3, 6.4, 6.5, 7.1, 7.2, 7.3

MODULE-4	**FREQUENCY RESPONSE ANALYSIS**	**25ECE451.5**	**9 Hours**

Introduction, Correlation between time and frequency domain, Bode plots, Polar plots, Stability analysis using Nyquist plots, Gain margin phase margin, Compensation techniques – Lag, Lead, LeadLag Controllers in frequency domain.

Self-study	Study frequency response characteristics and analyze stability using Bode and Nyquist plots.

Text Book	Textbook 1: 8.1, 8.2, 8.3, 8.4, 9.2, 9.3, 9.4 Textbook 2: 11.3-11.5		
MODULE-5	**STATE SPACE ANALYSIS AND ADVANCED CONTROL TECHNIQUES**	**25ECE451.6**	**9 Hours**
Concept of state, state variables and state model, State models for Linear continuous time systems, Derivation of transfer function from state models, Diagonalization, Solution of state equations – state transition matrix and its properties, Controllability and Observability, Introduction to Optimal Control, Evolution of control systems with artificial intelligence.			
Case Study	Analyze the role of controllability and observability in designing stable control systems		
Text Book	Textbook 1: 12.2, 12.3, 12.4, 12.5, 12.6, 12.7, 14.1		

CIE Assessment Pattern (50 Marks – Theory) –

RBT Levels		Marks Distribution		
		Test (s)	AAT1	AAT2
		25	15	10
L1	Remember	-	-	-
L2	Understand	5	-	-
L3	Apply	10	5	5
L4	Analyze	5	5	5
L5	Evaluate	5	5	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	10
L3	Apply	20
L4	Analyze	10
L5	Evaluate	10
L6	Create	-

Suggested Learning Resources:

Text Books:

1) J Nagrath, M. Gopal, "Control Systems Engineering, 7th Edition, New Age International Private Limited, 2021, ISBN: 978-8195175581.

2) Norman S. Nise, "Control Systems Engineering", 8th Edition (Indian Adaptation), Wiley, Ltd., 2024, ISBN 978-9357463980.

Reference Books:

1) Katsuhiko Ogata, "Modern Control Engineering", 5th Edition, Pearson Education, Published: 2015, ISBN: 978-9332550162
2) Richard C. Dorf and Robert H. Bishop, Modern Control Systems, 14th Edition, Pearson Education Limited, 2021. ISBN : 978-1292422374.
3) J. David Powell, Abbas F. Emami-Naeini and Christina M. Ivler, "Feedback Control of Dynamic Systems", 9th Edition, Pearson Education, Published on March 18, 2025, ISBN: 978-0138095000.
4) https://www.controleng.com/evolution-of-control-systems-with-artificial-intelligence/?_cf_chl_tk=PCFyaOrfZoulBuLB.Up7rWMxLcbDAFIA2bs8a_n1F2M-1782068413-1.0.1.1-3Vku_y.7.H4Xlq2B69C3iP13FaHN5lPsMdQI1QubQn0

Web links and Video Lectures (e-Resources):

- **https://onlinecourses.nptel.ac.in/e-learning/preview/noc20_ee90**
- **https://www.classcentral.com/course/udemy-control-systems-made-simple-modeling-**

simulation-control-87590 • https://www.elevify.com/en-in/courses/engineering-construction-and-technology/engineering/control-systems-course-17e1c • https://in.mathworks.com/solutions/control-systems/teaching-control-systems.html
Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning • Conduct group discussions on fundamental concepts of control systems and their real-world applications. • Implement flipped classroom activities where students explain concepts such as feedback, transfer function and stability analysis. • Assign students to simulate P, PI and PID controllers using MATLAB/Simulink and compare system responses. • Conduct simulation activities to study Root Locus, Bode and Nyquist plots using MATLAB/Simulink.

LINEAR INTEGRATED CIRCUITS			
Course Code	**25ECE452**	**Credits**	**03**
L:T:P:S	**3:0:0:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**45**	**SEE Marks**	**50**
TW & SL / Sem	**45**	**Total Marks**	**100**
Total Hours /Sem	**90**	**Exam Hours**	**03**

Course outcomes:
At the end of the course, the student will be able to:

25ECE452.1	Analyze the characteristics, configurations, and frequency response of operational amplifier circuits
25ECE452.2	Design non-linear signal processing circuits including rectifiers, clippers, clampers, sample-and-hold circuits, and waveform generators using operational amplifiers
25ECE452.3	Analyze stability, compensation techniques, noise effects, and active filter responses in Op-Amp-based systems
25ECE452.4	Design timer-based circuits, oscillators, voltage-controlled oscillators, and phase-locked loop circuits for electronic applications
25ECE452.5	Analyze the performance of voltage regulators, data converters, and their applications in analog and mixed-signal systems
25ECE452.6	Apply the concepts of linear integrated circuits to solve engineering problems through circuit design, simulation, case studies, and technical presentations

MODULE-1	**OP-AMP AS AC AMPLIFIERS**	**25ECE452.1, 25ECE452.6**	**9 Hours**

IC Operational Amplifier- Review of Op-Amp circuit, configuration, parameters. Capacitor-Coupled Voltage Follower, High Z_{in} Capacitor-Coupled Voltage Follower, Capacitor-Coupled Noninverting Amplifier, High Z_{in} Capacitor-Coupled Noninverting Amplifier, Capacitor-Coupled Inverting Amplifier, Setting the Upper Cutoff Frequency, Capacitor-Coupled Difference Amplifier.

Case Study	Usage of Single polarity supply for Op-Amp.
Text Book	Text Book 1: 2.1to 2.15; 4.1 to 4.7

MODULE-2	**SIGNAL PROCESSING CIRCUITS AND SIGNAL GENERATORS**	**25ECE452.2, 25ECE452.6**	**9 Hours**

Precision Half-Wave Rectifiers, Precision Full-Wave Rectifiers, Limiting Circuits, Clamping Circuits- Precision Clamping Circuit, Peak Detectors, Sample-and-Hold Circuits, Square wave Generator-Non inverting Schmitt Trigger, Triangular wave generator using Op-Amp, Function Generator using Op-Amp.

Self-study	Square wave Generators using astable multivibrator and Pulse wave Generations using Monostable multivibrators using Op-Amp.
Text Book	Text Book 1: 9.1 to 9.6, 8.4, 10.3

MODULE-3	**FREQUENCY RESPONSE, STABILITY AND ACTIVE FILTERS**	**25ECE452.3, 25ECE452.6**	**9 Hours**

Op-Amp Circuit Stability, Frequency compensation Techniques, Circuit Bandwidth and Slew rate, Noise in Op-Amp- Thermal Noise, Shot Noise. Active Filters – 2^{nd} Order Low Pass Filters, 2^{nd} order High Pass Filters, Band Pass filters, Notch filters, All Pass filters.

Case Study	Simulation of higher order filters (HPF & LPF)
Text Book	Text Book 1: 5.1, 5.2,6.1,6.2, 6.3, 12.3, 12.5,12.6,12.7

MODULE-4	**TIMERS, OSCILLATORS & PLL**	**25ECE452.4, 25ECE452.6**	**9 Hours**

555 timer configurations – One shot/ Monostable Multivibrator, Astable multivibrator. Voltage-Controlled Oscillator. Phase Shift Oscillators Circuit and Design, Colpitts and Hartley Oscillators. Phase-Locked Loop- Basic PLL System, PLL Components, PLL Performance Factors.

Applications	Design of Function generator using 555 timer.		
Text Book	Text Book 2:8.1 to 8.3; 9.1 – 9.5		
MODULE-5	**VOLTAGE REGULATORS AND DATA CONVERTERS**	**25ECE452.5, 25ECE452.6**	**9 Hours**
Voltage Regulator Basics, Op-Amp Series Voltage Regulator, IC Linear Voltage Regulators- 723 IC Regulator, Switching regulators. Analog/Digital Conversion Basics, Analog-to-Digital Conversion, Digital-to-Analog Conversion, Weighted Resistor DAC, R-2R DAC, ADC Counting Methods-Linear Ramp ADC and SAR ADC. Role of ADCs in AI-Based Embedded Systems.			
Self-study	High Speed signal converters – ADCs and DACs		
Text Book	Text Book 1: 13.1, 13.2, 13.5, 13.6, 15.1, 15.2,15.4 Ref. Book 3 : Ch. 14		

CIE Assessment Pattern (50 Marks – Theory) –

RBT Levels		Marks Distribution		
		Test (s)	AAT1	AAT2
		25	15	10
L1	Remember	-	-	-
L2	Understand	5	-	-
L3	Apply	10	5	5
L4	Analyze	5	5	5
L5	Evaluate	5	5	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	10
L3	Apply	20
L4	Analyze	10
L5	Evaluate	10
L6	Create	--

Suggested Learning Resources: Text Books:

1. Operational Amplifiers and Linear ICs, David A. Bell, 3rd edition, Oxford University Press, 2011. ISBN-13: 978-0-19-569613-4.

2. Linear Integrated Circuits, D Roy Choudhury, Shail Bala Jain, New Age International (P) Ltd., 7th edition, 2025. ISBN13: 9789360746063

Reference Books:

1. Op-amps & linear ICs- Ramakanth A.Gayakwad, PHI. 2015. ISBN-13: 978-9332549913

2. Op Amps & Linear Integrated Circuits-Theory and Applications James M. Fiore, Cengage Learning/ Jaico, 2019. ISBN13: 978-1796856897

3. TinyML: Machine Learning with TensorFlow Lite on Arduino and Ultra-Low-Power Microcontrollers, Pete Warden and Daniel Situnayake, 1st Edition, O'Reilly Media, 2019. ISBN: 978-1492052043.

