SILVER HORIZONS 25 YEARS OF GLOBAL LEARNING

NEW HORIZON
COLLEGE OF ENGINEERING

Department of Electronics and Communication Engineering

Academic Year: 2025-26
III Year
Scheme and Syllabus

Batch 2023-27
Credits: 160

NEW HORIZON
COLLEGE OF ENGINEERING

Department of Electronics and Communication Engineering

Academic Year 2025-26

5th and 6th Semester Scheme & Syllabus

BATCH: 2023-27

CREDITS:160

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.
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

Program Outcomes (PO) with Graduate Attributes

	Graduate Attributes	Program Outcomes (POs)
1	**Engineering knowledge**	**PO1:** Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems in Electronics and Communication Engineering.
2	**Problem analysis**	**PO2:** Identify, formulate, review research literature, and analyze complex engineering problems in Electronics and Communication Engineering reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3	**Design/development of solutions**	**PO3:** Design solutions for complex engineering problems and design system components or processes of Electronics and Communication Engineering that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4	**Conduct investigations of complex problems**	**PO4:** Use research-based knowledge and research methods including design of experiments in Electronics and Communication Engineering, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5	**Modern tool usage**	**PO5:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities in Electronics and Communication Engineering with an understanding of the limitations.
6	**The engineer and society**	**PO6:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice in Electronics and Communication Engineering.
7	**Environment and sustainability**	**PO7:** Understand the impact of the professional engineering solutions of Electronics and Communication Engineering in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8	**Ethics**	**PO8:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9	**Individual and team work**	**PO9:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10	**Communication**	**PO10:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11	**Project management and finance**	**PO11:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12	**Life-long learning**	**PO12:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes

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

Mapping of PEOs to POs & PSOs

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

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

NEW HORIZON COLLEGE OF ENGINEERING

B. E. in Electronics and Communication Engineering

Scheme of Teaching and Examinations for 2023- 2027 BATCH (2022 Scheme)

V 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	HSMC	22ECE51	Operations Research and Management	EC	3	0	0	0	3	3	50	50	**100**
2	PCC	22ECE52	Communication Systems - I	EC	3	0	0	0	3	3	50	50	**100**
3	PCCL	22ECL52	Communication Systems - I Lab	EC	0	0	1	0	1	2	50	50	**100**
4	PCC	22ECE53	CMOS VLSI Design	EC	3	0	0	0	3	3	50	50	**100**
5	PCCL	22ECL53	CMOS VLSI Design Lab	EC	0	0	1	0	1	2	50	50	**100**
6	PEC	22ECE54X	Professional Elective Course - I	EC	3	0	0	0	3	3	50	50	**100**
7	AEC	22RMK55	Research Methodology and IPR	EC	1	1	0	0	2	3	50	50	**100**
8	AEC	22SDK56	Critical and Creative Thinking Skills	EC	0	0	1	0	1	2	50	--	**50**
9	UHV	22ESK57	Environmental Studies	EC	1	0	0	0	1	1	50	50	**100**
10	PROJ	22ECE58	Mini Project-II	EC	0	0	1	0	1	0	50	50	**100**
11	NCMC	22NSS50	National Service Scheme (NSS)	NSS coordinator	0	0	0	0	0	2	50	--	**50**
		22PED50	Physical Education (PE) (Sports and Athletics)	Physical Education Director									
		22YOG50	Yoga	Yoga Teacher									
Total									**19**	**24**	**550**	**450**	**1000**

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **UHV**: Universal Human Value Course, **NCMC:** Non-Credit Mandatory Course, **AEC**: Ability Enhancement Course, **PEC**: Professional Elective Course, **PROJ**: Mini Project work **L:** Lecture, **T**: Tutorial, **P**: Practical **S:**

SDA: Self Study for Skill Development, **CIE**: Continuous Internal Evaluation, **SEE**:Semester End Evaluation

Professional Elective Course-I			
22ECE541	Data Communication and Networking	22ECE544	Internet of Things
22ECE542	Electromagnetic Field Theory	22ECE545	Competitive Coding
22ECE543	DSP Algorithms and Architecture	22ECE546	Real Time Operating System - QNX

Mini-project II: 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

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

2) 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:

1. **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.
2. **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.

Professional Elective Courses (PEC): A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses can be added to supplement the latest trend and advanced technology in the selected stream of engineering.

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 2023- 2027 BATCH (2022 Scheme)

VI 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	PCC	22ECE61	Embedded System Design	EC	3	0	0	0	3	3	50	50	**100**
2	PCCL	22ECL61	Embedded System Design Lab	EC	0	0	1	0	1	2	50	50	**100**
3	PCC	22ECE62	Communication Systems - II	EC	3	0	0	0	3	3	50	50	**100**
4	PCCL	22ECL62	Communication Systems - II Lab	EC	0	0	1	0	1	2	50	50	**100**
5	PCC	22ECE63	Essentials of Cyber Security	EC	2	1	0	0	3	4	50	50	**100**
6	PEC	22ECE64X	Professional Elective Course-II	EC	3	0	0	0	3	3	50	50	**100**
7	PROJ	22ECE65	Project Phase-I	EC	0	0	2	0	2	0	50	50	**100**
8	AEC	22SDK66	Problem Solving Skills	EC	0	0	1	0	1	2	50	--	**50**
9	AEC	22ECE67X	Ability Enhancement Course – V	EC	0	0	1	0	1	2	50	50	**100**
10	OEC	23NHOP6XX	Industrial Open Elective Course-I	Offering Dept.	3	0	0	0	3	3	50	50	**100**
11	NCMC	22NSS60	National Service Scheme (NSS)	NSS coordinator	0	0	0	0	0	2	50	--	**50**
		22PED60	Physical Education (PE) (Sports and Athletics)	Physical Education Director									
		22YOG60	Yoga	Yoga Teacher									
Total									**21**	**26**	**550**	**450**	**1000**

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **NCMC:** Non-Credit Mandatory Course, **AEC**: Ability Enhancement Course, **PEC**: Professional Elective Course, **OEC**: Open Elective Course, **PROJ**: Project work**, L:** Lecture, **T**: Tutorial, **P**: Practical **S: SDA**: Self Study for Skill Development, C**IE**: Continuous Internal Evaluation, **SEE**:Semester End Evaluation.

Professional Elective Course-II			
22ECE641	Machine Learning Algorithms	22ECE644	Low Power VLSI Design
22ECE642	Biomedical Signal Processing	22ECE645	Optical Communication
22ECE643	RTL Design and Verification		

Ability Enhancement Course – V			
22ECE671	Antenna simulation using Ansys	22ECE673	Linux and Shell Programming
22ECE672	Network simulation using NS-2	22ECE674	ALP with Microcontrollers

Industrial Open Elective Courses-I:
Credit for OEC is 03 (L: T: P: S) can be considered as (3: 0: 0 : 0). The teaching and learning of these Courses will be based on hands-on. The Course Assessment will be based on CIE and SEE in practical mode. This Courses will be offered by Centre of Excellence to students of all the branches. Registration to Industrial open electives shall be documented and monitored on college level.

Project Phase-I: Students have to discuss with the mentor /guide and with their help he/she has to complete the literature survey and prepare the report and finally define the problem statement for the project work.

Professional Elective Courses (PEC): A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses can be added to supplement the latest trend and advanced technology in the selected stream of engineering.

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

FIFTH SEMESTER

(SYLLABUS)

OPERATIONS RESEARCH AND MANAGEMENT

Course Code	**22ECE51**	**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:

22ECE51.1	Apply basic principles of project management for real time problems
22ECE51.2	Promote entrepreneurship as an individual or as a group by creating awareness on its needs and roles with respect to growth of economic development
22ECE51.3	Develop solutions for barriers in small scale industries
22ECE51.4	Estimating the interest rates, cash flows and costing materials, production and overheads
22ECE51.5	Analyse the sequence of jobs on various machines
22ECE51.6	Make use of game theory concepts to determine the optimal solution

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
22ECE51.1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
22ECE51.2	3	2	-	-	-	-	-	-	-	-	2	2	2	2
22ECE51.3	3	2	-	-	-	-	-	-	-	-	2	2	2	2
22ECE51.4	3	2	-	-	-	-	-	-	-	-	2	2	2	2
22ECE51.5	3	2	-	-	-	-	-	-	-	-	2	2	2	2
22ECE51.6	3	-	-	-	-	-	-	-	-	-	2	2	2	2

MODULE 1	**BASICS OF PROJECT MANAGEMENT**	**22ECE51.1**	**8 Hours**

Introduction, Definition of project, characteristics of projects, types of projects, need for project management, phases of project life cycle management, impact of delays in project completions, roles and responsibilities of project leader.

Applications	Create project management plan by taking any real time project as example.
Text Book	Text Book 3: 1.1, 1.1, 1.8, 1.9, 1.10, 1.18, 1.16.

MODULE 2	**ENTREPRENEUR AND SSI**	**22ECE51.2 22ECE51.3**	**8 Hours**

Meaning of Entrepreneur, Functions of an Entrepreneur, Types of Entrepreneur, Stages in entrepreneurial process; Role of entrepreneurs in Economic Development. Entrepreneurship in India; women entrepreneurs, Entrepreneurship - its Barriers,
SSI Impact of Liberalization, Privatization, Globalization on SSI Effect of WTO/GATT Supporting Agencies of Government for SSI, Meaning, Nature of support. Objectives; Functions; Types of Help.

Self-study	List out some of the Small-Scale Industries which are mainly focused on women empowerment.

Text Book	Text Book 4: 2.2, 2.3, 2.4 to 2.15		
MODULE 3	**INTEREST, CASH FLOW, ESTIMATION AND COSTING**	**22ECE51.4**	**8 Hours**
Law of demand and supply, Law of returns, Interest and Interest factors: Interest rate, Simple interest, Compound interest, Cash - flow diagrams, Personal loans and EMI Payment, Exercises and Discussion. Components of costs such as Direct Material Costs, Direct Labor Costs, Fixed Over-Heads, Factory cost, Administrative Over-Heads, First cost, Marginal cost, Selling price, Estimation for simple components.			
Text Book	Text Book 5: 2.1 to 2.10		
MODULE 4	**SEQUENCING**	**22ECE51.5**	**8 Hours**
Basic assumptions, sequencing 'n' jobs on single machine using priority rules, sequencing using Johnson's rule- 'n' jobs on 2 machines, 'n' jobs on 3 machines, 'n' jobs on 'm' machines. Sequencing 2 jobs on 'm' machines using graphical method.			
Case Study	Case study on sequencing by taking any real time examples.		
Text Book	Text Book 2: Chapter 11		
MODULE 5	**GAME THEORY**	**22ECE51.6**	**8 Hours**
Formulation of games, Two person-Zero sum game, games with and without saddle point, Graphical solution (2x n, m x 2 game), dominance property.			
Case Study	Case study on game theory by taking any real time examples.		
Text Book	Text Book 1: 15.4 , Text Book 2: Chapter 14		

CIE Assessment Pattern (50 Marks – Theory) –

RBT Levels		Marks Distribution		
		Test (s)	Qualitative Assessment (s)	MCQ's
		25	15	10
L1	Remember	5	-	5
L2	Understand	10	5	5
L3	Apply	5	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	20
L3	Apply	10
L4	Analyze	10
L5	Evaluate	-
L6	Create	--

Suggested Learning Resources:

Text Books:

1. Operations Research: An Introduction, H A Taha, Pearson; 10th edition (17 January2017), ISBN-13: 978-1292165547.
2. Operation Research, S D Sharma, KedarNath RamNath publication, 2014 edition, ISBN-13: 1234567142552.
3. Contemporary Project Management, Timothy J Kloppenborg, Cengage Learning, 2 nd Edition, ISBN: 97881315187.
4. Project Management a System approach to Planning Scheduling & Controlling, Harold Kerzner, CBS Publishers and Distributors.2nd Ed., ISBN: 9788123908670.
5. Engineering Economy, Riggs J.L., 4 TH ed., McGraw Hill, 2002.

Reference Books:

1. Engineering Economy, Thuesen H.G. PHI, 2002.
2. Operations Research: Principles and Practice, A. Ravindran, John Wiley & Sons; 2nd Edition (February 15, 2016), ISBN-13: 978-1118886143.

Web links and Video Lectures (e-Resources):

- **https://onlinecourses.nptel.ac.in/noc22_ge24/preview**
- **https://projectmanagement.berkeley.edu/project-managemenet-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

- Demonstration of project management by taking any real time examples.
- Demonstration of implementation of game theory in industries.
- Demonstration of application of sequencing in the industries.
- Motivational videos from a women entrepreneur.
- 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.

