SILVER HORIZONS 25 YEARS OF GLOBAL LEARNING

NEW HORIZON COLLEGE OF ENGINEERING

Department of Electronics and Communication Engineering

Academic Year: 2025-26

II Year

Scheme and Syllabus

Batch 2024-28

Credits: 160

NEW HORIZON
COLLEGE OF ENGINEERING

Department of Electronics and Communication Engineering

Academic Year 2025-26

3rd and 4th Semester Scheme & Syllabus

BATCH: 2024-28

CREDITS:160

NEW HORIZON
COLLEGE OF ENGINEERING

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

3rd and 4th Semester Scheme & Syllabus

Academic Year 2025-26

BATCH:2024-28 (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**	**PSO1**	**PSO2**
PEO1	3	3	2	2	2	1	1	1	1	1	1	1	1
PEO2	3	3	3	3	3	2	2	2	2	2	2	3	2
PEO3	3	3	3	3	3	3	3	2	2	2	2	3	3
PEO4	1	1	1	1	1	2	2	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 2024- 2028 BATCH (2024 Scheme)

III Semester														
S. No.	Course and Course Code		Course Title	BoS	Credit Distribution				Overall Credits	Contact Hours	Marks			
					L	T	P	S			CIE	SEE	Total	
1	BSC	24MAE31	Numerical Methods and Transforms	BS	2	1	0	0	3	4	50	50	**100**	
2	PCC	24ECE32	Analog Electronic Circuits	EC	3	0	0	0	3	3	50	50	**100**	
3	PCCL	24ECL32	Analog Electronic Circuits Lab	EC	0	0	1	0	1	2	50	50	**100**	
4	PCC	24ECE33	Digital Electronic Circuits	EC	3	0	0	0	3	3	50	50	**100**	
5	PCCL	24ECL33	Digital Electronic Circuits Lab	EC	0	0	1	0	1	2	50	50	**100**	
6	PCC	24ECE34	Signals and Systems	EC	3	0	0	0	3	3	50	50	**100**	
7	PCC	24ECE35	Circuit Design and Analysis	EC	3	0	0	0	3	3	50	50	**100**	
8	AEC	24ECE36X	Ability Enhancement Course – III	EC	0	0	1	0	1	2	50	50	**100**	
9	UHV	24DTK37	Design Thinking and Fabrication	ME	1	0	0	0	1	1	50	50	**100**	
10	NCMC	24NSS30	National Service Scheme	--	0	0	0	0	0	2	50	--	**50**	
		24PED30	Physical Education and Sports	--										
		24YOG30	Yoga	--										
Total									**19**	**25**	**500**	**450**	**950**	

11	NCMC*	24DMAT31	Basic Applied Mathematics -I	BS	0	0	0	0	0	2	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, **L:** Lecture, **T**: Tutorial, **P**: Practical **S: SDA**: Self Study for Skill Development, **K:** This letter in the course code indicates common to all the stream of engineering. **ESC:** Engineering Science Course, **ETC**: Emerging Technology Course, **PLC**: Programming Language Course, **CIE**: Continuous Internal Evaluation, **SEE**:Semester End Evaluation

Ability Enhancement Course – III (0-0-1-0)			
24ECE361	Electronics System Design using Proteus	24ECE364	Data Visualization with Scilab
24ECE362	Programming on Raspberry Pi using Python	24ECE365	Bioinspired Design and Innovation (1:0:0:0)
24ECE363	Industrial Robot Programming using Roboguide		

NCMC*:24DMAT31: This non-credit mandatory course to be offered to Lateral entry students.

National Service Scheme /Physical Education/Yoga: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education(PE) (Sports and Athletics), and Yoga (YOG) with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 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, and Yoga 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.

Credit Definition: 1-hour Lecture (L) per week=1Credit 2-hoursTutorial(T) per week=1Credit 2-hours Practical / Drawing (P) per week=1Credit 2-hous Self Study for Skill Development (SDA) per week = 1 Credit	03-Credits courses are to be designed for 40 hours in Teaching-Learning Session 02-Credits courses are to be designed for 25 hours of Teaching-Learning Session 01-Credit courses are to be designed for 15 hours of Teaching-Learning Sessions

NEW HORIZON COLLEGE OF ENGINEERING

B. E. in Electronics and Communication Engineering

Scheme of Teaching and Examinations for 2024- 2028 BATCH (2024 Scheme)

IV Semester														
S. No.	**Course and Course Code**		**Course Title**	**BoS**	**Credit Distribution**				**Overall Credits**	**Contact Hours**	**Marks**		
					L	**T**	**P**	**S**			**CIE**	**SEE**	**Total**
1	BSC	24MAE41	Numerical, Complex Analysis and Probability Theory	BS	2	1	0	0	3	4	50	50	**100**
2	PCC	24ECE42	System Design using HDL	EC	3	0	0	0	3	3	50	50	**100**
3	PCCL	24ECL42	System Design using HDL Lab	EC	0	0	1	0	1	2	50	50	**100**
4	PCC	24ECE43	Digital Signal Processing	EC	3	0	0	0	3	3	50	50	**100**
5	PCCL	24ECL43	Digital Signal Processing Lab	EC	0	0	1	0	1	2	50	50	**100**
6	PCC	24ECE44	Microprocessors and Microcontrollers	EC	3	0	0	0	3	3	50	50	**100**
7	PCCL	24ECL44	Microprocessors and Microcontrollers Lab	EC	0	0	1	0	1	2	50	50	**100**
8	PEC	24ECE45X	Professional Elective Course-I	EC	3	0	0	0	3	3	50	50	**100**
9	AEC	24ECE46X	Ability Enhancement Course – IV	EC	0	0	1	0	1	2	50	50	**100**
10	UHV	24UHK47	Universal Human Values & Life Skills	LS	1	0	0	0	1	2	50	50	**100**
11	PROJ	24ECE48	Mini Project	EC	0	0	1	0	1	2	50	50	**100**
12	NCMC	24NSS40	National Service Scheme	--	0	0	0	0	0	2	50	--	**50**
		24PED40	Physical Education and Sports	--									
		24YOG40	Yoga	--									
Total									**21**	**30**	**600**	**550**	**1150**

13	NCMC*	24DMAT41*	Basic Applied Mathematics-II	BS	0	0	0	0	0	2	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**: Self Study for Skill Development, **K:** This letter in the course code indicates common to all the stream of engineering. **ESC:** Engineering Science Course, **ETC**: Emerging Technology Course, **PLC**: Programming Language Course, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation.

NCMC*:24DMAT41: This non-credit mandatory course to be offered to Lateral entry students.

Professional Elective Course-I			
24ECE451	Control Systems	24ECE454	Biomedical Signal Processing
24ECE452	Linear Integrated Circuits	24ECE455	Competitive Coding
24ECE453	Electromagnetic Field Theory		

Ability Enhancement Course – IV (0-0-1-0)			
24ECE461	ALP with Microcontroller	24ECE464	Embedded Design using MPLAB
24ECE462	PCB Design using OrCAD	24ECE465	Real Time Operating System - QNX
24ECE463	Virtual Instrumentation using LabVIEW		

Mini-project work: Mini Project is a laboratory-oriented/hands on course that will provide a platform to students to enhance their practical knowledge and skills by the development of small systems/applications etc. Based on the ability/abilities of the student/s and recommendations of the mentor. A student can do mini project as

(i) A group of 2 if mini project work is single discipline (applicable to all IT allied branches)

(ii) A group of 2- 4 if mini project work is single discipline (applicable to all Core Branches)

(iii) A group of 2 - 4 students if the Mini Project work is a multidisciplinary (Applicable to all Branches)

CIE procedure for Mini-project:

(i) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two faculty members of the Department, one of them being the Guide. The CIE marks awarded for the Mini-project work shall be based on the evaluation of the project report, project presentation skill, and question and answer session in the ratio of 50:25:25. The marks awarded for the project report shall be the same for all the batches mates.

(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 Mini-project, shall be based on the evaluation of the project report, project presentation skill, and question

and answer session in the percentage ratio of 50:25:25. The marks awarded for the project report shall be the same for all the batch mates

National Service Scheme /Physical Education/Yoga: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE) (Sports and Athletics), and Yoga (YOG) with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 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, and Yoga 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.

Credit Definition: 1-hour Lecture (L) per week=1Credit 2-hoursTutorial(T) per week=1Credit 2-hours Practical / Drawing (P) per week=1Credit 2-hous Self Study for Skill Development (SDA) per week = 1 Credit	03-Credits courses are to be designed for 40 hours in Teaching-Learning Session 02- Credits courses are to be designed for 25 hours of Teaching-Learning Session 01-Credit courses are to be designed for 15 hours of Teaching-Learning Sessions

THIRD SEMESTER

(SYLLABUS)

NUMERICAL METHODS AND TRANSFORMS

Course Code	**24MAE31**	**CIE Marks**	**50**
L:T:P:S	**2:1:0:0**	**SEE Marks**	**50**
Hrs. / Week	**4**	**Total Marks**	**100**
Credits	**3**	**Exam Hours**	**3**

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

24MAE31.1	Use appropriate numerical methods to solve algebraic equations and transcendental equations
24MAE31.2	Differentiate the physical problems numerically, evaluate a definite integral numerically and use appropriate numerical methods to solve boundary value problems in partial differential equations
24MAE31.3	Justify Z-transforms method to solve continuous/discrete model problems
24MAE31.4	Express the periodic functions as Fourier series expansion analytically and numerically
24MAE31.5	Solve the continuous model problems using Fourier transform and analyze the fast Fourier transforms method to solve the discrete model problems

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24MAE31.1	3	-	-	-	-	-	-	-	-	-	-	-	-
24MAE31.2	3	3	-	-	-	-	-	-	-	-	-	-	-
24MAE31.3	3	3	-	-	-	-	-	-	-	-	-	-	-
24MAE31.4	3	3	-	-	-	-	-	-	-	-	-	-	-
24MAE31.5	3	3	-	-	-	-	-	-	-	-	-	-	-

MODULE-1	**NUMERICAL SOLUTIONS AND INTERPOLATION**	**24MAE31.1**	**8 Hours**

Numerical solution of algebraic and transcendental equations: Newton-Raphson Method-Problems. Interpolation: Newton's forward and backward formulae for equal intervals, Newton divided difference, Lagrange's formula and Lagrange's inverse interpolation formula for unequal intervals (without proofs)-Problems.

Text Book	Text Book 1: 28.2, 28.3, 29.6, 29.10, 29.12, 29.13, Text Book 3: 19.2, 19.3.

MODULE-2	**NUMERICAL DIFFERENTIATION AND INTEGRATION**	**24MAE31.2**	**8 Hours**

Numerical Differentiation: Derivatives of first order and second order using Newton's forward differences and Newton's backward differences. Numerical solution of one-dimensional wave equation, heat equation and two-dimensional Laplace's equation. Numerical integration: Trapezoidal rule, Simpson's 1/3rd rule and Simpson's 3/8th rule (without proofs)-Problems. Application of numerical integration to velocity of a particle and volume of solids

Text Book	Text Book 1: 30.2, 30.6, 30.7, 30.8, 33.5, 33.8, 33.10, Text Book 3: 19.5.

MODULE-3	**Z-TRANSFORMS**	**24MAE31.3**	**8 Hours**

Definition, Z-transforms of some standard functions, properties, damping rule, shifting rule (without proof), initial and final value theorems. Inverse Z- transforms by partial fractions method. Convolution theorem (Statement only). Solution of difference equations using Z-transform

Text Book	Text Book 1: 23.3, 23.4, 23.5, 23.6, 23.9, 23.15, 23.16. Text Book 2: 6.14.11, 6.14.12

MODULE-4	**FOURIER SERIES**	**24MAE31.4**	**8 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 – problems.

Text Book	Text Book 1: 10.2, 10.4, 10.5, 10.6, 10.7, 10.11, Text Book 3: 11.1

MODULE-5	**FOURIER TRANSFORMS**	**24MAE31.5**	**8 Hours**

Fourier Transforms: Infinite Fourier transforms, Fourier Sine and Cosine transforms, Inverse Fourier sine and cosine transforms. Convolution theorem (Statement only). Discrete Fourier Transform and Fast Fourier Transform: Definition of N-Point DFT, problems for 4-points and inverse DFT for four points only. FFT algorithm to compute the Fourier transforms 4-point only.

Text Book	Text Book 1: 22.4, 22.5, Text Book 2:8.3, 8.4, 9.2, 9.3, Text Book 3: 11.8, 11.9

List of Tutorial Contents

Sl. No.	Contents	COs
1.	Use Newton's forward formula for equal interval problems.	24MAE31.1
2.	Use Newton's backward formula for equal interval problems.	24MAE31.1
3.	Uses of Simpson's rule	24MAE31.2
4.	Numerical solution of one-dimensional heat equation and two-dimensional Laplace's equation.	24MAE31.2
5.	Solve difference equations using Z-transform.	24MAE31.3
6.	Solve difference equations using inverse Z-transform.	24MAE31.3
7.	Practical harmonic analysis-Problems.	24MAE31.4
8.	Practical harmonic analysis-Problems.	24MAE31.4
9.	Uses of DFT in problems.	24MAE31.5
10.	Uses of FFT in problems.	24MAE31.5

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Theory Tests	AAT1	AAT2
		25	15	10
L1	Remember	5	-	-
L2	Understand	5	-	-
L3	Apply	5	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	5
L2	Understand	5
L3	Apply	15
L4	Analyze	15
L5	Evaluate	10
L6	Create	-

Suggested Learning Resources:

Text Books:

1) B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, Forty fourth Edition, 2022, ISBN: 9788193328491.
2) Tarun Kumar Rawat, Digital Signal Processing, Oxford University Press, Wiley-India Publishers, Second impression, 2015, ISBN: 9780198081937.
3) Erwin Kreyszig, Advanced Engineering Mathematics, Wiley-India Publishers, Tenth Edition, Reprint 2016, ISBN: 9788126554232.

Reference Books:

1) Glyn James, Advanced Modern Engineering Mathematics, Pearson Education, Fourth Edition, 2015, ISBN: 9780273719236.
2) B. V. Ramana, Higher Engineering Mathematics, McGraw Hill Education (India) Private Limited, Fourth Edition, 2017, ISBN: 9780070634190.
3) H. K. Dass, Advanced Engineering Mathematics, S. Chand & Company Ltd., Twenty Second Edition, 2018, ISBN: 9789352533831.
4) N. P. Bali and Manish Goyal, A Text Book of Engineering Mathematics, Laxmi Publications (P) Ltd., Ninth Edition, 2014, ISBN: 9788131808320.

Web links and Video Lectures (e-Resources):

1)https://youtu.be/IgoJV4g_0LM?si=JO1_bkIvMR8xlC0V
2)https://youtu.be/mIFwzg11uO4?si=Xd13dh0eNlmIswPS

3)https://youtu.be/74g5_3TC-tQ?si=yB2PHVGr4hxIlqPo
4)https://youtu.be/QQFIWwDA9NM?si=3wJrtlm1NdPSbXmB
5)https://youtu.be/5817fLmsTGE?si=Y7ORyV2ETSCxZRAZ
6)https://youtu.be/XJRW6jamUHk?si=G_UTgCM622bz9yh4
7)https://youtu.be/QHH50jy8s_A?si=eNUoUXYLEvEZj3KM
8)https://youtu.be/m3mMeXLt2OQ?si=r9QXzwCRo0PC0ewz
9)https://youtu.be/aSu5Yde9Sfk?si=6kZbU3QRXEfEn2ua
10)https://www.youtube.com/live/tjBxcBLBe6I?si=v4RH4oqyttKhfaPd
11)https://youtu.be/-Y_0FY-IDrI?si=-ERIHGln3U2dr54J
12)https://youtu.be/zWRVxWdwXaw?si=Y78g7TogvDZIKhvs
13)https://youtu.be/nl9TZanwbBk?si=LdywSeCJ0EIt5zCx
14)https://youtu.be/E8HeD-MUrjY?si=JWwQzkQWfaTIqVhG

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

- Contents related activities (Activity-based discussions)
  - Problem solving Approach
  - Organizing Group wise discussions on related topics
  - Seminars

ANALOG ELECTRONIC CIRCUITS

Course Code	**24ECE32**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**3**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

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

24ECE32.1	Compare the BJT and JFET configurations and its respective biasing methods to perform the load line analysis
24ECE32.2	Examine the AC model of BJT and JFET to perform the small signal analysis
24ECE32.3	Analyze the frequency response of BJT and FET amplifier circuits
24ECE32.4	Compare the effect of feedback topologies in amplifier circuits
24ECE32.5	Apply the positive feedback topology to the BJT circuit to obtain the frequency of different oscillator circuits
24ECE32.6	Analyze the working principles of power amplifiers for real world applications

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24ECE32.1	3	-	-	-	-	-	-	-	-	-	-	3	1
24ECE32.2	3	3	-	-	-	-	-	-	-	-	-	3	1
24ECE32.3	3	3	1	-	-	-	-	-	-	-	2	3	1
24ECE32.4	3	-	-	-	-	-	-	-	-	-	2	3	1
24ECE32.5	3	-	-	-	-	-	-	-	-	-	2	3	1
24ECE32.6	3	3	1	-	-	-	-	-	-	-	2	3	1

MODULE-1	**BJT BIASING AND AC ANALYSIS**	**24ECE32.1**	**8 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 r_e 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 - 4.1 to 4.5, 4.7, 4.8, 5.4 to 5.6, 5.8, 5.9		
MODULE-2	**JFET BIASING AND AMPLIFIERS**	**24ECE32.2**	**8 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 7.5, 8.1 to 8.5		
MODULE-3	**BJT AND JFET FREQUENCY RESPONSE**	**24ECE32.3**	**8 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 9.3, 9.6 ,9.7 9.9 to 9.12, 5.19, 5.20 Text Book 2:16.6.16.8.16.9		
MODULE-4	**FEEDBACK AND OSCILLATOR CIRCUITS**	**24ECE32.4, 24ECE32.5**	**8 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.			
Application	Scrutinize the different types of oscillators and their applications.		

Text Book	Text Book 1 - 14.1 to 14.9		
MODULE-5	**POWER AMPLIFIERS**	**24ECE32.6**	**8 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.			
Application	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, 11thedition, Pearson Education/PHI, 2008, ISBN-13: 978-0135026496.

2) Electronic Principles, Albert Malvino and David Bates, 7th edition, McGraw-Hill, 2015, ISBN-13: 978-0073373881.

Reference Books:

1) Electric Circuits, (Schaum's Outline Series) by M Nahvi, Joseph Edminister, K Rao, 5th edition, McGraw-Hill Education, ISBN-13: 978-0071633727.

2) Electronics Devices and Circuits, Millman J and Halkias C, 3rd edition, 2007, 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

- Visit to any electronics/VLSI industry
- Demonstration of bode plot for frequency response of BJT and FET
- Video demonstration of latest trends in transistors
- Contents related activities (Activity-based discussions)
- Organizing Group wise discussions on issues.