Web links and Video Lectures (e-Resources):

- https://onlinecourses.nptel.ac.in/noc25_ee143/preview?utm_source=chatgpt.com
- https://nptel.ac.in/courses/108108111
- https://onlinecourses.nptel.ac.in/e-learning/preview/noc24_ee73
- https://ocw.mit.edu/courses/6-002-circuits-and-electronics-spring-2007/resources/lecture-19/?
- https://www.ti.com/video/series/precision-labs/ti-precision-labs-op-amps.html

• **https://www.youtube.com/watch?v=pEWUL6WhnEc**
Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning • Practical Activities - Problem Solving Exercises • Case Studies / Case Lets on Op-Amp, PLL, Data Converter, and Analog Circuit Applications. • Participatory & Industry-Integrated Learning Class Presentations • Mini Project Problem-Based Study

ELECTROMAGNETIC FIELD THEORY			
Course Code	**25ECE453**	**Credits**	**03**
L:T:P:S	**3:0:0:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**45**	**SEE Marks**	**50**
TW & SL / Sem	**45**	**Total Marks**	**100**
Total Hours /Sem	**90**	**Exam Hours**	**03**

Course outcomes:
At the end of the course, the student will be able to:

25ECE453.1	Apply vector algebra and vector calculus concepts to electromagnetic field problems
25ECE453.2	Analyze electrostatic fields, electric potential, and electric field distributions
25ECE453.3	Evaluate electric fields in material media and solve boundary value problems
25ECE453.4	Analyze magnetostatic fields and magnetic materials using Maxwell's equations
25ECE453.5	Analyze electromagnetic wave propagation and transmission line characteristics
25ECE453.6	Apply electromagnetic wave propagation, transmission line, and waveguide concepts to analyze and design microwave and wireless communication systems

MODULE-1	**VECTOR ANALYSIS AND COORDINATE SYSTEMS**	**25ECE453.1**	**9 Hours**

Vector Algebra: Scalars and vectors, vector addition and subtraction, position and distance vectors, dot and cross products, vector components.
Coordinate Systems and Transformations: Cartesian, cylindrical and spherical coordinate systems.
Vector Calculus: Differential length, area and volume, line, surface and volume integrals, gradient, divergence, curl, divergence theorem, Stokes' theorem and Laplacian.

Applications	Application of vector calculus in electromagnetic field computations and engineering problems.
Text Book	Text Book 1: 1.3,1.5,1.6,1.7,1.8, 2.2, 2.3, 2.4, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8

MODULE-2	**ELECTROSTATIC FIELDS**	**25ECE453.2**	**9 Hours**

Coulomb's Law, Electric Field Intensity, Electric Flux Density, Gauss's Law and its applications, Electric Potential, Electric Dipole, Energy Density in Electrostatic Fields.

Applications	Electrostatic discharge protection and high-voltage insulation systems.
Text Book	Text Book 1: 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.9, 4.10

MODULE-3	**ELECTRIC FIELDS IN MATERIAL SPACE AND BOUNDARY VALUE PROBLEMS**	**25ECE453.3 25ECE453.4**	**9 Hours**

Properties of Materials, Conductors, Dielectrics, Polarization, Dielectric Constant, Boundary Conditions.
Poisson's Equation, Laplace's Equation, Resistance and Capacitance, Method of Images.

Applications	Capacitance of microstrip lines and dielectric materials used in RF systems.
Text Book	Text Book 1: 5.2, 5.4, 5.5, 5.6, 5.9, 6.2, 6.5, 6.6

MODULE-4	**MAGNETOSTATIC FIELDS AND MAXWELL'S EQUATIONS**	**25ECE453.5**	**9 Hours**

Biot-Savart Law, Ampere's Circuital Law, Magnetic Flux Density, Magnetic Scalar and Vector Potentials.
Magnetic Forces, Torque, Magnetic Materials, Inductance and Magnetic Energy.
Faraday's Law, Displacement Current and Maxwell's Equations.

Applications	Wireless power transfer and electromagnetic compatibility.
Text Book	Text Book 1: 7.2, 7.3, 7.5, 7.7, 8.2, 8.3, 8.5, 8.8, 8.9, 9.2, 9.4, 9.5

MODULE-5	**ELECTROMAGNETIC WAVES, TRANSMISSION LINES AND WAVEGUIDES**	**25ECE453.6**	**9 Hours**

Electromagnetic Wave Propagation: Wave Propagation in Lossless and Lossy Media, Plane Waves, Poynting Vector, Reflection and Transmission.
Transmission Lines: Transmission Line Parameters, Transmission Line Equations, Standing Wave Ratio,

Input Impedance and Smith Chart, AI-assisted impedance matching using optimization algorithms. Waveguides: Rectangular Waveguides, TE and TM Modes, Wave Propagation in Waveguides, Cut-off Frequency, Phase and Group Velocity, Waveguide Applications.	
Applications	Applications of transmission lines and waveguides in microwave communication, radar -AI-based target detection and object classification systems, satellite communication and RF systems.
Text Book	Text Book 1: 10.2, 10.3, 10.4, 10.5, 10.8, 10.9, 10.10, 11.2, 11.3, 11.4, 11.5, 12.2, 12.3, 12.4, 12.5, 12.6

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	AAT1	AAT2
		25	15	10
L1	Remember	5	-	-
L2	Understand	5	-	-
L3	Apply	10	5	5
L4	Analyze	10	5	5
L5	Evaluate	-	5	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	10
L3	Apply	20
L4	Analyze	10
L5	Evaluate	10
L6	Create	--

Suggested Learning Resources:

Text Books:

1. Matthew N. O. Sadiku and S. V. Kulkarni, **Elements of Electromagnetics**, 8th Edition, Oxford University Press, 2022, ISBN: 9780197614020.

Reference Books:

2. Nathan Ida, **Engineering Electromagnetics**, 4th Edition, Springer, 2021, ISBN: 9783030671471.
3. Joseph A. Edminister and Mahmood Nahvi, Schaum's **Outline of Electromagnetics**, 7th Edition, McGraw-Hill Education, 2023, ISBN: 9781264267712.
4. Karl E. Lonngren and Sava V. Savov, **Fundamentals of Electromagnetics with MATLAB**, 3rd Edition, SciTech Publishing, 2021, ISBN: 9781839531446.
5. Fawwaz T. Ulaby and Umberto Ravaioli, **Fundamentals of Applied Electromagnetics**, 8th Edition, Pearson Education, 2023, ISBN: 9780137562666.

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/108104087
- https://nptel.ac.in/courses/108102119
- https://www.allaboutcircuits.com/textbook/alternating-current/
- https://www.youtube.com/channel/UCPC6uCfBVSK71MnPPcp8AGA
- https://ocw.mit.edu/courses/6-013-electromagnetics-and-applications-spring-2009/
- https://ocw.mit.edu/courses/8-07-electromagnetism-ii-fall-2012/

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- **Practical Orientation on Electromagnetic Simulation Tools** (MATLAB, HFSS) for visualization of electric and magnetic fields.
- **Problem-Solving Exercises** involving vector calculus.

- **Group Discussions** on applications of electromagnetic fields in wireless communication, radar, and satellite systems.
- **Case Studies** on electromagnetic interference (EMI), electromagnetic compatibility (EMC), wireless power transfer, and high-voltage insulation systems.
- **Participation in External Seminars / Workshops** on Electromagnetic Field Theory, RF Engineering, Microwave Engineering, and Wireless Communication

BIOMEDICAL SIGNAL PROCESSING			
Course Code	**25ECE454**	**Credits**	**03**
L:T:P:S	**3:0:0:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**45**	**SEE Marks**	**50**
TW & SL / Sem	**45**	**Total Marks**	**100**
Total Hours /Sem	**90**	**Exam Hours**	**03**

Course outcomes:
At the end of the course, the student will be able to:

25ECE454.1	Understand the origin, characteristics, and clinical relevance of major biomedical signals and their role in computer-aided diagnosis.
25ECE454.2	Apply time-, frequency-, and adaptive-filtering techniques to suppress noise and extract relevant information from biomedical signals.
25ECE454.3	Develop mathematical and computational skills to detect and analyze biomedical events, rhythms, and waveforms in ECG, EEG, and heart-sound signals.
25ECE454.4	Analyze non-stationary ECG, EEG, and HRV signals using time-frequency analysis, adaptive segmentation, and component-separation techniques.
25ECE454.5	Model and classify biomedical signals using point-process, autoregressive, spectral, and machine-learning techniques.
25ECE454.6	Classify biomedical signals using supervised, unsupervised, logistic regression, and neural network techniques.

MODULE-1	**INTRODUCTION TO BIOMEDICAL SIGNALS**	**25ECE454.1**	**9 Hours**
The nature of Biomedical Signals, Examples of biomedical signals: The action potential of a cardiac myocyte, The action potential of a neuron, The electroneurogram, The electromyogram, The electrocardiogram, The electroencephalogram, The electrogastrogram, Objectives of Biomedical Signal Analysis, Difficulties in Biomedical Signal Analysis, Computer-Aided Diagnosis.			
Self-study	Filtering and Frequency Analysis of 2D Images		
Text Book	Text Book 1: 1.1, 1.2, 1.2.1, 1.2.2, 1.2.3, 1.2.4, 1.2.5, 1.2.6, 1.2.8, 1.3, 1.4, 1.5.		
MODULE-2	**FILTERING FOR REMOVAL OF ARTIFACTS FROM BIOMEDICAL SIGNAL**	**25ECE454.2**	**9 Hours**
Random, Structured and Physiological Noise: Random Noise, Structured Noise, Physiological Interference, Stationary, non-stationary and cyclo-stationary processes, Fundamental Concepts of Filtering: Linear Shift Invariant Filters, Time-domain filters: Synchronized Averaging, Frequency domain filters: Removal of high frequency noise: Butterworth Lowpass Filters.			
Self-study	Filtering and Frequency Analysis: ECG		
Text Book	Text Book 1: 3.2,3.2.1, 3.2.2, 3.2.3,3.2.4, 3.4.1,3.5, 3.5.1, 3.6.1.		
MODULE-3	**EVENT DETECTION IN BIOMEDICAL SIGNALS**	**25ECE454.3**	**9 Hours**
Detection of Events and Waves: Derivative-based methods for QRS detection, Correlation Analysis of EEG rhythms: Detection of EEG rhythms, Template matching, Cross-Spectral Techniques: Coherence Analysis of EEG channels, ECG Rhythm Analysis.			
Self-study	Medical Image Segmentation		
Text Book	Text Book 1: 4.3,4.3.1, 4.3.2, 4.3.3, 4.4,4.4.1,4.4.2, 4.5, 4.5.1,4.9.		
MODULE-4	**ANALYSIS OF NONSTATIONARY SIGNALS AND MULTICOMPONENT SIGNALS**	**25ECE454.4**	**9 Hours**
Time-variant Systems: Characterization of non-stationary signals and dynamic systems, Considerations in short-time analysis, Adaptive Segmentation: Spectral and Error Measure, ACF distance, Use of Adaptive Filters for Segmentation: Monitoring the RLS filter, The RLS lattice Filter.			
Self-study	Medical Image Analysis.		
Text Book	Text Book 1: 8.3, 8.3.1, 8.4.2, 8.5, 8.5.1, 8.5.2, 8.6,8.6.1,8.6.2.		
MODULE-5	**MODELLING BIOMEDICAL SYSTEMS, PATTERN CLASSIFICATION AND DIAGNOSTIC DECISION**	**25ECE454.5**	**9 Hours**

Point Processes, Parametric System Modeling, Autoregressive or All-pole Modeling, Spectral matching and parametrization, Optical Model order, Electromechanical Models of Signal Generation: Modeling of Respiratory Sounds, Heart Rate Variability, Pattern Classification, Supervised Pattern Classification.