COMMUNICATION SYSTEMS - I

Course Code	**22ECE52**	**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:

22ECE52.1	Compare the Generation and Detection of Analog modulation techniques
22ECE52.2	Evaluate the Power consumption and Bandwidth utilization in Analog modulation techniques
22ECE52.3	Examine the statistical averages associated with random processes
22ECE52.4	Apply the fundamentals of digital Communication for baseband signal processing and coding
22ECE52.5	Categorize digital modulation techniques based on Bit Error Rate performance
22ECE52.6	Estimate the signal in presence of noise by appropriate receiver design

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
22ECE52.1	3	-	-	-	-	-	-	-	-	-	-	2	3	3
22ECE52.2	3	2	1	-	-	-	-	-	-	-	-	2	3	3
22ECE52.3	3	2	-	-	-	-	-	-	-	-	-	2	3	3
22ECE52.4	3	-	1	-	-	-	-	-	-	-	-	2	3	3
22ECE52.5	3	2	1	-	-	-	-	-	-	-	-	2	3	3
22ECE52.6	3	2	1	-	-	-	-	-	-	-	-	2	3	3

MODULE-1	**ANALOG MODULATION**	**22ECE52.1, 22ECE52.2**	**8 Hours**

Introduction, Amplitude Modulation, Double side band-suppressed carrier modulation, Quadrature Carrier Multiplexing, Single-sideband modulation, VSB Modulation, Theme Example: VSB Transmission of Analog and Digital Television, Frequency Translation, Frequency- Division Multiplexing

Phase and Frequency modulation: Basic definitions, Frequency Modulation, Phase–Locked Loop

Applications	Investigate the applications of AM and FM in today's Communication scenario
Text Book	Text Book 1: 3.1-3.8, 4.1 – 4.4

MODULE-2	**RANDOM VARIABLES AND PROCESSES**	**22ECE52.3**	**8 Hours**

Introduction, Probability, Random variables, Statistical averages, Random processes, Mean, correlation, and Covariance functions

Power spectral density, Gaussian process, Noise, Narrowband noise

Self-study	Investigate the effect of noise in Communication Systems and methods to tackle it.
Text Book	Text Book 1: 5.1 – 5.6, 5.8 – 5.11

MODULE-3	**SAMPLING PROCESS AND WAVEFORM CODING TECHNIQUES**	**22ECE52.4**	**8 Hours**

Sampling Theorem, Quadrature sampling of band pass signals, Reconstruction of a message process from its samples, Practical aspects of sampling and signal recovery, Pulse Amplitude Modulation, Time Division Multiplexing

Pulse code modulation, Quantization noise and Signal-to-noise ratio, Robust quantization, Differential PCM, Delta modulation

Self-study	Explore the uses of analog-to-digital conversion in current Digital Systems.
Text Book	Text Book 2: 4.1 – 4.3,4.5-4.7, 5.1,5.3-5.6

MODULE-4	**DIGITAL MODULATION TECHNIQUES**	**22ECE52.5**	**8 Hours**

Digital Modulation formats, Coherent binary modulation techniques- Coherent Binary PSK, Coherent Binary FSK,Coherent quadrature modulation techniques-Quadri phase-shift keying, Noncoherent binary modulation techniques-Differential PSK.

Applications	Explore the applications of digital modulation techniques in today's Communication scenario.

Text Book	Text Book 2: 7.1 – 7.2, 7.3 (1), 7.4 (2)		
MODULE-5	**DETECTION AND ESTIMATION**	**22ECE52.6**	**8 Hours**
Model of Digital Communication System, Gram-Schmidt Orthogonalization procedure, geometric interpretation of signals, response of bank of correlators to noisy input, Detection of known signals in noise, correlation receiver, matched filter receiver Estimation: concepts and criteria, Maximum Likelihood Estimation			
Self-study	Survey on the different detection techniques used in existing Communication Systems.		
Text Book	Text Book 2: 3.1–3.5,3.7-3.8, 3.10 ,3.11		

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	Qualitative Assessment (s)	Quiz
		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) Communications Systems, 5th Edition, Simon Haykin, Michael Moher, Publisher: WILEY India Pvt. Ltd, 2019 ISBN: 978-81-265-2151-7

2) Digital Communications, Simon Haykin, Publisher: WILEY India Pvt. Ltd, 2006, ISBN-10 : 8126508248, ISBN-13: 978-8126508242

Reference Books:

1) An Introduction to Analog and Digital Communication, Simon Haykin, 2008, John Wiley India Pvt. Ltd.

2) Modern digital and analog Communication systems, B. P. Lathi, 3rd edition, 2015, Oxford University Press.

3) Electronic communication systems, Kennedy and Davis, 5th edition, 2011, TMH.

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=-PWg-0k2oks
- https://www.youtube.com/watch?v=wMflxR3KsXg&list=PLt3Fk5B7L7NZJv3PAZkxW83Fp7ww6_JE
- https://www.youtube.com/watch?v=ZW1glqkIgcw&t=135s
- https://www.youtube.com/watch?v=692SRjrT2MY

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

- Visit to any communication-based company/public sector enterprise.
- Simulation demonstration on modulation processes.
- Video demonstration of latest trends in communication sector.
- Contents related activities (Activity-based discussions)
  - For active participation of students, instruct the students to prepare presentations on

current research topics in communication sector.

- Organizing Group wise discussions on applications or products.
- Seminars.

COMMUNICATION SYSTEMS – I LAB

Course Code	**22ECL52**	**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:

22ECL52.1	Demonstrate generation and detection of analog modulation techniques
22ECL52.2	Analyze pulse modulation systems and their performance
22ECL52.3	Examine the different digital modulation schemes used in the field of communication
22ECL52.4	Evaluate the performance of modulation and demodulation techniques in various transmission environments

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
22ECL52.1	3	3	2	1	3	-	-	-	2	-	-	3	3	3
22ECL52.2	3	3	2	1	3	-	-	-	2	-	-	3	3	3
22ECL52.3	3	3	2	1	3	-	1	-	2	-	-	3	3	3
22ECL52.4	3	3	2	1	3	-	1	-	2	-	-	3	3	3

Exp. No. / Pgm. No.	List of Experiments	Hours	COs
	Prerequisite Programs		
	To Learn the basics of using MATLAB simulation software and also to learn the communication system toolbox in MATLAB **https://youtu.be/Ul9lup_hjnY**	2	NA
	PART-A		
1	To generate Amplitude Modulation technique using transistor.	2	22ECL52.1 22ECL52.4
2	Generation and detection of ASK.	2	22ECL52.3 22ECL52.4
3	Generation and detection of PAM.	2	22ECL52.2 22ECL52.4
4	Generation of PWM.	2	22ECL52.2 22ECL52.4
5	Generation of FSK using IC 555 Timer	2	22ECL52.3 22ECL52.4
6	Generation of PSK.	2	22ECL52.3 22ECL52.4
	PART-B		
7	Frequency Modulation and Demodulation using MATLAB.	2	22ECL52.1 22ECL52.4
8	Implementation and analysis of QPSK modulation and demodulation.	2	22ECL52.3 22ECL52.4
9	Generation and detection of Pulse Code Modulation using MATLAB.	2	22ECL52.2 22ECL52.4
10	Realize Time Division Multiplexing and Demultiplexing of two band limited signals.	2	22ECL52.4
11	Signal to Noise ratio calculation using MATLAB.	2	22ECL52.4
12	Simulation of QAM Generation and Detection Schemes.	2	22ECL52.4
	PART-C **Beyond Syllabus Virtual Lab Content** **(To be done during Lab but not to be included for CIE or SEE)**		

1. Method to set and measure the depth of modulation and trapezoidal display.
   https://web.njit.edu/~gilhc/ECE489/ece489-V.htm
2. Study the envelope of a wideband signal.
   https://web.njit.edu/~gilhc/ECE489/ece489-VI.htm
3. Explore Two path channel pass band simulation.
   https://www.etti.unibw.de/labalive/experiment/two-path-channel-baseband/
4. Examination of AM transmission - synchronous detector.
   https://www.etti.unibw.de/labalive/experiment/amtransmissionsynchronousdetector/
5. Encode and decode messages and observe the impact of coding on error detection and correction.
   https://in.mathworks.com/help/comm/ug/error-detection-and-correction.html
6. Computation of BER for QAM System with AWGN Using MATLAB.
   https://in.mathworks.com/help/comm/gs/use-pulse-shaping-on-16-qam-signal.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	10
L3	Apply	20
L4	Analyze	10
L5	Evaluate	10
L6	Create	-

Suggested Learning Resources:

Reference Books:

1. Raveendranathan, K. C. Communication systems modelling and simulation: using MATLAB and Simulink. Universities Press, 2011. ISBN: 978-81-737-1722-2.
2. Hari, Bhat K N, Digital Communications with Lab Manual, 3/E. Pearson Education India, 2010. ISBN-10. 8131732371; ISBN-13. 978-8131732373.

CMOS VLSI DESIGN			
Course Code	**22ECE53**	**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:

22ECE53.1	Recognize the generic model and basic concepts of MOSFET
22ECE53.2	Identify the process sequence for the fabrication of ICs and the relevant layout design rules
22ECE53.3	Employ the delay model to the combinational MOS circuits
22ECE53.4	Differentiate the different combinational circuit designs that are currently in use
22ECE53.5	Examine the sequential circuits in terms of the delay constraints
22ECE53.6	Evaluate the Combinational and Sequential Circuits in terms of timing

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
22ECE53.1	3	-	-	-	-	-	-	-	-	-	-	-	3	2
22ECE53.2	3	3	-	-	-	-	-	-	-	-	-	2	3	2
22ECE53.3	3	3	-	-	-	-	-	-	-	-	-	2	3	2
22ECE53.4	3	3	-	-	-	-	-	-	-	-	-	2	3	2
22ECE53.5	3	3	-	-	-	-	-	-	-	-	-	2	3	2
22ECE53.6	3	3	-	-	-	-	-	-	-	-	-	2	3	2

MODULE-1	**MOS TRANSISTORS**	**22ECE53.1**	**8 Hours**

MOS Transistors: Introduction, MOS transistors, CMOS Logic, Design portioning.
MOS Transistor Theory: Introduction, Long-Channel I-V characteristics, C-V Characteristics - Simple MOS Capacitance Models, Non-ideal I-V effects, DC transfer characteristics.

Case Study	Investigate how to Enhance the Power Efficiency in Mobile Devices with Advanced MOS Transistor Technology.
Text Book	Text Book-1: 1.3, 1.4, 1.6, 2.1, 2.2, 2.3 (up to 2.3.1), 2.4, 2.5

MODULE-2	**CMOS PROCESSING TECHNOLOGY**	**22ECE53.2**	**8 Hours**

CMOS Processing Technology: CMOS Fabrication and Layout, Exercises for stick diagram and layout, CMOS Technologies, Layout Design Rules, CMOS Process Enhancements.

Applications	Explore the Significance of CMOS technology in various electronic applications.
Text Book	Text Book 1: 1.5, 3.1, 3.2, 3.3, 3.4

MODULE-3	**DELAY & COMBINATIONAL CIRCUIT BASICS**	**22ECE53.3, 22ECE53.4**	**8 Hours**

Delay: Introduction, Transient Response, RC Delay Model – Effective Resistance, Gate and Diffusion Capacitance, Equivalent RC Circuits, Transient Response, Elmore Delay, Layout Dependence of Capacitance, Linear Delay Model - Logical Effort, Parasitic Delay, Delay in a Logic Gate, Drive.
Combinational Circuit Basics: Introduction, Circuit Families - Static CMOS.

Self-Study	Optimization of combinational circuits to minimize delay.
Text Book	Text Book 1: 4.1, 4.2, 4.3 (excluding 4.3.7), 4.4 (up to 4.4.4), 9.1, 9.2 (up to 9.2.1)

MODULE-4	**COMBINATIONAL & SEQUENTIAL CIRCUIT DESIGN**	**22ECE53.4, 23ECE53.5**	**8 Hours**

Combinational Circuit Design: Circuit Families - Ratioed Circuits, Cascode Voltage Switch Logic, Dynamic Circuits- Domino Logic, Silicon-On-Insulator Circuit Design.
Sequential Circuit Design: Introduction, Sequencing Static Circuits, Circuit Design of Latches and Flip-Flops - Conventional CMOS Latches, Conventional CMOS Flip-Flops, Pulsed Latches, Resettable Latches
and Flip-Flops.

Self-Study	Introduction to System-on-Chip (SoC) Design.
Text Book	Text Book 1: 9.2 (up to 9.2.4.1), 9.5, 10.1, 10.2, 10.3 (up to 10.3.4)

MODULE-5	TIMING ANALYSIS	22ECE53.6	8 Hours

Timing Analysis: Delay in general, Slew Balancing & Transistor Equivalency, Design of 2-Inputs NAND & NOR Gates for Equal Rise and Fall Slew, MOS Capacitances, Design Techniques for Delay Reduction, Intrinsic Delay of Inverter and its Sizing Effect on Propagation Delay, Inverter Chain Design, Timing Terms - Analysis - Models - Goals, Static Timing Analysis, Timing Constraints & Verification, Timing Convergence, Timing driven Logic and Layout Synthesis.

Case Study	Emphasizes the importance of timing analysis and optimization in the context of CMOS VLSI design.
Text Book	Text Book 2: 10.1 - 10.6, 10.8 - 10.10, 10.12 - 10.15, 10.19 - 10.39

CIE Assessment Pattern (50 Marks – Theory)

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

SEE Assessment Pattern (50 Marks – Theory)

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

Suggested Learning Resources:

Text Books:

1) "CMOS VLSI Design – A Circuits and Systems Perspective", Neil H. E. Weste, David Money Harris, 4th Edition, Pearson Education, 2015.
2) VLSI Design, Debaprasad Das, 2nd edition, 2016, Oxford University Press.