ANALOG ELECTRONIC CIRCUITS LAB

Course Code	**24ECL32**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs / Week	**02**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**3**

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

24ECL32.1	Apply the knowledge of network theorems and device models to demonstrate the given analog electronic circuit
24ECL32.2	Model the applications of diode, BJT and FET circuits using discrete components and simulation tools
24ECL32.3	Construct analog circuits for the given design specification using suitable analog electronic components
24ECL32.4	Evaluate the performance of advanced analog circuit configurations

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24ECL32.1	3	-	-	-	2	-	-	-	-	-	-	3	3
24ECL32.2	3	2	2	1	2	-	-	-	-	-	-	3	3
24ECL32.3	3	2	2	1	2	-	-	-	-	-	-	3	3
24ECL32.4	3	2	2	1	2	-	-	-	-	-	-	3	3

Exp. No. / Pgm. No.	List of Experiments / Programs	Hours	COs
	Prerequisite Experiments / Programs / Demo		
	• **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, plot the input, output waveforms and transfer characteristics	2	24ECL32.1 24ECL32.2
2	To design and test Clamper circuits, plot the input and output waveforms	2	24ECL32.1 24ECL32.2
3	To design and test the Integrators and Differentiators circuit. Plot the input and output waveforms	2	24ECL32.1 24ECL32.2
4	To design and set-up the following tuned oscillator circuits using BJT, and determine the frequency of oscillation a. Hartley Oscillator b. Colpitts Oscillator	2	24ECL32.1 24ECL32.2
5	To design and test the single stage RC coupled BJT amplifier	2	24ECL32.2 24ECL32.3
6	To design and test differential amplifier using BJT	2	24ECL32.2 24ECL32.3
	PART-B		
	For simulation experiments, use PSPICE		
7	Simulation of voltage multipliers: doublers, triplers, quadruplers	2	24ECL32.2 24ECL32.3
8	Simulation of RC phase shift oscillator for the given frequency	2	24ECL32.2 24ECL32.3
9	Simulation of Common Source Amplifier	2	24ECL32.2 24ECL32.3
10	Simulation of current-series and voltage shunt feedback amplifier and	2	24ECL32.2

	to calculate the following parameters with and without feedback a. Mid band gain b. Bandwidth and cut-off frequencies c. Input and output impedance		24ECL32.4
11	Simulation of Darlington emitter follower circuit to calculate the Bandwidth	2	24ECL32.2 24ECL32.4
12	Simulation of Class B push pull amplifier & observe the crossover distortion	2	24ECL32.2 24ECL32.4

PART-C

Beyond Syllabus Virtual Lab Content

(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 http://vlabs.iitkgp.ac.in/aec/exp2/index.html
3. Monostable Multivibrator using IC 555 http://vlabs.iitkgp.ac.in/aec/exp3/index.html
4. Astable Multivibrator using IC 555 http://vlabs.iitkgp.ac.in/aec/exp4/index.html
5. Schmitt Trigger http://vlabs.iitkgp.ac.in/aec/exp5/index.html
6. Frequency Response of CS Amplifier http://vlabs.iitkgp.ac.in/aec/exp6/index.html

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		20	30
L1	Remember	-	-
L2	Understand	5	10
L3	Apply	10	10
L4	Analyze	5	10
L5	Evaluate	-	-
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	5
L2	Understand	10
L3	Apply	20
L4	Analyze	15
L5	Evaluate	-
L6	Create	-

Suggested Learning Resources:

Reference Books:

1) Robert L. Boylestad and Louis Nashelsky, Electronic Devices and Circuit Theory, 11th edition, Pearson, 2012, 978-0-13-262226-4

2) Adel S. Sedra and Kenneth C. Smith, Tony Chan Carusone and Vincent Gaudet, Microelectronic Circuits - Theory and applications, Oxford Univ Press; International edition, 2020, 978-0190853501

DIGITAL ELECTRONIC CIRCUITS			
Course Code	**24ECE33**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**3Hrs**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

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

24ECE33.1	Apply the fundamental concepts of Digital logic to implement the functions using logic gates
24ECE33.2	Make use of standard methods to simplify the Boolean expressions
24ECE33.3	Employ the simplification methods for designing combinational logic circuits
24ECE33.4	Demonstrate the design of general sequential logic circuits
24ECE33.5	Design the circuits of standard Registers and Counters using flip flops
24ECE33.6	Examine the significance of state machines in Digital system design

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24ECE33.1	3	-	-	-	-	-	-	-	-	-	-	3	1
24ECE33.2	3	3	-	-		-	-	-	-	-		3	1
24ECE33.3	3	3	3	-	-	-	-	-	-	-	-	3	1
24ECE33.4	3	3	3	3	-	-	-	-	-	-	-	3	1
24ECE33.5	3	3	3	3		-	-	-	-	-		3	1
24ECE33.6	3	3	3	3		-	-	-	-	-		3	1

MODULE-1	**PRINCIPLES OF COMBINATIONAL LOGIC**	**24ECE33.1 24ECE33.2**	**8 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), QM method & 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)

MODULE-2	**ANALYSIS AND DESIGN OF COMBINATIONAL LOGIC**	**24ECE33.3**	**8 Hours**

Full Adder, Ripple carry Adder, Carry Look Ahead Adder, Full Subtractor, 8x3 Encoder, 3x8 Decoder, Binary Comparator(1Bit&2Bit), Code Conversion(Binary to Gray vice versa),Multiplexer(4x1& 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)

MODULE-3	**LATCHES AND FLIPFLOPS**	**24ECE33.4**	**8 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)

MODULE-4	**SEQUENTIAL CIRCUITS**	**24ECE33.5**	**8 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)

MODULE-5	**FINITE STATE MACHINE**	**24ECE33.6**	**8 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)

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. Digital Logic: Applications and Design, John M. Yarbrough, Cengage Learning,2015 reprint, ISBN-13: 978-8131505748.
2. Digital Principles and Design, Donald D. Givone, 2003, Tata McGraw Hill Edition2002, ISBN-13: 978-0072525038.

Reference Books:

1. Digital Fundamentals, Thomas Floyd, 11thedition,2014, Pearson Education, ISBN-13: 978-0132737968.
2. Digital Logic and Computer Design: M. Morris Mano, Pearson Education, ISBN-13: 978-0130898968.
3. An Illustrative Approach to Logic Design, R.D. Sudhakar Samuel, 2010, Pearson Education, ISBN-13: 978-8131732526.

Web links and Video Lectures (e-Resources):

- https://www.electronicsforu.com/technology-trends/learn-electronics/digitalelectronics-basics
- https://onlinecourses.nptel.ac.in/noc20_ee32/preview

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

DIGITAL ELECTRONIC CIRCUITS LAB

Course Code	**24ECL33**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs / Week	**2**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**3**

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

24ECL33.1	Apply logic gates to construct and interpret truth tables for various logical expressions and combinational circuits
24ECL33.2	Analyse digital combinational and sequential logic circuits to interpret their functionality and timing behaviour
24ECL33.3	Design digital combinational and sequential logic circuits to meet specified functional requirements
24ECL33.4	Demonstrate various types of Shift registers, up/down counters, Mealy and Moore model

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24ECL33.1	3	-	-	-	2	-	-	-	-	-	-	3	2
24ECL33.2	3	2	2	-	2	-	-	-	-	-	-	3	2
24ECL33.3	3	2	2	-	2	-	-	-	-	-	-	3	2
24ECL33.4	3	2	2	-	2	-	-	-	-	-	-	3	2

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	24ECL33.1 24ECL33.2
2	Realization of Half/Full adder and Half/Full Subtractor using Logic gates.	2	24ECL33.1 24ECL33.2
3	a) Realization of parallel adder/ Subtractors using7483chip b) BCD to Excess-3code conversion and vice versa.	2	24ECL33.1 24ECL33.2
4	Realization of Binary to Gray code conversion and vice versa.	2	24ECL33.1 24ECL33.2
5	MUX/DEMUX–use of 74153, 74139 for arithmetic circuits and code Converter.	2	24ECL33.1 24ECL33.2
6	Realization of One/Two bit comparator and study of 7485 Magnitude comparator.	2	24ECL33.1 24ECL33.2
	PART-B		
7	a) Use of Decoder chip to drive LED display b) Verifying the functionality of Priority encoder	2	24ECL33.2 24ECL33.3
8	Truth table verification of Flip-Flops: a) JK Master slave b) T type c) D type	2	24ECL33.2 24ECL33.3
9	Shift left; Shift right, SIPO, SISO, PISO, PIPO operations using74S95.	2	24ECL33.2 24ECL33.3 24ECL33.4
10	Realization of Johnson and Ring counter.	2	24ECL33.2 24ECL33.3

			24ECL33.4
11	Realization of synchronous and asynchronous counters.	2	24ECL33.2 24ECL33.3 24ECL33.4
12	Design and implementation of synchronous or clocked sequential circuits using Mealy and Moore model.	2	24ECL33.3 24ECL33.4

PART-C

Beyond Syllabus Virtual Lab Content

(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
		20	30
L1	Remember	-	-
L2	Understand	5	10
L3	Apply	10	10
L4	Analyze	5	10
L5	Evaluate	-	-
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	5
L2	Understand	10
L3	Apply	20
L4	Analyze	15
L5	Evaluate	-
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	**24ECE34**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**3**	**Total Marks**	**100**
Credits	**3**	**Exam Hours**	**3**

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

24ECE34.1	Classify the continuous time and discrete time signals and systems, concepts of sampling and visualize the signal behavior using signal transformation
24ECE34.2	Apply convolution techniques to determine the output of continuous and discrete-time LTI systems using impulse and step responses
24ECE34.3	Solve the system response from differential and difference equations for natural and forced inputs
24ECE34.4	Analyze Fourier and Z-Transform techniques to represent and interpret the frequency domain behavior of continuous and discrete-time signals
24ECE34.5	Evaluate discrete systems using Z transform properties
24ECE34.6	Interpret the role of AI in signal processing to support modern engineering applications

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24ECE34.1	3	3	-	-	-	-	-	-	-	-	2	3	2
24ECE34.2	3	-	-	-	-	-	-	-	-	-	-	3	2
24ECE34.3	3	-	-	-	-	-	-	-	-	-	-	3	2
24ECE34.4	3	3	-	-	-	-	-	-	-	-	2	3	2
24ECE34.5	3	3	-	-	1	-	-	-	-	-	2	3	2
24ECE34.6	3	-	-	2	1	2	1	-	-	-	2	3	2

MODULE-1	**INTRODUCTION TO SIGNALS AND SYSTEMS**	**24ECE34.1**	**8 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), LTI system.

Applications	Signal Processing in a Digital Camera.
Text Book	Text Book 1 : 1.1,1.2,1.4,1.5,1.6

MODULE-2	**TIME DOMAIN REPRESENTATION AND ANALYSIS OF LTI SYSTEMS**	**24ECE34.2 24ECE34.3**	**8 Hours**

Properties of impulse response representation, Impulse response and step response of a continuous time and discrete time LTI system, Convolution Sum, Convolution Integral.
Solution for Differential & Difference equations- Natural Response, Forced Response and Complete response.

Applications	Analysis of discrete and continuous time LTI system.
Text Book	Text Book 1 : 2.1,2.2,2.3.8,2.4

MODULE-3	**ANALYSIS OF CONTINUOUS TIME SIGNALS**	**24ECE34.4**	**8 Hours**

Fourier Transform of continuous time Aperiodic signals, Properties of Fourier Transform, The Fourier transform of periodic signals, Magnitude Spectrum, Phase Spectrum, Energy Spectral Density, Power Spectral Density.

Self- Study	Explore how Fourier Transform is used for frequency analysis in audio signals.
Text Book	Text Book 1: 4.1,4.2,4.3

MODULE-4	**ANALYSIS OF DISCRETE TIME SIGNALS**	**24ECE34.4 24ECE34.5**	**8 Hours**

Sampling: Sampling theorem, Reconstruction of signal, Aliasing.
Z-Transform: Definition, ROC, Inverse Z-Transform, Properties, Transform analysis of LTI Systems.

Self-Study	Realization of Digital Filters.		
Text Book	Text Book 1 : 7.1,7.2,7.3,10.1,10.2,10.3,10.5,10.7		
MODULE-5	**ROLE OF AI IN SIGNAL PROCESSING**	**24ECE34.6**	**8 Hours**
Overview of Biomedical data, Role of AI in Biomedical data, challenges, Role of AI in Biomedical application, Signal processing Techniques in Biomedical systems, Integration of AI in signal Processing(overview), Overview of AI algorithm in Biomedical data 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		

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

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

Reference Books:

1.Principles of Linear Systems and Signals, B. P. Lathi, 2nd edition, Oxford University Press, 2009, ISBN:9780198062271

2. Signals and Systems, Uday kumar S, 6th edition, Prism book House, 2012, ISBN:9788172866921.

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

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)

  ➢ Seminars

CIRCUIT DESIGN AND ANALYSIS

Course Code	**24ECE35**	**CIE Marks**	**50**
L: T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**3**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course outcomes:

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

24ECE35.1	Apply basic electrical laws and techniques such as mesh and nodal analysis for solving DC electrical circuits
24ECE35.2	Analyze electrical networks using circuit theorems and characterize two-port networks using various parameters
24ECE35.3	Evaluate transient response of first and second order RL, RC, and RLC circuits using Laplace transform methods
24ECE35.4	Analyze the behavior of electrical elements under switching conditions and evaluate initial/final conditions
24ECE35.5	Apply the fundamental characteristics and parameters of operational amplifiers to design and analyse basic DC amplifier configurations
24ECE35.6	Design Op-Amp based amplifier circuits and active filters for analog signal processing

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
24ECE35.1	3	-	-	-	-	-	-	-	-	-	2	3	2
24ECE35.2	3	3	2	-	-	-	-	-	-	-	2	3	2
24ECE35.3	3	-	-	-	-	-	-	-	-	-	2	3	2
24ECE35.4	3	3	2	1	-	-	-	-	-	-	2	3	2
24ECE35.5	3	3	-	-	-	-	-	-	-	-	2	3	2
24ECE35.6	3	3	2	1	-	1	-	-	-	-	2	3	2

MODULE-1	**BASIC LAWS AND NETWORK ANALYSIS TECHNIQUES**	**24ECE35.1**	**8 Hours**

Introduction to basic electrical laws, Wye-Delta transformation, nodal analysis and mesh analysis using independent sources, 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:30-51,80-102)

MODULE-2	**NETWORK THEOREMS AND TWO-PORT NETWORK ANALYSIS**	**24ECE35.2**	**8 Hours**

Circuit Theorem- 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**	**24ECE35.3, 24ECE35.4**	**8 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.

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) 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**	**24ECE35.5**	**8 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**	**24ECE35.6**	**8 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 978-93-325-5013-1
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, ISBN-13:978-0132808682.
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	**24ECE361**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs / Week	**2**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

Course outcomes:

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

24ECE361.1	Apply the fundamental concepts of electronics for creating schematics and layout of electronics design problems
24ECE361.2	Simulate electronic circuits to study the behavior of components and circuits before building physically
24ECE361.3	Make use of software interface for placing components on the board and routing traces to establish connections, mimicking the real-world PCB fabrication process
24ECE361.4	Analyze the functionality of the code and its interaction with the hardware components without needing physical hardware

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24ECE361.1	3	-	-	-	2	-	-	-	-	-	-	3	3
24ECE361.2	3	3	1	1	2	-	-	-	-	-	-	3	3
24ECE361.3	3	3	1	1	2	-	-	-	-	-	-	3	3
24ECE361.4	3	3	1	1	2	-	-	-	-	-	-	3	3

Exp. No. / Pgm. No.	List of Simulation Programs	Hours	COs
	Prerequisite Experiments / Programs / Demo		
-	• **Basic Electronics Knowledge** • **Proteus Software Installation** • **Components and Libraries** • **Circuit Design Basics**. • **Circuit Simulation**	2	NA
	PART-A		
1	To understand the principles of LED operation and current limiting	2	24ECE361.1
2	To investigate the charging behavior of capacitors.	2	24ECE361.1
3	To design transistor as a Switch	2	24ECE361.1
4	To design and analyze an inverting amplifier	2	24ECE361.1
5	To create a square wave generator using 555 Timer in Astable Mode	2	24ECE361.2
6	To convert an AC signal to DC Using a Rectifier (Half wave)	2	24ECE361.2
	PART-B		
7	To obtain a stable 5V DC output using LM7805 Voltage Regulator	2	24ECE361.2
8	To investigate the basic logic gates	2	24ECE361.2
9	To Investigate serial to parallel conversion using Shift register	2	24ECE361.3
10	To design and analyze a crystal oscillator	2	24ECE361.3
11	To display frequency of an input signal using 7-segment Display	2	24ECE361.4
12	To convert an AC signal to DC Using a Rectifier (Full wave)	2	24ECE361.4

PART-C

Beyond Syllabus Virtual Lab Content

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

1. Draw the layout for 5V DC Power Supply circuit on Proteus. https://www.theengineeringprojects.com/2015/04/how-to-design-a-dc-power-supply-in-proteus.html

2. Design and Simulation of Hartley Oscillator. https://www.youtube.com/watch?v=akqoYmkaiSc
3. Flashing LED's Using 555 IC Circuit, Simulation, And PCB Layout Design. https://www.youtube.com/watch?v=j2A35oHB3tM
4. Half Adder using Proteus. https://www.youtube.com/watch?v=CAMURFssBaQ

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		20	30
L1	Remember	-	-
L2	Understand	-	10
L3	Apply	10	10
L4	Analyze	5	10
L5	Evaluate	-	-
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	5
L2	Understand	10
L3	Apply	20
L4	Analyze	15
L5	Evaluate	-
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	**24ECE362**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs / Week	**2**	**Total Marks**	**100**
Credits	**1**	**Exam Hours**	**3**

Course outcomes:

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

24ECE362.1	Understand the fundamental core concepts of Python Programming and Raspberry Pi
24ECE362.2	Apply the basic knowledge of python Programming and system control to perform a specific task
24ECE362.3	Conduct experiments to interface different I/O's to perform different tasks
24ECE362.4	Develop programming skills in embedded systems for various applications

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24ECE362.1	2	-	-	-	3	-	-	-	-	-	-	3	3
24ECE362.2	3	-	-	-	3	-	-	-	-	-	-	3	3
24ECE362.3	3	2	1	-	3	-	-	-	-	-	-	3	3
24ECE362.4	3	2	1	-	3	-	-	-	-	-	-	3	3

Exp. No. / Pgm. No.	List of Programs	Hours	COs
	Prerequisite Programs / Demo		
	A basic understanding in Arduino controllers and Python Programming.	2	NA
	PART-A		
1	Getting started with Raspberry Pi. i. Introduction to Raspberry Pi and supporting Operating systems	2	24ECE362.1
2	Basic programming in Python on Raspberry Pi. i. Printing message ii. File handling iii. Using different looping statements	2	24ECE362.2
3	GPIO Programming: Write a Python program to control GPIO pins in Raspberry Pi. i. LED's ii. Push Buttons	2	24ECE362.2
4	Write a Python program for Traffic light controlling unit in Raspberry Pi.	2	24ECE362.2
5	Write a Python program to interface temperature sensor (DHT11) in Raspberry Pi, to display the temperature and humidity on the console..	2	24ECE362.3
6	Write a Python program for human motion detection unit in Raspberry Pi.	2	24ECE362.3
	PART-B		
7	Write a Python program for controlling the speed of servo motor using PWM in Raspberry Pi.	2	24ECE362.3
8	Interface an ultrasonic sensor (HC-SR04) to measure distance and display it on the terminal using Python.	2	24ECE362.3
9	Write a Python script to display "Welcome to Raspberry Pi" on a 16x2 LCD using the I2C interface.	2	24ECE362.3
10	Write a Python-Flask application to control an LED from a webpage hosted on Raspberry Pi.	2	24ECE362.4

11	Develop a Python program to send DHT11 sensor data to the ThingSpeak cloud platform.	2	24ECE362.4
12	Write a Python script that captures sensor data and sends an email alert if temperature exceeds 30°C.	2	24ECE362.4

PART-C

Beyond Syllabus Virtual Lab Content

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

1. **Design and implement a smart home control system using Raspberry Pi, Python, and sensors (LED, PIR, and Temperature). Include both automatic and manual control using a web interface.**
2. **Use SPI communication to interface an ADC (e.g., MCP3008) and display analog sensor data.**

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		20	30
L1	Remember	-	-
L2	Understand	5	10
L3	Apply	10	10
L4	Analyze	5	10
L5	Evaluate	-	-
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	5
L2	Understand	10
L3	Apply	20
L4	Analyze	15
L5	Evaluate	-
L6	Create	-

Suggested Learning Resources:

Reference Books:

1) "Programming the Raspberry Pi: Getting Started with Python", 3rd Edition, Simon Monk, McGraw-Hill Education. ISBN: 9781260121736.

2) "Raspberry Pi Cookbook- Software and Hardware Problems & Solutions", 4th Edition, Simon Monk, O'Reilly.

INDUSTRIAL ROBOT PROGRAMMING USING ROBOGUIDE

Course Code	**24ECE363**	**CIE Marks**	**50**
L:T:P:S	**0: 0: 1: 0**	**SEE Marks**	**50**
Hrs / Week	**2**	**Total Marks**	**100**
Credits	**1**	**Exam Hours**	**3hrs**

Course outcomes:

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

24ECE363.1	Apply knowledge of industrial robot anatomy, coordinate systems, and teach pendant programming to execute basic motion tasks using FANUC Roboguide
24ECE363.2	Develop logic-driven robot programs using registers, timers, branching, and conditional execution to automate task sequences
24ECE363.3	Create simulation-based robotic applications using macros, program shifting, and gripper operations for industrial pick-and-place tasks
24ECE363.4	Evaluate digital/analog I/O control, user panel interaction, and task-level automation with diagnostics and recovery mechanisms

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24ECE363.1	3	-	-	-	3	-	-	-	-	-	-	3	2
24ECE363.2	3	3	3	2	3	-	-	-	-	-	-	3	2
24ECE363.3	3	3	3	2	3	-	-	-	-	-	-	3	3
24ECE363.4	3	3	3	2	3	-	-	-	-	-	-	3	3

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. RoboGuide Package.	2	NA
	PART-A		
1	To identify robot components, understand EOAT, robot axes, payload, and coordinate systems.	2	24ECE363.1
2	To orient the tool, create teach programs, and perform Joint, Linear, motion programming.	2	24ECE363.1
3	To create a robot program to perform arc and circular arc motions.	2	24ECE363.1
4	To define and use multiple Tool and User frames using Three-point, Six-point, and Direct Entry methods.	2	24ECE363.2
5	To create logic-driven robot programs using registers, timers, conditional instructions.	2	24ECE363.2
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	24ECE363.2
	PART-B		
7	To create logic-driven robot programs using position registers.	2	24ECE363.3
8	To create reusable macros and procedures for path transformation.	2	24ECE363.3
9	To create reusable macros and shift programs for path transformation.	2	24ECE363.3
10	To control gripper movements using digital output signals through RO/RI commands.	2	24ECE363.4
11	To program pick-and-place and palletization tasks with looped logic, counters, and user-defined routines.	2	24ECE363.4
12	To program and control digital/analog I/O, user panel I/O, and robot I/O to interface with external devices	2	24ECE363.4
	PART-C		

Beyond Syllabus Virtual Lab Content

(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**

CIE Assessment Pattern (50 Marks – Lab)

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

SEE Assessment Pattern (50 Marks – Lab)

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

Suggested Learning Resources:

Reference Books:

1) Introduction to Robotics: mechanics and control, Craig J J, 3/E,Pearson Education, India,2008.
2) Mikell P Groover & Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta,
Industrial Robotics, "Technology Programming and Applications", McGraw Hill, 2012.
3) ROBOT GUIDE MANUAL, FANUC.