Self-study	Mini-project on Bio-Medical Imaging Systems
Text Book	Text Book 1: 7.3, 7.4, 7.5.1, 7.5.2, 7.7, 7.7.1, 7.8, 9.3, 9.4.

CIE Assessment Pattern (50 Marks – Theory) –

RBT Levels		Marks Distribution		
		Test (s)	AAT1	AAT2
		25	15	10
L1	Remember	-	-	-
L2	Understand	5	-	-
L3	Apply	10	5	5
L4	Analyze	5	5	5
L5	Evaluate	5	5	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	10
L3	Apply	20
L4	Analyze	10
L5	Evaluate	10
L6	Create	--

Suggested Learning Resources:

Text Books:

1) Rangaraj M. Rangayyan Reprint: 2016, Biomedical Signal Analysis, Second Edition, Wiley, IEEE Press, ISBN: 978-81-265-6289-3.
2) Tompkins, W. J. (Ed.). (2000). Biomedical Digital Signal Processing: C-Language Examples and Laboratory Experiments for the IBM PC (reprint ed., 368 pp.). New Delhi: Prentice-Hall of India/PHI Learning. ISBN 978-81-203-1478-8.
3) Ahad, M. A. R., S Ahmed, M. U. (Eds.). (2021). Signal Processing Techniques for Computational Health Informatics (1st ed., 334 pp., Intelligent Systems Reference Library, Vol. 192). Springer Nature Switzerland AG. Softcover ISBN: 978-3-030-54934-3; eBook ISBN: 978-3-030-54932-9; DOI: 10.1007/978-3-030-54932-9.

Reference Books:

1) Ahirwal, M. K., Kumar, A., S Singh, G. K. (2021). Computational Intelligence and Biomedical Signal Processing: An Interdisciplinary, Easy and Practical Approach (1st ed., xxiv + 152 pp.). Springer Cham. ISBN 978-3-030-67097-9; eISBN 978-3-030-67098-6; doi:10.1007/978-3-030-67098-6.
2) Catrambone, V., S Valenza, G. (2021). Functional Brain-Heart Interplay: From Physiology to Advanced Methodology of Signal Processing and Modeling (1st ed., x + 236 pp.). Springer Cham. ISBN 978-3-030-79933-5; eISBN 978-3-030-79934-2; doi:10.1007/978-3-030-79934-2.
3) Rojas, I., Castillo-Secilla, D., Herrera, L. J., S Pomares, H. (Eds.). (2021). Bioengineering and Biomedical Signal and Image Processing: Proceedings of BIOMESIP 2021 (1st ed., Lecture Notes in Computer Science, Vol. 12940, xviii + 517 pp.). Springer Cham. ISBN 978-3-030-88162-7; eISBN 978-3-030-88163-4; doi:10.1007/978-3-030-88163-4.

Web links and Video Lectures (e-Resources):

- Biomedical signal processing NPTEL course.
- Biomedical signal processing NPTEL lecture videos
- https://www.youtube.com/watch?v=ezfPl8kUdbgSlist=PLVDPthxoc3lNzu07XCbQWPZNMboPXKtb
- Biomedical Signal processing lecture videos by Dr.Geetika Dua https://www.youtube.com/watch?v=R7WaykzESlgSlist=PLeefXVKiX48rcnK0TentV2rXrQ oIhuqpy

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Contents related activities (Activity-based discussions).
- For active participation of students, instruct the students to prepare Flowcharts and Handouts.
- Organizing group-wise discussions on issues.
- Seminars & Flip-classes.

COMPETITIVE CODING			
Course Code	**25ECE455**	**Credits**	**03**
L:T:P:S	**3:0:0:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**45**	**SEE Marks**	**50**
TW & SL / Sem	**45**	**Total Marks**	**100**
Total Hours /Sem	**90**	**Exam Hours**	**03**

Course outcomes:
At the end of the course, the student will be able to:

25ECE455.1	Analyze the efficiency of C programs using asymptotic notations and complexity measures
25ECE455.2	Implement stack and queue data structures using C programming techniques for problem solving
25ECE455.3	Implement linked list data structures and associated operations to solve computational problems
25ECE455.4	Apply tree data structures and graph traversal algorithms for searching and problem-solving applications
25ECE455.5	Evaluate greedy and dynamic programming approaches for solving optimization problems
25ECE455.6	Develop competitive programming solutions by selecting appropriate data structures and algorithms

MODULE-1	**INTRODUCTION TO DATA STRUCTURES AND PROBLEM SOLVING**	**25ECE455.1**	**9 Hours**

Arrays, Structures, Unions, Pointers, Dynamic Memory Allocation, Algorithm Specification, Abstract Data Type (ADT), ADT of Natural Numbers. Introduction to Data Structures: Primitive and Non-Primitive Data Types, Classification of Data Structures.

Self-study	Study the real-time usage of Arrays, Structures and Unions.
Text Book	Text Book 1: 8.1–8.4, 11.2–11.5, 12.2, 12.3, 17.1–17.4 Text Book 2: 1.1, 1.2, 1.3, 1.4, 1.5

MODULE-2	**STACKS AND QUEUES**	**25ECE455.2**	**9 Hours**

Stack ADT, Representation of Stacks, Operations on Stacks, Applications of Stacks: Infix to Postfix Conversion and Postfix Evaluation.
Queue ADT, Representation of Queues, Operations on Queues, Circular Queues, Applications of Queues: Job Scheduling.

Self -study	Exercises on Infix, Postfix and Prefix Conversions. Study the real-time use of Stacks and Queues.
Text Book	Text Book 2: 5.1, 5.2, 5.3, 5.4, 5.5, 6.1, 6.2, 6.3, 6.4, 6.5

MODULE-3	**LINKED LISTS AND DYNAMIC DATA STRUCTURES**	**25ECE455.3**	**9 Hours**

Linked Lists: Introduction, Singly Linked Lists, Doubly Linked Lists, Circular Linked Lists, Basic Operations (Insertion, Deletion, Traversal), Applications of Linked Lists.

Application	Develop efficient solutions for dynamic data storage, insertion, deletion, and traversal operations using linked list data structures.
Text Book	Text Book 2: 7.1 – 7.9

MODULE-4	**TREES AND GRAPH TRAVERSAL ALGORITHMS**	**25ECE455.4**	**9 Hours**

Trees: Terminology and Representation, Binary Trees, Binary Tree Traversals, Binary Search Trees (BST), Heaps and Priority Queues, Trie Data Structure and Applications.
Graphs: Graph Representation, Breadth First Search (BFS), Depth First Search (DFS).

Case Study	Investigate tree-based and graph traversal techniques for searching, indexing, and network exploration problems.

Text Book	Text Book 2 : 10.1–10.9, 11.1–11.6, 13.1–13.4, 14.1–14.4, 16.1–16.4		
MODULE-5	**ALGORITHMIC PARADIGMS FOR COMPETITIVE PROGRAMMING**	**25ECE455.5, 25ECE455.6**	**9 Hours**
Greedy Algorithms, Activity Selection Problem, Fractional Knapsack, Dynamic Programming Concepts, 0/1 Knapsack, Longest Common Subsequence, Longest Increasing Subsequence.			
Self-study	Evaluate alternative algorithmic solutions.		
Text Book	Text Book 2: 18.1 to 18.5		

CIE Assessment Pattern (50 Marks – Theory) –

RBT Levels		Marks Distribution		
		Test (s)	AAT1	AAT2
		25	15	10
L1	Remember	-	-	-
L2	Understand	10	-	-
L3	Apply	10	10	5
L4	Analyze	5	5	5
L5	Evaluate	-	-	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	10
L2	Understand	20
L3	Apply	10
L4	Analyze	10
L5	Evaluate	--
L6	Create	--

Suggested Learning Resources:

Text Books:

1. K. N. King, *C Programming: A Modern Approach*, 2nd Edition, W.W. Norton & Company, Reprint 2021. ISBN: 978-0393979503
2. Reema Thareja, *Data Structures Using C*, 3rd Edition, Oxford University Press, Reprint 2022. ISBN: 978-0199488056

Reference Books:

1. Steven Halim, Felix Halim and Suhendry Effendy, Competitive Programming 4, 2022.
2. Antti Laaksonen, Guide to Competitive Programming, Springer, 2021.
3. Thomas H. Cormen et al., Introduction to Algorithms, 4th Edition, MIT Press, 2022.

Web links and Video Lectures (e-Resources):

- https://www.geeksforgeeks.org/need-of-data-structures-and-algorithms-for-deep-learning-and-machine-learning/
- https://www.geeksforgeeks.org/analysis-algorithms-big-o-analysis/
- https://www.geeksforgeeks.org/dsa/greedy-algorithms/
- https://www.geeksforgeeks.org/comparison-among-greedy-divide-and-conquer-and-dynamic-programming-algorithm/
- https://www.programiz.com/dsa/divide-and-conquer

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Problem-Solving Challenges like Linked List Maze and Data Structure Race
- Assessment Activities on Trace and Predict

- Coding Contest using HackerRank/LeetCode
- Group-based Algorithm Design Challenge

ALP WITH MICROCONTROLLER			
Course Code	**25ECE461**	**Credits**	**01**
L:T:P:S	**0:0:1:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**30**	**SEE Marks**	**50**
TW & SL / Sem	**-**	**Total Marks**	**100**
Total Hours /Sem	**30**	**Exam Hours**	**03**

Course outcomes:
At the end of the course, the student will be able to:

25ECE461.1	Develop 8051 assembly level programs to perform arithmetic and logical operations, code conversion programs
25ECE461.2	Apply the basic knowledge of addressing modes and instructions to develop assembly language program in 8051 Microcontroller
25ECE461.3	Analyze 8051 assembly language programs for timer, interrupt, and serial communication applications.
25ECE461.4	Interface peripherals with the 8051 microcontroller for specified applications