Reference Books:

1) CMOS Digital Integrated Circuits, Analysis and Design, Sung-Mo Kang & Yusuf Leblebici, 3rd Edition, 2007, TMH.
2) Digital Integrated Circuits – A design Perspective, Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic, 2nd Edition, 2009, Prentice-Hall.
3) Basic VLSI Design, Douglas A. Pucknell and Kamran Eshraghian, 3rd Edition, 2011, PHI.
4) Static Timing Analysis for Nanometer Designs - A Practical Approach, J. Bhasker, Rakesh Chadha, Springer, 2009.

Web links and Video Lectures (e-Resources):

- https://onlinecourses.nptel.ac.in/noc21_ee09/preview
- https://nptel.ac.in/courses/117101105

- **https://resources.pcb.cadence.com/blog/2020-cmos-vlsi-design-and-circuit-simulation-tasks**
- **http://pages.hmc.edu/harris/cmosvlsi/4e/index.html**
- **https://www.tutorialspoint.com/vlsi_design/index.htm**

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

- Visit to any VLSI Industry.
- Demonstration of Layout/STA/Fabrication Process.
- Demonstration of working of Silicon Fab.
- Demonstration of purification Silicon from MGS to EGS.
- Video demonstration of latest trends in Semiconductor and VLSI Industry.
- 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.

CMOS VLSI DESIGN Lab

Course Code	**22ECL53**	**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:

22ECL53.1	Demonstrate the working of analog and digital CMOS circuits through simulation
22ECL53.2	Use the schematics of CMOS circuits to construct and verify their layouts
22ECL53.3	Apply Switch level description to digital CMOS circuits Modeling
22ECL53.4	Employ the Gate level description of digital CMOS circuits for simulation and synthesis

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
22ECL53.1	3	3	2	1	3	-	-	-	3	-	-	3	3	2
22ECL53.2	3	-	-	-	3	-	-	-	3	-	-	3	3	2
22ECL53.3	3	-	-	-	3	-	-	-	3	-	-	3	3	2
22ECL53.4	3	3	2	1	3	-	-	-	3	-	-	3	3	2

Exp. No. / Pgm. No.	List of Experiments / Programs	Hours	COs
	Prerequisite Experiments / Programs / Demo		
	Introduction to CMOS VLSI Design and analog VLSI Design. Introduction to Verilog and System Design using Verilog.	2	NA
	PART-A		
1	Draw the schematic of CMOS Inverter for the given specifications, and verify using Transient and DC Analyses.	2	22ECL53.1 22ECL53.2
2	Draw the schematic of the following circuits for the given specifications, and verify using Transient and DC Analyses: i) 2-input CMOS NAND gate, ii) 2-input CMOS NOR gate.	2	22ECL53.1 22ECL53.2
3	Draw the schematic of transmission gate for the given specifications, and verify using Transient and DC Analyses.	2	22ECL53.1 22ECL53.2
4	Draw the schematic of the following amplifiers for the given specifications, and verify the same using Transient, DC and AC Analyses: i) Common Source amplifier, ii) Common Drain amplifier.	2	22ECL53.1 22ECL53.2
5	Draw the layout of the CMOS Inverter and perform physical verification using DRC, ERC and LVS. Extract RC and back-annotate the same and verify the Design.	2	22ECL53.1 22ECL53.2
6	Draw the layout of the following circuits and perform physical verification using DRC, ERC and LVS. Extract RC and back-annotate the same and verify the Design: i) 2-input CMOS NAND gate ii) 2-input CMOS NOR gate.	2	22ECL53.1 22ECL53.2
	PART-B		
7	For the following circuits, write the switch level Verilog Code, and verify using Test Bench: i) CMOS inverter, ii) 2-input CMOS NAND and NOR gates.	2	22ECL53.1 22ECL53.3
8	For the following circuits, write the switch level Verilog Code and verify using Test Bench: i) 2-input EXOR gate using CMOS logic, ii) 2-input EXOR gate using PTL.	2	22ECL53.1 22ECL53.3
9	Synthesize the following circuits using the gate level Verilog Code, with the given Constraints: i) CMOS inverter, ii) 2-input CMOS NAND and NOR gates.	2	22ECL53.1 22ECL53.4

10	For the following circuits, write the Verilog Code, verify using Test Bench, and then synthesize with the given Constraints: i) 4-bit Parallel adder ii) D Flip-flop.	2	22ECL53.1 22ECL53.4
11	For the following circuits, write the Verilog Code, verify using Test Bench, and then synthesize with the given Constraints: i) T Flip-flop, ii) 4-bit Synchronous counter.	2	22ECL53.1 22ECL53.4
12	Write the Verilog Code for Sequence detector using Mealy and Moore, verify using Test Bench, and then synthesize with the given Constraints.	2	22ECL53.1 22ECL53.4

PART-C

Beyond Syllabus Virtual Lab Content

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

1. **MOSFET – To plot the (i) output characteristics & (ii) transfer characteristics of an n-channel and p-channel MOSFET**
   http://vlsi-iitg.vlabs.ac.in/MOSFET_theory.html
2. **Ring Oscillator - To design and plot the output characteristics of a 3-inverter ring oscillator.**
   http://vlsi-iitg.vlabs.ac.in/RingOscillator_theory.html
3. **4X1 multiplexer - To design and plot the characteristics of 4x1 digital multiplexer using pass transistor logic.**
   http://vlsi-iitg.vlabs.ac.in/Multiplexer_theory.html
4. **Latches - To design and plot the characteristics of a positive and negative latch based on multiplexers.**
   http://vlsi-iitg.vlabs.ac.in/Latches_theory.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:

1) "CMOS VLSI Design – A Circuits and Systems Perspective", Neil H. E. Weste, David Money Harris, 4th Edition, Pearson Education, 2015
2) VLSI Design, Deba prasad Das, 2nd edition, 2016, Oxford University Press.
3) Digital System design Using Verilog, Charles H. Roth Jr., Lizy Kurian John, Byeong Kil Lee, 1st Edition, 2015, CL Engineering.
4) Digital Design: An Embedded Systems approach Using VERILOG, Peter J. Ashenden, 2014, Elesvier.

DATA COMMUNICATION AND NETWORKING

Course Code	**22ECE541**	**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:

22ECE541.1	Understand the various components of data communication
22ECE541.2	Apply the principles of protocol layering and compare the TCP/IP protocol suite with the OSI model
22ECE541.3	Differentiate between various transmission modes, such as baseband and broadband transmission, and their respective applications in data communication network
22ECE541.4	Analyze the fundamental principle of digital communication and switching
22ECE541.5	Compare data link layer protocols in computer networks
22ECE541.6	Summarize IEEE 802.xx standards

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
22ECE541.1	3	-	-	-	-	-	-	-	-	-	-	2	3	2
22ECE541.2	3	-	-	-	-	-	-	-	-	-	-	2	3	2
22ECE541.3	3	3	-	-	-	-	-	-	-	-	-	2	3	2
22ECE541.4	3	3	-	-	-	-	-	-	-	-	-	2	3	2
22ECE541.5	3	3	-	-	-	-	-	-	-	-	-	2	3	2
22ECE541.6	3	3	-	-	-	-	-	-	-	-	-	2	3	2

MODULE-1	**Introduction**	**22ECE541.1 22ECE541.2**	**8 Hours**

Data Communications, Networks, Network Types, Internet History, Standards and Administration, Networks Models: Network topologies, Protocol Layering, TCP/IP Protocol suite, The OSI model. Introduction to Physical Layer-1: Data and Signals, Digital Signals, Transmission Impairment, Data Rate limits, Performance.

Text Book	Text Book 1: Ch 1.1 to 1.5, 2.1 to 2.3, 3.1, 3.3 to 3.6

MODULE-2	**Digital Transmission**	**22ECE541.3**	**8 Hours**

Digital to digital conversion (Only Line coding: Polar, Bipolar and Manchester coding).
Physical Layer-2: Analog to digital conversion (only PCM), Transmission Modes
Analog Transmission: Digital to analog conversion.

Text Book	Text Book 1: Ch 4.1 to 4.3, 5.1

MODULE-3	**Network bandwidth utilization**	**22ECE541.4**	**8 Hours**

Bandwidth Utilization: Multiplexing and Spread Spectrum, switching: Introduction, Circuit Switched Networks and Packet switching. Error Detection and Correction: Introduction, Block coding, Cyclic codes, Checksum

Text Book	Textbook1: Ch 6.1, 6.2, 8.1 to 8.3, 10.1 to 10.4

MODULE-4	**Data link control**	**22ECE541.4 22ECE541.5**	**8 Hours**

Data link control: DLC services, Data link layer protocols, Point to Point protocol (Framing, Transition phases only). Media Access control: Random Access, Controlled Access and Channelization, Introduction to Data-Link Layer: Introduction, Link-Layer Addressing, ARP. IPv4 Addressing and subnetting: Classful and CIDR addressing, DHCP, NAT

Text Book	Textbook1: Ch 9.1, 9.2, 11.1, 11.2 11.4, 12.1 to 12.3, 18.4 RBT: L1, L2

MODULE-5	**Wired LANs Ethernet**	**22ECE541.6**	**8 Hours**

Wired LANs Ethernet: Ethernet Protocol, Standard Ethernet, Fast Ethernet, Gigabit Ethernet and 10 Gigabit

Ethernet, Wireless LANs: Introduction, IEEE 802.11 Project and Bluetooth. Other wireless Networks: Cellular Telephony.

Text Book	Textbook1: Ch 13.1 to 13.5, 15.1 to 15.3, 16.2

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution	
		Test (s)	NPTEL
		25	25
L1	Remember	5	-
L2	Understand	5	5
L3	Apply	10	10
L4	Analyze	5	10
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) Behrouz A. Forouzan, Data Communications and Networking 5E, 5th Edition, Tata McGraw-Hill, 2013.

Reference Books:

1) Alberto Leon-Garcia and Indra Widjaja: Communication Networks - Fundamental Concepts and Key architectures, 2nd Edition Tata McGraw-Hill, 2004.

2. William Stallings: Data and Computer Communication, 8th Edition, Pearson Education, 2007.

3. Larry L. Peterson and Bruce S. Davie: Computer Networks – A Systems Approach, 4th Edition, Elsevier, 2007.

Web links and Video Lectures (e-Resources):

- https://ocw.mit.edu/courses/6-263j-data-communication-networks-fall-2002/
- https://archive.nptel.ac.in/courses/106/105/106105082/

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

- Demonstration of NS2 software's
  - Organizing Group wise discussions on new trends in Networking

ELECTROMAGNETIC FIELD THEORY

Course Code	**22ECE542**	**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:

22ECE542.1	Apply the laws and theorems of Maxwells equation to solve electrostatic field variables
22ECE542.2	Compare the static characteristics of electric and magnetic fields to understand the charge and current distribution
22ECE542.3	Analyze the boundary characteristics of electric fields on various medium
22ECE542.4	Illustrate the concept of capacitance and inductance using electric and magnetic fields
22ECE542.5	Categorize the Maxwell's Equations for static and time varying electromagnetic fields
22ECE542.6	Analyze the characteristics of electromagnetic waves over various medium

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
22ECE542.1	3	-	-	-	-	-	-	-	-	-	-	-	3	2
22ECE542.2	3	-	-	-	-	-	-	-	-	-	-	-	3	2
22ECE542.3	3	3	2	1	-	-	-	-	-	-	-	-	3	2
22ECE542.4	3	3	2	-	-	3	3	-	-	-	-	3	3	2
22ECE542.5	3	3	2	-	-	3	3	-	-	-	-	3	3	2
22ECE542.6	3	3	2	1	-	3	3	-	-	-	-	3	3	2

MODULE-1	**COULOMB'S LAW, ELECTRIC FIELD INTENSITY, FLUX DENSITY GAUSS'S LAW AND DIVERGENCE**	**22ECE542.1 22ECE542.2**	**8 Hours**

Vector Analysis, Various Coordinate systems, Experimental law of Coulomb, Electric field intensity, Field due to infinite line charge, Electric flux density and Gauss law, Concept of Divergence, Maxwell 's First equation (Electrostatics) and divergence theorem.

Case Study	Expression for gradient, divergence and curl in rectangular, cylindrical and spherical co-ordinate systems.
Text Book	Text-1: Chapter 1, 2.1, 2.2, 2.3, 2.4, 3.1, 3.2, 3.5, 3.6, 3.7

MODULE-2	**POTENTIAL AND CURRENT**	**22ECE542.3 22ECE542.4**	**8 Hours**

Definition of potential and potential difference, potential gradient, Current and current density, Concept of Continuity equation, Conductor properties and boundary conditions.

Poisson's and Laplace's Equations

Concept of capacitance, Derivation of Poisson 's and Laplace 's Equations, Examples of the solution of Laplace 's equation: Parallel plate capacitor, Co-axial cable and spherical capacitor.

Case Study	Parallel plate capacitor with two dielectrics with dielectric interface parallel to the conducting plates.
Text Book	Text-1: 4.3, 4.6, 5.1, 5.2, 5.4, 6.3, 7.1, 7.3

MODULE-3	**STEADY MAGNETIC FIELD**	**22ECE542.1 22ECE542.2 22ECE542.4**	**8 Hours**

Biot-Savart Law and its application: Magnetic Field due to straight current carrying conductor, Ampere 's circuital law and its application: Magnetic Field due to co-axial cable, Concept of Curl, Stokes' theorem, Scalar and Vector Magnetic Potentials.