DATA VISUALIZATION USING SCILAB

Course Code	**24ECE364**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs / Week	**02**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

Course outcomes:

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

24ECE364.1	Apply and use data visual tools of SCI Lab for data visualization
24ECE364.2	Analyze different types of data using plotting functions in Scilab software
24ECE364.3	Create 2D and 3D plots for analyzing different mathematical equations
24ECE364.4	Design applications with Scilab Xcos simulator and GUI toolbox

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO2
24ECE364.1	3	-	-	-	2	-	-	-	-	-	2	3	3
24ECE364.2	3	3	2	2	2	-	-	-	-	-	2	3	3
24ECE364.3	3	3	2	2	2	-	-	-	-	-	2	3	3
24ECE364.4	3	3	2	2	2	-	-	-	-	-	2	3	3

Exp. No. / Pgm. No.	List of Experiments / Programs	Hours	COs
	Prerequisite Experiments / Programs / 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	24ECE364.1 24ECE364.2
2	To plot y = sin(x) and y = cos(x) on the same graph.	2	24ECE364.1 24ECE364.2
3	To represent student marks using a bar chart & Pie chart.	2	24ECE364.1 24ECE364.2
4	Create Scatter plot to visualize correlation.	2	24ECE364.1 24ECE364.2
5	Implementing time series plot for temperature data over time	2	24ECE364.1 24ECE364.2
6	Create a Parametric plot to plot a Lissajous curve.	2	24ECE364.1 24ECE364.2
	PART-B		
7	Implementing Multi-Series 2D Plots in Scilab Using 2D to 2D4 Functions	2	24ECE364.1 24ECE364.3
8	Create 3D surface plot for the equation z = sin(x)*cos(y).	2	24ECE364.1 24ECE364.3
9	To read and visualize data from a CSV file.	2	24ECE364.1 24ECE364.3
10	Create interactive 3D plot to view and rotate a 3D surface interactively.	2	24ECE364.1 24ECE364.3
11	Design and Analysis of Basic Electrical Circuits Using Xcos Simulator.	2	24ECE364.1 24ECE364.4
12	Creating Basic Graphical User Interfaces in Scilab Using GUI Toolbox	2	24ECE364.1 24ECE364.4
	PART-C		

Beyond Syllabus Virtual Lab Content
(To be done during Lab but not to be included for CIE or SEE)

1. Study of basic properties of operational amplifier: inverting and non-inverting
https://be-iitkgp.vlabs.ac.in/exp/non-inverting-amplifiers/
2. Study of Differentiator and Integrator using Operational Amplifier
https://be-iitkgp.vlabs.ac.in/exp/operational-amplifier/
3. RC Differentiator and Integrator
https://be-iitkgp.vlabs.ac.in/exp/differentiator-integrator/
4. To develop an APP with SCILAB
https://www.youtube.com/watch?v=pPbVYJvct6U

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		20	30
L1	Remember	-	-
L2	Understand	5	10
L3	Apply	10	10
L4	Analyze	5	10
L5	Evaluate	-	-
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	5
L2	Understand	10
L3	Apply	20
L4	Analyze	15
L5	Evaluate	-
L6	Create	-

Suggested Learning Resources:
Reference Books:
1. Sandeep Nagar, *Introduction to Scilab: For Engineers and Scientists*. Apress publisher, New York, USA, 2017.
2. 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/

BIO INSPIRED DESIGN AND INNOVATION

Course Code	**24ECE365**	**CIE Marks**	**50**
L:T:P:S	**1:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**01**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**02**

Course outcomes:

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

24ECE365.1	Apply the biomimetics principles for real life challenges
24ECE365.2	Investigate novel bioengineering initiatives by evaluating design and development principles
24ECE365.3	Apply the bio computing optimization through research and experiential learning
24ECE365.4	Review the fundamental biological ideas through pertinent industrial applications and case studies

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24ECE365.1	3	3	3	3	2	-	-	-	1	1	2	3	3
24ECE365.2	3	3	3	3	2	-	-	-	1	1	2	3	3
24ECE365.3	3	3	3	3	2	-	-	-	1	1	2	3	3
24ECE365.4	3	3	3	3	2	-	-	-	1	1	2	3	3

MODULE-1	**BIO-INSPIRED DESIGN AND ENGINEERING**	**24ECE365.1**	**3 Hours**

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

Self-study / Case Study / Applications	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**	**24ECE365.2**	**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)

Self-study / Case Study / Applications	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**	**24ECE365.3, 24ECE365.4**	**3 Hours**

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

Self-study / Case Study / Applications	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 COMPUTING AND OPTIMISATION**	**24ECE365.5**	**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 / Case Study / Applications	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 INNOVATIONS**	**24ECE365.6**	**3 Hours**

Bioinspired innovations in– Automotive, Automation, Materials and Manufacturing, Carbon Neutral Solutions (Coral Reefs, Eco-cements), Carbon Free Solutions (Lotus leaf inspired paints), Eco-restorations (Eco-friendly pesticide).	
Self-study / Case Study /Applications	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	-	-
L3	Apply	5	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	10
L2	Understand	10
L3	Apply	10
L4	Analyze	10
L5	Evaluate	10
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

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, 2020, Revised Selected Papers (Vol. 1363). Springer Nature, 2021

3) Wann D, "Bio Logic: Designing with nature to protect the environment", Wiley Publisher, 1994

Web links and Video Lectures (e-Resources) :

- https://onlinecourses.nptel.ac.in/noc22_ge24/preview
- https://biodesign.berkeley.edu/bioinspired-design-course/
- https://www.youtube.com/watch?v=cwxXY9Qe8ss
- https://www.youtube.com/watch?v=V2GvQXvjhLA
- 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

- Video demonstration of latest trends in bio inspired design
- 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

DESIGN THINKING AND FABRICATION			
Course Code	**24DTK37**	**CIE Marks**	**50**
L:T:P:S	**1:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**01**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**02**

Course outcomes:

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

24DTK37.1	Identify innovation opportunities through real-world problem analysis and observation
24DTK37.2	Propose a product or service idea using technical knowledge and feasibility insights
24DTK37..3	Demonstrate empathy and creative thinking in the ideation and concept generation stages
24DTK37.4	Design, prototype, and test functional models using appropriate tools and fabrication

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24DTK37.1	3	-	-	-	-	-	-	-	-	-	-	-	-
24DTK37.2	3	3	2	-	-	-	-	-	-	-	-	-	-
24DTK37.3	3	3	2	-	-	-	-	-	-	-	-	-	-
24DTK37.4	3	3	2	1	2	-	-	-	-	-	2	-	-

MODULE-1	**INTRODUCTION TO DESIGN THINKING**	**24DTK37.1 24DTK37.3**	**3 Hours**

Definition, origin, and key features of Design Thinking. Role of a Design Thinker in organisations. Core principles and stages of the Design Thinking process. Collaborative design thinking with examples of MVPS or prototyping

Self-study	Smart Agricultural Monitoring System
Text Book:	Text Book 1: 2.1,2.2,2.4,2.5,2.6,2.7 Text Book 2: Page No. 1-90

MODULE-2	**DESIGN THINKING METHODOLOGY**	**24DTK37.3**	**3 Hours**

Design Thinking Methodology: The 5 Stages of the Design Thinking Process- Empathise, define (the problem), Ideate, Prototype, and Test.

Self-study	Autonomous Drone for Aerial Surveillance
Text Book	Text Book 1:5.1,5.2,5.3 Text Book 2: Page No.100-124

MODULE-3	**TOOLS FOR DESIGN THINKING**	**24DTK37.1**	**3 Hours**

Ideation tools & exercises. Sample Design Challenge, Introduction to the Design Challenge Themes, Storytelling and Tools for Innovation.

Self-study	Smart Home Automation System
Text Book	Text Book 1:4.1,4.2,4.6,4.8,6.1,6.2,6.3 Text Book 2: Page No.125-138

MODULE-4	**EMPATHY MAPS**	**24DTK37.3**	**3 Hours**

Empathise-Understand customers, Empathy Maps, Empathise-Step into customers' shoes, Customer Journey Maps, Define- Analysis & Drawing Inferences from Research.

Self-study	Custom Drone with Payload Integration for Search and Rescue
Text Book	Text Book 1: 9.1,9.2,9.3,10.1,10.2,10.3,10.4 Text Book 2:Page No.139-146

MODULE-5	**DESIGN CHALLENGE AND PROTOTYPING**	**24DTK37.2 24DTK37.4**	**3 Hours**

The Design Challenge: Define the Design Challenge, Prototyping & Iteration- Feasibility Study, Testing, Documentation, and the Pitching.

Self-study	Automated PCB Inspection System
Text Book	Text Book 1:3.1,3.2 Text Book 2: Page No.147 and 189

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	-	-
L4	Analyze	5	5	-
L5	Evaluate	-	5	5
L6	Create	-	5	5

SEE Assessment Pattern (50 Marks – Theory)

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

Suggested Learning Resources:

Text Books:

1) Christian Mueller-Roterberg, Handbook of Design Thinking - Tips & Tools for how to design thinking. ISBN-13: 978-1790435371
2) John. R. Karsnitz, Stephen O'Brien and John P. Hutchinson, "Engineering Design", Cengage learning (International edition) Second Edition, 2013. ISBN-13: 978-1111645823

Reference Books:

1) Roger Martin, "The Design of Business: Why Design Thinking is the Next Competitive Advantage", Harvard Business Press, 2009. ISBN-13: 978-1422177808
2) Hasso Plattner, Christoph Meinel and Larry Leifer (eds), "Design Thinking: Understand – Improve - Apply", Springer, 2011, ISBN-13: 978-3-642-13756-3
3) Yousef Haik and Tamer M. Shahin, "Engineering Design Process", Cengage Learning, Second Edition, 2011. 48 , ISBN-13: 978-0495668145
4) Book - Solving Problems with Design Thinking - Ten Stories of What Works (Columbia Business School Publishing) Hardcover – 20 Sep 2013 by Jeanne Liedtka (Author), Andrew King (Author), Kevin Bennett (Author), ISBN-13: 978-0231163569

Web links and Video Lectures (e-Resources)

- https://www.ibm.com/design/thinking/
- https://www.ideou.com/pages/design-thinking

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

- Ergonomic Kitchen Tool Handle: Reverse Engineering and Redesign
- Customizable Modular Furniture System: From Concept to Prototype
- Rapid PCB Prototyping for Bluetooth Applications
- CNC Milling for Custom Circuit Board Fabrication
- Smart Motion Detection System Using Microprocessor
- IoT-Based Smart Home Automation System Using Microprocessor
- Design and Fabrication of Rotary Milling Fixture
- Design and Fabrication of Milling Vise Attachment on Lathe Machine
- AI-Driven Drone for Search and Rescue Operations
- Autonomous Drone for Wildfire Detection and Monitoring
- Drone-Based Delivery System for Emergency Medical Supplies

NATIONAL SERVICE SCHEME

Course Code	**24NSS30, 24NSS40, 24NSS50, 24NSS60**	**CIE Marks (each Semester)**	**50**
L:T:P:S	**0:0:0:0**	**SEE Marks**	**--**
Hrs / Week	**2**	**Total Marks**	**50 x 4 = 200**
Credits	**00**	**Exam Hours**	**02**

Course outcomes:

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

24NSSX0.1	Understand the importance of his / her responsibilities towards society
24NSSX0.2	Analyse the environmental and societal problems/issues and will be able to design solutions for the same
24NSSX0.3	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
24NSSX0.4	Develop capacity to meet emergencies and natural disasters & practice national integration and social harmony in general

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
24NSSX0.1	-	-	-	-	-	3	3	2	-	-	1
24NSSX0.2	-	-	-	-	-	3	3	2	-	-	1
24NSSX0.3	-	-	-	-	-	3	3	2	-	-	1
24NSSX0.4	-	-	-	-	-	3	3	2	-	-	1

Semester/ Course Code	CONTENT	COs	HOURS
3RD 24NSS30	1. Organic farming, Indian Agriculture (Past, Present and Future) Connectivity for marketing 2. Waste management–Public, Private and Govt organization, 5R's. 3. Setting of the information imparting club for women leading to contribution in social and economic issues.	24NSS30.1, 24NSS30.2, 24NSS30.3, 24NSS30.4	30 HRS
4TH 24NSS40	4. Water conservation techniques – Role of different stakeholders– Implementation. 5. Preparing an actionable business proposal for enhancing the village income and approach forimplementation. 6. Helping local schools to achieve good results and enhance their enrolment in Higher/ technical/ vocational education.	24NSS40.1, 24NSS40.2, 24NSS40.3, 24NSS40.4	30 HRS
5TH 24NSS50	7. Developing Sustainable Water management system for rural areas and implementationapproaches. 8. Contribution to any national level initiative of Government of India. Foreg. Digital India, Skill India, Swachh Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme, Skill developmentprograms etc. 9. Spreading public awareness under rural outreach programs. (minimum 5 programs).	24NSS50.1, 24NSS50.2, 24NSS50.3, 24NSS50.4	30 HRS
6TH 24NSS60	10. Organize National integration and social harmony events / workshops / seminars. (Minimum TWO programs). 11. Govt. school Rejuvenation and helping them to achieve good infrastructure.	24NSS60.1, 24NSS60.2, 24NSS60.3, 24NSS60.4	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 6th 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.
- At last, in 6th semester consolidated report of all activities from 3rd to 6th semester, compiled report should be submitted as per the instructions.
- 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/Co ntinuous 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.	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/pro per 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
4.	Water conservation techniques – Role of different stakeholders– Implementation.	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
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/pro per 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/Govern ment Schemes officers	School selection/prope r 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.	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
8.	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/pro per 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.	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/pro per 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.	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
11.	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	**24PED30, 24PED40, 24PED50, 24PED60**	**CIE Marks (each semester)**	**50**
L:T:P:S	**0:0:0:0**	**SEE Marks**	**--**
Hrs / Week	**2**	**Total Marks**	**50 x 4= 200**
Credits	**00**	**Exam Hours**	**02**

Course outcomes:

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

24PEDX0.1	Understand the fundamental concepts and skills of Physical Education, Health, Nutrition and Fitness
24PEDX0.2	Create consciousness among the students on Health, Fitness and Wellness in developing and maintaining a healthy lifestyle
24PEDX0.3	Perform in the selected sports or athletics of student's choice and participate in the competition at regional/state / national / international levels.
24PEDX0.4	Understand the roles and responsibilities of organization and administration of sports and games

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
24PEDX0.1	-	-	-	-	-	2	-	3	3	-	2
24PEDX0.2	-	-	-	-	-	2	-	3	3	-	2
24PEDX0.3	-	-	-	-	-	2	-	3	3	-	2
24PEDX0.4	-	-	-	-	-	2	-	3	3	-	2

Semester	CONTENT	COs	HOURS
3RD 24PED30	**Module 1: Orientation** A. Lifestyle, B. Fitness C. Food & Nutrition D. Health & Wellness E. Pre-Fitness test.	24PED30.1, 24PED30.2	5 HRS
	Module 2: General Fitness & Components of Fitness A. Warming up (Free Hand exercises) B. Strength – Push-up / Pull-ups C. Speed – 30 Mtr Dash D. Agility – Shuttle Run E. Flexibility – Sit and Reach F. Cardiovascular Endurance – Harvard step Test	24PED30.2, 24PED30.3	15 HRS
	Module 3: Recreational Activities A. Postural deformities. B. Stress management. C. Aerobics. D. Traditional Games.	24PED30.3, 24PED30.4	10 HRS
4TH 24PED40	**Module 1: Ethics and Moral Values** A. Ethics in Sports B. Moral Values in Sports and Games	24PED40.1, 24PED40.2	5 HRS
	Module 2: Specific Games (Anyone to be selected by the student) A. Volleyball – Attack, Block, Service, Upper Hand Pass and Lower hand Pass. B. Throwball – Service, Receive, Spin attack, Net Drop & Jump throw. C. Kabaddi – Hand touch, Toe Touch, Thigh Hold, Ankle hold and Bonus. D. Kho-Kho – Giving Kho, Single Chain, Pole dive, Pole turning, 3-	24PED40.3	20 HRS

	6 Up. E. Table Tennis – Service (Fore Hand & Back Hand), Receive (Fore Hand & Back Hand), Smash. F. Athletics (Track / Field Events) – Any event as per availability of Ground.		
	Module 3: Role of Organization and administration	24PED40.4	5 HRS
5TH 24PED50	**Fitness Components:** Meaning and Importance, Fit India Movement, Definition of fitness, Components of fitness, Benefits of fitness, Types of fitness and Fitness tips. **Practical Components:** Speed, Strength, Endurance, Flexibility, and Agility **Athletics**: 1. Track -Sprints: • Starting Techniques: Standing start and Crouch start (its variations) use of Starting Block. • Acceleration with proper running techniques. • Finishing technique: Run Through, Forward Lunging and Shoulder Shrug. 2. Jumps- Long Jump: Approach Run, Take-off, Flight in the air (Hang Style/Hitch Kick) and Landing 3. Throws- Shot Put: Holding the Shot, Placement, Initial Stance, Glide, Delivery Stance and Recovery (Perry O'Brien Technique) **Handball OR Ball Badminton** **Handball:** A. Fundamental Skills 1. Catching, Throwing and Ball control, 2. Goal Throws: Jumpshot, Centershot, Diveshot, Reverseshot. 3. Dribbling: High and low. 4. Attack and counter attack, simple counter attack, counter attack from two wings and center. 5. Blocking, Goal Keeping and Defensive skills. 6. Game practice with application of Rules and Regulations. B. Rules and their interpretations and duties of officials **Ball badminton:** A. Fundamental Skills 1. Basic Knowledge: Various parts of the Racket and Grip. 2. Service: Short service, Long service, Long-high service. 3. Shots: Overhead shot, Defensive clearshot, Attacking clearshot, Dropshot, Netshot, Smash. 4. Game practice with application of Rules and Regulations. B. Rules and their interpretation and duties of officials.	24PED50.1, 24PED50.2, 24PED50.3, 24PED50.4	Total 30 Hrs/ Semester 2 Hrs/week
6TH 24PED60	**Athletics**: 1. Track -110 Mtrs and 400Mtrs: • Hurdling Technique: Lead leg Technique, Trail leg Technique, Side Hurdling, Over the Hurdles • Crouch start (its variations) use of Starting Block. • Approach to First Hurdles, In Between Hurdles, Last Hurdles to Finishing. 2. Jumps- High jump: Approach Run, Take-off, Bar Clearance (Straddle) and Landing. 3. Throws- Discus Throw: Holding the Discus, Initial Stance Primary Swing, Turn, Release and Recovery (Rotation in the circle).	24PED60.1, 24PED60.2, 24PED60.3, 24PED60.4	Total 30 Hrs/ Semester 2 Hrs/week

Football OR Hockey

Football:

A. Fundamental Skills

1. Kicking: Kicking the ball with inside of the foot, Kicking the ball with Full Instep of the foot, Kicking the ball with Inner Instep of the foot, Kicking the ball with Outer Instep of the foot and Lofted Kick.
2. Trapping: Trapping- the Rolling ball, and the Bouncing ball with sole of the foot.
3. Dribbling: Dribbling the ball with Instep of the foot, Dribbling the ball with Inner and Outer Instep of the foot.
4. Heading: In standing, running and jumping condition.
5. Throw-in: Standing throw-in and Running throw-in.
6. Feinting: With the lower limb and upper part of the body.
7. Tackling: Simple Tackling, Slide Tackling.
8. Goal Keeping: Collection of Ball, Ball clearance-kicking, throwing and deflecting.
9. Game practice with application of Rules and Regulations.