Exp. No. / Pgm. No.	List of Experiments / Programs	Hours	Cos
	Prerequisite Experiments / Programs / Demo		
	To understand the architecture of 8051 Microcontroller and to aspire design aspects of I/O and Memory interfacing circuits. Knowledge in modern tools and engage in self-learning to carry out real-world project.	2	NA
	PART-A		
1	Data Transfer - Block move, Exchange	2	25ECE461.1
2	Arithmetic Instructions – Addition, subtraction, multiplication and division, square, Cube – (16 bits Arithmetic operations – bit addressable)	2	25ECE461.1
3	Boolean Logical Instructions (Bit manipulations).	2	25ECE461.1
4	Code conversion: BCD – ASCII; ASCII – Decimal; Decimal - ASCII; HEX - Decimal and Decimal – HEX.	2	25ECE461.1
5	Sorting and finding largest/smallest element in an array.	2	25ECE461.2
6	Counter Programming Using 8051 Assembly Language	2	25ECE461.2
	PART-B		
7	Programs to generate delay, Programs using serial port and on- Chip timer / counter.	2	25ECE461.2
8	Embedded C Programming to illustrate the interfacing of stepper motor in clockwise /anti –clockwise rotation with the microcontroller 8051.	2	25ECE461.2
9	Embedded C Programming to illustrate the interfacing of simple switches with the microcontroller 8051	2	25ECE461.3
10	Embedded C Programming to illustrate the interfacing of LCD modules with the microcontroller 8051	2	25ECE461.3
11	Embedded C Program to illustrate the interfacing of LED modules with the microcontroller 8051	2	25ECE461.4
12	Write an Embedded C Program to transfer letter "A" serially at 4800 baud, continuously	2	25ECE461.4

PART-C
Beyond Syllabus Virtual Lab Content (4 Hours)
(To be done during Lab but not to be included for CIE or SEE)

1. Representation of Integers and their Arithmetic
   https://cse11-iiith.vlabs.ac.in/exp/integers-arithmetic/

2. Floating PointNumbers Representation
https://cse11-iiith.vlabs.ac.in/exp/floating-point-numbers/
3. Interfacing of ADC and data transfer by software polling, study of aliasing
http://vlabs.iitkgp.ernet.in/rtes/exp4/index.html
4.MCU-DAC interfacing and generation of ramp wave
http://vlabs.iitkgp.ernet.in/rtes/exp3/index.html
5.Interfacing 4x4 switch matrix with the microcontroller
http://vlabs.iitkgp.ernet.in/rtes/exp12/index.html

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		30	20
L1	Remember	-	-
L2	Understand	05	05
L3	Apply	10	10
L4	Analyze	10	05
L5	Evaluate	05	-
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	05
L3	Apply	15
L4	Analyze	20
L5	Evaluate	10
L6	Create	-

Suggested Learning Resources:

1) Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D. McKinlay, "The 8051 Microcontroller and Embedded Systems – using assembly and C " PHI, 2006 / Pearson, 2006. ISBN: 9788131758991
2) Kenneth J. Ayala, "The 8051 Microcontroller Architecture, Programming & Applications", 3rd Edition, Cengage Learning India, 2007, ISBN: 9788131502006

Reference Books:

1). Dr. J.Augustin Jocob, "Microcontroller", Royal Technical Publication, 2024, ISBN:978-8197408236
2). Eldhose P Sim, "A Comprehensive Guide for Microprocessor and Microcontroller", Notion Press, 2024, ISBN: 979-8894158532

PCB DESIGN USING OrCAD

Course Code	**25ECE462**	**Credits**	**01**
L:T:P:S	**0:0:1:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**30**	**SEE Marks**	**50**
TW & SL / Sem	**-**	**Total Marks**	**100**
Total Hours /Sem	**30**	**Exam Hours**	**03**

Course outcomes:
At the end of the course, the student will be able to:

25ECE462.1	Apply the knowledge of electronic circuits and components to develop schematic designs for digital applications using OrCAD
25ECE462.2	Create and manage schematic symbols, footprints, netlists, and component libraries required for PCB development
25ECE462.3	Design and implement single-layer and multi-layer PCB layouts for power supply, analog, digital, and sensor-based circuits using OrCAD PCB Editor
25ECE462.4	Validate PCB designs using Design Rule Check (DRC), and routing optimization in accordance with industry standards

Exp. No. / Pgm. No.	List of Experiments / Programs	Hours	Cos
	Prerequisite Experiments / Programs / Demo		
	• Knowledge of Basic Electronics Components • Familiar with Basic electronic circuit connections • Basic knowledge to use computer	2	NA
	PART-A		
1	PCB Design of Rectifier Circuits (Half Wave, Full Wave Centre-Tapped, and Bridge Rectifier)	2	25ECE462.1, 25ECE462.2
2	PCB Design of Basic Digital Gates and Circuits (NOT, AND, OR, NAND, NOR, XOR, Half Adder, Full Adder)	2	25ECE462.1, 25ECE462.2
3	PCB Design of 7805 Regulated Power Supply	2	25ECE462.1, 25ECE462.2
4	PCB Design of LM317 Adjustable Voltage Regulator	2	25ECE462.1, 25ECE462.2
5	PCB Design of 555 Timer Astable Multivibrator	2	25ECE462.1
6	PCB Design of 555 Timer Monostable Multivibrator	2	25ECE462.1
	PART-B		
7	PCB Design of Op-Amp Based Comparator	2	25ECE462.3, 25ECE462.4
8	PCB Design of Op-Amp Inverting and Non-Inverting Amplifier	2	25ECE462.3, 25ECE462.4
9	PCB Design of Audio Amplifier using LM386	2	25ECE462.3, 25ECE462.4
10	PCB Design of Temperature Monitoring Circuit using LM35 Sensor	2	25ECE462.3, 25ECE462.4
11	PCB Design of Relay Driver Circuit using Transistor and Relay.	2	25ECE462.3, 25ECE462.4
12	PCB Design and Testing of Active High-Pass Filter Using IC 741	2	25ECE462.3, 25ECE462.4

PART-C
Beyond Syllabus Virtual Lab Content (4 Hours)
(To be done during Lab but not to be included for CIE or SEE)

1. Create A simple schematic circuits using OrCAD
https://resources.pcb.cadence.com/orcad-tutorials/2021-capture-walk-through-1-starting-a schematic
2. Complete Design flow of two stage RC circuit on OrCAD Tool
https://www.youtube.com/watch?v=JgxPh7m-qqo 86
3.OrCAD simple flow from schematic to PCB
https://www.youtube.com/watch?v=4882amwAHfA from schematic to PCB
4.LM317 Adjustable Voltage Regulator
https://www.youtube.com/watch?v=enhQhQmW-a0

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		30	20
L1	Remember	-	-
L2	Understand	05	05
L3	Apply	10	10
L4	Analyze	10	05
L5	Evaluate	05	-
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	05
L3	Apply	20
L4	Analyze	15
L5	Evaluate	10
L6	Create	-

Suggested Learning Resources:
Reference Books:
1) ORCAD software User manual.
2) R S Khandpur, Printed Circuit Boards- Design Fabrication, Assembly and Testing, Tata Mc Graw Hill Publishing Company Limited, 1st edition 2008

VIRTUAL INSTRUMENTATION USING LabVIEW			
Course Code	**25ECE463**	**Credits**	**01**
L:T:P:S	**0:0:1:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**30**	**SEE Marks**	**50**
TW & SL / Sem	**-**	**Total Marks**	**100**
Total Hours /Sem	**30**	**Exam Hours**	**03**

Course outcomes:
At the end of the course, the student will be able to:

25ECE463.1	Design and develop basic LabVIEW programs using front panel controls, indicators, and block diagram elements for data acquisition and signal processing.
25ECE463.2	Implement arithmetic, comparison, string, array, and cluster operations using LabVIEW programming structures such as loops and case structures.
25ECE463.3	Create and utilize SubVIs, file I/O operations, and waveform generation/analysis techniques for virtual instrumentation applications.
25ECE463.4	Interface LabVIEW with real-world signals using DAQ, build instrument control systems using GPIB/serial communication, and evaluate measurement results.

Exp. No. / Pgm. No.	List of Experiments / Programs	Hours	Cos
Prerequisite Experiments / Programs / Demo			
	• Introduction to LabVIEW Environment: Front Panel, Block Diagram, Controls Palette, Functions Palette • VI development workflow. Demo: Wiring, data types, error handling basics	2	NA
PART-A			
1	Create a LabVIEW VI to perform basic arithmetic operations (addition, subtraction, multiplication, division) using Numeric Controls and Indicators.	2	25ECE463.1
2	Develop a VI to implement Boolean logic operations (AND, OR, NOT, XOR) using Boolean Controls and LEDs as indicators on the front panel	2	25ECE463.1
3	Design a VI using For Loop and While Loop structures to compute factorial and Fibonacci series; display results using waveform charts.	2	25ECE463.1
4	Implement a VI using Case Structure for a temperature unit converter (Celsius, Fahrenheit, Kelvin) and simulate a simple alarm system.	2	25ECE463.1
5	Create a VI to perform array operations: build array, index array, array size, sort, and statistical operations (mean, standard deviation, min/max).	2	25ECE463.2
6	Develop a VI to perform Cluster and Waveform operations — bundling/unbundling data and displaying multi-channel waveforms on a graph.	2	25ECE463.2
PART-B			
7	Build a SubVI for a mathematical function (e.g., RMS value calculator) and integrate it into a main VI; use connector pane and icon editor.	2	25ECE463.2
8	Design a VI to perform String operations: string length, concatenation, search & replace, type-cast numeric to string, and build a simple data logger.	2	25ECE463.2
9	Implement File I/O operations in LabVIEW — write measurement data to a spreadsheet/text file and read it back for display on a waveform graph.	2	25ECE463.3
10	Generate standard waveforms (sine, square, triangular, sawtooth) using LabVIEW signal generation VIs and analyze frequency spectrum	2	25ECE463.3

	using FFT.		
11	Simulate a DAQ-based data acquisition system in LabVIEW using simulated channels; acquire, display, and analyze voltage signals with scaling and triggering.	2	25ECE463.4
12	Design a LabVIEW-based instrument control application: simulate serial/GPIB communication using VISA, send/receive commands, and log instrument data.	2	25ECE463.4

PART-C

Beyond Syllabus Virtual Lab Content (4 Hours)

(To be done during Lab but not to be included for CIE or SEE)

1. Signal processing VIs using LabVIEW
   https://www.ni.com/docs/en-GG/bundle/labview/page/signal-generation-in-labview.html
2. PID controller simulation using LabVIEW
   https://forums.ni.com/t5/Example-Code/Construct-PID-in-Control-Design-and-Simulation-Module/ta-p/3531054
3. RF communication simulation using LabVIEW
   http://www.ni.com/example/30146/en/
4. Biomedical signal analysis using LabVIEW
   https://forums.ni.com/t5/Example-Code/1-Simulating-an-EEG-using-the-Biomedical-Toolkit-for-LabVIEW/ta-p/3535815

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		30	20
L1	Remember	-	-
L2	Understand	05	05
L3	Apply	10	10
L4	Analyze	10	05
L5	Evaluate	05	-
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	05
L3	Apply	20
L4	Analyze	15
L5	Evaluate	10
L6	Create	-

Suggested Learning Resources:

Reference Books:

1) National Instruments, LabVIEW User Manual, NI Publication, 2023. Available at: ni.com/manuals
2) Robert H. Bishop, Learning with LabVIEW, Pearson Education, 2015.