Magnetic Materials and Inductance

Magnetic circuits, Inductance and mutual inductance

Case Study	Nature of magnetic materials, magnetization and permeability.
Text Book	Text-1: 8.1, 8.2 , 8.3, 8.4 , 8.6 , 9.8 , 9.10

MODULE-4	**TIME-VARYING FIELDS AND MAXWELL'S EQUATIONS**	**22ECE542.5**	**8 Hours**

Faraday 's law, displacement current, Maxwell 's equations in point form, Maxwell's equations in integral form.

Applications	Retarded Potentials.qwe4t
Text Book	Text-1: 10.1, 10.2, 10.3, 10.4

MODULE-5	**UNIFORM PLANE WAVE**	**22ECE542.6**	**8 Hours**

Wave propagation in free space, dielectrics and good conductors. Poynting's theorem and wave power, Skin Effect, Reflection of uniform plane waves at normal incidence and Standing wave ratio.

Applications	VSWR Measurement for various EM structures.
Text Book	Text-1: 12.1, 12.2, 12.3, 12.4, 13.1, 13.2

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution	
		Test (s)	NPTEL
		25	25
L1	Remember	5	-
L2	Understand	5	5
L3	Apply	10	10
L4	Analyze	5	10
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.H. Hayt and J.A. Buck, "Engineering Electromagnetics", 7th Edition, Tata McGraw Hill, 2009, ISBN-978-0-07-061223-5.

Reference Books:

1) John Krauss and Daniel, A Fleisch, "Electromagnetics with applications", McGraw- Hill,2017
2.) N. Narayana Rao, "Fundamentals of Electromagnetics for Engineering", Pearson,2008.

Web links and Video Lectures (e-Resources):

- https://onlinecourses.nptel.ac.in/noc21_ee83/preview#:~:text=The%20course%20covers%20static%20and,numerical%20methods%20are%20also%20discussed.
- https://byjus.com/jee/electromagnetic-spectrum-and-electromagnetic-waves/

• **https://www.youtube.com/watch?v=508ZsmsIlno**
Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning • Demonstration of Magnetic field and flux density • Demonstration of working of EM waves • Video classes for the EM wave propagation

DSP ALGORITHMS AND ARCHITECTURE

Course Code	**22ECE543**	**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:

22ECE543.1	Recognize the fundamental concepts of fixed- and floating-point architecture of various DSPs
22ECE543.2	Analyze the architecture of digital signal processors
22ECE543.3	Develop the programming knowledge using the instruction set of DSP processor
22ECE543.4	Analyze the signal processing algorithms in DSP
22ECE543.5	Apply the signal architecture in embedded applications
22ECE543.6	Categories the advantages of modern digital signal processors for real world signal processing applications

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
22ECE543.1	3	-	-	-	-	-	-	-	-	-	-	3	3	3
22ECE543.2	3	3	2	-	-	-	-	-	3	-	-	3	3	3
22ECE543.3	3	3	-	-	-	-	-	-	3	-	-	3	3	3
22ECE543.4	3	3	2	-	-	-	-	-	-	-	-	3	3	3
22ECE543.5	3	3	-	-	-	-	-	-	3	-	-	3	3	3
22ECE543.6	3	3	2		-	-	-	-	3	-	-	3	3	3

MODULE-1	**INTRODUCTION OF DSP PROCESSOR**	**22ECE543.1, 22ECE543.2**	**8 Hours**

DSPs are different from other Microprocessors, Circular Buffering, Architecture of the Digital signal Processor, Fixed versus Floating point, C versus Assembly, Requirements of DSP Processor, Evolution of Digital signal processor in market.

Self-study	Importance of DSP in Smartphone.
Text Book	Text Book 1: 28.1-28.7

MODULE-2	**PROGRAMMABLE DSP PROCESSOR**	**22ECE543.2, 22ECE543.3**	**8 Hours**

Architecture, Finite word length, Data Addressing Modes of TMS32O54XX, Instruction set and Programming, Pipeline Operation of DSP Processor, Introduction to TMS320C6713 DSP Processor and C6713 DSK.

Self-study	Explore different DSP architectures such as fixed-point vs floating point and their impact on signal processing tasks.
Text Book	Text Book 2: 5.3,5.4,5.5,5.7,5.10 Text Book 3: 10.1,10.3

MODULE-3	**IMPLEMENTATION OF DSP ALGORITHMS**	**22ECE543.4**	**8 Hours**

FIR Filters, IIR Filters, FFT Algorithm for DFT Computation, Overflow and Scaling, Bit-Reversed Index Generation & Implementation on the TMS32OC67XX, Introduction to adaptive filters.

Applications	Design of an adaptive filter in digital signal processor for active noise control.
Text Book	Text Book 2 :7.3,7.4,7.5,7.6,8.2,8.3,8.4,8.5,8.6

MODULE-4	**EMBEDDED SIGNAL PROCESSING AND CONCEPTS**	**22ECE543.5**	**8 Hours**

Introduction to micro signal architecture, Overview of Blackfin Processor, Data arithmetic unit, address arithmetic unit, control unit, Bus Architecture and memory.			
Case Study	Investigate how to design a Real Time Graphic Equalizer using Blackfin Processor.		
Text Book	Text Book 4: 5.1.1,5.1.2,5.1.3,5.1.4		
MODULE-5	**APPLICATIONS OF DSP PROCESSORS**	**22ECE543.6**	**8 Hours**
CODEC Interface Circuit. DSP Based Bio-telemetry Receiver, audio equalization and filtering. speech recognition system, An Image Processing System, DTMF Detection using modified Goertzel algorithm.			
Case Study	Research and analyze real-world applications of DSP processors, such as noise cancellation headphones, medical imaging devices, or radar systems to represent their findings and discuss the DSP principles involved.		
Text Book	Text Book 3: 8.8,8.9,9.1,9.2,9.4 Reference Book 3: Chapter 1		

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution	
		Test (s)	NPTEL
		25	25
L1	Remember	5	-
L2	Understand	5	5
L3	Apply	10	10
L4	Analyze	5	10
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) Steven W. Smith, 2002, The Scientist and Engineer's Guide to Digital Signal Processing, California Technical Publishing, ISBN 978-0966017632.
2) Avatar Singh and S. Srinivasan, 2004, "Digital Signal Processing", Thomson Learning, 2004,ISBN 978-0534400756.
3) Andhe Pallavi & K. Uma Rao, 2012, "Digital Signal Processors-Architecture, Programming and Applications", Sanguine Technical Publishers, ISBN 978-9380644104.
4) Woon Seng Gan, Sen M. Kuo, Hoboken,2007, "Embedded Signal processing with the micro signal architecture", New Jersey Publisher, ISBN 978-0471690078.

Reference Books:

1) B Venkataramani and M Bhaskar,2010, "Digital Signal Processors", TMH, 2nd edition,ISBN 978-0070702567.
2) Sen M. Kuo and Woon-Seng Gan. 2004, "Digital Signal Processors: Architectures, Implementations, and Applications",ISBN 978-0130352144.

3) Chiouguey J Chen, 1996, "Application report on: "Modified Goertzel algorithm in DTMF Detection using TMS320C80.
4)R. Chassaing, 2004 ,'Digital Signal Processing and Applications with the C6713 and C6416 DSK', John Wiley and Sons, Inc., New York, ISBN 978-0471690078.

Web links and Video Lectures (e-Resources):

- **https://www.dspguide.com/ch12.htm**
- **https://www.ti.com/lit/ug/spru307a/spru307a.pdf?ts=1691420154210&ref_url=https%253A%252F%252Fwww.google.com%252F**
- **https://www.ti.com/lit/ug/spru733a/spru733a.pdf?ts=1691469745326&ref_url=https%253A%252F%252Fwww.google.com%252F**
- **https://www.slideshare.net/pantechsolutions/blackfin-core-architectureslides**
- **https://onlinelibrary.wiley.com/doi/10.1002/acs.959**
- **https://www.nxp.com/docs/en/application-note/AN2110.pdf**

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

- Demonstration of DSP program with actual hardware or software simulation tools to implement and test signal processing algorithm.
- Video demonstration of Digital Signal Processor market Overview.
- Contents related activities (Activity-based discussions)
  - For active participation of students, debate the advantage and limitation of different DSP Techniques.
  - 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.
  - Seminars

INTERNET OF THINGS

Course Code	**22ECE544**	**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:

22ECE544.1	Recognize the challenges for IoT and compare the IoT architectures
22ECE544.2	Characterize the smart objects and communication protocols for IoT network
22ECE544.3	Interpret design principles and cloud computing for IoT network
22ECE544.4	Apply software design concepts and program MQTT clients and server
22ECE544.5	Identify the security attacks and solutions in IoT network
22ECE544.6	Investigate the IoT applications for resolving real-world problems and life-long learning

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
22ECE544.1	2	-	-	-	-	-	-	-	-	-	-	2	3	2
22ECE544.2	3	-	-	-	-	-	-	-	-	-	-	2	3	2
22ECE544.3	3	-	-	-	-	-	-	-	-	-	-	2	3	2
22ECE544.4	3	3	2	-	-	-	-	-	-	-	-	2	3	2
22ECE544.5	3	3	2	-	-	-	-	-	-	-	-	2	3	2
22ECE544.6	3	3	2	-	-	-	-	-	-	-	-	3	3	2

MODULE-1	**IOT OVERVIEW AND ARCHITECTURE**	**22ECE544.1**	**8 Hours**

Overview of Internet of Things: Genesis of IoT -IoT and Digitization, IoT Impact, IoT Challenges.
IoT Network Architecture: Drivers Behind New Network Architectures, Comparing IoT Architectures, A Simplified IoT Architecture, The Core IoT Functional Stack, IoT Data Management and Compute Stack.

Self-Study	Explore the significance of IoT in the modern world.
Text Book	Text Book 1: 1,2

MODULE-2	**SMART OBJECTS AND COMMUNICATION PROTOCOLS IN IOT**	**22ECE544.2**	**8 Hours**

Smart Objects- *The "Things" in IoT, Sensors, Actuators, and Smart Objects, Sensor Networks.*
Design Principles for Web Connectivity- *Web communication protocols for connected devices, Message communication protocols (CoAP-SMS, CoAP-MQ, MQTT, XMPP) for IoT/M2M device.*

Self-Study	Explore various IoT devices, sensors, and actuators used to collect and transmit data.
Text Book	Text Book 1: 2, Text Book 2: 3.2,3.3

MODULE-3	**IOT DESIGN AND COMPUTING**	**22ECE544.3**	**8 Hours**

Design Principles for IoT- Introduction, Internet connectivity, Internet based communication, IPv4, IPv6,6LoWPAN protocol, IP Addressing in the IoT.
Data Collection, Storage and Computing using a Cloud Platform- Introduction, Cloud computing paradigm for data collection, storage and computing, Cloud service models, IoT Cloud- based data collection, storage and computing services using Nimbits.

Case Study	Study wireless communication technologies such as Wi-Fi, Bluetooth, Zigbee, LoRaWAN, and Cellular (e.g., 4G LTE, 5G) for IoT connectivity.
Text Book	Text Book 2: 4.1,4.2,4.3.1, 4.3.2, 4.4, 6.1,6.2,6.3,6.4.2

MODULE-4	**PROTOTYPE AND SOFTWARE FOR IOT APPLICATIONS**	**22ECE544.4**	**8 Hours**

Prototyping and Designing Software for IoT Applications- Introduction, Prototyping Embedded device software, Programming Embedded Device Arduino Platform using IDE, Reading data from sensors and devices, Devices, Gateways, Internet and Web/Cloud services software development, Programming MQTT clients and MQTT server.

Application	Analyze the impact of IoT in the automotive industry, including connected car technologies, autonomous vehicles, and predictive maintenance.
Text Book	Text Book 2: 9.1, 9.2.1,9.2.2,9.3

MODULE-5	**SECURITY AND SMART APPLICATION**	**22ECE544.5 22ECE544.6**	**8 Hours**

Introduction to IoT privacy and security - Vulnerabilities, security requirements and threat analysis, IoT Security Tomography and layered attacker model, Identity management, and establishment, access control and secure message communication.

Connected Cities and Smart Transportation- IoT applications for smart homes, cities, environment-monitoring and agriculture

Case Study	Investigate how IoT is used in agriculture for soil monitoring, crop management, and precision agriculture.
Text Book	Text Book 2: 10.1, 10.2, 10.4, 12.3.1, 12.5

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution	
		Test (s)	Qualitative Assessment (s)
		25	25
L1	Remember	5	-
L2	Understand	5	5
L3	Apply	10	10
L4	Analyze	5	10
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) David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry," IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", First Edition, Cisco Press, 2017, ISBN 978-1587144561.

2) Raj Kamal, "Internet of Things: Architecture and Design Principles", First Edition, McGraw Hill Education, 2017, ISBN 978-935260522.

Reference Books:

1) Adrian Mcewen, Hakin Cassimally, "Designing the Internet of Things", First Edition, Wiley, 2014, ISBN 978-1118430629.

2) Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Aves and, Stamatis Karnouskos, David Boyle, From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence, 1st Edition, Academic Press, 2014, ISBN 978-0124076846.