A. Rules and their interpretation and duties of officials.

Hockey:

A. Fundamental Skills

1. Passing: Short pass, Longpass, pushpass, hit
2. Trapping.

3. Dribbling and Dozing
4. Penalty stroke practice.
5. Penalty corner practice.
6. Tackling: Simple Tackling, Slide Tackling.
7. Goal Keeping, Ball clearance- kicking, and deflecting.
8. Game practice with application of Rules and Regulations.

B. Rules and their interpretation and duties of officials

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	**24YOG30, 24YOG40, 24YOG50, 24YOG60**	**CIE Marks**	**50**
L:T:P:S	**0:0:0:0**	**SEE Marks**	**--**
Hrs / Week	**2**	**Total Marks**	**50 x 4 = 200**
Credits	**00**	**Exam Hours**	**02**

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

24YOGX0.1	Understanding the origin, history, aim and objectives of Yoga
24YOGX0.2	Become familiar with an authentic foundation of Yogic practices
24YOGX0.3	Practice different Yogic methods such as Suryanamaskara, Pranayama and some of the Shat
24YOGX0.4	Use the teachings of Patanjali in daily life.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
24YOGX0.1	-	-	-	-	-	3	-	-	-	-	1
24YOGX0.2	-	-	-	-	-	3	-	-	-	-	1
24YOGX0.3	-	-	-	-	-	3	-	-	-	-	1
24YOGX0.4	-	-	-	-	-	3	-	-	-	-	1

Semester / Course Code	CONTENT	COs	HOURS
3rd 24YOG30	**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 b of Suryanamaskar. 2. Suryanamaskar 12 count,2rounds **Different types of Asanas**: 1. Sitting: Padmasana, Vajrasana, Sukhasana 2. Standing: Vrikshana, Trikonasana, Ardhakati Chakrasana 3. Prone line: Bhujangasana, Shalabhasana 4. Supineline: Utthitadvipadasana, Ardhahalasana, Halasana	24YOG30.1, 24YOG30.2, 24YOG30.3, 24YOG30.4	Total 32 Hrs/ Semester 2 Hrs/week
4TH 24YOG40	**Suryanamaskara:** Suryanamaskar 12 count,4rounds **Brief introduction and importance of:** **Kapalabhati:** Revision of Kapalabhati -40strokes/min3rounds **Different types of Asanas**: 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 **Patanjali's Ashtanga Yoga**: Asana, Pranayama **Pranayama:** Chandra Bhedana, Nadishodhana, Surya Bhedana	24YOG40.1, 24YOG40.2, 24YOG40.3, 24YOG40.4	Total 32 Hrs/ Semester 2 Hrs/week

5TH 24YOG50	**Kapalabhati:** Revision of Kapalabhati - 60strokes/min3rounds **Brief introduction and importance of:** **Different types of Asanas**: 1. Sitting: Yogamudra in Padmasana, Vibhakta Paschimottanasana, Yogamudra in Vajrasana 2. Standing: Parivritta Trikonasana, Utkatasana, Parshvakonasana 3. Prone line: Padangushtha Dhanurasana, Poorna Bhujangasana / Rajakapotasana 4. Supine line: Navasana/Noukasana, Pavanamuktasana, Sarvanga **Patanjali's Ashtanga Yoga**: Pratyahara, Dharana **Pranayama:** Ujjayi, Sheetali, Sheektari	24YOG50.1, 24YOG50.2, 24YOG50.3, 24YOG50.4	Total 32 Hrs/ Semester 2 Hrs/week
6TH 24YOG60	**Kapalabhati:** Revision of Kapalabhati – 80 strokes/min3rounds **Brief introduction and importance of:** **Different types of Asanas**: 1. Sitting: Bakasana, Hanumanasana, Ekapada Rajakapotasana 2. Standing: Parivritta Trikonasana, Utkatasana, Parshvakonasana 3. Supine line: Setubandhasana, Shavasanaa (Relaxation posture) 4. Balancing: Sheershasana **Patanjali's AshtangaYoga**: Dhyana (Meditation), Samadhi **Pranayama:** Bhastrika, Bhramari, Ujjai **Shat Kriyas:** Jalaneti and sutraneti, Sheetkarma Kapalabhati	24YOG60.1, 24YOG60.2, 24YOG60.3, 24YOG60.4	Total 32 Hrs/ Semester 2 Hrs/week

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

BASIC APPLIED MATHEMATICS-I
(Common to all Branches)

Course Code	**24DMAT31**	**CIE Marks**	**50**
L:T:P:S	**0:0:0:0**	**SEE Marks**	**-**
Hrs. / Week	**2**	**Total Marks**	**50**
Credits	**0**	**Exam Hours**	**-**

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

24DMAT31.1	Know the principles of engineering mathematics through calculus
24DMAT31.2	Determine the power series expansion of a function
24DMAT31.3	Find the definite integrals with standard limits and also develop the ability to solve different types of differential equations
24DMAT31.4	Apply ideas from linear algebra in solving systems of linear equations and determine the Eigen values and Eigen vectors of a matrix

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PSO 1	PSO2
24DMAT31.1	3	3	-	-	-	-	-	-	-	-	-	-	-
24DMAT31.2	3	3	-	-	-	-	-	-	-	-	-	-	-
24DMAT31.3	3	3	-	-	-	-	-	-	-	-	-	-	-
24DMAT31.4	3	3	-	-	-	-	-	-	-	-	-	-	-

MODULE-1	**DIFFERENTIAL CALCULUS**	24DMAT31.1 24DMAT31.2	**8 Hours**
Polar Curves-Problems on angle between the radius vector and tangent, Angle between two curves-Problems, Pedal equation for polar curves-Problems. Maclaurin's theorem for function of one variable (statement only)-Problems.			
Text Book	Text Book 1: 4.4, 4.7, 4.8, Text Book 2: 15.4		
MODULE-2	**PARTIAL DIFFERENTIATION**	24DMAT31.1	**8 Hours**
Definition and Simple problems, Euler's theorem for Homogeneous function (NO Derivation and NO extended theorem)-Problems, Jacobians of order two - definition and problems.			
Text Book	Text Book 1: 5.4, 5.7,		
MODULE-3	**INTEGRAL CALCULUS AND DIFFERENTIAL EQUATIONS**	24DMAT31.3	**8 Hours**
Problems on evaluation of sin n x and cos n x integrals with standard limits (0 to $\pi/2$). Solution of first order and first-degree differential equations-Variable separable, Linear and Exact differential equations.			
Text Book	Text Book 1: 6.2, 11.6, 11.9, 11.11, Text Book 2: 1.3, 1.4, 1.5		
MODULE-4	**LINEAR ALGEBRA-1**	24DMAT31.4	**8 Hours**
Problems on rank of a matrix by elementary transformations, Solution of system of linear equations by Gauss elimination method-Problems.			
Text Book	Text Book 1: 2.7, 28.6, Text Book 2: 7.3, 7.4		
MODULE-5	**LINEAR ALGEBRA-2**	24DMAT31.4	**8 Hours**
Linear transformation, Eigen values and Eigen Vectors of square matrix-Problems.			
Text Book	Text Book 1: 2.11, 2.13, Text Book 2: 7.9, 8.1.		

CIE Assessment Pattern (50 X 2=100 Marks – Theory)

RBT Levels		Marks Distribution		
		Theory Tests	AAT1	AAT2
		25	15	10
L1	Remember	5	-	-

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

Suggested Learning Resources:

Text Books:

1) B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, Forty fourth Edition, 2022, ISBN: 9788193328491.
2) Erwin Kreyszig, Advanced Engineering Mathematics, Wiley-India Publishers, Tenth Edition, Reprint 2016, ISBN: 9788126554232.

Reference Books:

1) Glyn James, Advanced Modern Engineering Mathematics, Pearson Education, Fourth Edition, 2015, ISBN: 9780273719236.
2) B. V. Ramana, Higher Engineering Mathematics, McGraw Hill Education (India) Private Limited, Fourth Edition, 2017, ISBN: 9780070634190.
3) H. K. Dass, Advanced Engineering Mathematics, S. Chand & Company Ltd., Twenty Second Edition, 2018, ISBN: 9789352533831.
4) N.P.Bali and Manish Goyal, A Text Book of Engineering Mathematics, Laxmi Publications (P) Ltd., Ninth Edition, 2014, ISBN: 9788131808320.

Web links and Video Lectures (e-Resources):

1)https://youtu.be/IUV0_Nj4d1s?si=eO3s7keCbCO1_jcz
2)https://youtu.be/VzUcs7aiqgg?si=YLtTUGr4Xp88KGY3
3)https://youtu.be/LDBnS4c7YbA?si=udUOdJ-u0ZxFmBAW
4)https://youtu.be/palSdK9P-ns?si=7A8_VSxEI4lGvksB
5)https://youtu.be/Bw5yEqwMjQU?si=jzbklZmVev1w8K2S
6)https://youtu.be/LBqdGn1r_fQ?si=DWcAIiFnosT7zikY
7)https://youtu.be/N5YCGOyTSuU?si=Wsf75V5fkUpfVVxr
8)https://youtu.be/gd1FYn86P0c?si=7drzBEqVFSv6sQeZ
9)https://youtu.be/cSj82GG6MX4?si=4QN1DFXEqaJoUBn7
10)https://youtu.be/0c3yq9btr3A?si=jIoz8eu5TgV7mh8G
11)https://youtu.be/PhfbEr2btGQ?si=HVK1uk65oHph0t8G

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

- Contents related activities (Activity-based discussions)
  - Problem solving Approach
  - Organizing Group wise discussions on related topics
  - Seminars

FOURTH SEMESTER

(SYLLABUS)

COMPLEX ANALYSIS AND PROBABILITY

Course Code	**24MAE41**	**CIE Marks**	**50**
L:T:P:S	**2:1:0:0**	**SEE Marks**	**50**
Hrs. / Week	**4**	**Total Marks**	**100**
Credits	**3**	**Exam Hours**	**3**

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

24MAE41.1	Solve initial value problems using appropriate numerical methods
24MAE41.2	Apply the concepts of Complex variables, Transformations and Complex integration to solve Engineering Problems
24MAE41.3	Demonstrate the idea of Linear Dependence and Independence of sets in the vector space
24MAE41.4	Gain ability to use probability distributions to analyze and solve real time problems
24MAE41.5	Apply the concept of sampling distribution to solve engineering problems and use the concepts to analyze the data to make decision about the hypothesis

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24MAE41.1	3	3	-	-	-	-	-	-	-	-	-	-	-
24MAE41.2	3	3	-	-	-	-	-	-	-	-	-	-	-
24MAE41.3	3	3	-	-	-	-	-	-	-	-	-	-	-
24MAE41.4	3	3	-	-	-	-	-	-	-	-	-	-	-
24MAE41.5	3	3	-	-	-	-	-	-	-	-	-	-	-

MODULE-1	**NUMERICAL SOLUTIONS TO DIFFERENTIAL EQUATIONS**	**24MAE41.1**	**8 Hours**

Numerical solution of ordinary differential equations of first order and of first degree: Taylor's series method, Modified Euler's method and Runge-Kutta method of fourth-order-Problems. Milne's predictor and corrector methods-Problems. Numerical Solution of second order ordinary differential equations by Runge-Kutta method of fourth-order-Problems.

Text Book	Text Book 1: 32.3, 32.5, 32.7, 32.9, 32.12, Text Book 2: 21.1.

MODULE-2	**COMPLEX ANALYSIS**	**24MAE41.2**	**8 Hours**

Functions of complex variables, Analytical functions, Cauchy-Riemann Equations in Cartesian and Polar forms, Harmonic functions and Construction of analytic functions-Problems 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 (with proof), Generalized Cauchy's integral formula

Text Book	Text Book 1: 20.2, 20.4, 20.5, 20.6, 20.10, 20.14, Text Book 2: 13.1, 13.2, 13.3, 13.4.

MODULE-3	**VECTOR SPACES AND LINEAR TRANSFORMATIONS**	**24MAE41.3**	**8 Hours**

Vector Space definition and examples, Subspaces and Spanning sets, Linear Dependence and Independence, Linear Independence and Spanning Sets, Bases: Orthogonal and Orthonormal bases and Dimension. Introduction to Linear Transformations and Basic Problems

Text Book	Text Book 3: 4.1, 4.2, 4.3, 4.4, 4.5.

MODULE-4	**PROBABILITY DISTRIBUTIONS**	**24MAE41.4**	**8 Hours**

Random variables (discrete and continuous), probability density functions, Discrete Probability distributions: Binomial and Poisson Distributions-Problems. Continuous Probability distributions: Exponential and Normal Distributions-Problems. Joint Probability Distribution-Problems.

Text Book	Text Book 1: 26.7, 26.8, 26.9, 26.12, 26.14, 26.15, 26.16.

MODULE-5	**SAMPLING THEORY**	**24MAE41.5**	**8 Hours**

Sampling, Sampling distributions, test of hypothesis of large samples for means and proportions, Inferences for variance and proportion. Central limit theorem (without proof), Confidence limits for means, Student's t-distribution, F-distribution and Chi-Square test for test of goodness of fit for small samples.

Text Book	Text Book 1: 27.2, 27.3, 27.4, 27.5, 27.6, 27.7, 27.8, 27.9, 27.10, 27.11, 27.12, 27.14, 27.15, 27.16, 27.17, 27.19.

List of Tutorial Contents

Sl. No.	Contents	COs
1.	Use Runge-Kutta method of fourth-order to solve first order and of first-degree ordinary differential equations.	24MAE41.1
2.	Use Runge-Kutta method of fourth-order to solve second order ordinary differential equations.	24MAE41.1
3.	Applications of Flow Problems-Velocity potential, Stream functions	24MAE41.2
4.	Find the images/regions in the w-plane bounded regions under the transformation $W = z^2$. $W = e^z$	24MAE41.2
5.	Use Wronskian to test a set of solutions of a linear homogeneous differential equation for linear independence.	24MAE41.3
6.	Usage of linear transformation for scale rotate and manipulate images	24MAE41.3
7.	Use of Binomial Distribution in real life problems.	24MAE41.4
8.	Use of Normal Distribution in real life problems.	24MAE41.4
9.	Use Student's t-distribution to test goodness of fit for small samples.	24MAE41.5
10.	Use Chi-square distribution to test goodness of fit for small samples.	24MAE41.5

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Theory Tests	AAT1	AAT2
		25	15	10
L1	Remember	5	-	-
L2	Understand	5	5	-
L3	Apply	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	5
L2	Understand	10
L3	Apply	10
L4	Analyze	15
L5	Evaluate	10
L6	Create	-

Suggested Learning Resources:

Text Books:

1) B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, Forty fourth Edition, 2022, ISBN: 9788193328491.
2) Erwin Kreyszig, Advanced Engineering Mathematics, Wiley-India Publishers, Tenth Edition, Reprint 2016, 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, ISBN: 9780273719236.
2) B. V. Ramana, Higher Engineering Mathematics, McGraw Hill Education (India) Private Limited, Fourth Edition, 2017, ISBN: 9780070634190.
3) H. K. Dass, Advanced Engineering Mathematics, S. Chand & Company Ltd., Twenty Second Edition, 2018, ISBN: 9789352533831.
4) N.P.Bali and Manish Goyal, A Text Book of Engineering Mathematics, Laxmi Publications (P) Ltd., Ninth Edition, 2014, ISBN: 9788131808320.

Web links and Video Lectures (e-Resources):

1)https://youtu.be/4lCiEnuhbA4?si=My95pvqwAMRDfjid
2)https://youtu.be/QQFIWwDA9NM?si=3wJrtlm1NdPSbXmB
3)https://youtu.be/bI46OqXUtd8?si=_Po-jfjq_94X4p_O
4)https://youtu.be/NqZUHJgitHk?si=Y6viSg1DFA4hgM9u
5)https://youtu.be/oPPJNoKYCro?si=A5zWC_vQQaHY7HlQ
6)https://youtu.be/hll0DAilhoA?si=2dN3KfJMBy9ZGxjD
7)https://youtu.be/x6X1P8rGXXs?si=YcmH8nxx1iQwq8mA
8) https://youtu.be/q3xj16shDuw?si=ewdlKAC8UEc6oRQV
9) https://youtu.be/89Z0tOvHjNU?si=3jT-oriJZaC1kSzx
10) https://youtu.be/dOr0NKyD31Q?si=dMBU-BXGdGL6jIZy
11) https://youtu.be/BR1nN8DW2Vg?si=melzz97SqhK3wr--
12)https://youtu.be/z0Ry_3_qhDw?si=6IG2a65BZgdbaKsn
13)https://youtu.be/36cAE1Ovpq4?si=jfR8gkFmMOCkWNZ_
14)https://youtu.be/vFz2FG65HBc?si=SCHi3Y1XuHWg-pPT
15)https://youtu.be/2Dsz1lZBJ3Y?si=8ATLUE-mkJSMewO3

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

- Contents related activities (Activity-based discussions)
  - Problem solving Approach
  - Organizing Group wise discussions on related topics
  - Seminars

SYSTEM DESIGN USING HDL

Course Code	**24ECE42**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**3**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

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

24ECE42.1	Illustrate the importance of HDL for the automation of VLSI design
24ECE42.2	Utilize Verilog data types and operators to describe digital hardware
24ECE42.3	Develop combinational and sequential digital circuits using Verilog constructs
24ECE42.4	Analyze simulation and synthesis procedures for HDL-based designs
24ECE42.5	Differentiate between commonly used programmable logic devices
24ECE42.6	Design and implement digital functions on FPGAs using Verilog and synthesis tools

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24ECE42.1	3	-	-	-	-	-	-	-	-	-	2	3	2
24ECE42.2	3	-	-	-	-	-	-	-	-	-	2	3	2
24ECE42.3	3	3	-	-	-	-	-	-	-	-	2	3	2
24ECE42.4	3	3	2	-	-	-	-	-	-	-	2	3	2
24ECE42.5	3	3	2	-	-	-	-	-	-	-	2	3	2
24ECE42.6	3	3	2	-	-	-	-	-	-	-	2	3	2

MODULE-1	**INTRODUCTION TO VHDL AND VERILOG**	**24ECE42.1, 24ECE42.2, 24ECE42.3**	**8 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**	**24ECE42.1, 24ECE42.2, 24ECE42.3**	**8 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**	**24ECE42.3, 24ECE42.4**	**8 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, 32-bit Adders, 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**	**24ECE42.5, 24ECE42.6**	**8 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**	**24ECE42.5, 24ECE42.6**	**8 Hours**
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, 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)	Qualitative Assessment (s)	MCQ's
		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	10
L2	Understand	10
L3	Apply	20
L4	Analyze	10
L5	Evaluate	-
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)

HARDWARE DESCRIPTION LANGUAGE LAB

Course Code	**24ECL42**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs / Week	**2**	**Total Marks**	**100**
Credits	**1**	**Exam Hours**	**03**

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

22ECL42.1	Design Combinational digital circuits using HDL in different levels of Abstractions
22ECL42.2	Design sequential circuits like flip flops and counters using HDL in Behavioral description
22ECL42.3	Develop Verilog/VHDL testbenches for functional verification and simulation of digital designs
22ECL42.4	Perform logic synthesis and implement synthesized designs on hardware platforms

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
22ECL42.1	3	3	2	-	3	-	-	1	-	-	2	3	2
22ECL42.2	3	3	2	-	3	-	-	1	-	-	2	3	2
22ECL42.3	3	3	2	1	3	-	-	1	-	-	2	3	2
22ECL42.4	3	3	2	1	3	-	-	1	-	-	2	3	2

Exp. No. / Pgm. No.	List of Experiments / 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	22ECL42.1 22ECL42.3 22ECL42.4
2	Write an HDL code to describe the functions of a Full Adder using three modeling styles.	2	22ECL42.1 22ECL42.3 22ECL42.4
3	Write a model for 16bit ALU using the 4bit opcodes; the requisite functions can be defined for the chosen opcodes.	2	22ECL42.1 22ECL42.3 22ECL42.4
4	Write an HDL program for the following designs: a) 4-bit Binary to Gray converter b) 4-bit Binary Comparator	2	22ECL42.1 22ECL42.3 22ECL42.4
5	Write an HDL code for the following designs: a) Decoder b) Encoder	2	22ECL42.1 22ECL42.3 22ECL42.4
6	Write an HDL code for the following designs: a) Multiplexer b) Demultiplexer	2	22ECL42.1 22ECL42.3 22ECL42.4
	PART-B		
7	Write an HDL code for the following designs: a) SR and JK flipflops b) T and D flipflops	2	22ECL42.2 22ECL42.3 22ECL42.4
8	Design 4-bit Binary and BCD counters (Synchronous reset and Asynchronous reset and “any sequence” counters).	2	22ECL42.2 22ECL42.3 22ECL42.4
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	22ECL42.2 22ECL42.3 22ECL42.4
10	Write an HDL code to display messages on the given seven segment display	2	22ECL42.2

			22ECL42.3 22ECL42.4
11	Write the HDL code to control speed, direction of stepper motor	2	22ECL42.2 22ECL42.3 22ECL42.4
12	Write the HDL code to generate different waveforms (sawtooth, sine wave, square, triangle, ramp etc) using DAC and FPGA kit.	2	22ECL42.2 22ECL42.3 22ECL42.4

PART-C

Beyond Syllabus Virtual Lab Content

(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. **2. To design multiplexers etc. using vhdl coding** https://vlab.amrita.edu/?sub=3&brch=66&sim=531&cnt=862
3. **3. To build an FSM that would detect the pattern 101** https://mddl-iitb.vlabs.ac.in/sequence_detector/index.html
4. **4. Simple Processor** https://www.intel.com/content/www/us/en/developer/topic-technology/fpgaacademic/materials-digital-logic.html

1

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		20	30
L1	Remember	-	-
L2	Understand	-	5
L3	Apply	10	10
L4	Analyze	5	10
L5	Evaluate	5	5
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	5
L3	Apply	20
L4	Analyze	15
L5	Evaluate	10
L6	Create	-

Suggested Learning Resources:

Reference Books:

1. HDL Programming (VHDL and Verilog), Nazeih M. Botros, 2015, John-Wiley India Pvt. Ltd
2. Digital System design Using Verilog, Charles H. Roth Jr., Lizy Kurian John, Byeong Kil Lee, 1 st Edition, 2015, CL Engineering.
3. Volnei A. Pedroni, "Circuit Design with VHDL", The MIT Press, 2004
4. Digital Systems Design using VHDL, Charles H Roth, Jr., 2007, Thomson
5. Digital Design: An Embedded Systems Approach Using VERILOG, Peter J. Ashenden, 2014, Elsevier.
6. Verilog HDL: A Guide to Digital Design and Synthesis, 2 nd Ed, Samir Palnitkar, PHI, 2003.