PROGRAMMING OF INDUSTRIAL ROBOT USING RoboDK			
Course Code	**25ECE464**	**Credits**	**01**
L:T:P:S	**0:0:1:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**30**	**SEE Marks**	**50**
TW & SL / Sem	**-**	**Total Marks**	**100**
Total Hours /Sem	**30**	**Exam Hours**	**03**

Course outcomes:
At the end of the course, the student will be able to:

25ECE464.1	Apply the concepts of industrial robot anatomy, coordinate systems, and teach pendant programming to perform basic robotic motion tasks using RoboDK.
25ECE464.2	Develop and implement robot programs using registers, timers, branching, and conditional statements to automate industrial task sequences.
25ECE464.3	Apply macros, program shifting, and gripper operations to design and simulate robotic pick-and-place applications in an industrial environment.
25ECE464.4	Assess the performance of digital and analog I/O control, user panel functionalities, and task-level automation in robotic applications with diagnostic and recovery features.

Exp. No. / Pgm. No.	List of Experiments / Programs	Hours	Cos
Prerequisite Experiments / Programs / Demo			
	Basic Knowledge of Robotics and Automation, Fundamentals of Coordinate Systems, Introduction to Programming Concepts. RoboDk Package.	2	NA
PART-A			
1	To identify robot components, understand EOAT, robot axes, payload, and coordinate systems.	2	25ECE464.1
2	To orient the tool, create teach programs, and perform Joint, Linear, motion programming.	2	25ECE464.1
3	To create a robot program to perform arc and circular arc motions.	2	25ECE464.1
4	To define and use multiple Tool and User frames using Three-point, Six point, and Direct Entry methods.	2	25ECE464.1
5	To create logic-driven robot programs using registers, timers, conditional instructions.	2	25ECE464.2
6	To create a robot program to calculate the total amount of time consumed to complete a job. The time to be returned to one of the registers.	2	25ECE464.2
PART-B			
7	To apply position registers to create and execute logic-based robot programs for industrial tasks.	2	25ECE464.2
8	To develop reusable macros and procedures for path transformation in robotic programming applications.	2	25ECE464.2
9	To control gripper movements using digital output signals through RO/RI commands.	2	25ECE464.3
10	To program pick-and-place tasks with looped logic, counters, and user-defined routines.	2	25ECE464.3
11	To program palletization tasks with looped logic, counters, and user-defined routines.	2	25ECE464.4
12	To utilize digital/analog I/O, user panel I/O, and robot I/O functions to interface robotic systems with peripheral equipment.	2	25ECE464.4

PART-C
Beyond Syllabus Virtual Lab Content (4 Hours)
(To be done during Lab but not to be included for CIE or SEE)

1. **Frames in Robotics** https://youtu.be/lj4bbQHKIEY?si=zuWgROurrxFURjUv

2. **Frames in Robotics - Tool frames https://youtu.be/RL8sPOipzrk?si=0UDm44WgnyGpdu8a**
3. **Simulate the robot motion for various inputs of the joint angular value using RoboDK https://www.youtube.com/shorts/r2xbpmklzus**
4. **Robot Synchronization- https://www.youtube.com/watch?v=MMKJaplGfKc**

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		30	20
L1	Remember	-	-
L2	Understand	05	05
L3	Apply	10	10
L4	Analyze	10	05
L5	Evaluate	05	-
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	05
L3	Apply	20
L4	Analyze	15
L5	Evaluate	10
L6	Create	-

Suggested Learning Resources:

Reference Books:

1) "Introduction to Robotics: Mechanics and Control", John J. Craig, 4th Edition, Pearson publisher, 2022, ISBN-13: 9781292164939

2) "Robotics, Vision and Control: Fundamental Algorithms in Python", Peter Corke, 3rd Edition, Springer, 2023, ISBN: 9783031064685.

EMBEDDED DESIGN USING MPLAB			
Course Code	**25ECE465**	**Credits**	**01**
L:T:P:S	**0:0:1:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**30**	**SEE Marks**	**50**
TW & SL / Sem	**--**	**Total Marks**	**100**
Total Hours /Sem	**30**	**Exam Hours**	**03**

Course outcomes:
At the end of the course, the student will be able to:

25ECE465.1	Demonstrate the fundamental core concepts of programming with MPLAB XC8
25ECE465.2	Apply the basic knowledge of programming and system control to perform a specific task
25ECE465.3	Implement experiments to interface different peripherals
25ECE465.4	Develop programming skills in embedded systems for various applications

Exp. No. / Pgm. No.	List of Experiments / Programs	Hours	Cos
	Prerequisite Experiments / Programs		
	* Revisit C programming concepts. * Introduction to MPLAB X IDE, MPLAB XC8 Compiler toolchain, project creation, and MPLAB X SIMULATOR simulation. Hardware debugging environments, using MPLAB PICkit or ICD (In-Circuit Debugger). *Target Boards: Curiosity Development Boards. Ex: CURIOSITY HIGH PIN COUNT (HPC) DEVELOPMENT BOARD, **Part Number:** DM164136,	2	NA
	PART-A		
1	Write a program to perform addition, subtraction, multiplication and division operation using PIC Microcontroller and display the result in the MPLAB console.	2	25ECE465.1
2	Write a program to sort a given number of series in ascending/descending order, and display the result in the MPLAB console.	2	25ECE465.1
3	Write a program for code conversion form Hex to ASCII and ASCII to Hex, display results in the MPLAB console.	2	25ECE465.1
4	Write a program to perform logical operations using PIC Microcontroller, display results in the MPLAB console.	2	25ECE465.1
5	Write a program for delay calculation using PIC Microcontroller, display result in the MPLAB console.	2	25ECE465.2
6	Write a program to find the largest number and the smallest number from a given series, display result in the MPLAB console.	2	25ECE465.2
	PART-B		
7	Write a program for the blinking of LED, with 1 sec delay. Flash the code on the Target board using MPLAB PICkit or ICD (In-Circuit Debugger). Show LED blinking ON/OFF.	2	25ECE465.2
8	Interface an LCD with PIC Microcontroller. Write the code to display characters/Strings in the LCD, and flash the code on the Target board using MPLAB PICkit or ICD (In-Circuit Debugger). Display characters/strings in the LCD.	2	25ECE465.2
9	Interface a Stepper Motor with PIC Microcontroller. Write the code run the Stepper Motor, and flash the code on the Target board using MPLAB PICkit or ICD (In-Circuit Debugger). Run the Stepper Motor clockwise & anti-clockwise.	2	25ECE465.3
10	Interface a Temperature sensor with PIC Microcontroller. Write the	2	25ECE465.3

	code and flash the code using In-Circuit Debugger (ICD). Read the sensor values and display it in the MPLAB console.		
11	Set up the internal Universal Asynchronous Receiver-Transmitter (UART) module to match a specific baud rate. Implement string transmission and reception routines to communicate interactively between the Target board and a PC serial terminal (e.g., Putty/TeraTerm).	2	25ECE465.4
12	Configure the Capture/Compare/PWM (CCP) module to generate varying PWM duty cycles. Use this output to smoothly vary the brightness of an LED or regulate the speed of a small DC Motor via a driver IC.	2	25ECE465.4

PART-C

Beyond Syllabus Virtual Lab Content (4 Hours)

(To be done during Lab but not to be included for CIE or SEE)

1. **https://www.microchip.com/en-us/development-tool/dm164136**
2. **https://www.microchip.com/en-us/development-tool/dm164137**
3. **https://mu.microchip.com/page/embedded-system-design**
4. **https://www.microchip.com/en-us/tools-resources/develop/mplab-x-ide**
5. **https://deepbluembedded.com/creating-new-project-with-mplab/**

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		30	20
L1	Remember	-	-
L2	Understand	05	05
L3	Apply	10	10
L4	Analyze	10	05
L5	Evaluate	05	-
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	05
L3	Apply	20
L4	Analyze	15
L5	Evaluate	10
L6	Create	-

Suggested Learning Resources:

Reference Books (There are no Reference Books for MPLAB Software. Therefore, listed below are the Web links, related to MPLAB Software) :

1) https://www.microchip.com/en-us/tools-resources/develop/mplab-x-ide

2)https://skills.microchip.com/page/mplab-x-ide

3) https://www.microchip.com/en-us/tools-resources/evaluation-boards/curiosity

ENVIRONMENTAL SCIENCE PROJECT

Course Code	**25EPP47**	**Credits**	**02**
L:T:P:S	**0:0:2:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**-**	**SEE Marks**	**50**
TW & SL / Sem	**60**	**Total Marks**	**100**
Total Hours /Sem	**60**	**Exam Hours**	**03**

Course outcomes: At the end of the course, the student will be able to:

25EPP47.1	Identify environmental issues and their impact on ecosystems, natural resources, and sustainable development.
25EPP47.2	Evaluate environmental conditions using data obtained through field surveys, case studies, environmental audits, and related investigations
25EPP47.3	Develop skills in project planning, field survey, data collection, implementation, documentation and reporting
25EPP47.4	Design sustainable solutions to mitigate identified environmental problems using scientific and engineering principles.

The Environmental Science Project is a practical, applied-learning course that builds students' environmental awareness and responsibility. It focuses on real issues such as climate change, pollution, biodiversity, resource use, soil erosion, and thermal comfort, using field surveys, case studies, data collection, audits, and analysis to develop feasible and sustainable solutions. Students are encouraged to propose feasible, sustainable, and technically sound solutions based on scientific principles and engineering practices.

The project may be undertaken **individually or in groups of up to four students**, including interdisciplinary teams wherever appropriate. Student performance shall be evaluated based on the prescribed project assessment rubrics.

Methods for project identification: Students may identify the project topic using one or more of the following methods: interaction with local rural or urban stakeholders such as local leaders, corporation/municipality personnel, NGOs, panchayat representatives, etc.; review of issues highlighted in print and electronic media, and social networks; and, after selecting a broad topic, collect data, conduct a feasibility survey, estimate timelines and resources, approximate expenditure, and define the problem statement and objectives clearly.

Restrictions and professional conduct:

Environmental Science Projects should be academic, socially responsible, technically focused, and politically neutral. Students and faculty must maintain professionalism, ethical conduct, and respect while working with communities and stakeholders, and avoid any political, ideological, commercial, or disruptive activities. Projects should also consider practical constraints such as cost, resources, safety, environmental impact, and stakeholder cooperation.