3) Alessandro Bassi, Martin Bauer, Martin Fiedler, Thorsten Kramp, Rob van Kranenburg, Sebastian Lange, Stefan Meissner, Enabling things to talk Designing IoT solutions with the IoT Architecture Reference Model, 2013, Springer Open, USA, ISBN 978-3319004913.

Web links and Video Lectures (e-Resources):

- https://onlinecourses.nptel.ac.in/noc23_cs83/preview
- https://www.youtube.com/watch?v=irq66O8NdvA
- https://www.youtube.com/watch?v=36zducUX16w

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

- Video demonstration of latest trends and applications of IoT.
- Contents related activities (Activity-based discussions)
  - Seminars on architecture designs for IoT applications and programming sensors.

COMPETITIVE CODING

Course Code	**22ECE545**	**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:

22ECE545.1	Use advanced pointer techniques and dynamic memory functions effectively.
22ECE545.2	Summarize the concepts of complex data structures and illustrate their applications in various scenarios.
22ECE545.3	Implement advanced linked lists and arrays in the real time projects.
22ECE545.4	Differentiate between various advanced tree and graph algorithms and contrast their performance.
22ECE545.5	Judge the efficiency of different sorting and searching algorithms by measuring their time and space complexities.
22ECE545.6	Formulate solutions for optimization problems using dynamic programming and devise efficient algorithms.

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
22ECE545.1	3	3	-	-	-	-	-	-	-	-	-	3	3	3
22ECE545.2	3	3	-	-	3	-	-	-	2	-	-	3	3	3
22ECE545.3	3	3	-	-	3	-	-	-	2	-	-	3	3	3
22ECE545.4	3	-	2	2	3	-	-	-	2	-	-	3	3	3
22ECE545.5	3	3	-	-	3	-	-	-		-	-	3	3	3
22ECE545.6	3	3	2	2	-	-	-	-	-	-	-	3	3	3

MODULE-1	**Advanced Pointers and Dynamic Memory Management**	**22ECE545.1**	**8 Hours**

Pointers and Double Pointers: Pointer Arithmetic, Double Pointer, Function Pointers, Pointers to Functions Returning Pointers, Dynamic Memory Allocation using Pointers.
Dynamic memory management: Functions for dynamic memory management: malloc, calloc, realloc, and free, Memory Leaks and their prevention, memory pools and custom allocators.

Applications	Given a large dataset that needs to be processed in chunks. Write a C program that dynamically allocates memory for each chunk, processes the data, and then frees the memory. Ensure that the program handles memory allocation failures gracefully.
Text Book	Text Book 1: Chapter 11, 12, 13, 14

MODULE-2	**Advanced Structures and Unions**	**22ECE545.2**	**8 Hours**

Nested Structures, Self-referential Structures, Bit-fields in Structures, Unions and their applications, Anonymous Unions and Structures, Creating and using bit-fields in structures, Enumerated Types and their uses.

Applications	Develop a system to manage student records. Each student has a name, roll number, and marks in three subjects. Use nested structures to store this information. Additionally, use an enumerated type to represent the grade (A, B, C, D, F) based on the average marks. Write a program to input student details, calculate the average marks, assign a grade, and display the student information.
Text Book	Text Book 2: Chapter 10, 11, 12

MODULE-3	**Advanced Linked Lists and Arrays**	**22ECE545.2 22ECE545.3**	**8 Hours**

Advanced Linked List: Circular Linked Lists, Skip Lists, XOR Linked Lists. **Advanced Arrays:** Dynamic Arrays and Resizable Arrays, Multi-dimensional Arrays and their Applications, Sparse Arrays			
Applications	Develop a scheduling system for a round-robin tournament. Each team plays every other team exactly once, and the schedule needs to be managed efficiently. Implement a circular linked list to store the schedule of matches. Write functions to add a match, remove a match, and display the schedule in a loop.		
Text Book	Text Book 3: Chapter 3, 4, 5, 6, 7, 8		
MODULE-4	**Trees and Graphs**	**22ECE545.4**	**8 Hours**
Binary Trees and Binary Search Trees: AVL Trees, Red-Black Trees, and Splay Trees, B-Trees and B+ Trees, Trie and Suffix Trees **Graph Representations:** Adjacency Matrix, Adjacency List, Graph Traversal Algorithms- Depth-first and breadth-first search algorithms.			
Applications	Develop a spell-checking application that uses a trie to store a dictionary of valid words. Implement a trie to store the dictionary and write functions to insert words, delete words, and check if a word is valid. Additionally, implement a function to suggest corrections for misspelled words by finding the closest matches in the trie..		
Text Book	Text Book 3: Chapter 9, 10, 11		
MODULE-5	**Advanced Algorithms**	**22ECE545.5 22ECE545.6**	**8 Hours**
Sorting Algorithms: Merge Sort and Heap Sort, **Searching Algorithms**: Binary Search and Ternary Search, **Dynamic Programming:** Knapsack Problem, Longest Common Subsequence			
Applications	Develop a resource allocation system for a project management tool. Each task has a specific importance and resource requirement. Implement the knapsack problem to allocate resources to the tasks in a way that maximizes the total importance within the given resource constraints. Write functions to solve the problem using dynamic programming and display the optimal allocation		
Text Book	Text Book 3: Chapter 12		

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	7.5	5
L5	Evaluate	5	7.5	-
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) K. N. King, "C Programming: A Modern Approach", ISBN: 978-0393979503, Publisher: W. W. Norton & Company, 2nd Edition, 2022
2) E. Balagurusamy, Programming in ANSI C" ISBN: 978-9353165130, McGraw Hill Education, 8th Edition, 2019
3) Mark Allen Weiss, Data Structures and Algorithm Analysis in C, ISBN: 978-0201498400, Pearson, 2nd Edition, 2019

Reference Books:

1) Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, Introduction to Algorithms", 4th Edition, ISBN: 978-0262046305, The MIT Press, 2022
2) Donald E. Knuth, "The Art of Computer Programming" , 3rd Edition, ISBN: 978-0201896831, Addison-Wesley Professional

Web links and Video Lectures (e-Resources):

- **Learn C: Pointers and Memory | Codecademy**
- **C Programming: Pointers and Memory Management - 4 | Coursera**
- **C Unions (With Examples) (programiz.com)**
- **Structures & Unions in C (Solved Problem) - YouTube**
- **Linked Lists vs. Arrays - Data Structures for Coding Interviews in C++ (educative.io)**
- **AlgoDaily - Merge Sort vs. Quick Sort vs. Heap Sort**

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

- Practical based learning: Provide students with coding exercises that require implementing dynamic programming solutions. Use online coding platforms like LeetCode, HackerRank, or Codeforces for practice.
- Have students exchange their code with peers for review. Each student will review and debug their peer's code, providing feedback and suggestions for improvement.
- Encourage students to participate in online competitive programming contests that feature dynamic programming problems. Platforms like Codeforces, AtCoder, and TopCoder host regular contests.
- Use software tools to visually represent the state space, decision tree, and memorization table for dynamic programming problems. Encourage students to draw these visual aids themselves.

REAL TIME OPERATING SYSTEM - QNX

Course Code	22ECE546	**CIE Marks**	50
L:T:P:S	3:0:0:0	**SEE Marks**	50
Hrs / Week	3 Hrs	**Total Marks**	100
Credits	03	**Exam Hours**	03

Course Out comes:

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

22ECE546.1	Understand the Architecture of QNX Neutrino RTOS and implement Real-Time Applications.
22ECE546.2	Apply the working of QNX Development Tools on Processes, Threads & Synchronization.
22ECE546.3	Implement the QNX Inter-Process Communication and compare QNX IPC Methods.
22ECE546.4	Apply the QNX Inter-Process Communication with Hardware Programming and Interrupt handling.
22ECE546.5	Understand the timing architecture, High-Resolution Timers, Images & Build files.
22ECE546.6	Understand the concept of 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
22ECE546.1	3	-	-	-	2	-	-	-	-	-	-	2	2
22ECE546.2	3	2	-	-	3	-	-	-	-	-	3	2	2
22ECE546.3	3	-	-	-	3	-	-	-	-	-	3	2	2
22ECE546.4	3	2	-	-	3	-	-	-	-	-	3	2	2
22ECE546.5	3	2	-	-	3	-	-	-	-	-	3	2	2
22ECE546.6	3	2	-	-	3	-	-	-	-	-	3	2	2

MODULE-1	**Introduction to QNX Real Time Operating System**	**22ECE546.1,2**	**8 Hours**

QNX Architecture – Executive, Microkernel, Inter process Communication, Processes and Threads model, Timing, Interrupt Handling, Scheduling, Boot Sequence and Security.

Text Book

MODULE-2	**Introduction to Processes, Threads and Security Policies**	**22ECE546.2**	**8Hours**

Security Policies: Introduction to the use of security policies in securing a QNX system, Process Managers: System Library, Shared Objects, OS Services, Boot Sequence and Security.

Processes, Threads & Synchronization: Introduction, Processes Creation and Detecting termination, Threads, Process Termination and Cleanup.

Text Book

MODULE-3	**Introduction to QNX Inter-Process Communication**	**22ECE546.3,4**	**8Hours**

Introduction to QNX Inter-Process Communication: Message Passing, Designing a Message Passing System (1): Pulses, Client Information Structure, How a Client Finds a Server, Multi-Part Messages.

Comparing QNX IPC Methods: Choice of Methods.

Text Book

MODULE-4	**Introduction to Hardware Programming**	**22ECE546.4**	**8 Hours**

Issues Related to Priorities, Designing a Message Passing System: Event Delivery Shared Memory, Hardware I/O, Programming PCI bus devices, Handling Interrupts.

Text Book			
MODULE-5	**Introduction to Timers and Resource Managers**	**22ECE546.5,6**	**8Hours**

Timers, Clocks and Timeouts: Introduction, Timing Architecture, Getting and Setting the System Clock, Introduction to Timers, High-Resolution Timers, Design Considerations, Kernel Timeouts.
Build a QNX Neutrino Boot/OS Image: Introduction, Images & Build files.
Resource Managers: Introduction, A Simple Resource Manager: Initialization and Handling read() and write().

Text Book

CIE Assessment Pattern (50 Marks – Theory)

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

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:
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

Web links and Video Lectures (e-Resources):

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

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

- RTOS Development

RESEARCH METHODOLOGY AND IPR

Course Code	**22RMK55**	**CIE Marks**	**50**
L: T: P: S	**1:1:0:0**	**SEE Marks**	**50**
Hours / Week	**03**	**Total Marks**	**100**
Credits	**02**	**Exam Hours**	**03**

Course outcomes:

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

22RMK55.1	Define a research problem and to formulate research questions
22RMK55.2	Demonstrate the various processing techniques of research
22RMK55.3	Choose appropriate methods to formulate research objectives
22RMK55.4	Develop advanced critical thinking skills and enhance writing skills
22RMK55.5	Understand the statutory provisions of different forms of IPRs in simple forms
22RMK55.6	Identify the significance of practice and procedure of patents

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
22RMK55.1	3	3	2	2	1	-	-	-	1	2	-	-
22RMK55.2	3	3	2	2	2	-	-	-	1	2	-	-
22RMK55.3	3	3	2	2	1	-	-	-	1	2	-	-
22RMK55.4	3	2	2	-	1	-	-	-	1	2	-	-
22RMK55.5	3	3	2	1	-	-	-	1	1	2	-	-
22RMK55.6	3	3	2	1	-	-	-	1	1	2	-	-

MODULE-1	**FORMULATION OF RESEARCH PROBLEM**	**22RMK55.1, 22RMK55.2**	**6 Hours**

Research– Meaning and Objectives – Criteria of Good Research–Problems Encountered by Researchers –Types of Research–Research Approaches-Research Process–Literature Review– Significance of Literature Review–Review of Selected Literature– Research Problem– Identification and Defining the Research Problem.

Text Book	Text Book 1: Ch. 1, 2

MODULE-2	**RESEARCH DESIGN PROCEDURES**	**22RMK55.2, 22RMK55.3**	**6 Hours**

Meaning of Research Design – Need for Research design – Features of a Good Design –Concepts Related to Research Design– Different Research Designs – Basic Principles of Experimental Designs.

Case Study	To find the solution for the given research problem using different types of research methods
Text Book	Text Book 1: Ch. 3

MODULE-3	**INTERPRETATION AND REPORT WRITING**	**22RMK55.4**	**6 Hours**

Meaning and Technique of Interpretation – Precautions in interpretation – Significance of Report Writing – Different Steps in Report Writing – Layout of a Research Report– Types of Report – Mechanics of Writing a Research Report –Conclusion-Referencing in Academic Writing –Bibliography.

Text Book	Text Book 2: Ch. 14

MODULE-4	**INTRODUCTION TO IPR**	**22RMK55.5**	**6 Hours**

Introduction and Significance of Intellectual Property Rights –Types of Intellectual Property Rights–Need for IPR –Rationale for Protection of IPR–IPR in India and Abroad–Forms of IPR – Royalty – Copyright – Trademark – Patents – Industrial Designs – Trade Secrets – Geographical Indications – Application of Different Forms of IPR– Future Aspects of IPR– Some Examples of IPR.