DIGITAL SIGNAL PROCESSING

Course Code	**24ECE43**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**3**	**Total Marks**	**100**
Credits	**3**	**Exam Hours**	**3**

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

24ECE43.1	Apply the knowledge of Fourier analysis to compute Discrete Fourier Transforms of signals
24ECE43.2	Use the concept of convolutional operators for linear filtering techniques
24ECE43.3	Determine the DFT and inverse DFT using Fast Fourier Transform algorithms
24ECE43.4	Design the digital filters to obtain the desired response
24ECE43.5	Illustrate the basic features of programmable Digital Signal Processor
24ECE43.6	Develop different digital signal processing applications using DSP processor

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24ECE43.1	3	-	-	-	-	-	-	-	-	-	2	3	2
24ECE43.2	3	3	-	-	-	-	-	-	-	-	2	3	2
24ECE43.3	3	3	2	-	-	-	-	-	-	-	2	3	2
24ECE43.4	3	3	2	-	-	-	-	-	-	-	2	3	2
24ECE43.5	3	-	-	-	-	-	-	-	-	-	2	3	2
24ECE43.6	3	-	-	1	2	-	-	-	-	-	2	3	2

MODULE-1	**INTRODUCTION TO SIGNAL PROCESSING AND DISCRETE FOURIER TRANSFORMS**	**24ECE43.1**	**8 Hours**

Classification of signals and systems, 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 Book1: 7.1, 7.2

MODULE-2	**DSP ALGORITHMS**	**24ECE43.2, 24ECE43.3**	**8 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.

Self-study	Case study on Designing wind speeds using fast Fourier transform
Text Book	Text Book 1: 8.1,8.1.3

MODULE-3	**FIR AND IIR FILTERS**	**24ECE43.4**	**8 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.

Case Study	Realization of 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**	**24ECE43.5, 24ECE43.6**	**8 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.

Application	Interfacing FIR LPF of order 5 and cut off frequency of 1000 HZ. Audio application using C/C++		
Text Book	Text Book2: -1.1,1.2,1.3, 3.1,3.2 ,4.1,4.2,4.3 ,7.2		
MODULE-5	**MULTI-RATE DIGITAL SIGNAL PROCESSING AND ITS APPLICATIONS**	**24ECE43.5, 24ECE43.6**	**8 Hours**

Applications: Application of digital filters in noise cancellation; Limitations of Linear filters, Random noise cancellation, Adaptive filters, LMS Algorithm.

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

Application	Radar signal Processing, DSP based measurement system.
Text Book	Text Book2: 1.1,1.2,1.3, 3.1,3.2 ,4.1,4.2,4.3 ,7.2

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. Digital signal processing: Principles, Algorithms & Applications, Proakis & Monalakis, 4thEdition, 2014, Pearson education, ISBN-13: 978-0131873742.
2. Digital Signal Processing, Avtar Singh & S. Srinivasan, Thomson Brooks /Cole, 2004, ISBN-13: 978-0534401042.
3. "Digital Signal Processing," Tarun Kumar Rawat, Oxford University Press (16 December 2014).

Reference Books:

1.Discrete Time Signal Processing, Oppenheim & Schaffer, 7th Edition, 2010, TMH, ISBN-13: 978-0131988422
2. Digital Signal Processing, S. K. Mitra, 4thEdition, 2014, Tata Mc-GrawHill, ISBN-13: 978-0073380490. 3. 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=ADnSkJnprBY
- https://www.youtube.com/watch?v=Bdw3XcXgHa8
- https://www.youtube.com/watch?v=HVGW85eGPQQ&list=PLyqSpQzTE6M_h5UgZWpybzBVDGmHGhQQb
- https://www.youtube.com/watch?v=MQzY8cIBiFs&list=PLgMDNELGJ1CYvviJ_ZHrHy5TKLbVn7-r
- https://www.youtube.com/watch?v=Iw77CYUT74c&t=17s

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 issues
- Seminars

DIGITAL SIGNAL PROCESSING LAB

Course Code	**24ECL43**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs / Week	**2**	**Total Marks**	**100**
Credits	**1**	**Exam Hours**	**3**

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

24ECL43.1	Conduct time and frequency domain analyses of signals processed by different DSP techniques
24ECL43.2	Design FIR and IIR filters for the desired frequency response
24ECL43.3	Execute discrete computations with a DSP processor
24ECL43.4	Analyse the behaviour of digital filters with a simulation tool

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24ECL43.1	3	2	1	-	3	-	-	-	-	-	2	3	2
24ECL43.2	3	2	1	-	3	-	-	-	-	-	2	3	2
24ECL43.3	3	2	1	-	3	-	-	-	-	-	2	3	2
24ECL43.4	3	2	1	-	3	-	-	-	-	-	2	3	2

Exp. No. / Pgm. No.	List of Experiments / Programs	Hours	COs
	Prerequisite Experiments / Programs / Demo		
	● **LTI System and its properties.** ● **Types of signals, autocorrelation and cross correlation basics.**	2	NA
	PART-A		
1	Computation of N-point DFT of a given sequence and plotting of Magnitude and phase spectrum.	2	**24ECL43.1**
2	Linear convolution & Circular convolution of two sequences using both time and frequency domain.	2	**24ECL43.1**
3	Auto correlation and cross correlation of given signals in time domain and frequency domain.	2	**24ECL43.1**
4	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	**24ECL43.2**
5	Design and implementation of FIR filters of different types using windowing techniques to meet given specifications.	2	**24ECL43.2**
6	Perform decimation and interpolation of signals using MATLAB.	2	**24ECL43.1**
	PART-B		
7	Computation of N-Point DFT of a given sequence using DSP Processor	2	**24ECL43.3**
8	Impulse response of first order and second order system using DSP Processor.	2	**24ECL43.3**
9	Linear convolution and circular convolution of two given sequences using DSP Processor.	2	**24ECL43.3**
10	Sampling of a signal using MATLAB Simulink.	2	**24ECL43.4**
11	Design of IIR filter of different types (Butter worth): low pass, high pass, band pass and band reject) and FIR filters to meet given specifications using MATLAB Simulink.	2	**24ECL43.4**
12	Implement LMS Adaptive Filter for noise cancellation using DSP toolbox	2	**24ECL43.4**
	PART-C **Beyond Syllabus Virtual Lab Content**		

(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.htm
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
		20	30
L1	Remember	-	-
L2	Understand	-	5
L3	Apply	10	10
L4	Analyze	5	10
L5	Evaluate	5	5
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	5
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	**24ECE44**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**3**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course outcomes:

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

24ECE44.1	Understand the functional features of 8086 Microprocessor
24ECE44.2	Apply the knowledge of addressing modes to write assembly language program in 8086
24ECE44.3	Analyze different assembler directives and interrupt methods in 8086 programming
24ECE44.4	Understand MSP430 architecture and write embedded C code
24ECE44.5	Implement timers, interrupts, and communication interfaces in MSP430
24ECE44.6	Design and interface MSP430 with peripherals and sensors for embedded applications

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24ECE44.1	-	-	-	-	-	-	-	-	-	-	-	3	-
24ECE44.2	3	-	-	-	2	-	-	-	-	-	-	3	2
24ECE44.3	3	3	-	-	2	-	-	-	-	-	-	3	2
24ECE44.4	3	3	-	-	2	-	-	-	-	-	-	3	-
24ECE44.5	3	3	2	-	2	-	-	-	-	-	-	3	2
24ECE44.6	3	3	2	2	2	-	-	-	-	-	-	3	2

MODULE-1	**ARCHITECTURE OF 8086**	**24ECE44.1**	**8 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, interrupts and interrupt response, 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**	**24ECE44.2, 24ECE44.3**	**8 Hours**

Program development steps, instructions, addressing modes, assembler directives, writing simple programs with an assembler, assembly language program development tools. Procedures 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**	**24ECE44.4**	**8 Hours**

Micro Controllers introduction, Differences between Microcontrollers and Microprocessors, RISC vs CISC, MSP430 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

Case Study	To design a temperature monitoring system was developed using the MSP430G2553 microcontroller to demonstrate the architecture and programming basics of the MSP430 platform.
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 TIMERS, INTERRUPTS, AND COMMUNICATION	24ECE44.5	8 Hours
Watchdog Timer, Timer_A, Timer_B modes, Timer-based delay and PWM generation, External interrupts and ISR configuration, communication peripherals in MSP430, Serial peripheral interfacing.			
Applications	Automatic Street Light Controller with PWM and UART Feedback		
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 ADC, LCD, AND SENSOR INTERFACING	24ECE44.6	8 Hours
ADC10/ADC12 overview and channel selection, Reading analog sensors, LCD interfacing in 4-bit mode, Real-world applications: temperature sensor, weighing machine, Basics of mini-project building using MSP430 LAUNCH BOX. 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	-	-
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) 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 Newnes, An imprint of Elsevier 2012.ISBN:978-93-80501-85-7

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	**24ECL44**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs / Week	**2**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

Course outcomes:

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

24ECL44.1	Develop assembly level programs using 8086 to perform arithmetic and logical operations
24ECL44.2	Build assembly code for string operations, sorting of numbers and branch instructions of 8086
24ECL44.3	Understand Programming of MSP430 using Embedded C
24ECL44.4	Demonstrate the performance of the various interfacing devices using MSP430

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
24ECL44.1	3	-	-	-	2	-	-	-	1	-	-	2	3	2
24ECL44.2	3	3	-	-	2	-	-	-	1	-	-	2	3	2
24ECL44.3	3	-	1	-	2	-	-	-	1	-	-	2	3	2
24ECL44.4	3	3	1	1	2	-	-	-	1	-	-	2	3	2

Pgm. No.	List of Programs	Hours	Cos
	Prerequisite Programs		
	Basic knowledge of Digital System Design Basic structure of a processor- instructions, registers and memory Introduction to microcontroller MSP430	2	NA
	PART-A		
1	Write an assembly level programs for basic arithmetic and logical operations using 8086 a. To Perform addition of n-numbers b. To perform signed and unsigned multiplication operation c. To perform signed and unsigned division operation d. To evaluate an expression.	2	24ECL44.1
2	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	24ECL44.2
3	Write an assembly Level programs for code conversion using 8086 a. Binary to BCD b. BCD to Binary c. BCD to seven segment code conversion using XLAT instruction.	2	24ECL44.1
4	Write an assembly Level programs using DOS interrupt functions a. To read a character from keyboard b. To display single character c. To display string on console d. Write an ALP to read buffered input from the keyboard using dos interrupts.	2	24ECL44.1
5	Write an assembly level program using 8086 for sorting operations like ascending, descending, largest and smallest in microprocessor.	2	24ECL44.2
6	Write an assembly level program using procedures and Macros a. To find factorial of a number b. To find whether the given number is prime or not c. To generateFibonacci series Using ALP d. To display “NHCE” using Macro.	2	24ECL44.2

	PART-B		
7	Interfacing and programming of ports of MSP430 a. To blink the RED LED using C language. b. To control the on-board LED by taking the input from switch	2	22ECL44.4
8	Interrupt programming through GPIOs OF MSP430.	2	22ECL44.3
9	a. PWM generation using Timer on MSP430 GPIO b. Generation of up/down counter using TIMER	2	22ECL44.3
10	Interfacing Potentiometer with MSP430.	2	22ECL44.4
11	PWM based Speed Control of Motor by Potentiometer.	2	22ECL44.4
12	Serial Communication using MSP430.	2	22ECL44.4

PART-C

Beyond Syllabus Virtual Lab Content

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

1. Design of Ripple Carry Adders https://cse.iitkgp.ac.in/~chitta/coldvl/rca_design.html
2. Design of Arithmetic Logic Unit http://vlabs.iitkgp.ac.in/coa/exp8/index.html
3. CPU Design http://vlabs.iitkgp.ac.in/coa/exp12/index.html#
4. Booth Multiplier http://vlabs.iitkgp.ernet.in/coa/exp7/index.html
5. Traffic light Controller using 8086 https://www.youtube.com/watch?v=t3thKRqMK2M
6. Optimized MSP Programming Across Active and Low Power Modes https://www.youtube.com/watch?v=CsV2LrdAyaw
7. Energy Trace: MSP430™ Real-time Monitoring of Power Consume. https://www.youtube.com/watch?v=oo3NnQ7cygQ

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		20	30
L1	Remember	-	-
L2	Understand	-	5
L3	Apply	10	10
L4	Analyze	5	10
L5	Evaluate	5	5
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	**24ECE451**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**3**	**Total Marks**	**100**
Credits	**3**	**Exam Hours**	**3**

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

24ECE451.1	Apply mathematical modeling techniques to represent and solve problems related to physical systems
24ECE451.2	Apply standard methods to determine the time domain response of physical systems
24ECE451.3	Analyze the frequency response characteristics of linear systems
24ECE451.4	Analyze the effect of PD, PI, and PID controllers on the transient and steady-state response of a control system
24ECE451.5	Design a control system for a given specification
24ECE451.6	Apply artificial intelligence techniques to optimize control systems for real-world applications

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24ECE451.1	3	3	-	-	-	-	-	-	-	-	-	2	2
24ECE451.2	3	3	-	-	-	-	-	-	-	-	-	2	2
24ECE451.3	3	3	-	-	-	-	-	-	-	-	-	2	2
24ECE451.4	3	3	-	2	-	-	-	-	-	-	-	2	2
24ECE451.5	3	3	-	2	-	-	-	-	-	-	-	2	2
24ECE451.6	3	-	-	-	-	-	-	-	-	-	2	2	2

MODULE-1	**Mathematical models of physical systems**	24ECE451.1	**8 Hours**

Introduction to control systems: Introduction, classification of control systems.
Mathematical models of physical systems: Modelling of mechanical system elements, electrical systems, Analogous systems, Transfer function, Single input single output systems, Procedure for deriving transfer functions, servomotors, gear trains.

Self-study	Control System modeling using Simulink
Text Book	Text Book-1 – Chapter 2.1, 2.2, 2.3 Text Book-2 – Chapter 2

MODULE-2	**Block Diagram and Signal Flow Graph representation**	24ECE451.1, 24ECE451.2	**8 Hours**

Block diagram: Block diagram of a closed loop system, procedure for drawing block diagram and block diagram reduction to find transfer function.
Signal flow graphs: Construction of signal flow graphs, basic properties of signal flow graph, signal flow graph algebra, construction of signal flow graph for control systems.

Self-study	Build block diagram models in MATLAB Simulink
Text Book	Text Book-1 – Chapter 2.4, 2.5, 2.6, 2.7,3.1, 3.2

MODULE-3	**Time Domain Analysis**	24ECE451.2	**8 Hours**

Time Domain Analysis: Standard test signals, time response of first order systems, time response of second order systems, steady state errors and error constants, types of control systems.
Routh Stability criterion: BIBO stability, Necessary conditions for stability, Routh stability criterion, difficulties in formulation of Routh table, application of Routh stability criterion to linear feedback systems, relative stability analysis.
Root locus technique: Introduction, root locus concepts, construction of root loci, rules for the construction of root locus.

Case Study	A Case study on Time domain analysis of a position control system/ A Case sTudy on Automatic Control System
Text Book	Text Book -1 – Chapters 5.1, 5.2, 5.3, 5.4, 5.5, 6, 5.7, 5.8, 5.9, 5.10, 6.1, 6.2, 6.3, 6.4, 6.5, 7.1, 7.2, 7.3, 7.4

MODULE-4	**Frequency Response analysis**	24ECE451.3	**8 Hours**

Frequency Response analysis: Co-relation between time and frequency response – 2nd order systems only.
Bode plots and Polar plots: Basic factors G(iw)/H(jw), General procedure for constructing bode plots, computation of gain margin and phase margin and Polar plots.

Application	Frequency Domain model estimation case study		
Text Book	Text Book -1 – Chapter 8.1, 8.2, 8.3, 8.4, 8.5, 8.6, 8.7		
MODULE-5	**Tuning Mechanisms for Control Systems**	24ECE451.4, 24ECE451.5, 24ECE451.6	**8 Hours**

Design of Control Systems: Introduction, Design with the PD Controller, Design with the PI Controller, Design with the PID Controller, Design with Phase-Lead Controller, Design with Phase - Lag Controller, Design with Lead-Lag Controller.
AI Applications of Control Systems: Introduction to AI techniques in Control System Optimization., FLC controllers, Applications in Real World Systems.

Application	Design PID tuning using Optimization techniques/ Design a Fuzzy Logic Controller using MATLAB
Text Book	Text Book -1 – Chapter 10.1, 10.2, 10.3, 10.4, 10.5, 10.6, 10.7, 15.1, 15.2, 15.3

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. "Control Systems Engineering" by I. J. Nagrath and M. Gopal. New Age International Publisher 6th Edition, 2018
2. Control System Engineering, Norman S. Nise, 5thEdition, 2009, Wiley.

Reference Books:
1. Modern Control Engineering, Ogata Katsuhiko, 5th Edition, 2010, PHI
2. B. C. Kuo", "Automatic Control Systems", John Wiley and sons, 8th edition, 2003.

Web links and Video Lectures (e-Resources):
- http://www.digimat.in/nptel/courses/video/108106098/L01.html
- http://www.digimat.in/nptel/courses/video/108103007/L01.html
- https://www.youtube.com/watch?v=w3t4mBIXf2c
- https://www.youtube.com/watch?v=RJleGwXorUk

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning
- Problem Solving exercises to solve manually and also to use virtual lab https://vlab.amrita.edu
- Video Analysis
- Class presentation

LINEAR INTEGRATED CIRCUITS

Course Code	**24ECE452**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**3**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**3**

Course outcomes:

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

24ECE452.1	Analyze the frequency response of various Op-Amp based AC amplifiers and evaluate their performance parameters
24ECE452.2	Design a precision signal processing circuits and waveform generators using Op-Amps
24ECE452.3	Evaluate the characteristics of active filters and implement noise reduction techniques in Op-Amp circuits
24ECE452.4	Design timing and oscillator circuits using 555 timer and function generator ICs for practical applications
24ECE452.5	Construct analog and digital interfacing systems using ADCs, DACs, voltage regulators, and PLLs
24ECE452.6	Analyze datasheets, technical references, and application notes for IC-based design

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24ECE452.1	3	3	-	-	-	-	-	-	-	-	1	2	1
24ECE452.2	3	3	3	-	-	-	-	-	-	-	1	2	1
24ECE452.3	3	3	-	-	-	-	-	-	-	-	1	2	1
24ECE452.4	3	3	3	-	-	-	-	-	-	-	1	2	1
24ECE452.5	3	3	-	-	-	-	-	-	-	-	1	2	1
24ECE452.6	3	3	-	-	-	-	-	-	-	-	1	2	1

MODULE-1	**OP-AMP AS AC AMPLIFIERS**	24ECE452.1	**8 Hours**

IC Operational Amplifier- Circuit Symbol and Terminals, Basic Op-Amp Circuit, 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.