CIE Assessment Pattern (50 Marks)

RBT Levels		**Periodical Reviews and Evaluation**
		50
L1	**Remember**	**-**
L2	**Understand**	**05**
L3	**Apply**	**15**
L4	**Analyze**	**10**
L5	**Evaluate**	**10**
L6	**Create**	**10**

SEE Assessment Pattern (50 Marks)

RBT Levels		**Exam Marks Distribution (50)**
L1	**Remember**	**-**
L2	**Understand**	**05**

L3	**Apply**	**15**
L4	**Analyze**	**10**
L5	**Evaluate**	**10**
L6	**Create**	**10**

Suggested Learning Resources:

Textbooks:

1. Phadke, N. D. Community Engagement and Social Innovation. 1st ed., Oxford University Press, New Delhi.
2. Garg, N. R. Project-Based Learning in Engineering Education. 1st ed., Pearson India Education Services, Noida.
3. Gupta, A. and P. Singh. Service Learning and Community Projects. 1st ed., McGraw-Hill Education (India), New Delhi.
4. Wilson, G. Practical Guide to Community Development Projects. 2nd ed., Routledge, London.

Reference books:

1. NPTEL courses on Project-Based Learning and Social Innovation.
2. SWAYAM courses on community engagement and sustainability.
3. UN Sustainable Development Goals portal: https://sdgs.un.org
4. MyGov India and local civic body portals for community initiatives.
5. YouTube resources on design thinking, social innovation, and community service learning.
6. NGO and government field-action case studies related to sanitation, water, health, education, and environment.

Web links and Video Lectures (e-Resources):

1. NPTEL courses on Engineering Geology (IIT Roorkee, IIT Kharagpur).
2. NPTEL courses on Soil Mechanics and Foundation Engineering (IIT Delhi, IIT Bombay).
3. Virtual Labs – Geotechnical Engineering Virtual Lab (IIT Kanpur): https://vlab.co.in
4. Geological Survey of India (GSI) – Maps, reports, and publications: https://www.gsi.gov.in
5. YouTube channels: Civil Engineering Essentials, The Engineering Classroom (soil mechanics experiments). 6. American Society of Civil Engineers (ASCE) – Geotechnical resources and standards

NATIONAL SERVICE SCHEME			
Course Code	**25NSS30, 24NSS40**	**Credits**	**00**
L:T:P:S	**0:0:0:0**	**CIE Marks (each semester)**	**50**
TLP Contact Hours / Sem	**15**	**SEE Marks**	**--**
TW & SL / Sem	**15**	**Total Marks**	**50 x 2= 100**
Total Hours /Sem	**30**	**Exam Hours**	**02**

Course outcomes: At the end of the course, the student will be able to:

25NSSX0.1	Understand the importance of his / her responsibilities towards society.
25NSSX0.2	Analyse the environmental and societal problems/issues and will be able to design solutions for the same.
25NSSX0.3	Evaluate the existing system and to propose practical solutions for the same for sustainable development. Implement government or self-driven projects effectively in the field.
25NSSX0.4	Develop capacity to meet emergencies and natural disasters & practice national integration and social harmony in general.

Semester/ Course Code	CONTENT	COs	HOURS
3RD 25NSS30	1. Organic farming, Indian Agriculture (Past, Present and Future) Connectivity for marketing 2. Waste management–Public, Private and Govt organization, 5R's. 3. Developing Sustainable Water management system for rural areas and implementationapproaches. 4. Setting of the information imparting club for women leading to contribution in social and economic issues. 5. Preparing an actionable business proposal for enhancing the village income and approach for implementation.	25NSS30.1, 25NSS30.2, 25NSS30.3, 25NSS30.4	30 HRS
4TH 25NSS40	1. Helping local schools to achieve good results and enhance their enrolment in Higher/ technical/ vocational education. 2. Contribution to any national level initiative of Government of India. Digital India, Skill India, Swachh Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme, Skill developmentprograms etc. 3. Spreading public awareness under rural outreach programs. (minimum 5 programs). 4. Organize National integration and social harmony events / workshops / seminars. (Minimum TWO programs). 5. Govt. school Rejuvenation and helping them to achieve good infrastructure.	25NSS40.1, 25NSS40.2, 25NSS40.3, 25NSS40.4	30 HRS

CIE Assessment Pattern (50 Marks – Activity based) –

CIE component for every semester	Marks
Presentation - 1 Selection of topic, PHASE - 1	10
Commencement of activity and its progress - PHASE - 2	10
Case study-based Assessment Individual performance	10
Sector wise study and its consolidation	10
Video based seminar for 10 minutes by each student at the end of semester with Report.	10
Total marks for the course in each semester	**50**

- Implementation strategies of the project (NSS work).
- The last report should be signed by NSS Officer, the HOD and Principal.
- At last report should be evaluated by the NSS officer of the Institute.
- Finally, the consolidated marks sheet should be sent to the university and also to be made available at LIC visit.

Suggested Learning Resources:

Reference Books:

1. NSS Course Manual, Published by NSS Cell, VTU Belagavi.
2. Government of Karnataka, NSS cell, activities reports and its manual.
3. Government of India, NSS cell, Activities reports and its manual.

Pre-requisites to take this Course:

1. Students should have a service-oriented mindset and social concern.
2. Students should have dedication to work at any remote place, anytime with available resources and proper time management for the other works.
3. Students should be ready to sacrifice some of the time and wishes to achieve service-oriented targets on time.

Pedagogy:

- In every semester from 3rd semester to 4th semester, each student should do activities according to the scheme and syllabus.
- At the end of every semester student performance has to be evaluated by the NSS officer for the assigned activity progress and its completion.
- State the need for NSS activities and its present relevance in the society and provide real-life examples.
- Support and guide the students for self-planned activities.
- NSS coordinator will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress in real activities in the field.
- Encourage the students for group work to improve their creative and analytical skills.

Plan of Action:

- Student/s in individual or in a group Should select any one activity in the beginning of each semester till end of that respective semester for successful completion as per the instructions of NSS officer with the consent of HOD of the department.
- At the end of every semester, activity report should be submitted for evaluation.
- Practice Session Description:
    - Lecture session by NSS Officer
    - Students Presentation on Topics
    - Presentation - 1, Selection of topic, PHASE – 1
    - Commencement of activity and its progress - PHASE – 2
    - Execution of Activity
    - Case study-based Assessment, Individual performance
    - Sector/ Team wise study and its consolidation
    - Video based seminar for 10 minutes by each student at the end of semester with Report.

Sl No	Topic	Groupsize	Location	Activity execution	Reporting	Evaluation of the Topic
1.	Organic farming, IndianAgriculture (Past, Present and Future) Connectivity for marketing.	May be individual or team	Farmers land/Villages/ roadside / Community area / College campus	Site selection /proper consultation/ Continuous monitoring/ Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer

2.	Waste management– Public, Private and Govtorganization, 5 R's.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemes officers/ campus	Site selection /proper consultation/Continuous monitoring/ Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
3.	Developing SustainableWater management system for rural areas and implementation approaches.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemes officers/ campus	site selection/properconsultation/ Continuous monitoring/ Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
4.	Setting of the information imparting club for women leading to contributionin social and economic issues.	May be individual or team	Women empowerment groups/ Consulting NGOs & Govt Teams / College campus	Group selection/proper consultation/ Continuous monitoring/ Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
5.	Preparing an actionable business proposal for enhancing the village income and approach for implementation.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemes officers/ campus	Group selection/proper consultation/ Continuous monitoring/ Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
6.	Helping local schools toachieve good results and enhance their enrolment in Higher/ technical/ vocational education.	May be individual or team	Local government / private/ aided schools/Government Schemes officers	School selection/proper consultation/ Continuous monitoring/ Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer

7.	Contribution to any national level initiative of Government of India.For eg. Digital India, Skill India, Swachh Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme,Skill development programs etc.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemes officers/ campus	Group selection/proper consultation/ Continuous monitoring / Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
8.	Spreading public awareness under ruraloutreach programs. (minimum5 programs)	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemes officers/ campus	Group selection/proper consultation/ Continuous monitoring / Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
9.	Organize National integration and socialharmony events / Workshops / Seminars. (Minimum 02 programs).	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemes officers/ campus	Place selection/proper consultation/ Continuous monitoring / Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
10.	Govt. school Rejuvenation and helping them to achieve good infrastructure.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemes officers/ campus	Place selection/proper consultation/ Continuous monitoring / Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer

PHYSICAL EDUCATION AND SPORTS

Course Code	**25PED30, 25PED40**	**Credits**	**00**
L:T:P:S	**0:0:0:0**	**CIE Marks (each semester)**	**50**
TLP Contact Hours / Sem	**15**	**SEE Marks**	**--**
TW & SL / Sem	**15**	**Total Marks**	**50 x 2= 100**
Total Hours /Sem	**30**	**Exam Hours**	**02**

Course outcomes: At the end of the course, the student will be able to:

25PEDX0.1	Understand the fundamental concepts and skills of Physical Education, Health, Nutrition and Fitness
25PEDX0.2	Create consciousness among the students on Health, Fitness and Wellness in developing and maintaining a healthy lifestyle
25PEDX0.3	Perform in the selected sports or athletics of student's choice and participate in the competition at regional/state / national / international levels.
25PEDX0.4	Understand the roles and responsibilities of organization and administration of sports and games

Semester	CONTENT	COs	HOURS
3RD 25PED30	**Module 1: Orientation** A. Lifestyle B. Food & Nutrition C. Health & Wellness D. Pre-Fitness test. **Module 2: General Fitness & Components of Fitness** A. Warming up (Free Hand exercises) B. Strength – Push-up / Pull-ups C. Speed – 30 Mtr Dash **Module 3:** **Specific games (Any one to be selected by the student)** 1. Kabaddi – Hand touch, Toe Touch, Thigh Hold, Ankle hold and Bonus. 2. Kho-Kho – Giving Kho, Single Chain, Pole dive, Pole turning, 3-6 Up.	25PED30.1, 25PED30.2, 25PED30.3, 25PED30.4	30 HRS
4TH 25PED40	**Module 1: Ethics and Moral Values** A. Ethics in Sports B. Moral Values in Sports and Games **Module 2: Specific Games (Anyone to be selected by the student)** A. Volleyball – Attack, Block, Service, Upper Hand Pass and Lower hand Pass. B. Athletics (Track Events) – Any event as per availability of Ground. **Module 3: Role of Organization and administration**	25PED40.1, 25PED40.2, 25PED40.3, 25PED40.4	30 HRS

CIE Assessment Pattern (50 Marks – Practical) –

CIE to be evaluated every semester end based on practical demonstration of Sports and Athletics activities learnt in the semester.