Text Book	Text Book 2: Ch. 1 and 2

MODULE-5	BASICS OF PATENTS	22RMK55.5, 22RMK55.6	6 Hours

Patents and its Basics – Patentable and Non-Patentable Inventions–Patent Application Process (National and International level) – Searching a Patent-Drafting and Filing a Patent –Types of Patent Applications–Patent Documents– Specification and Claims–Assignment, Licensing, Infringement–Different Layers of International Patent System–Some Examples of Patent – forms requirement for patent application with charges

Case Study	Analyze different domains of filed patents
Text Book	Text Book 2: Ch. 1 and 2

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	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) Kothari, C.R., Research Methodology: Methods and Techniques, New Age International, 2018, ISBN-13: 978-8122436235
2) Ramakrishna Chintakunta, A Text book of Intellectual Property rights, Blue Hill Publication, ASIN: B09T6YDB5N, 2022

Reference Books:

1) Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K, An Introduction to Research Methodology, RBSA Publishers. 2015, ISBN-13:978-8176111652
2) Ranjith Kumar, Research methodology, Saga publications,4th edition, 2014, ISBN-13- 978-9351501336
3) Sinha, S.C. and Dhiman, A.K., Research Methodology, EssEss Publications. 2 volumes, 2012. ISBN: 81-7000-324-5, 81-7000-334-2
4) Asha Vijay Durafe, Dhanashree K. Toradmalle , Intellectual Property Rights, Dreamtech Press,2020, ISBN:9390395917

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=GSeeyJVD0JU
- https://www.youtube.com/watch?v=nv7MOoHMM2k
- https://www.youtube.com/watch?v=BGSgZ1J8-yQ

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

- Video Sessions
- Organizing Group Wise Discussions
- Seminars

CRITICAL AND CREATIVE THINKING SKILLS

Course Code	**22SDK56**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**-**
Hrs / Week	**2**	**Total Marks**	**50**
Credits	**1**	**Exam Hours**	**01**

Course outcomes:

Upon successful completion of this course, the student will be able to:

22SDK56.1	Demonstrate proficiency in solving quantitative aptitude problems using fundamental concepts
22SDK56.2	Apply advanced quantitative techniques to address and solve complex real-world problems.
22SDK56.3	Develop and enhance logical reasoning skills essential for problem-solving in various competitive examinations.
22SDK56.4	Cultivate critical and creative thinking skills necessary for analytical reasoning and problem-solving.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
22SDK56.1	3	3	-	-	2	-	-	-	-	-	-	2
22SDK56.2	3	3	-	-	2	-	-	-	-	-	-	2
22SDK56.3	3	3	-	-	2	-	-	-	-	-	-	2
22SDK56.4	3	3	-	-	2	-	-	-	-	-	-	2

MODULE-1	**CRITICAL THINKING THROUGH QUANTITATIVE ANALYSIS**	**22SDK56.1 22SDK56.2**	**6 Hours**

Number systems: LCM and HCF of numbers, Squaring and Cubing Techniques, Multiplication Tricks, Divisibility rules, Digit sum method, Speed Math, Simplifications, Approximations.

Percentages: Conversion of Fraction to Percentage Table, Percentage Change, Net percentage change/Effective percentage change, Successive Percentage, Concept of more/less percentage, Percentage of percentage, Product constancy, Increased/decreased by P%, Percentage Changes in Numerator and Denominator, Successive Percentage.

Averages: Basic concept, Consecutive Numbers, Non-Consecutive Numbers, Equation Concept, True/False concept, Including/Excluding concept, Replacement concept, Average Speed concept.

MODULE-2	**NUMERICAL TECHNIQUES FOR PROBLEM SOLVING**	**22SDK56.1 22SDK56.2**	**6 Hours**

Profit and Loss: Basic concept, Profit Percentage, Loss Percentage, Profit/Loss Percentage, Overall Profit/Loss, Dishonest shopkeeper, More/less loss concept.

Discounts: Successive discounts, Buy X and Get Y Free, Profit after allowing discount, True Discount, Difference between percentage profit and percentage discount.

Ratio and Proportion: Concept Explanation, Duplicate Ratio, Triplicate Ratio, Direct Proportion, Indirect Proportion, Double rule of three or compound proportion, Ratio in investment, Ratio in partnership, Ratio in averages, Ratio in profit and loss, Ratio in interest rates.

Time and Work: Unit work, Combined work, Individual efficiency, Group efficiencies, Time taken by an individual or a group, Work done by an individual or a group, Total work done, Chain Rule Concept, Pipes and Cisterns, 4 Rules of Pipes and Cistern.

MODULE-3	**ADVANCED QUANTITATIVE TECHNIQUES**	**22SDK56.1 22SDK56.2**	**6 HOURS**

Algebra: Simple Arithmetic Operations, Linear equation is one, Two and three variables, Methods of solving linear equations, Methods of solving quadratic equations, Surds and indices, Logarithms.

Series and Progressions: Arithmetic Sequences, Geometric Sequences, Harmonic Sequences, Fibonacci Numbers.

Geometry: Concepts of Angles, Different polygons like triangles, rectangle, square, right-angle triangle, Pythagorean Theorem, Perimeter and Area of Triangle, Rectangle, and circles.

Statistics: Mean, Median, Mode, Standard Deviation, Variance.

MODULE-4	ANALYTICAL REASONING AND CREATIVE PROBLEM SOLVING	22SDK56.3 22SDK56.4	6 Hours

Number Series - Missing numbers, Incomplete series - Odd-even series, primes, Fibonacci series, Arithmetic progression, Geometric progression, Harmonic progression, Squares and cubes, Operations on digits, Exponential series, Increasing multiplication, Hybrid series.

Alphabetical Series- Missing alphabets, incomplete letter series - series of words, series of letters, arrangement of words/letters, letters marked with corresponding numbers sequence, positions of letters, ranking of the word in dictionary; Mixed Series - Missing numbers and words/letters, complete the series.

Analogies: Alphabet Classification, Word Classification, Number Classification.

Coding and Decoding: Coding based on order, Letter to Letter Mapping, Letter to number mapping, Letter to digit mapping, Re-ordering sequences; Word sequencing, Match the word to code, Symbol Coding.

MODULE-5	PROBLEM SOLVING THROUGH LOGICAL ANALYSIS	22SDK56.3 22SDK56.4	6 Hours

Directions: Eight Directions, Distance, Displacement, Starting and ending points, Referential directions, Directions of shadows, Axis based problems, Actual and conditional directions.

Seating Arrangements: Linear arrangement, Square Arrangement, Rectangular Arrangement, Circular arrangement, Vertical arrangement, Seating arrangement in a photograph, Tabular arrangement, Hexagonal Seating Arrangement, Complex arrangement, Miscellaneous arrangements.

Blood Relations: Relations defined, Generation Verticals, Family Tree, Single Person Blood Relations, Mixed/Chain Blood Relations, Symbol based Blood Relation.

CIE Assessment Pattern (50 Marks – Theory)

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

Reference Book:

1. **Quantitative Aptitude for Competitive Examinations**, R.S. Aggarwal, S Chand Publishing; 2021 Edition (1 July 2021), ISBN-13: 978-9352838318.
2. **Fast Track Objective Arithmetic**, Rajesh Verma, Arihant Publications; 3rd Edition (25 October 2018), ISBN-13: 978-9311640070 .
3. **Quantitative Aptitude Quantum CAT**, Sarvesh K. Verma, Arihant Publications; 8th Edition (20 April 2020), ISBN-13: 978-9324193440

ENVIRONMENTAL STUDIES

Course Code	**22ESK57**	**CIE Marks**	**50**
L:T:P:S	**1:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**1**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**02**

Course outcomes:

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

22ESK57.1	Understand the concepts of Environment, ecosystem and biodiversity.
22ESK57.2	Explain the strategies for management of natural resources to achieve sustainability
22ESK57.3	Analyze the control measures of Environmental pollution and global Environmental issues.
22ESK57.4	Apply the knowledge of Environment Impact Assessment, Technology, Environmental acts and laws in protecting Environment and human health.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO100	PO11	PO12
22ESK57.1	-	-	-	-	-	3	3	-	-	-		-
22ESK57.2	-	-	-	-	-	3	3	-	-	-	-	3
22ESK57.3	-	-	-	-	-	3	3	3	-	3	-	3
22ESK57.4	-	-	-	-	1	3	3	3	-	3	-	3

MODULE 1	**INTRODUCTION TO ENVIRONMENT, ECOSYSTEM AND BIODIVERSITY**	**22ESK57.1**	**3hrs**

Environment: Definition, Components of Environment; Ecosystem: Types & Structure of Ecosystem, Energy flow in the ecosystem; Biodiversity: Types, Hot-spots, Threats and Conservation of biodiversity.

Self-study	Environmental Impact of Electronic Waste: Understanding Ecosystem Interactions and Biodiversity Conservation.
Text Book	Text Book 1: Ch. 1 , 3 & 4

MODULE 2	**NATURAL RESOURCES**	**22ESK57.2**	**3hrs**

Advanced Energy resources (Hydrogen, Solar, OTEC, Tidal and Wind), merits and demerits, Water resources – cloud seeding, Mineral resources, Forest resources. Strategies of management, concept of sustainability.

Case Study	Environmental Impact of Electronic Waste: Understanding Ecosystem Interactions and Biodiversity Conservation
Text Book	Text Book 1: Ch. 2

MODULE 3	**ENVIRONMENTAL POLLUTION**	**22ESK57.3**	**3hrs**

Definition, Causes, effects and control measures of Air Pollution, Water Pollution, soil Pollution and Noise pollution. Solid wastes and its management. Role of society, NGO and Govt. agencies in prevention of pollution

Case Study	Impact of air pollution Bangalore city.
Text Book	Text Book 1: Ch. 5,6, Text Book 2: Ch. 5

MODULE 4	**GLOBAL ENVIRONMENTAL ISSUES, ENVIRONMENT ACTS AND AMENDMENTS**	**22ESK57.3**	**3hrs**

Fluoride problem in drinking water, Acid Rain, Ozone layer depletion, Global warming and climate change. National forest policy, Environmental laws and acts.International agreements and protocols.

Self-study	Impact of Fluoride in Drinking Water and National Policies for Environmental Protection
Text Book	Text Book 1: Ch. 6, Text Book 2: Ch. 6

MODULE 5	**HUMAN POPULATION AND ENVIRONMENT IMPACT ASSESSMENT**	**22ESK57.4**	**3hrs**

Population growth & explosion, Population pyramids. Negative impact of agriculture and urbanization, Role of Technology in protecting environment and human health. Environment Impact Assessment.

Self-study	Study the challenges associated with rapid population growth, including increased demand for food, water, and energy, and the strain on natural resources and ecosystems..

Text Book	Text Book 1: Ch. 7

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	10	5	5
L3	Apply	10	5	5
L4	Analyze		5	-
L5	Evaluate		-	-
L6	Create		-	-

SEE Assessment Pattern (50 Marks – Theory)

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

Suggested Learning Resources:

Text Books:

1. Environmental studies by Benny Joseph, Tata McGraw Hill Education Private Limited, 2009, ISBN: 9870070648135.
2. "Environmental Studies: Basic Concepts" by Ahluwalia, V. K. The Energy and Resources Institute (TERI) Publication, 2nd edition, 2016. ISBN: 817993571X, 9788179935712.

Reference Books:

1. Handbook of Environmental Engineering by Rao Surampalli, Tian C. Zhang, Satinder Kaur Brar, Krishnamoorthy Hegde, Rama Pulicharla, Mausam Verma; McGraw Hill Professional, 2018. ISBN: 125986023X, 9781259860232
2. Environmental Science and Engineering by P. Venugopala, Prentice Hall of India Pvt. Ltd, New Delhi, 2012 Edition. ISBN: 978-81-203-2893-8.
3. Elements of Environmental Science and Engineering by P. Meenakshi, Prentice Hall of India Pvt. Ltd, 2005 Edition. ISBN: 8120327748, 9788120327740

Web links and Video Lectures (e-Resources):

- https://archive.nptel.ac.in/courses/120/108/120108004/
- https://archive.nptel.ac.in/courses/103/107/103107215/

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

- Visit to any company to study the initiative taken for environmental impact.
- Case study based learning on engineering approaches for pollution prevention.
- Video/ model / charts based learning
- Activities/awareness program for preventing environmental pollution

MINI PROJECT-II

Course Code	**22ECE58**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs / Week	**0**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

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

22ECE58.1	Identify technical aspects of the chosen project with a comprehensive and systematic approach
22ECE58.2	Review the literature and develop solutions for problem statement
22ECE58.3	Work as an individual or in a team in development of technical projects
22ECE58.4	Test the various phases of planned project
22ECE58.5	Articulate the project related activities and findings
22ECE58.6	Extend or use the idea in mini project for major project

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
22ECE58.1	3	3	-	-	-	-	-	-	3	-	-	-	3	3
22ECE58.2	3	3	3	3	2	-	-	-	3	3	3	3	3	3
22ECE58.3	3	3	3	-	-	-	-	-	-	3	3	3	3	3
22ECE58.4	3	3	3	-	-	-	-	3	3	3	3	3	3	3
22ECE58.5	3	3	3	-	-	-	-	3	3	3	3	3	-	-
22ECE58.6	3	3	3	3	2	3	1	3	3	3	3	3	3	3

CIE Assessment Pattern (50 Marks)

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

SEE Assessment Pattern (50 Marks)