Self-study	Investigate how to calculate voltage gain and analyze frequency response in AC amplifier circuits.
Text Book	Text Book 1: 1.2, 2.2, 2.3, 2.4 to 2.15

MODULE-2	**Signal Processing Circuits and Signal Generators**	24ECE452.2	**8 Hours**

Precision Half-Wave Rectifiers-Saturating Precision Rectifier, Nonsaturating Precision Rectifier, Two-Output Precision Half-Wave Rectifier, Precision Full-Wave Rectifiers-Half-Wave Rectifier and Summing Circuit, Limiting Circuits- Peak Clipper, Dead Zone Circuit, Clamping Circuits- Precision Clamping Circuit, Op-Amp Sample-and-Hold Circuits, Astable Multivibrator, Monostable Multivibrator.

Self-study	• Build a precision clamping circuit and apply a sine wave input. Observe the clamped voltage. • Design a 1 kHz square wave astable multivibrator in a simulator. Measure time period and frequency. • Simulate a monostable multivibrator triggered by a push button. Observe pulse duration.
Text Book	Text Book 1: 9.1 to 9.4, 9.6, 10.1 to 10.2.

MODULE-3	**Active Filters and Noise in Op-Amp Circuits**	24ECE452.3	**8 Hours**

Filter Types and Characteristics, First-Order Active Filters, Second-Order Filters, Band-Pass Filters, Notch Filters, All-Pass Phase Shifting Circuits, Noise in Op-Amp Circuits- Thermal Noise, Shot Noise, Op-Amp Noise, Signal-to-Noise Ratio, Minimizing Noise.

Case Study	Design and Noise Optimization of Active Filter Circuits in Biomedical Signal Processing
Text Book	Text Book 1: 12.1 to 12.3, 12.5 to 12.7, 6.1 to 6.5.

MODULE-4	**Timers & Oscillators:**	24ECE452.4, 24ECE452.6	**8 Hours**

Designing a 555 Monostable, 555 Astable Design, Voltage-Controlled Oscillator, Phase Shift Oscillator Circuit and design, Colpitts Oscillator Circuit Design, Hartley Oscillator, Wein Bridge Oscillator, Basic 8038 Function Generator.			
Application	Design and Implementation of Multi-Waveform Signal Generator Using 555 Timer, Analog Oscillators, and 8038 IC		
Text Book	Text Book 1: 10.6 to 10.8, 11.1 to 11.3, 11.5.		
MODULE-5	**DC Voltage Regulators, ADC and DAC**	24ECE452.5, 24ECE452.6	**8 Hours**
Voltage Regulator Basics, Op-Amp Series Voltage Regulator, IC Linear Voltage Regulators- 723 IC Regulator, Analog/Digital Conversion Basics, Analog-to-Digital Conversion, Digital-to-Analog Conversion, Weighted Resistor DAC, R-2R DAC, Phase-Locked Loop- Basic PLL System, PLL Components, PLL Performance Factors.			
Application	How would you design a stable power supply and signal processing unit for a microcontroller-based system that requires both analog sensor input and synchronized digital communication? Describe the roles of a 723 voltage regulator, an ADC, a DAC (R-2R or weighted resistor type), and a Phase-Locked Loop (PLL) in your design.		
Text Book	Text Book 1: 13.1, 13.2, 13.5, 15.1, 15.2, 16.1, 16.2, 16.3.		

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	Qualitative Assessment (s)	MCQ's
		25	15	10
L1	Remember	-	-	-
L2	Understand	5	-	-
L3	Apply	10	-	5
L4	Analyze	5	5	5
L5	Evaluate	5	10	-
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.

Reference Books:

1. Op-amps & linear ICs- Ramakanth A.Gayakwad, PHI.2003.
2. Linear Integrated Circuits –D. Roy Chowdhury, New Age International (p) Ltd, 2ndEd., 2003.
3. Op Amps and Linear Integrated Circuits-Concepts and Applications James M. Fiore,Cengage Learning/ Jaico, 2009.

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=7iOPteIA2m0
- https://www.youtube.com/watch?v=WYKsYvLJ7HE
- https://www.youtube.com/watch?v=pEWUL6WhnEc

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.

ELECTROMAGNETIC FIELD THEORY

Course Code	**24ECE453**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**3**	**Total Marks**	**100**
Credits	**3**	**Exam Hours**	**3**

Course outcomes:

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

24ECE453.1	Apply vector calculus concepts such as gradient, divergence, and curl in analyzing electromagnetic field quantities.
24ECE453.2	Determine electric field intensity, flux density, and potential using Coulomb's Law and Gauss's Law for various charge distributions.
24ECE453.3	Analyze magnetic fields using Biot-Savart's Law and Ampere's Circuital Law and evaluate magnetic forces and inductance.
24ECE453.4	Formulate and interpret Maxwell's equations in both differential and integral forms for time-varying fields.
24ECE453.5	Evaluate the behavior of electromagnetic waves in different media and compute power flow using the Poynting vector.
24ECE453.6	Asses time varying fields and propagation of waves in different media.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24ECE453.1	3	-	-	-	-	-	-	-	-	-	-	3	-
24ECE453.2	3	-	-	-	-	-	-	-	-	-	-	3	-
24ECE453.3	3	3	1	-	-	-	-	-	-	-	-	3	-
24ECE453.4	3	3	1	-	-	-	-	-	-	-	-	3	-
24ECE453.5	3	3	1	-	1	-	-	-	-	-	-	3	1
24ECE453.6	3	3	1	-	1	-	-	-	-	-	-	3	1

MODULE-1	**VECTOR ANALYSIS**	**24ECE453.1**	**8 Hours**

Vector Algebra - Coordinate system - Differential Length, Area and Volume - Line, Surface and volume integrals - Gradient of a scalar - Divergence & Divergence Theorem - Curl & Stokes Theorem - Laplacian of a scalar.

Self-study	Numerical on vector calculus
Text Book	T1 – 1.3,1.4,1.5,1.6,1.7, 2.1, 3.2, 3.3, 3.5, 3.6, 3.7 & 3.8 Page Nos.: 4 – 16, 31-39, 59 – 92

MODULE-2	**ELECTROSTATICS**	**24ECE453.2**	**8 Hours**

Coulomb's law - Electric Field Intensity - Electric fields due to continuous charge distribution - Electric Flux Density - Gauss's Law - Applications of Gauss's Law - Electric Potential - Electric Dipole and Flux Lines - Boundary Condition - Poisson's and Laplace's Equations.

Self-study	Experimental demonstration of Gauss's law
Text Book	T1 – 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.9, 5.9 & 6.2 Page Nos.: 112 – 147, 150 – 153, 198 – 203, 225-226

MODULE-3	**MAGNETOSTATICS**	**24ECE453.3**	**8 Hours**

Biot-Savart's Law - Ampere's Circuit Law - Magnetic Flux Density - Maxwell's Equations for Static Fields - Magnetic Scalar and Vector Potential - Magnetic Boundary Condition - Inductors and Inductances - Force on Magnetic Materials.

Case Study	Calculate the Magnetic field at the inner side of a long solenoid.
Text Book	T1 – 7.2, 7.3, 7.5, 7.6, 7.7, 8.7, 8.8 & 8.11 Page Nos.: 298 – 309, 317 – 322, 376 – 384, 394 – 395

MODULE-4	**MAXWELL'S EQUATIONS**	**24ECE453.4 24ECE453.6**	**8 Hours**

Faraday's law - Transformer and Motional Electromotive Force - Displacement Current - Maxwell's equation in Differential form - maxwell's equation in Integral form - Time-Varying Potentials -Time - Harmonic Fields.

Self-study	Explore GNU octave for solving maxwell's equation
Text Book	T1 – 9.2, 9.3, 9.4, 9.5, 9.6, 9.7

	Page Nos.: 422 – 454		
MODULE-5	**ELECTROMAGNETIC WAVE PROPAGATION**	**24ECE453.5 24ECE453.6**	**8 Hours**
Introduction - Wave in Lossy Dielectrics - Plane waves in lossless dielectrics - Plane wave in free space - Plane wave in conductors - Wave Polarization - Powe and Poynting Vector - Reflection of plane wave at normal incident.			
Self-study	Explore GNU Octave for the EM simulation		
Text Book	T1 – 10.2, 10.3, 10.4, 10.5, 10.6, 10.7,10.8 & 10.9 Page Nos.: 474 – 516		

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	AAT - 1	AAT -2
		25	15	10
L1	Remember	5	-	5
L2	Understand	5	-	5
L3	Apply	10	10	-
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. Mathew N. O. Sadiku, S.V.Kulkarni, 'Principles of Electromagnetics', 6th Edition, Oxford University Press, 2015, Asian Edition.

Reference Books:

2. William H. Hayt and John A. Buck, 'Engineering Electromagnetics', Tata McGraw Hill ,8th Revised edition, 2014
3. Kraus and Fleish, 'Electromagnetics with Applications', McGraw Hill International Editions,Fifth Edition, 2010.
4. Joseph. A.Edminister, 'Schaum's Outline of Electromagnetics, Third Edition (Schaum's Outline Series), Tata McGraw Hill, 2010.
5. Ashutosh Pramanik, 'Electromagnetism – Theory and Applications', PHI Learning Private Limited, New Delhi, Second Edition-2009.

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/108104087

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

- Vector field visualization using online tools -Geogebra
- Hands-on measurement of magnetic field using Hall effect sensors and solenoids.
- Solve Maxwell's equations using GNU Octave and visualize time-varying fields.
- Design a radiating element using EDA tool and visualize radiation field.

BIOMEDICAL SIGNAL PROCESSING

Course Code	**24ECE454**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hours / Week	**3**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course outcomes:

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

24ECE454.1	Describe the origin, properties and suitable models of biomedical signals such as ECG and EEG
24ECE454.2	Apply signal processing methods to extract relevant information from biomedical signal measurements
24ECE454.3	Develop the relevant mathematical and computational skills relevant in compression of biomedical signals
24ECE454.4	Analyze the ECG Signal behavior using signal processing methods
24ECE454.5	Analyze the rhythms and detection process in neurological signal processing
24ECE454.6	Examine the quality of biomedical images acquired from Computed Tomographic Imaging and Ultrasound Imaging modalities

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24ECE454.1	-	-	-	-	-	-	-	-	-	-	-	3	1
24ECE454.2	3	3	-	-	-	-	-	-	-	-	-	3	1
24ECE454.3	3	3	2	-	-	-	-	-	-	-	-	3	1
24ECE454.4	3	3	-	3	-	3	-	-	-	-	-	3	1
24ECE454.5	3	3	-	3	-	3	-	-	-	-	-	3	1
24ECE454.6	3	-	2	3	1	3	-	-	-	-	-	3	1

MODULE-1	**INTRODUCTION TO BIOMEDICAL SIGNALS**	**24ECE454.1, 24ECE454.2**	**8 Hours**

The nature of Biomedical Signals, Examples of Biomedical Signals, Objectives and difficulties in Biomedical analysis, Simple signal conversion systems, Conversion requirements for biomedical signals, Signal conversioncircuits, Basics of signal averaging, signal averaging asa digital filter, a typical averager, software for signal averaging, limitations of signal averaging.

Self-Study	Filtering and Frequency Analysis of 2D Images
Text Book	Text Book no 1: 1.1,2.1-2.3,3.2-3.4; 9.1-9.5.

MODULE-2	**NOISE CANCELLATION AND DATA COMPRESSION TECHNIQUES**	**24ECE454.2, 24ECE454.3**	**8 Hours**

Adaptive Noise Cancelling: Principal noise canceller model, 60- Hz adaptive cancelling using a sine wave model, other applications of adaptive filtering.

Data Compression Techniques: Turning point algorithm, AZTEC algorithm, Fan algorithm, Huffman coding, data reduction algorithms, usage of Fourier transform, Correlation, Convolution, Power spectrum estimation for analysis of ECG signal time and frequency domains.

Self- Study	Filtering and Frequency Analysis: ECG
Text Book	Text Book no 1: 8.1-8.3,10.1-10.4,11.1-11.4

MODULE-3	**ELECTROCARDIOGRAPHY**	**24ECE454.4**	**8 Hours**

Basic Electrocardiography, ECG data acquisition, ECG lead system, ECG signal characteristics (parameters and their estimation), Analog filters, ECG amplifier, and QRS detector, Power spectrum of the ECG, Band-pass filtering techniques, Differentiation techniques, Template matching techniques, A QRS detection algorithm, Real-time ECG processing algorithm, ECG interpretation, ST segment analyzer, Portable arrhythmia monitor.

Self- Study	Medical Image Segmentation

Text Book	Text Book no 2: 7.1-7.4 Text Book no 1: 12.1-12.6,13.1-13.3

MODULE-4	EEG SIGNAL	24ECE454.5	8 Hours

Neurological signal processing: The brain and its potentials, The electrophysiological origin of brain waves, The EEG signal and its characteristics (EEG rhythms, waves, and transients), Correlation.
Analysis of EEG channels: Detection of EEG rhythms, Template matching for EEG, spike and wave detection.

Self- Study	Medical Image Analysis.
Text Book	Text Book no 2: 4.1-4.4

MODULE-5	BIOMEDICAL IMAGE PROCESSING	24ECE454.6	8 Hours

Biomedical Image Processing using CT: Introduction, CT Instrumentation, Image Formation, Image Quality in CT.
Biomedical Image Processing using Ultrasound: Introduction, Instrumentation, Pulse-Echo Imaging, Transducer Motion, Ultrasound Imaging Modes, Steering and Focusing, 3-D Ultrasound Imaging, Image Quality.

Case Study	Mini-project on Bio-Medical Imaging systems
Text Book	Text Book no 3: 6.1-6.4, 11.1-11.8

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. W. J. Tompkins, "Biomedical Digital Signal Processing," PHI Learning Private Limited,New Delhi, India, 2015.
2. D. C. Reddy, "Biomedical Signal Processing: Principles and techniques," Tata McGraw-Hill, New Delhi, India, 2015.
3. J. L. Prince, and J. M. Links, "Medical Imaging Signals and Systems," PearsonEducation, Inc., New Delhi, India, 2015.

Reference Books:

1. R. Rangayyan, "Biomedical Signal Analysis," Wiley India Private Limited, New Delhi,India, 2015.
2. Bruce, "Biomedical Signal Processing & Signal Modeling," John Wiley and Sons,Singapore, 2001.
3. Sörnmo, "Bioelectrical Signal Processing in Cardiac & Neurological Applications,"Reed Elsevier Private Limited, New York, U.S.A., 2009.
4. Semmlow, "Biosignal and Biomedical Image Processing," Marcel Dekker, London,U.K., 2004
5. Enderle, "Introduction to Biomedical Engineering," 2nd Edition, Reed Elsevier Private

Limited, New York, U.S.A., 2005.

Web links and Video Lectures (e-Resources):

- **Biomedical signal processing NPTEL course.**
- **Biomedical signal processing NPTEL lecture videos https://www.youtube.com/watch?v=ezfPl8kUdbg&list=PLVDPthxoc3lNzu07X-CbQWPZNMboPXKtb**
- **Biomedical Signal processing lecture videos by Dr.Geetika Dua https://www.youtube.com/watch?v=R7WaykzESlg&list=PLeefXVKiX48rcnK0TentV2rXrQoIhuqpy**

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	**24ECE455**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**03**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course outcomes:

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

24ECE455.1	Use advanced pointer techniques and dynamic memory functions effectively
24ECE455.2	Summarize the concepts of complex data structures and illustrate their applications in various scenarios
24ECE455.3	Implement linked lists and understand their working in real time applications
24ECE455.4	Differentiate between various advanced tree and graph algorithms and contrast their performance
24ECE455.5	Analyze the efficiency of different sorting and searching algorithms by measuring their time and space complexities
24ECE455.6	Formulate solutions for optimization problems using dynamic programming

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24ECE455.1	3	3	-	-	-	-	-	-	-	-	-	3	1
24ECE455.2	3	3	-	-	3	-	-	-	-	-	-	3	1
24ECE455.3	3	3	-	-	3	-	-	-	-	-	-	3	1
24ECE455.4	3	-	2	2	3	-	-	-	-	-	-	3	1
24ECE455.5	3	3	-	-	3	-	-	-	-	-	-	3	1
24ECE455.6	3	3	2	2	-	-	-	-	-	-	-	3	1

MODULE-1	**ADVANCED POINTERS AND DYNAMIC MEMORY MANAGEMENT**	24ECE455.1	**8 Hours**

The Address and Indirection operator, Pointer Assignment, Pointers as arguments, Pointers as return values, Using Pointers for Array Processing, Using an Array Name as a Pointer
Dynamic Storage Allocation, Dynamically Allocated Arrays, Deallocating Storage.

Text Book 1	11.2-11.5, 12.2,12.3, 17.1-17.4

MODULE-2	**ADVANCED STRUCTURES AND UNIONS**	24ECE455.2	**8 Hours**

Structure Types: Declaring a structure Tag, Defining a structure type, Structures as arguments and return values, Nested Arrays and Structures: Nested Structures, arrays of structures, Initializing an array of structures, Unions: Using Unions to build mixed data structures. Enumerations: Enum Tags, Enum as Integers, Using Enum to declare Tag Fields.

Text Book 1	16.2,16.3,16,4,16.5

MODULE-3	**LINEAR DATA STRUCTURES**	24ECE455.2 24ECE455.3	**8 Hours**

Introduction, Singly Linked Lists, Doubly linked Lists, Circular Linked Lists
Operations on Linked Lists, Application of Linked Lists: Polynomial Representation.

Case Study	Multi Linked Lists, Header Linked Lists
Text Book 2	6.1-6.5, 6.8

MODULE-4	**NON-LINEAR DATA STRUCTURES**	24ECE455.4	**8 Hours**

Trees: Types of Trees: General Trees, Forests, Binary Trees, Binary Search Trees, Creating a Binary Tree from a General Tree, Traversing a Binary Tree, Binary Search Trees, AVL Trees, Red-Black Trees, Splay Trees
Graphs: Terminology, Directed Graphs: Terminology of a Directed Graph, Representation of Graphs: Adjacency Matrix Representation, Adjacency List representation

Text Book 2	9.2.1-9.2.4, 9.3, 10.1,10.4, 10.5, 10.6, 13.1, 13.3, 13.5.1, 13.5.2

MODULE-5	**DSA Principles in AI**	24ECE455.5 24ECE455.6	**8 Hours**

Algorithm Selection, Shared Problem-Solving Approaches: divide-and-conquer, dynamic programming, and greedy algorithms. Big O Notation Usage: Understanding time and space complexity.

Web Link	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 https://workik.com/data-structure-generator

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. King, K.N, c-programming-a-modern-approach, 2nd edition W. W. Norton & Company, 2008, John Wiley & Sons, Ltd, 2005, 978-0393979503
2. Thareja, Reema, Data structures using C, 2nd Edition, Oxford, 2014, 978-01980993072. Thareja, Reema , "Data structures using C", 2nd Edition 2014

Reference Books:

1. Horowitz, Sahni, Anderson "Fundamentals of Data Structures in C", 2nd edition 2014, ISBN: 978 817371605 8.
2. Mark Allen Weiss, "Data structures and Algorithm analysis in C" 2nd edition, 2003, ISBN:81-7808-167-9.

Web links and Video Lectures (e-Resources):

- https://www.codecademy.com/learn/learn-c-pointers-and-memory
- https://www.coursera.org/learn/c-programming-pointers-and-memory-management
- https://www.programiz.com/c-programming/c-unions
- https://www.youtube.com/watch?v=gSYFHluoeHs
- https://www.educative.io/courses/data-structures-coding-interviews-cpp/linked-lists-vs-arrays
- https://algodaily.com/lessons/merge-sort-vs-quick-sort-heap-sort

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

ALP WITH MICROCONTROLLER

Course Code	**24ECE461**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs / Week	**2**	**Total Marks**	**100**
Credits	**1**	**Exam Hours**	**03**

Course outcomes:

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

24ECE461.1	Write 8051 assembly level programs to perform arithmetic and logical operations, code conversion programs
24ECE461.2	Apply the basic knowledge of addressing modes and instructions to write assembly language program in 8051 Microcontroller
24ECE461.3	Analyze the code in assembly level for application of 8051 Timers, Interrupts and Serial Communication interface
24ECE461.4	Demonstrate the peripheral interfacing of 8051

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24ECE461.1	3	3	3	2	3	-	-	-	3	-	-	3	3
24ECE461.2	3	3	3	-	3	-	-	-	3	-	-	3	3
24ECE461.3	3	3	3	2	3	-	-	-	3	3	2	3	3
24ECE461.4	3	3	3	2	3	-	-	-	3	3	2	3	3

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	24ECE461.1
2	Arithmetic Instructions – Addition, subtraction, multiplication and division, square, Cube – (16 bits Arithmetic operations – bit addressable)	2	24ECE461.1
3	Boolean & Logical Instructions (Bit manipulations).	2	24ECE461.1 24ECE461.2
4	Code conversion: BCD – ASCII; ASCII – Decimal; Decimal - ASCII; HEX - Decimal and Decimal – HEX.	2	24ECE461.2
5	Sorting and finding largest/smallest element in an array.	2	24ECE461.2
6	Counters	2	24ECE461.3
	PART-B		
7	Programs to generate delay, Programs using serial port and on- Chip timer / counter.	2	24ECE461.3
8	Embedded C Programming to illustrate the interfacing of stepper motor in clockwise /anti –clockwise rotation with the microcontroller 8051.	2	24ECE461.4
9	Embedded C Programming to illustrate the interfacing of simple switches with the microcontroller 8051	2	24ECE461.4
10	Embedded C Programming to illustrate the interfacing of LCD modules with the microcontroller 8051	2	24ECE461.4
11	Embedded C Program to illustrate the interfacing of LED modules with the microcontroller 8051	2	24ECE461.4
12	Write a Embedded C Program to transfer letter “A” serially at 4800 baud, continuously	2	24ECE461.4

PART-C

Beyond Syllabus Virtual Lab Content

(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 Point Numbers 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

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	**Remember**	-
L2	**Understand**	**5**
L3	**Apply**	**20**
L4	**Analyze**	**10**
L5	**Evaluate**	**10**
L6	**Create**	**5**

Suggested Learning Resources:

Reference Books:

1) "The 8051 Microcontroller and Embedded Systems – using assembly and C ", Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D. McKinlay; PHI, 2006 / Pearson, 2006.