CIE	Marks
Participation of student in all the modules	10
Quizzes – 2, each of 7.5 marks	15
Final presentation / exhibition / Participation in competitions/ practical on specific tasks assigned to the students	25
Total	**50**

Suggested Learning Resources:

Reference Books:

1. Saha, A.K. Sarir Siksher Ritiniti, Rana Publishing House, Kalyani.
2. Bandopadhyay, K. Sarir Siksha Parichay, Classic Publishers, Kolkata.
3. Petipus, et.al., Athlete's Guide to Career Planning, Human Kinetics.
4. Dharma, P.N. Fundamentals of Track and Field, Khel Sahitya Kendra, New Delhi.
5. Jain, R. Play and Learn Cricket, Khel Sahitya Kendra, New Delhi.
6. Vivek Thani, Coaching Cricket, Khel Sahitya Kendra, New Delhi.
7. Saha, A.K. Sarir Siksher Ritiniti, Rana Publishing House, Kalyani.
8. Bandopadhyay, K. Sarir Siksha Parichay, Classic Publishers, Kolkata
9. Naveen Jain, Play and Learn Basketball, Khel Sahitya Kendra, New Delhi.
10. Dubey H.C., Basketball, Discovery Publishing House, New Delhi.
11. Rachana Jain, Teach Yourself Basketball, Sports Publication.
12. Jack Nagle, Power Pattern Offences for Winning basketball, Parker Publishing Co., New York.
13. Renu Jain, Play and Learn Basketball, Khel Sahitya Kendra, New Delhi.
14. SallyKus, Coaching Volleyball Successfully, Human Kinetics.

YOGA			
Course Code	**25YOG30, 25YOG40**	**Credits**	**00**
L:T:P:S	**0:0:0:0**	**CIE Marks (each semester)**	**50**
TLP Contact Hours / Sem	**15**	**SEE Marks**	**--**
TW & SL / Sem	**15**	**Total Marks**	**50 x 2= 100**
Total Hours /Sem	**30**	**Exam Hours**	**02**

Course outcomes:
At the end of the course, the student will be able to:

25YOGX0.1	Understanding the origin, history, aim and objectives of Yoga
25YOGX0.2	Become familiar with an authentic foundation of Yogic practices
25YOGX0.3	Practice different Yogic methods such as Suryanamaskara, Pranayama and some of the Shat
25YOGX0.4	Use the teachings of Patanjali in daily life.

Semester / Course Code	CONTENT	COs	HOURS
3rd 25YOG30	**Introduction of Yoga:** Aim and Objectives of yoga, Prayer: Yoga, its origin, history and development. Yoga, its meaning, definitions. Different schools of yoga, importance of prayer **Brief introduction of yogic practices for common man:** Yogic practices for common man to promote positive health **Rules and regulations:** Rules to be followed during yogic practices by practitioner **Misconceptions of yoga:** Yoga its misconceptions, Difference between yogic and non-yogic practices. **Suryanamaskara:** 1. Suryanamaskar prayer and its meaning, Need, importance and benefits of Suryanamaskar. 2. Suryanamaskar 12 count,2rounds **Kapalabhati:** Revision of Kapalabhati -40strokes/min 3rounds **Different types of Asanas with Brief introduction and importance:** 1. Sitting: Padmasana, Vajrasana, Sukhasana 2. Standing: Vrikshana, Trikonasana, Ardhakati Chakrasana 3. Prone line: Bhujangasana, Shalabhasana 4. Supineline: Utthitadvipadasana, Ardhahalasana, Halasana	25YOG30.1, 25YOG30.2, 25YOG30.3, 25YOG30.4	30 Hrs
4TH 25YOG40	**Suryanamaskara:** Suryanamaskar 12 count,4rounds **Kapalabhati:** Revision of Kapalabhati - 60strokes/min3rounds **Different types of Asanas with Brief introduction and importance:** 1. Sitting: Paschimottanasana, Ardha Ushtrasana, Vakrasana, Aakarna Dhanurasana 2. Standing: Parshva Chakrasana, Urdhva Hastothanasana, Hastapadasana 3. Prone line: Dhanurasana 4. Supine line: Karna Peedasana, Sarvangasana, Chakraasana 5. Balancing: Sheershasana **Patanjali's Ashtanga Yoga**: Asana, Pranayama **Pranayama:** Chandra Bhedana, Nadishodhana, Surya Bhedana **Shat Kriyas:** Jalaneti and sutraneti, Sheetkarma Kapalabhati	25YOG40.1, 25YOG40.2, 25YOG40.3, 25YOG40.4	30 Hrs

CIE Assessment Pattern (50 Marks – Practical)

CIE to be evaluated every semester based on practical demonstration of Yogasana learnt in the semester and internal tests (objective type)

CIE	Marks
Avg of Test 1 and Test 2	25
Demonstration of Yogasana	25
Total	**50**

Suggested Learning Resources:

Reference Books:

1. Swami Kuvulyananda: Asma (Kavalyadhama, Lonavala)
2. Tiwari, O P: Asana Why and How
3. Ajitkumar: Yoga Pravesha (Kannada)
4. Swami Satyananda Saraswati: Asana Pranayama, Mudra, Bandha (Bihar School of yoga, Munger)
5. Swami Satyananda Saraswati: Surya Namaskar (Bihar School of yoga, Munger)
6. Nagendra H R: The art and science of Pranayama
7. Tiruka: Shatkriyegalu (Kannada)
8. Iyengar B K S: Yoga Pradipika (Kannada)
9. Iyengar B K S: Light on Yoga (English)

Web links and Video Lectures (e-Resources):

- **https://youtu.be/KB-TYlgd1wE**
- **https://youtu.be/aa-TG0Wg1Ls**

MUSIC			
Course Code	**25MUS30, 25MUS40**	**Credits**	**00**
L:T:P:S	**0:0:0:0**	**CIE Marks (each semester)**	**50**
TLP Contact Hours / Sem	**15**	**SEE Marks**	**--**
TW & SL / Sem	**15**	**Total Marks**	**50 x 2= 100**
Total Hours /Sem	**30**	**Exam Hours**	**02**

Course outcomes:
At the end of the course, the student will be able to:

25MUSX0.1	Identify and understand the origins and evolution of the Indian music system and its fundamental concepts
25MUSX0.2	Analyse and practice various types of compositions in Carnatic music and relate to different musical traditions
25MUSX0.3	Demonstrate knowledge of major composers and their contributions to Indian classical music
25MUSX0.4	Classify and understand various musical instruments and their construction

Mapping of Course Outcomes to Program Outcomes:

Semester / Course Code	CONTENT	COs	HOURS
3rd 25MUS30	**Origin of Indian Music** - Evolution of the Indian music system, Understanding of Shruthi, Nada, Swara, Taya, Raga, Tala, and Mla. Study of the fundamental concepts that form the foundation of Carnatic music. **Compositions in Carnatic Music** - Introduction to types of compositions including Geethe, Jathi, Swara, Swarajathi, Varna, Krithi, and Thillana. Understanding of notation systems and their application in musical compositions. **Composers and Their Contributions** - Biography and musical contributions of Purandaradasa (founder of Carnatic music pedagogy), Thyagaraja (prolific composer and saint), and Mysoro Vasudevacharya. Study of their impact on Indian classical music traditions. **Abhyasa Gana - Practical Training**- Singing of Sarale Varase exercises and notation writing. Introduction to Suladi Sapthatala. Singing of 2 Geethe in Malahiri. Foundation for practical music experience.	25MUS30.1, 25MUS30.2, 25MUS30.3, 25MUS30.4	30 Hrs
4TH 25MUS40	**Classification of Musical Instruments** - Classification and construction of string instruments (Veena, Sitar), wind instruments (Flute, Shehnai), percussion instruments (Mridangam, Tabla), and Idiophones (Ghana Vaadya - Gongs, Cymbals). Examples and characteristics of each class of instruments. **Abhyasa Gana - Practical Training**- Continuation of singing exercises including Sarale Varase at varying speeds. Complete notation writing for Sarale Varase and Suladi Sapthatala in Mayamalavagowla Raga. Singing of 2 additional Geethe in Malahiri, one Jathi Swara, and one Krithi in a Mela raga. Advanced practical music training.	25MUS40.1, 25MUS40.2, 25MUS40.3, 25MUS40.4	30 Hrs

CIE Assessment Pattern (50 Marks – Practical)

CIE to be evaluated every semester based on practical demonstration of Singing/Playing learnt in the semester and internal tests (MCQ type)

CIE	Marks
Avg of Test 1 and Test 2	20
Practical test on: a. Recite one Sarale Varase mentioned by the examiner in three speeds. b. Sing/Play the Geethe in Malahari. c. Singing/Playing Jathi Swara/Krithi.	30
Total	**50**

Textbooks:

1. Vidushi Vasantha Madhavi, "Theory of Music", Prism Publication, 2007.
2. T Sachidevi and T Sharadha (Thirumalai Sisters), Karnataka Sangeetha Dharpana - Vol.1 (English), Shreenivaas Prakaashana, 2018.

References:

1. Lakshminarayana Subramiam, Viji Subramaniam, "Classical Music of India: A Practical Guide", Tranqueber 2018.

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=ihFDT8ZBPxE
- https://www.youtube.com/watch?v=4XXl5tTXa0I
- **https://www.youtube.com/watch?v=n-60gfzGa1E**
- **https://www.youtube.com/watch?v=Vv_K7J7gx6M**
- **https://www.youtube.com/watch?v=BovAAPumYUo**
- **https://www.youtube.com/watch?v=F_aWPATb8V4**
- **https://www.youtube.com/watch?v=DPPCRWA3hXo**
- **https://www.youtube.com/watch?v=TuP00NK9eTM**
- **https://www.youtube.com/watch?v=LlolyBzZtdg**

BASIC APPLIED MATHEMATICS – II
(Common for All Branches)

Course Code	**25DMAT41**	**Credits**	**0**
L:T:P:S	**0:0:0:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**15**	**SEE Marks**	**--**
TW & SL / Sem	**15**	**Total Marks**	**50**
Total Hours /Sem	**30**	**Exam Hours**	**--**

Course outcomes:

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

25DMAT41.1	Understand the least squares method to fit linear, quadratic, and exponential curves to experimental data.
25DMAT41.2	Solve first-order and first-degree differential equations and interpret their solutions in engineering and scientific applications.
25DMAT41.3	Analyze higher-order linear differential equations solutions encountered in engineering systems.
25DMAT41.4	Apply the double and triple integrals concepts to compute the areas and volumes of engineering domains.
25DMAT41.5	Analyze the Laplace transforms and apply their properties to simplify mathematical models of engineering systems.
25DMAT41.6	Apply Laplace transform techniques to solve linear differential equations arising in the engineering applications.