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

NATIONAL SERVICE SCHEME (NSS)

Course Code	**22NSS30, 22NSS40, 22NSS50, 22NSS60**	**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:

22NSSX0.1	Understand the importance of his / her responsibilities towards society.
22NSSX0.2	Analyse the environmental and societal problems/issues and will be able to design solutions for the same.
22NSSX0.3	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.
22NSSX0.4	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	PO12
22NSSX0.1	-	-	-	-	-	3	3	-	2	-	-	1
22NSSX0.2	-	-	-	-	-	3	3	-	2	-	-	1
22NSSX0.3	-	-	-	-	-	3	3	-	2	-	-	1
22NSSX0.4	-	-	-	-	-	3	3	-	2	-	-	1

Semester/ Course Code	CONTENT	COs	HOURS
3RD 22NSS30	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.	22NSS30.1, 22NSS30.2, 22NSS30.3, 22NSS30.4	30 HRS
4TH 22NSS40	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.	22NSS40.1, 22NSS40.2, 22NSS40.3, 22NSS40.4	30 HRS
5TH 22NSS50	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).	22NSS50.1, 22NSS50.2, 22NSS50.3, 22NSS50.4	30 HRS
6TH 22NSS60	10. Organize National integration and social harmony events / workshops / seminars. (Minimum TWO programs). 11. Govt. school Rejuvenation and helping them to achieve good infrastructure.	22NSS60.1, 22NSS60.2, 22NSS60.3, 22NSS60.4	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/ Continuous monitoring/ Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
3.	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/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

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/proper consultation/ Continuous monitoring/ Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
8.	Contribution to any national level initiative of Government of India.For eg. Digital India, Skill India, Swachh Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme,Skill development programs etc.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemes officers/ campus	Group selection/proper consultation/ Continuous monitoring / Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
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/proper consultation/ Continuous monitoring / Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
10.	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 (PE) (SPORTS AND ATHLETICS)

Course Code	**22PED30, 22PED40, 22PED50, 22PED60**	**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:

22PEDX0.1	Understand the fundamental concepts and skills of Physical Education, Health, Nutrition and Fitness
22PEDX0.2	Create consciousness among the students on Health, Fitness and Wellness in developing and maintaining a healthy lifestyle
22PEDX0.3	Perform in the selected sports or athletics of student's choice and participate in the competition at regional/state / national / international levels.
22PEDX0.4	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	PO12
22PEDX0.1	-	-	-	-	-	2	-	3	3	-	-	2
22PEDX0.2	-	-	-	-	-	2	-	3	3	-	-	2
22PEDX0.3	-	-	-	-	-	2	-	3	3	-	-	2
22PEDX0.4	-	-	-	-	-	2	-	3	3	-	-	2

Semester	CONTENT	COs	HOURS
3RD 22PED30	**Module 1: Orientation** A. Lifestyle, B. Fitness C. Food & Nutrition D. Health & Wellness E. Pre-Fitness test.	22PED30.1, 22PED30.2	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	22PED30.2, 22PED30.3	15 HRS
	Module 3: Recreational Activities A. Postural deformities. B. Stress management. C. Aerobics. D. Traditional Games.	22PED30.3, 22PED30.4	10 HRS
4TH 22PED40	**Module 1: Ethics and Moral Values** A. Ethics in Sports B. Moral Values in Sports and Games	22PED40.1, 22PED40.2	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	22PED40.3	20 HRS

	throw. C. Kabaddi – Hand touch, Toe Touch, Thigh Hold, Ankle hold and Bonus. D. Kho-Kho – Giving Kho, Single Chain, Pole dive, Pole turning, 3-6 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	22PED40.4	5 HRS
5TH 22PED50	**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, Reverse-shot. 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.	22PED50.1, 22PED50.2, 22PED50.3, 22PED50.4	Total 30 Hrs/ Semester 2 Hrs/week
6TH 22PED60	**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.	22PED60.1, 22PED60.2, 22PED60.3, 22PED60.4	Total 30 Hrs/ Semester 2 Hrs/week

3. Throws- Discus Throw: Holding the Discus, Initial Stance Primary Swing, Turn, Release and Recovery (Rotation in the circle).

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.

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
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	**22YOG30, 22YOG40, 22YOG50, 22YOG60**	**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:

22YOGX0.1	Understanding the origin, history, aim and objectives of Yoga
22YOGX0.2	Become familiar with an authentic foundation of Yogic practices
22YOGX0.3	Practice different Yogic methods such as Suryanamaskara, Pranayama and some of the Shat
22YOGX0.4	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	PO12
22YOGX0.1	-	-	-	-	-	3	-	-	-	-	-	1
22YOGX0.2	-	-	-	-	-	3	-	-	-	-	-	1
22YOGX0.3	-	-	-	-	-	3	-	-	-	-	-	1
22YOGX0.4	-	-	-	-	-	3	-	-	-	-	-	1

Semester / Course Code	CONTENT	COs	HOURS
3rd 22YOG30	**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	22YOG30.1, 22YOG30.2, 22YOG30.3, 22YOG30.4	Total 32 Hrs/ Semester 2 Hrs/week
4TH 22YOG40	**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, Has-tapadasana 3. Prone line: Dhanurasana 4. Supine line: Karna Peedasana, Sarvangasana, Chakraasana **Patanjali's Ashtanga Yoga**: Asana, Pranayama **Pranayama:** Chandra Bhedana, Nadishodhana, Surya Bhedana	22YOG40.1, 22YOG40.2, 22YOG40.3, 22YOG40.4	Total 32 Hrs/ Semester 2 Hrs/week

5TH 22YOG50	**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, Parsh-vakonasana 3. Prone line: Padangushtha Dhanurasana, Poorna Bhujan-gasana / Rajakapotasana 4. Supine line: Navasana/Noukasana, Pavanamuktasana, Sarvanga **Patanjali's Ashtanga Yoga**: Pratyahara, Dharana **Pranayama:** Ujjayi, Sheetali, Sheektari	22YOG50.1, 22YOG50.2, 22YOG50.3, 22YOG50.4	Total 32 Hrs/ Semester 2 Hrs/week
6TH 22YOG60	**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, Parsh-vakonasana 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	22YOG60.1, 22YOG60.2, 22YOG60.3, 22YOG60.4	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**

SIXTH SEMESTER

(SYLLABUS)

EMBEDDED SYSTEM DESIGN

Course Code	**22ECE61**	**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:

22ECE61.1	Illustrate the Embedded System Design and Development and its architecture of ARM Processor.
22ECE61.2	Apply the programmer's model of Cortex M processors to give solutions for real world problems.
22ECE61.3	Identify the different types of Interrupts for various applications.
22ECE61.4	Apply the exception handling in real time embedded appliances.
22ECE61.5	Develop the hardware software co-design and firmware design approaches.
22ECE61.6	Explain the need of real time operating system for embedded system applications.

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
22ECE61.1	3	-	-	-	-	-	-	-	-	-	-	3	3	2
22ECE61.2	3	3	3	-	3	-	-	-	-	-	-	3	3	2
22ECE61.3	3	3	3	2	3	2	2	-	-	-	-	3	3	2
22ECE61.4	3	3	3	-	3	-	-	-	-	-	-	3	3	2
22ECE61.5	3	-	-	-	-	-	-	-	-	-	-	3	3	2
22ECE61.6	3	3	3	2	3	2	2	-	2	1	-	3	3	2

MODULE-1	**ARM EMBEDDED SYSTEMS**	**22ECE61.1**	**8 Hours**

An Embedded System-Definition, Embedded System Design and Development, Life Cycle, Embedded System Architecture, Embedded Systems Classification.
The RISC Design, Philosophy, The ARM Design Philosophy, Embedded System Hardware, Embedded System Software, Core Extensions, Architecture Revisions, ARM Processor Families

Self-study	Various cores of Embedded system appliances.
Text Book	Text Book 2: 1.1, 1.2, 1.3, 1.4 Text Book 1: 1.1, 1.2, 1.3, 1.4, 2.5, 2.6, 2.7

MODULE-2	**ARM CORTEX M PROCESSORS AND INSTRUCTION SET**	**22ECE61.2**	**8 Hours**

Cortex M4 Basics Architecture of ARM Cortex-M4, Block diagram of ARM Cortex-M4, Operation modes and states, Registers, Special Registers, Data type, Memory System.

Data Processing Instructions, Load – Store Instructions, Program Status Register Instructions, Branching and Conditional Execution, Introduction to Thumb Instructions.

Self-study	ALP programs using thumb instructions.
Text Book	Text Book 3: 4.1, 3.1.4, 4.2, 4.4, 4.5, 4.7 Text Book 1: 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8

MODULE-3	**EXCEPTIONS AND INTERRUPTS**	**22ECE61.3,**	**8 Hours**

		22ECE61.4	
Overview of exceptions and interrupts, Exception types, Overview of interrupt management, Definitions of priority, Vector table and vector table relocation, Interrupt inputs and pending behaviours, Exception sequence overview, Details of NVIC registers for interrupt control.			
Applications	Exception handling in real time embedded appliances.		
Text Book	Text Book3: 7.1 ,7.2, 7.3, 7.4, 7.5, 7.6, 7.7		
MODULE-4	**EMBEDDED SYSTEM DESIGN CONCEPTS**	**22ECE61.5**	**8 Hours**
Characteristics and Quality Attributes of Embedded Systems, Operational and non-operational quality attributes, Embedded Systems-Application and Domain specific, Hardware Software Co-Design and Program Modeling using UML, Embedded firmware design and development.			
Case Study	Embedded Systems-Application with hardware and software Co-Design		
Text Book	Text Book 2: Ch-3, Ch-4 (4.1, 4.2.1 and 4.2.2 only), Ch-7 (Sections 7.1, 7.2 only), Ch-9 (Sections 9.1, 9.2, 9.3.1,9.3.2 only)		
MODULE-5	**RTOS AND IDE FOR EMBEDDED SYSTEM DESIGN**	**22ECE61.6**	**8 Hours**
Operating System basics, Types of operating systems, Task, process and threads (Only POSIX Threads with an example program), Thread preemption, Preemptive Task scheduling techniques, Task Communication, Task synchronization issues – Racing and Deadlock, Concept of Binary and counting semaphores			
Case Study	How to choose an RTOS, Integration and testing of Embedded hardware and firmware.		
Text Book	Text Book 2: 10.1, 10.2, 10.3, 10.4, 10.5, 10.6, 10.7, 10.8		

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		**Marks Distribution**		
		Test (s)	**Qualitative Assessment (s)**	**MCQ's**
		25	**15**	**10**
L1	**Remember**	5	-	5
L2	**Understand**	5	-	5
L3	**Apply**	10	5	-
L4	**Analyze**	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) Andrew N Sloss, "ARM System Developer's guide", Elsevier Publications, 2016, ISBN 978-0124080828.
2) Introduction to Embedded Systems, Shibu K V, 2nd Edition 2017, McGRAW HILL, ISBN 978-1259001764.
3) The Definitive Guide to ARM Cortex –M3 and Cortex-M4 Processors Joseph Yiu, 3rd Edition, 2014, Elsevier,ISBN 978-0124080828.

Reference Books:

1) Embedded Systems – A contemporary Design Tool, James K, Peckol, 2014, John Wiley, ISBN 978-1118332910.
2) Cortex M4 Technical Reference Manual, ARM.
3) M4 Programming manual, ST microelectronics.

Web links and Video Lectures (e-Resources):

- https://archive.nptel.ac.in/courses/106/105/106105193/
- https://embeddedcomputing.com/technology/software-and-os/introduction-to-realtime-operating-systems-rtos
- https://www.youtube.com/watch?v=dOiJuXYFMkE&list=PLqmN55CTOn-LeArO1_td4vHkAY35h6GlHM
- https://www.arm.com/resources/education/education-kits/efficient-embedded-systems

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

- Visit to any ARM Company.
- Demonstration of STM ARM cortex M4.
- Complete the course available at https://www.arm.com/resources/education/online-courses.
- 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.