2) "The 8051 Microcontroller Architecture, Programming & Applications", 2e Kenneth J. Ayala, Penram International, 1996 /Thomson Learning 2005.

PCB DESIGN USING ORCAD

Course Code	**24ECE462**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs / Week	**2**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

Course outcomes:

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

24ECE462.1	Apply the knowledge of circuit analysis to select the appropriate electronic components for a given application
24ECE462.2	Simulate various Digital and Analog circuits using modern software tools
24ECE462.3	Design complex and functional PCB layouts for various electronic devices, from simple circuits to advanced systems
24ECE462.4	Create high-quality PCB designs that meet industry standards and best practices

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24ECE462.1	3	-	-	-	3	-	-	-	-	-	-	3	3
24ECE462.2	3	3	2	1	3	-	-	-	-	-	-	3	3
24ECE462.3	3	3	2	1	3	-	-	-	-	-	-	3	3
24ECE462.4	3	3	2	1	3	-	-	-	-	-	-	3	3

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	Introduction to circuit creation and simulation OrCAD software: Half Wave Rectifier.	2	24ECE462.1 24ECE462.2
2	Design and simulate a Full Wave Centre-Tapped Rectifier.	2	24ECE462.1 24ECE462.2
3	Analyze positive and negative clipper circuits.	2	24ECE462.1 24ECE462.2
4	Analyze positive and negative clamper circuits.	2	24ECE462.1 24ECE462.2
5	Verify the diode characteristics using OrCAD.	2	24ECE462.1
6	To verify the BJT Amplifier characteristics using OrCAD.	2	24ECE462.1
	PART-B		
7	Simulate all gates in OrCAD.	2	24ECE462.2
8	Implement the half adder using OrCAD.	2	24ECE462.2
9	Implement NAND as universal gate (NOT, AND, OR using NAND).	2	24ECE462.2
10	Introduction to PCB layout design.	2	24ECE462.3
11	PCB design of Half Wave Rectifier.	2	24ECE462.4
12	PCB design of Full Wave Centre Tapped Rectifier.	2	24ECE462.4

PART-C

Beyond Syllabus Virtual Lab Content

(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

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
		20	30
L1	Remember	-	-
L2	Understand	-	5
L3	Apply	10	10
L4	Analyze	5	10
L5	Evaluate	5	5
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	5
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	**22ECE463**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs / Week	**2**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

Course outcomes:

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

22ECE463.1	Select different functions available in Lab VIEW for engineering applications
22ECE463.2	Apply concepts of virtual instrumentation and develop basic programs using loops
22ECE463.3	Demonstrate user interfaces with charts, graph, and buttons
22ECE463.4	Use the Lab VIEW platform to create and analyze data acquisition systems

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
22ECE463.1	3	-	-	-	2	-	-	-	-	-	3	3	3
22ECE463.2	3	-	-	-	2	-	-	-	-	-	3	3	3
22ECE463.3	3	3	2	-	2	-	-	-	-	-	3	3	3
22ECE463.4	3	3	2	1	2	-	-	-	-	-	3	3	3

Exp. No. / Pgm. No.	List of Programs	Hours	COs
	Prerequisite Programs		
	• Knowledge of Microsoft Windows • Knowledge of writing algorithms in the form of flowcharts or block diagrams http://www.ni.com/getting-started/labview-basics/environment	2	NA
	PART-A		
1	To perform basic arithmetic operations: addition, subtraction, multiplication, and division using LabVIEW.	2	22ECE463.1
2	To perform Boolean operations: AND, OR, XOR, NOT and NAND using LabVIEW.	2	22ECE463.1
3	To find the Sum of 'n' numbers using 'for' loop and 'while' loop.	2	22ECE463.3
4	To perform the Factorial of a given number using 'for' loop and 'while' loop.	2	22ECE463.3
5	To sort even numbers using 'while' loop in an array.	2	22ECE463.3
6	To find the maximum and minimum variable from an array.	2	22ECE463.2
	PART-B		
7	To create a sine wave using formula node.	2	22ECE463.2
8	Build a Virtual Instrument which adds two sine waves of different frequencies and displays the result in a graph.	2	22ECE463.1
9	To apply filtering technique (median filter) for a given input signal.	2	22ECE463.1
10	To build a Virtual Instrument that converts Celsius to Fahrenheit.	2	22ECE463.4
11	To build a Virtual Instrument for acquiring and continuously displaying a thermocouple signal.	2	22ECE463.4
12	To acquire and analyze an ECG signal using NI ELVIS LabVIEW.	2	22ECE463.4

PART-C

Beyond Syllabus Virtual Lab Content

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

1. Simulations in LabVIEW
   https://www.youtube.com/watch?v=X6oRczEDOao
2. LabVIEW Formula Node
   https://www.youtube.com/watch?v=m5z_5j6iu2M

3. LabVIEW Mathscript
   https://www.youtube.com/watch?v=dQjmzEM8YKc
4. Reading data from Spreadsheet
   https://www.just.edu.jo/FacultiesandDepartments/FacultyofEngineering/Departments/BiomedicalEngineering/Documents/labview%20experiments.pdf

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		20	30
L1	Remember	-	-
L2	Understand	-	5
L3	Apply	10	10
L4	Analyze	5	10
L5	Evaluate	5	5
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) Virtual Instrumentation using LABVIEW, Jovitha Jerome, PHI, 2011
2) Virtual Instrumentation using LABVIEW, Sanjay Gupta, Joseph John, TMH, McGraw Hill, Second Edition, 2011.
3) Barry Paton, —Sensor, transducers and Lab view, Prentice Hall of India 2000.
4) LabVIEW Graphical Programming, Richard Jennings, Fabiola De la Cueva,5th edition, McGraw-Hill Publishing 2020.

EMBEDDED DESIGN USING MPLAB

Course Code	**24ECE464**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs / Week	**2**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

Course outcomes:

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

24ECE464.1	Understand the fundamental core concepts of programming with MPLAB XC8
24ECE464.2	Apply the basic knowledge of programming and system control to perform a specific task
24ECE464.3	Conduct experiments to interface different peripherals
24ECE464.4	Develop programming skills in embedded systems for various applications

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24ECE464.1	2	-	-	-	3	-	-	-	-	-	2	3	3
24ECE464.2	3	-	-		3	-	-	-	-	-	2	3	3
24ECE464.3	3	2	1		3	-	-	-	-	-	2	3	3
24ECE464.4	3	3	1		3	-	-	-	-	-	2	3	3

Exp. No. / Pgm. No.	List of Programs	Hours	COs
	Prerequisite Programs		
	Revisit to C basics	2	NA
	PART-A		
1	To familiarize with the MPLAB X IDE and XC8 compiler environment, and to configure a basic embedded C project using a PIC microcontroller.	2	24ECE464.1
2	To write and execute a program to blink an LED connected to a digital I/O pin of the PIC microcontroller	2	24ECE464.1 24ECE464.2
3	To implement a program that detects the press of a push-button and responds by toggling an output, such as an LED.	2	24ECE464.2
4	To develop a program to read the status of a digital switch and display the output status through LEDs.	2	24ECE464.2
5	To interface a seven-segment display with the microcontroller and display numeric digits by sending appropriate signals	2	24ECE464.3
6	To interface a 16x2 alphanumeric LCD with the microcontroller and display static and dynamic messages using embedded C code.	2	24ECE464.3
	PART-B		
7	To develop and demonstrate the use of external or timer interrupts in an embedded application using the PIC microcontroller.	2	24ECE464.3
8	To interface a temperature sensor and program the microcontroller to measure and display temperature values digitally.	2	24ECE464.3
9	To perform analog-to-digital conversion using the internal ADC module of the PIC microcontroller and display the corresponding digital value.	2	24ECE464.4
10	To interface a temperature and humidity sensor (like DHT11/DHT22) with the microcontroller and display real-time sensor readings.	2	24ECE464.4
11	To interface a 4x4 matrix keypad with the PIC microcontroller and write code to detect and display the pressed key.	2	24ECE464.4
12	To establish serial communication using the RS232 protocol between the PIC microcontroller and a PC or other device, and transmit/receive data.	2	24ECE464.4
	PART-C		

1.**Programming a Development Board (microchip.com)**
2.Interfacing of ADC and data transfer by software polling, study of aliasing
http://vlabs.iitkgp.ernet.in/rtes/exp4/index.html
3.MCU-DAC interfacing and generation of ramp wave
http://vlabs.iitkgp.ernet.in/rtes/exp3/index.html
4.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
		20	30
L1	Remember	-	-
L2	Understand	-	5
L3	Apply	10	10
L4	Analyze	5	10
L5	Evaluate	5	5
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 (MPLAB starting documents)
1) https://www.microchip.com/en-us/tools-resources/develop/mplab-x-ide
2) https://skills.microchip.com/page/mplab-x-ide

REAL TIME OPERATING SYSTEM - QNX

Course Code	**24ECE465**	**CIE Marks**	**50**
L: T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs / Week	**2**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

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

24ECE465.1	Apply the working of QNX Development Tools (Momentics IDE) on Processes, Threads & Synchronization
24ECE465.2	Implement the QNX Inter-Process Communication and compare QNX IPC Methods
24ECE465.3	Apply the QNX Inter-Process Communication with Hardware Programming and Interrupt handling
24ECE465.4	Understand the timing architecture, High-Resolution Timers, Images & Buildfiles and Resource Manager

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24ECE465.1	3	-	-	-	2	-	-	-	-	-	-	2	2
24ECE465.2	3	2	-	-	3	-	-	-	-	-	3	2	2
24ECE465.3	3	-	-	-	3	-	-	-	-	-	3	2	2
24ECE465.4	3	2	-	-	3	-	-	-	-	-	3	2	2

Exp. No. / Pgm. No.	List of Experiments / Programs	Hours	Cos
	Prerequisite Experiments / Programs / Demo		
	To understand the architecture Operating Systems basics and C programming and Linux commands. QNX Momentics Development Basics: Eclipse Basics, Targets, Projects and Source, Compiling, Exercise, Running and Debugging, Exercise and Versions. QNX Neutrino RTOS Environment Setup- Install and configure QNX SDP, Momentics IDE, and target system (real or virtual).	2	NA
	PART-A		
1	Create and run hello world example on VM Ware virtual machine or Rasp-pi board.	2	24ECE465.1
2	Write a program that creates multiple child processes using fork() and print different messages in parent and child process. Terminate the parent after 5 seconds and print the pid from the child.	2	24ECE465.1
3	Implement a multi-threaded application using POSIX threads (pthread_create). Each thread should process a different part of an array and the main thread should wait for all threads to complete using pthread_join.	2	24ECE465.1
4	Write a program to create a process with 4 threads that update the portin of array of size 1000 bytes by updating 250 bytes each. Make the main thread to join on the 4 threads and print the completion. Use mutex to prevent data corruption while each thread is updating the array	2	24ECE465.2
5	Implementing a thread-safe bounded buffer (also known as a circular queue) that is shared between multiple producer threads and multiple consumer threads. The buffer has a fixed size (N slots). Producers add items to the buffer, and consumers remove items from the buffer.	2	24ECE465.2

6	Create a server process that registers to receive pulses. Write a client that sends pulses to the server using MsgSendPulse, and have the server handle different pulse codes.	2	24ECE465.2, 24ECE465.3
	PART-B		
7	Develop two processes that communicate using QNX message passing (MsgSend, MsgReceive, MsgReply). The client shall send 3 types of messages and the client shall perform different operation based on the message type and reply to the client.	2	24ECE465.3
8	Write a program that uses QNX event notification (sigevent) to notify a process when a timer expires or an interrupt occurs. Demonstrate handling the event in the process. Enable the receiving process to modify the event and reply back to the calling process.	2	24ECE465.3
9	Implement two processes that communicate via shared memory using shm_open and mmap. One process writes data, and the other reads and displays it.	2	24ECE465.3
10	Create a program that sets up a periodic timer using timer_create and timer_settime. The timer should be used to track the time and kill the process after 10 seconds of execution.	2	24ECE465.4
11	Write a program that retrieves and displays the current system time using clock_gettime and allows the user to set the system time using clock_settime by passing time value from the command prompt	2	24ECE465.4
12	Write a Program to initialize Resource managers.	2	24ECE465.4

PART-C

Beyond Syllabus Virtual Lab Content

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

1. QNX Momentics Development Basics**:** Eclipse Basics, Targets, Projects and Source, Compiling, Exercise, Running and Debugging, Exercise and Versions

https://learning.qnx.com/qnx/courses/20207/modules/132649/elements/638218

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		**Test (s)**	**Weekly Assessment**
		20	**30**
L1	**Remember**	**-**	**-**
L2	**Understand**	-	5
L3	**Apply**	10	10
L4	**Analyze**	5	10
L5	**Evaluate**	5	5
L6	**Create**	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		**Exam Marks Distribution (50)**
L1	**Remember**	-
L2	**Understand**	**5**
L3	**Apply**	**20**
L4	**Analyze**	**10**
L5	**Evaluate**	**10**
L6	**Create**	**5**

Suggested Learning Resources:
Reference Books:

1. Operating Systems Design and Implementation By Andrew S. Tanenbaum, Albert S. Woodhull, Alfred Woodhull · 2006, Pearson, ISBN-13978-0131429383,Third Edition.
2. A Linux and UNIX System Programming Handbook By Michael Kerrisk · 2010, No Starch Press, ISBN:9781593272913, 159327291X

UNIVERSAL HUMAN VALUES AND LIFE SKILLS

Course Code	**24UHK47**	**CIE Marks**	**50**
L:T:P:S	**1:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**2**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**02**

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

24UHK47.1	Understand the concept and significance of life skills and universal human values.
24UHK47.2	Develop Self-awareness and Self-management skills to promote personal growth.
24UHK47.3	Apply Critical and Creative thinking and ethical decision-making skills in various contexts.
24UHK47.4	Promote teamwork and collaboration while respecting diversity and inclusivity.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
24UHK47.1	-	-	-	-	-	3	1	2	-	2	2
24UHK47.2	-	-	-	-	-	1	2	3	1	2	3
24UHK47.3	-	-	-	-	-	3	1	2	1	3	2
24UHK47.4	-	-	-	-	-	2	2	3	2	2	1

MODULE-1	**Self-Awareness and Self-Management**	**24UHK47.1, 24UHK47.2**	**3 Hours**

Emotional Intelligence, Techniques of self-awareness: SWOT and JOHARI WINDOWS, Stress management and coming out of comfort zone, managing failure, Time Management to recalibrate priorities.
Self-Exploration as a process of Value Education, the basic human Aspirations: Prosperity and Happiness, understanding infatuation.

Self-study / Role play	Understand qualities of Role Models, explore self and do SWOT analysis for growth; participate in role play and presentations to come out of comfort zone

MODULE-2	**Towards Yourself**	**24UHK47.1, 24UHK47.3**	**3 Hours**

Exploring opportunities, understanding expectations and self for right fitment in profession, Goal Setting - Personal and Professional, aligning Personal and Professional goals for greater achievement, Mind-Maps as a tool for Goal Setting

Self-study / Mind Maps	Understand industry expectations to set professional goals; realizing connection between personal and professional goals for peaceful living

MODULE-3	**Leading self to lead others**	**24UHK47.3, 24UHK47.4**	**3 Hours**

Quality analysis of leader and self-evaluation, Critical thinking, Creative thinking and Ethical decision making, Critical thinking and Creative thinking for contribution to technical world, Six thinking hats, Exploring ethical decision-making frameworks and principles.

Case study	Case studies for Critical thinking and activities for Creative thinking

MODULE-4	**Ownership towards Family and Society**	**24UHK47.2, 24UHK47.3 24UHK47.4**	**3 Hours**

Responsibility, Diversity and Inclusivity:
Understanding personal and social responsibility; Appreciating diversity and managing inclusivity, promoting teamwork and collaboration while respecting differences.

Self-study / Interview with corporate people	Working on Task bar; team building activities; Interviewing Corporate experts to understand expectations

MODULE-5	**Towards Nature and Industry**	**24UHK47.3, 24UHK47.4**	**3 Hours**

Personal code of conduct for harmony between self and nature, resisting external pressures, negotiation and conflict resolution, assertiveness and empathy, change management

Role play	Role play to understand contributions to nature and industry.

CIE Assessment Pattern (50 Marks – Theory) –

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

SEE Assessment Pattern (50 Marks – Group Discussion)

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:

REFERENCE BOOKS:

1. The 7 Habits of Highly Effective People, Stephen R Covey, Neha publishers.
2. Seven Habits of Highly Effective Teens, Convey Sean, New York, Fireside Publishers, 1998.
3. Emotional Intelligence, Daniel Coleman, Bantam Book, 2006.
4. How to Win Friends and Influence People, Dale Carnegie.
5. BHAGAVADGITA for college students, Sandeepa Guntreddy.

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

- Conduct interviews with HR personnel of corporates to understand expectations in terms of Soft Skills and Values
- Participate in role plays and presentations to come out of comfort zone
- Talk to industry people to understand opportunities available
- Make a short movie to display creativity
- Use Mind maps to plan successful completion of semester
- Actively participate in Group Discussions and JAM sessions

MINI PROJECT

Course Code	**24ECE48**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs / Week	**2**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

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

24ECE48.1	Identify an open ended problem in the field of Electronics and communication engineering which requires further investigation
24ECE48.2	Review relevant literature and propose solutions for the defined problem statement
24ECE48.3	Design a functional model to address the identified problem
24ECE48.4	Test and validate the developed model to ensure its functionality
24ECE48.5	Analyze the performance of the implemented project
24ECE48.6	Present and demonstrate the completed project along with its outcomes effectively

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24ECE48.1	3	3	-	-	-	3	-	-	-	-	-	3	3
24ECE48.2	3	3	-	-	-	-	-	-	2	-	2	3	3
24ECE48.3	3	3	2	2	3	-	-	2	-	2	2	3	3
24ECE48.4	3	3	2	-	3	-	-	2	2	-	2	3	3
24ECE48.5	3	3	2	-	3	-	-	-	2	-	2	3	3
24ECE48.6	3	3	2	-	-	-	1	2	2	2	2	3	3

CIE Assessment Pattern (50 Marks)

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

SEE Assessment Pattern (50 Marks)

RBT Levels	Exam Marks Distribution (50)
Remember	**-**
Understand	10
Apply	10
Analyze	10
Evaluate	10
Create	10

NATIONAL SERVICE SCHEME

Course Code	**24NSS30, 24NSS40, 24NSS50, 24NSS60**	**CIE Marks (each Semester)**	**50**
L:T:P:S	**0:0:0:0**	**SEE Marks**	**--**
Hrs / Week	**2**	**Total Marks**	**50 x 4 = 200**
Credits	**00**	**Exam Hours**	**02**

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

24NSSX0.1	Understand the importance of his / her responsibilities towards society.
24NSSX0.2	Analyse the environmental and societal problems/issues and will be able to design solutions for the same.
24NSSX0.3	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.
24NSSX0.4	Develop capacity to meet emergencies and natural disasters & practice national integration and social harmony in general.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
24NSSX0.1	-	-	-	-	-	3	3	2	-	-	1
24NSSX0.2	-	-	-	-	-	3	3	2	-	-	1
24NSSX0.3	-	-	-	-	-	3	3	2	-	-	1
24NSSX0.4	-	-	-	-	-	3	3	2	-	-	1

Semester/ Course Code	CONTENT	COs	HOURS
3RD 24NSS30	12. Organic farming, Indian Agriculture (Past, Present and Future) Connectivity for marketing 13. Waste management–Public, Private and Govt organization, 5R's. 14. Setting of the information imparting club for women leading to contribution in social and economic issues.	24NSS30.1, 24NSS30.2, 24NSS30.3, 24NSS30.4	30 HRS
4TH 24NSS40	15. Water conservation techniques – Role of different stakeholders– Implementation. 16. Preparing an actionable business proposal for enhancing the village income and approach forimplementation. 17. Helping local schools to achieve good results and enhance their enrolment in Higher/ technical/ vocational education.	24NSS40.1, 24NSS40.2, 24NSS40.3, 24NSS40.4	30 HRS
5TH 24NSS50	18. Developing Sustainable Water management system for rural areas and implementationapproaches. 19. Contribution to any national level initiative of Government of India. Foreg. Digital India, Skill India, Swachh Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme, Skill developmentprograms etc. 20. Spreading public awareness under rural outreach programs. (minimum 5 programs).	24NSS50.1, 24NSS50.2, 24NSS50.3, 24NSS50.4	30 HRS
6TH 24NSS60	21. Organize National integration and social harmony events / workshops / seminars. (Minimum TWO programs). 22. Govt. school Rejuvenation and helping them to achieve good infrastructure.	24NSS60.1, 24NSS60.2, 24NSS60.3, 24NSS60.4	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:

10. NSS Course Manual, Published by NSS Cell, VTU Belagavi.
11. Government of Karnataka, NSS cell, activities reports and its manual.
12. Government of India, NSS cell, Activities reports and its manual.