MODULE-1	**STATISTICAL ANALYSIS**	**25DMAT41.1**	**3 Hours**
Fitting of the linear curves, quadratic curves and exponential curves by least square method. Correlation, Coefficient of correlation and Lines of Regression.			
Self-study	Fitting of the geometric curves.		
Text Book	Text Book 1: 24.5, 25.12, 25.13, 25.14		
MODULE-2	**ORDINARY DIFFERENTIAL EQUATIONS**	**25DMAT41.2 25DMAT41.3**	**3 Hours**
Solution of first order and first-degree differential equations – Exact differential equations. Solution of second and higher order homogeneous and non-homogeneous (e^{ax}, $\sin ax$, $\cos ax$) linear differential equations.			
Self-study	Solution of first order linear differential equations		
Text Book	Text Book 1: 11.11, 11.12, 13.5		
MODULE-3	**INTEGRAL CALCULUS**	**25DMAT41.4**	**3 Hours**
Evaluation of double integrals, evaluation of double integrals by change of order of integration, double integrals in polar coordinates, Area enclosed by plane curves, Evaluation of triple integrals.			
Self-study	Evaluation of double integrals over the region of integration.		
Text Book	Text Book 1: 7.1, 7.2, 7.3.		
MODULE-4	**LAPLACE TRANSFORMS**	**25DMAT41.5**	**3 Hours**
Definition and Laplace transform of simple functions, Properties of Laplace transforms -Shifting property problems, Laplace transform of Periodic functions problems.			
Self-study	Laplace transform of elementary functions		
Text Book	Text Book 1: 21.3, 21.4, 21.5, Text Book 2: 6.1.		
MODULE-5	**INVERSE LAPLACE TRANSFORMS**	**25DMAT41.6**	**3 Hours**
Inverse Laplace Transform by partial fractions and completing square forms. Solution of linear differential equations using Laplace Transform techniques.			
Self-study	Inverse Laplace transform of simple functions		
Text Book	Text Book 1: 21.12, 21.15, Text Book 2: 6.4.		

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels	**Marks Distribution**		
	Test (s)	**AAT1**	**AAT2**
	25	**15**	**10**

L1	**Remember**	-	**-**	**-**
L2	**Understand**	5	**-**	**-**
L3	**Apply**	10	**5**	5
L4	**Analyze**	10	5	5
L5	**Evaluate**	-	5	-
L6	**Create**			**-**

Suggested Learning Resources:

Text Books:

1) B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, Forty fourth Edition, 2022, 9788193328491.
2) Erwin Kreyszig, Advanced Engineering Mathematics, Wiley-India Publishers, Tenth Edition, Reprint ISBN: 9788126554232.

Reference Books:

1) Glyn James, Advanced Modern Engineering Mathematics, Pearson Education, Fourth Edition, 2015, 9780273719236
2) B. V. Ramana, Higher Engineering Mathematics, McGraw Hill Education (India) Private Limited, 4th Edition ISBN: 9780070634190
3) H. K. Dass, Advanced Engineering Mathematics, S. Chand & Company Ltd., Twenty Second Edition, 2018 9789352533831
4) N. P. Bali and Manish Goyal, A Text Book of Engineering Mathematics, Laxmi Publications (P) Ltd., 9th Ed 2014, ISBN: 9788131808320

Web links and Video Lectures (e-Resources):

- https://youtu.be/SaNDPSk1UVM?si=FRxMnRi1btCUIscK
- https://youtu.be/HxrLu-qRJKc?si=pKc9XOCllBx-H4Wp
- https://youtu.be/ma1QmE1SH3I?si=Hoo3_cjiIds203os
- https://youtu.be/TKBXey91Gc4?si=JjZfQvJxdxN8I6YQ
- https://youtu.be/1THkFmuIPXM?si=pc9VvmZ-9cQe_Wr_
- https://youtu.be/m7jH0jfRf2I?si=OOEWttfQhieJ9wih
- https://youtu.be/qFnoRfZknBY?si=BeMrhMF3LML4hBGa
- https://youtu.be/n9XP6pljtw8?si=3gU-XKgt5JIZe9LE

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Problem solving Approach
- Organizing Group wise discussions on related topics
- Seminars

APPENDIX A

List of Assessment Patterns

1	Assignments
2	Group Discussions
3	Case Studies/ Caselets
4	Practical Orientation on Design thinking
5	Participatory & Industry-integrated Learning
6	Practical activities / Problem solving exercises
7	Class Presentations
8	Analysis of Industry / Technical / Business Reports
9	Reports on Industrial Visit
10	Industrial / Social / Rural Projects
11	Participation in external seminars / workshops
12	Any other academic activity
13	Online / Offline Quizzes

APPENDIX B

Outcome Based Education

Outcome-based education (OBE) is an educational theory that bases each part of an educational system around goals (outcomes). By the end of the educational experience each student should have achieved the goal. There is no specified style of teaching or assessment in OBE; instead classes, opportunities, and assessments should all help students achieve the specified outcomes.

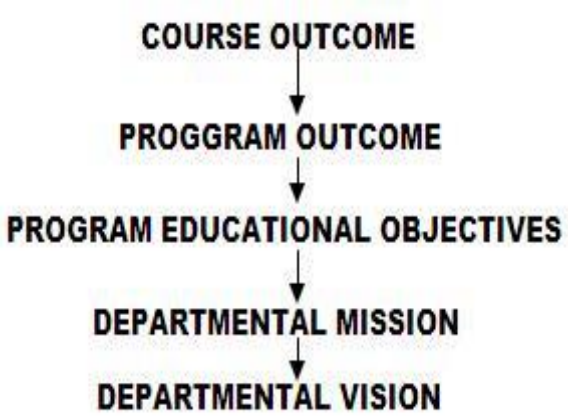
There are three educational Outcomes as defined by the National Board of Accreditation:

Program Educational Objectives: The Educational objectives of an engineering degree program are the statements that describe the expected achievements of graduate in their career and also in particular what the graduates are expected to perform and achieve during the first few years after graduation. [nbaindia.org]

Program Outcomes: What the student would demonstrate upon graduation. Graduate attributes are separately listed in Appendix C

Course Outcome: The specific outcome/s of each course/subject that is a part of the program curriculum. Each subject/course is expected to have a set of Course Outcomes

Mapping of Outcomes



APPENDIX C

The Graduate Attributes of NBA

Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop solutions to complex engineering problems.

Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.

Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems, components or processes to meet identified needs with consideration for public health and safety, whole-life cost, net zero carbon, culture, society and environment.

Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis and interpretation of data to provide valid conclusions.

Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering and IT tools, including prediction and modelling, recognizing their limitations to solve complex engineering problems.

The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for their impact on sustainability with reference to economy, health, safety, legal framework, culture and environment.

Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national and international laws.

Individual and Collaborative Team Work: Function effectively as an individual, and as a member or leader in diverse and multidisciplinary teams.

Communication: Communicate effectively and inclusively within the engineering community and society at large, including effective reports, design documentation and presentations, considering cultural, language and learning differences.

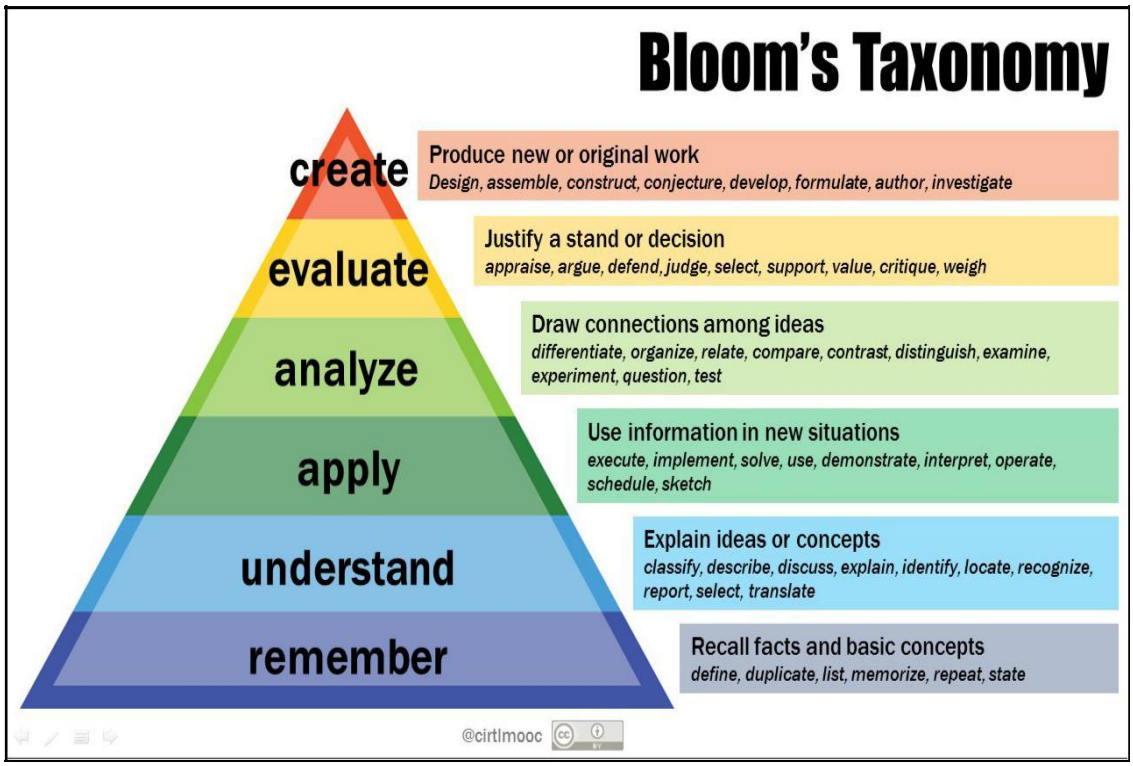
Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

Life-Long Learning: Recognize the need for, and have the preparation and ability for independent and life-long learning, adaptability to new and emerging technologies, and critical thinking in the broadest context of technological change.

APPENDIX D

BLOOM'S TAXONOMY

Bloom's taxonomy is a classification system used to define and distinguish different levels of human cognition—i.e., thinking, learning, and understanding. Educators have typically used Bloom's taxonomy to inform or guide the development of assessments (tests and other evaluations of student learning), curriculum (units, lessons, projects, and other learning activities), and instructional methods such as questioning strategies.



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