Pre-requisites to take this Course:

4. Students should have a service-oriented mindset and social concern.
5. Students should have dedication to work at any remote place, anytime with available resources and proper time management for the other works.
6. 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 6th 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.
- At last, in 6th semester consolidated report of all activities from 3rd to 6th semester, compiled report should be submitted as per the instructions.
- 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/Co ntinuous 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.	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/pro per 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
4.	Water conservation techniques – Role of different stakeholders– Implementation.	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
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/pro per 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/Govern ment Schemes officers	School selection/prope r 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.	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
8.	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/pro per 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.	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/pro per 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.	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/prope r 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
11.	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/prope r 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	**24PED30, 24PED40, 24PED50, 24PED60**	**CIE Marks (each semester)**	**50**
L:T:P:S	**0:0:0:0**	**SEE Marks**	**--**
Hrs / Week	**2**	**Total Marks**	**50 x 4= 200**
Credits	**00**	**Exam Hours**	**02**

Course outcomes:

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

24PEDX0.1	Understand the fundamental concepts and skills of Physical Education, Health, Nutrition and Fitness
24PEDX0.2	Create consciousness among the students on Health, Fitness and Wellness in developing and maintaining a healthy lifestyle
24PEDX0.3	Perform in the selected sports or athletics of student's choice and participate in the competition at regional/state / national / international levels.
24PEDX0.4	Understand the roles and responsibilities of organization and administration of sports and games

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
24PEDX0.1	-	-	-	-	-	2	-	3	3	-	2
24PEDX0.2	-	-	-	-	-	2	-	3	3	-	2
24PEDX0.3	-	-	-	-	-	2	-	3	3	-	2
24PEDX0.4	-	-	-	-	-	2	-	3	3	-	2

Semester	CONTENT	COs	HOURS
3RD 24PED30	**Module 1: Orientation** F. Lifestyle, G. Fitness H. Food & Nutrition I. Health & Wellness J. Pre-Fitness test.	24PED30.1, 24PED30.2	5 HRS
	Module 2: General Fitness & Components of Fitness G. Warming up (Free Hand exercises) H. Strength – Push-up / Pull-ups I. Speed – 30 Mtr Dash J. Agility – Shuttle Run K. Flexibility – Sit and Reach L. Cardiovascular Endurance – Harvard step Test	24PED30.2, 24PED30.3	15 HRS
	Module 3: Recreational Activities E. Postural deformities. F. Stress management. G. Aerobics. H. Traditional Games.	24PED30.3, 24PED30.4	10 HRS
4TH 24PED40	**Module 1: Ethics and Moral Values** C. Ethics in Sports D. Moral Values in Sports and Games	24PED40.1, 24PED40.2	5 HRS
	Module 2: Specific Games (Anyone to be selected by the student) G. Volleyball – Attack, Block, Service, Upper Hand Pass and Lower hand Pass. H. Throwball – Service, Receive, Spin attack, Net Drop & Jump throw. I. Kabaddi – Hand touch, Toe Touch, Thigh Hold, Ankle hold and Bonus. J. Kho-Kho – Giving Kho, Single Chain, Pole dive, Pole turning, 3-	24PED40.3	20 HRS

	6 Up. K. Table Tennis – Service (Fore Hand & Back Hand), Receive (Fore Hand & Back Hand), Smash. L. Athletics (Track / Field Events) – Any event as per availability of Ground.		
	Module 3: Role of Organization and administration	24PED40.4	5 HRS
5TH 24PED50	**Fitness Components:** Meaning and Importance, Fit India Movement, Definition of fitness, Components of fitness, Benefits of fitness, Types of fitness and Fitness tips. **Practical Components:** Speed, Strength, Endurance, Flexibility, and Agility **Athletics**: 4. Track -Sprints: • Starting Techniques: Standing start and Crouch start (its variations) use of Starting Block. • Acceleration with proper running techniques. • Finishing technique: Run Through, Forward Lunging and Shoulder Shrug. 5. Jumps- Long Jump: Approach Run, Take-off, Flight in the air (Hang Style/Hitch Kick) and Landing 6. Throws- Shot Put: Holding the Shot, Placement, Initial Stance, Glide, Delivery Stance and Recovery (Perry O'Brien Technique) **Handball OR Ball Badminton** **Handball:** B. Fundamental Skills 7. Catching, Throwing and Ball control, 8. Goal Throws: Jumpshot, Centershot, Diveshot, Reverseshot. 9. Dribbling: High and low. 10. Attack and counter attack, simple counter attack, counter attack from two wings and center. 11. Blocking, Goal Keeping and Defensive skills. 12. Game practice with application of Rules and Regulations. C. Rules and their interpretations and duties of officials **Ball badminton:** B. Fundamental Skills 5. Basic Knowledge: Various parts of the Racket and Grip. 6. Service: Short service, Long service, Long-high service. 7. Shots: Overhead shot, Defensive clearshot, Attacking clearshot, Dropshot, Netshot, Smash. 8. Game practice with application of Rules and Regulations. B. Rules and their interpretation and duties of officials.	24PED50.1, 24PED50.2, 24PED50.3, 24PED50.4	Total 30 Hrs/ Semester 2 Hrs/week
6TH 24PED60	**Athletics**: 4. Track -110 Mtrs and 400Mtrs: • Hurdling Technique: Lead leg Technique, Trail leg Technique, Side Hurdling, Over the Hurdles • Crouch start (its variations) use of Starting Block. • Approach to First Hurdles, In Between Hurdles, Last Hurdles to Finishing. 5. Jumps- High jump: Approach Run, Take-off, Bar Clearance (Straddle) and Landing. 6. Throws- Discus Throw: Holding the Discus, Initial Stance Primary Swing, Turn, Release and Recovery (Rotation in the circle). **Football OR Hockey**	24PED60.1, 24PED60.2, 24PED60.3, 24PED60.4	Total 30 Hrs/ Semester 2 Hrs/week

	Football: A. Fundamental Skills 1. Kicking: Kicking the ball with inside of the foot, Kicking the ball with Full Instep of the foot, Kicking the ball with Inner Instep of the foot, Kicking the ball with Outer Instep of the foot and Lofted Kick. 10. Trapping: Trapping- the Rolling ball, and the Bouncing ball with sole of the foot. 11. Dribbling: Dribbling the ball with Instep of the foot, Dribbling the ball with Inner and Outer Instep of the foot. 12. Heading: In standing, running and jumping condition. 13. Throw-in: Standing throw-in and Running throw-in. 14. Feinting: With the lower limb and upper part of the body. 15. Tackling: Simple Tackling, Slide Tackling. 16. Goal Keeping: Collection of Ball, Ball clearance-kicking, throwing and deflecting. 17. Game practice with application of Rules and Regulations. B. Rules and their interpretation and duties of officials. **Hockey:** A. Fundamental Skills 1. Passing: Short pass, Longpass, pushpass, hit 2. Trapping. 3. Dribbling and Dozing 9. Penalty stroke practice. 10. Penalty corner practice. 11. Tackling: Simple Tackling, Slide Tackling. 12. Goal Keeping, Ball clearance- kicking, and deflecting. 13. Game practice with application of Rules and Regulations. B. Rules and their interpretation and duties of officials		

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	**24YOG30, 24YOG40, 24YOG50, 24YOG60**	**CIE Marks**	**50**
L:T:P:S	**0:0:0:0**	**SEE Marks**	**--**
Hrs / Week	**2**	**Total Marks**	**50 x 4 = 200**
Credits	**00**	**Exam Hours**	**02**

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

24YOGX0.1	Understanding the origin, history, aim and objectives of Yoga
24YOGX0.2	Become familiar with an authentic foundation of Yogic practices
24YOGX0.3	Practice different Yogic methods such as Suryanamaskara, Pranayama and some of the Shat
24YOGX0.4	Use the teachings of Patanjali in daily life.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
24YOGX0.1	-	-	-	-	-	3	-	-	-	-	1
24YOGX0.2	-	-	-	-	-	3	-	-	-	-	1
24YOGX0.3	-	-	-	-	-	3	-	-	-	-	1
24YOGX0.4	-	-	-	-	-	3	-	-	-	-	1

Semester / Course Code	CONTENT	COs	HOURS
3rd 24YOG30	**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:** 13. Suryanamaskar prayer and its meaning, Need, importance and b of Suryanamaskar. 14. Suryanamaskar 12 count,2rounds **Different types of Asanas**: 5. Sitting: Padmasana, Vajrasana, Sukhasana 6. Standing: Vrikshana, Trikonasana, Ardhakati Chakrasana 7. Prone line: Bhujangasana, Shalabhasana 8. Supineline: Utthitadvipadasana, Ardhahalasana, Halasana	24YOG30.1, 24YOG30.2, 24YOG30.3, 24YOG30.4	Total 32 Hrs/ Semester 2 Hrs/week
4TH 24YOG40	**Suryanamaskara:** Suryanamaskar 12 count,4rounds **Brief introduction and importance of:** **Kapalabhati:** Revision of Kapalabhati -40strokes/min3rounds **Different types of Asanas**: 5. Sitting: Paschimottanasana, Ardha Ushtrasana, Vakrasana, Aakarna Dhanurasana 6. Standing: Parshva Chakrasana, Urdhva Hastothanasana, Hastapadasana 7. Prone line: Dhanurasana 8. Supine line: Karna Peedasana, Sarvangasana, Chakraasana **Patanjali's Ashtanga Yoga**: Asana, Pranayama **Pranayama:** Chandra Bhedana, Nadishodhana, Surya Bhedana	24YOG40.1, 24YOG40.2, 24YOG40.3, 24YOG40.4	Total 32 Hrs/ Semester 2 Hrs/week

5TH 24YOG50	**Kapalabhati:** Revision of Kapalabhati - 60strokes/min3rounds **Brief introduction and importance of:** **Different types of Asanas**: 5. Sitting: Yogamudra in Padmasana, Vibhakta Paschimottanasana, Yogamudra in Vajrasana 6. Standing: Parivritta Trikonasana, Utkatasana, Parshvakonasana 7. Prone line: Padangushtha Dhanurasana, Poorna Bhujangasana / Rajakapotasana 8. Supine line: Navasana/Noukasana, Pavanamuktasana, Sarvanga **Patanjali's Ashtanga Yoga**: Pratyahara, Dharana **Pranayama:** Ujjayi, Sheetali, Sheektari	24YOG50.1, 24YOG50.2, 24YOG50.3, 24YOG50.4	Total 32 Hrs/ Semester 2 Hrs/week
6TH 24YOG60	**Kapalabhati:** Revision of Kapalabhati – 80 strokes/min3rounds **Brief introduction and importance of:** **Different types of Asanas**: 5. Sitting: Bakasana, Hanumanasana, Ekapada Rajakapotasana 6. Standing: Parivritta Trikonasana, Utkatasana, Parshvakonasana 7. Supine line: Setubandhasana, Shavasanaa (Relaxation posture) 8. Balancing: Sheershasana **Patanjali's AshtangaYoga**: Dhyana (Meditation), Samadhi **Pranayama:** Bhastrika, Bhramari, Ujjai **Shat Kriyas:** Jalaneti and sutraneti, Sheetkarma Kapalabhati	24YOG60.1, 24YOG60.2, 24YOG60.3, 24YOG60.4	Total 32 Hrs/ Semester 2 Hrs/week

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

BASIC APPLIED MATHEMATICS-II
(Common to all Branches)

Course Code	**24DMAT41**	**CIE Marks**	**50**
L:T:P:S	**0:0:0:0**	**SEE Marks**	**--**
Hrs. / Week	**2**	**Total Marks**	**50**
Credits	**00**	**Exam Hours**	**--**

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

24DMAT41.1	Gain knowledge of basic operations of vectors
24DMAT41.2	Use curl and divergence of a vector function in three dimensions
24DMAT41.3	Develop the ability to solve higher order Linear differential equations
24DMAT41.4	Know the basic concepts of Laplace transform to solve the Periodic functions and also solve initial and boundary value problems using Laplace transform method.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSo 2
24DMAT41.1	3	3	-	-	-	-	-	-	-	-	-	-	-
24DMAT41.2	3	3	-	-	-	-	-	-	-	-	-	-	-
24DMAT41.3	3	3	-	-	-	-	-	-	-	-	-	-	-
24DMAT41.4	3	3	-	-	-	-	-	-	-	-	-	-	-

MODULE-1	**VECTORS**	24DMAT31.1	**8 Hours**

Definition of scalar and vector, Vector addition, Subtraction and Multiplication-Dot product, Cross product, Scalar triple product. Orthogonal, Co-planar and Angle between vectors-Problems.

Text Book	Text Book 1: 3.1, 3.5, 3.6, 3.9, Text Book 2: 7.1, 9.2, 9.3, 9.4.

MODULE-2	**VECTOR DIFFERENTIATION**	24DMAT31.2	**8 Hours**

Vector differential operator-Gradient of a scalar function, Divergence of a vector function, Curl of vector functior Problems. Solenoidal and irrotational vector fields-Problems.

Text Book	Text Book 1: 8.5, 8.6, 8.7, Text Book 2: 9.7, 9.8, 9.9.

MODULE-3	**LINEAR DIFFERENTIAL EQUATIONS WITH CONSTANT COEFFICIENTS**	24DMAT31.3	**8 Hours**

Solution of initial and boundary value problems, Inverse differential operator techniques for the functions-e^{ax}, $\sin(ax + b)$ and $\cos(ax + b)$.

Text Book	Text Book 1: 13.3, 13.4, 13.5, 13.6,

MODULE-4	**LAPLACE TRANSFORM**	24DMAT31.4	**8 Hours**

Definition and Laplace transforms of elementary functions-Problems. Properties of Laplace transforms (Shifting property-without proof), Periodic functions (without proof)-problems.

Text Book	Text Book 1: 21.3, 21.4, 21.5, Text Book 2: 6.1.

MODULE-5	**INVERSE LAPLACE TRANSFORM**	24DMAT31.4	**8 Hours**

Inverse Laplace Transform by partial fractions-Problems. Solution of linear differential equations using Laplace Transforms-Problems.

Text Book	Text Book 1: 21.12, 21.15, Text Book 2: 6.4.

CIE Assessment Pattern (50 X 2=100 Marks – Theory)

RBT Levels		Marks Distribution		
		Theory Tests	AAT1	AAT2
		25	15	10
L1	Remember	5	-	-
L2	Understand	5	5	-
L3	Apply	5	-	5
L4	Analyze	5	5	5
L5	Evaluate	5	5	-
L6	Create	-	-	-

Suggested Learning Resources:

Text Books:

1) B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, Forty fourth Edition, 2022, ISBN: 9788193328491.
2) Erwin Kreyszig, Advanced Engineering Mathematics, Wiley-India Publishers, Tenth Edition, Reprint 2016, ISBN: 9788126554232.

Reference Books:

1) Glyn James, Advanced Modern Engineering Mathematics, Pearson Education, Fourth Edition, 2015, ISBN: 9780273719236.
2) B. V. Ramana, Higher Engineering Mathematics, McGraw Hill Education (India) Private Limited, Fourth Edition, 2017, ISBN: 9780070634190.
3) H. K. Dass, Advanced Engineering Mathematics, S. Chand & Company Ltd., Twenty Second Edition, 2018, ISBN: 9789352533831.
4) N.P.Bali and Manish Goyal, A Text Book of Engineering Mathematics, Laxmi Publications (P) Ltd., Ninth Edition, 2014, ISBN: 9788131808320.

Web links and Video Lectures (e-Resources):

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

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

- Contents related activities (Activity-based discussions)
  - 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.

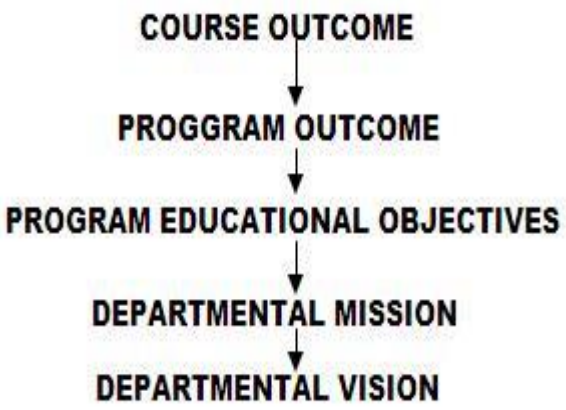
There are three educational Outcomes as defined by the National Board of Accreditation:

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

Knowledge and Attitude Profile (WK)

WK1: A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.

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.

WK3: A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.

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.

WK5: Knowledge, including efficient resource use, environmental impacts, whole-life cost, reuse of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.

WK6: Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.

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.

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.

WK9: Ethics, inclusive behavior 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.

Engineering Knowledge: 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.

Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)

Design/Development of Solutions: 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)

Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).

Engineering Tool Usage: 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)

The Engineer and The World: 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).

Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)

Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

Communication: 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

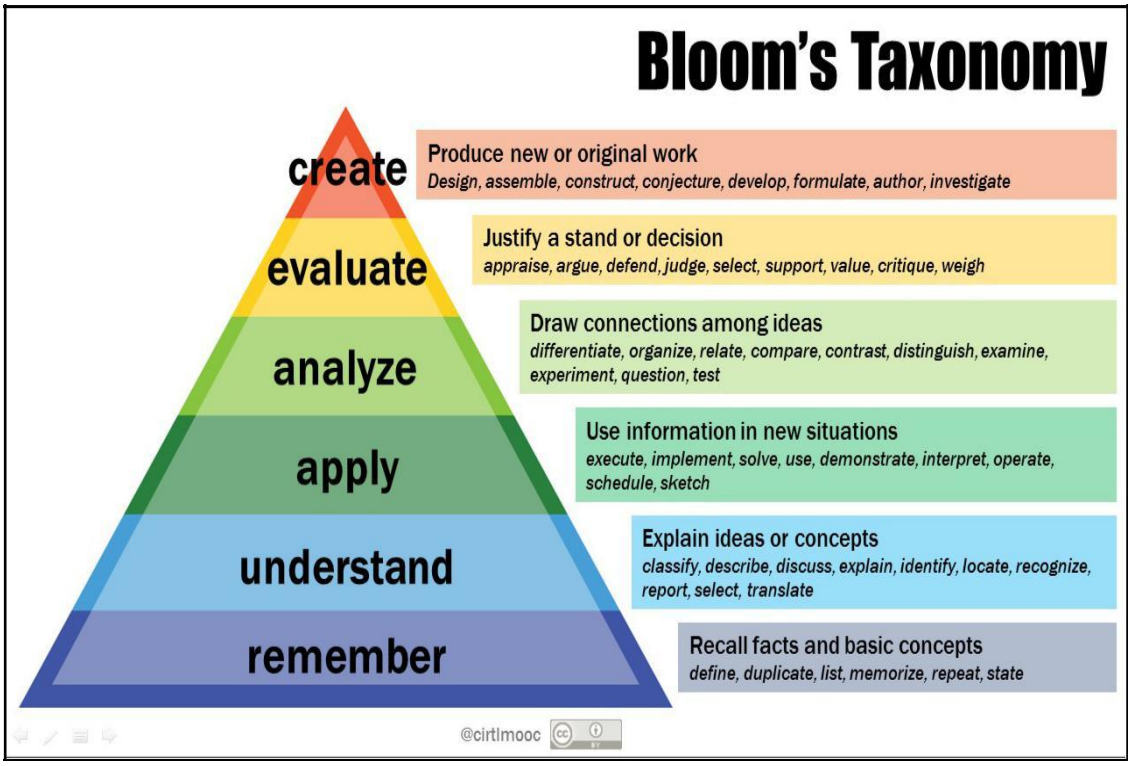
Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

Life-Long Learning: Recognize the need for, and have the preparation and ability for 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)

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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