EMBEDDED SYSTEM DESIGN LAB

Course Code	**22ECL61**	**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:

22ECL61.1	Conduct experiments to understand data transfer, process and memory access instructions
22ECL61.2	Conduct experiments using bit field and process control instructions
22ECL61.3	Develop code for saturation and floating-point operations
22ECL61.4	Use Embedded C code to demonstrate peripheral interfacing with ARM development kit and various simulation platforms

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO10	PO11	PO12	PSO1	PSO2
22ECL61.1	3	3	1	2	3	-	-	-	2	2	-	1	3	3
22ECL61.2	3	3	1	2	3	-	-	-	2	2	-	1	3	3
22ECL61.3	3	3	1	2	3	-	-	-	2	2	-	1	3	3
22ECL61.4	3	3	1	2	3	-	-	-	2	2	-	1	3	3

Exp. No. / Pgm. No.	List of Programs	Hours	COs
	Prerequisite Experiments / Programs / Demo		
	• **Revisit to 8086 and 8051 programming basic programming** • **Study of ARM- Cortex M4 processor development board**	2	NA
	PART-A		
1	Assembly Level Program (ALP) involving instructions for transferring data within the processor.	2	22ECL61.1
2	ALP to demonstrate memory access instruction for various data sizes and addressing modes.	2	22ECL61.1
3	ALP involving logic operations	2	22ECL61.1
4	ALP involving data conversion operations	2	22ECL61.1
5	ALP involving shift and rotate operations	2	22ECL61.1
6	ALP to illustrate bit field processing instruction	2	22ECL61.2
7	ALP to illustrate program flow instruction.	2	22ECL61.2
8	ALP to illustrate saturation operation	2	22ECL61.3
9	ALP involving floating point operations	2	22ECL61.3
	PART-B		
10	Interfacing LED with ARM STM32F401xx using Embedded C programming a. With delay b. Without delay	2	22ECL61.4
11	Embedded C program to demonstrate serial communication (UART) using ARM Cortex development board.	2	22ECL61.4
12	Embedded C program to Interface LCD using STM32CUBE IDE	2	22ECL61.4

13	Embedded C Program to interface 4*3 Keypad with STM32 using Proteus	2	22ECL61.4

PART-C

1. **Fixed Point Arithmetic Operations and Logical Operators**
   https://portal.coepvlab.ac.in/vlab/auth/home?dept=1&lab=1
2. **Floating Point Arithmetic Operations**
   https://portal.coepvlab.ac.in/vlab/auth/home?dept=1&lab=1
3. **Pulse Width Modulation (PWM) Generation Using FPGA**
   https://portal.coepvlab.ac.in/vlab/auth/home?dept=1&lab=1

CIE Assessment Pattern (50 Marks – Lab)

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

1) https://developer.arm.com/documentation/dui0068/b/ARM-Instruction-Reference
2) https://developer.arm.com/documentation/ddi0403/d/Application-Level-Architecture/Application-Level-Programmers--Model/The-optional-Floating-point-extension/Floating-point-data-types-and-arithmetic?lang=en
3) https://www.st.com/en/development-tools/stm32cubeide.html

COMMUNICATION SYSTEMS - II

Course Code	**22ECE62**	**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:

22ECE62.1	Analyze the behavior and characteristics of microwave active components
22ECE62.2	Solve the transmission line problems using analytical and graphical approach
22ECE62.3	Apply the knowledge of low frequency network to express Scattering parameter for microwave multiport junctions
22ECE62.4	Interpret the relationships between antenna parameters
22ECE62.5	Analyze the power radiated by different antennas and their radiation characteristics
22ECE62.6	Interpret RADAR based system working and its specific applications

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
22ECE62.1	3	3	2	-	2	-	-	-	-	-	-	3	3	3
22ECE62.2	3	3	-	-	-	-	-	-	-	-	-	3	3	3
22ECE62.3	3	-	-	-	2	-	-	-	-	-	-	3	3	3
22ECE62.4	3	3	-	-	2	-	-	-	-	-	-	3	3	3
22ECE62.5	3	3	-	-	2	-	-	-	-	-	-	3	3	3
22ECE62.6	3	3	2	-	-	-	-	-	-	-	-	2	3	3

MODULE 1	**MICROWAVE SOURCES AND TRANSMISSION LINES**	**22ECE62.1, 22ECE62.2**	**8 Hours**

MICROWAVE SOURCES: Introduction to Microwave System and Microwave frequencies. Generation of Microwaves- Reflex Klystron, TWT, Magnetron.
TRANSMISSION LINES: Equivalent Circuit of a Transmission Line, Transmission Line equations and solutions, Analysis of Primary and Secondary Constants. Reflection and Transmission Coefficients, Standing Waves and SWR, Smith Chart, Single Stub matching.

Self-study / Case Study / Applications	Radiation Hazards, Applications of Microwave System
Text Book	Text Book 1: 9.1, 9.2, 9.3, 9.5 Text Book 2 – 0.1, 0.2, 0.3, 3.1, 3.2, 3.3, 3.4, 3.5, 3.6

MODULE 2	**MICROWAVE NETWORK THEORY AND PASSIVE COMPONENTS**	**22ECE62.3**	**8 Hours**

MICROWAVE NETWORK THEORY: Introduction, S matrix representation of multiport networks, Properties of S parameters, S- parameters of a Two-port network with mismatched load.

PASSIVE COMPONENTS: Attenuators, Waveguide Tees, Magic Tees, Circulators and Isolators, Directional Couplers-Bethe Hole Coupler.

Self-study	Analyze the S parameter *of* a microwave passive devices
Text Book	Text Book 2: 6.1, 6.2, 6.3, 6.4.2,6.4.14, 6.4.15, 6.4.16

MODULE 3	ANTENNA FUNDAMENTALS	22ECE62.4	8 Hours
Introduction, Radiation patterns, Radiation Power Density and intensity, Beam-width, Directivity, Antenna Efficiency, Gain, Beam Efficiency, Bandwidth, Polarization, Input Impedance, Antenna Radiation Efficiency, Vector Effective Length and Equivalent Areas, Maximum Effective Area, Antenna temperature, Friis Equation. Antenna field zones.			
Case Study	Simulation of Antenna Parameters		
Text Book	Text Book 3: 2.1 - 2.7, 2.9-2.11, 2.13		
MODULE 4	**POINT SOURCES AND ARRAYS AND ELECTRIC DIPOLES**	**22ECE62.4, 22ECE62.5**	**8 Hours**
POINT SOURCES AND ARRAYS: Point Sources, Power Patterns, Power Theorem, Radiation Intensity, Arrays of two isotropic point sources, Linear Arrays of n Isotropic Point Sources of equal Amplitude and Spacing. **ELECTRIC DIPOLES:** Introduction, Short Electric Dipole, Fields of a Short Dipole, Radiation Resistance of a Short Electric Dipole, Thin Linear Antenna (Field Analyses)			
Self-study	Design of an Antenna		
Text Book	Text Book 3: 5.1- 5.6, 5.9, 5.13, 6.1 - 6.5		
MODULE 5	**RADAR AND ITS APPLICATIONS:**	**22ECE62.6**	**8 Hours**
Basic Radar, Radar frequencies, The simple form of the Radar equation, Radar block diagram. Introduction to Doppler and MTI Radar, delay line Cancellers, digital MTI processing, Moving target detector, Pulse Doppler Radar, application of Radar.			
Self-study	Propagation of RADAR waves		
Text Book	Text Book 5: 1.1, 1.2, 1.3, 3.1,3.2,3.5, 3.6, 3.9, 1.5		

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Test (s)	Qualitative Assessment	MCQs
		25	15	10
L1	Remember	5	-	5
L2	Understand	5	5	5
L3	Apply	10	5	-
L4	Analyze	5	5	-
L5	Evaluate	-	-	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

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

Suggested Learning Resources:

Text Books:

1. Microwave Engineering – Sushrut Das, Oxford Higher Education, 2nd Edn, 2015, ISBN 978-0199458338
2. Microwave Engineering - Annapurna Das, Sisir K Das, TMH, Publication, 2nd, 2010, ISBN 978-0070667458.
3. Antennas and Wave Propagation-John D. Krauss, Ronald J Marhefka, Ahmad S Khan, 4th Edition, McGraw Hill Education, 2013, ISBN 978-0073380647.
4. Antennas and Wave Propagation - Harish and Sachidananda: Oxford University Press, 2007, ISBN 978-0195683351.
5. Introduction to Radar Systems - Merrill I. Skolnik, McGraw-Hill, 3rd Edition, 2001, ISBN 978-

0071452275

Reference Books:

1. Microwave Engineering - David M Pozar, John Wiley India Pvt. Ltd., 3rd Edn,2008, 978-0471681740
2. Microwave Devices and circuits- Liao, Pearson Education.,2005, ISBN 978-0131265685.
3. Antennas and Wave Propagation - Harish and Sachidananda: Oxford University Press, 2007,ISBN 978-0195683351.

Web links and Video Lectures (e-Resources):

- **https://youtu.be/2SxSBMum4gc**
- **https://youtu.be/0NgWS9HvSDk**
- **https://youtu.be/ldBBrD6259A**
- **https://youtu.be/wx_tIvaajAI**
- **https://youtu.be/JPwk9Cjjo_I**
- **https://youtu.be/s4yTE2h_OYM**
- **https://youtu.be/bUsS5KUMLvw**

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

- Visit to any manufacturing/Assembling unit of Transmission Line or Antenna printed boards.
- Video demonstration of latest trends in Microwave System/ Antenna Design.
- Contents related activities (Activity-based discussions).

➢ Group Discussion.
➢ Case- Study

COMMUNICATION SYSTEMS - II LAB

Course Code	**22ECL62**	**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:

22ECL62.1	Calculate different microwave parameters for microwave circuits
22ECL62.2	Demonstrate the working of various microwave components
22ECL62.3	Model an optical communication system and analyze its characteristics
22ECL62.4	Analyze the design of antenna parameters and radiation pattern of different antenna types

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
22ECL62.1	3	3	-	-	-	-	-	-	2	-	-	3	3	2
22ECL62.2	3	3	2	-	2	-	-	-	2	-	-	3	3	2
22ECL62.3	3	3	2	1	-	-	-	-	2	-	-	3	3	2
22ECL62.4	3	3	2	1	2	-	-	-	2	-	-	3	3	2

Exp. No. / Pgm. No.	List of Experiments / Programs	Hours	COs
	Prerequisite Experiments / Programs / Demo		
	• Learning to use and simulate EDA tools: https://www.youtube.com/watch?v=oOH6hVP6vcA&list=PL0lZXwHtV6Ol3KjVHLhOZF3q1Ey491LF7 • https://www.youtube.com/watch?v=2ADK971gKKU&list=PL4lHevQbRIlnAhw2BJlhiHDi2lkGaS9Xs	2	NA
	PART-A		
1	Measurement of frequency, guide wavelength, power, VSWR and attenuation in microwave test bench.	2	22ECL62.1
2	To conduct an experiment to find out the insertion loss and coupling factor for the Magic Tee.	2	22ECL62.1 22ECL62.2
3	Determination of Coupling and isolation characteristics of microstrip directional coupler.	2	22ECL62.2
4	Determination of (a) Resonance characteristics of microstrip ring resonator and computation of dielectric constant of the substrate. (b) Power division and isolation of microstrip power divider.	2	22ECL62.2
5	Measurement of propagation loss, bending loss and numerical aperture of an optical fiber.	2	22ECL62.3
6	Measurement of directivity and gain of microstrip dipole and Yagi antennas	2	22ECL62.4
	PART-B		
7	To generate Electromagnetic Wave using MATLAB software.	2	22ECL62.3 22ECL62.4
8	To plot radiation pattern of dipole antenna using MATLAB software.	2	22ECL62.4
9	To plot radiation pattern of uniform linear Array using MATLAB	2	22ECL62.4

	software.		
10	To design and simulate rectangular microstrip patch antenna with coaxial probe feeding technique for the frequency f=3.5GHz using any EDA tool.	2	22ECL62.4
11	To design and simulate rectangular microstrip patch antenna for the frequency 3GHz using strip line feed using any EDA Tool.	2	22ECL62.4
12	To design and simulate U-shaped Slot Rectangular Microstrip Patch Antenna with strip line feed working at operational frequency 5 GHz using any EDA Tool.	2	22ECL62.4

PART-C

Beyond Syllabus Virtual Lab Content

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

1. Measurement of VSWR on a line: http://eem-iitd.vlabs.ac.in/exp1.html
2. Determination of unknown impedance: http://eem-iitd.vlabs.ac.in/exp2.html
3. Microwave Coupler: http://eem-iitd.vlabs.ac.in/exp5.html
4. Radiation Pattern of Horn Antenna: http://eem-iitd.vlabs.ac.in/exp7.html
5. Antenna Gain measurement: http://eem-iitd.vlabs.ac.in/exp8.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:

1) Constantine A. Balanis, "Antenna Theory: Analysis and Design" 4th Edition, Publisher: Wiley, 2016, ISBN: 978-1-118-64206-1

2) David M. Pozar, "Microwave Engineering" 4th Edition, Publisher: Wiley, 2021, ISBN: 978-1-119-77062-6

ESSENTIALS OF CYBER SECURITY

Course Code	**22ECE63**	**CIE Marks**	**50**
L:T:P:S	**2:1:0:0**	**SEE Marks**	**50**
Hrs / Week	**4**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

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

22ECE63.1	Understand the key concepts, terminology, and principles in cyber security, including threat landscapes, attack vectors, and defence strategies.
22ECE63.2	Apply fundamental cyber security principles to analyze and mitigate risks in practical scenarios, such as securing networks, systems, and data.
22ECE63.3	Evaluate different cyber security solutions and technologies and make informed decisions on their suitability based on organizational needs and threat environments.
22ECE63.4	Acquire hands-on experience in implementing secure practices across various domains, including encryption techniques, access controls, and incident response protocols.
22ECE63.5	Proficient in detecting, analysing, and responding to security incidents using appropriate tools and methodologies, ensuring minimal impact on organizational operations.
22ECE63.6	Develop communication skills to effectively convey cyber security concepts, risks, and solutions to diverse stakeholders, fostering a culture of awareness and responsibility within organizations.

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
22ECE63.1	3	-	-	-	-	-	-	-	-	-	-	2	3	2
22ECE63.2	3	-	-	-	-	-	-	-	-	-	-	2	3	2
22ECE63.3	3	2	-	-	-	2	-	-	-	-	-	2	3	2
22ECE63.4	3	2	-	-	-	-	2	-	-	-	-	2	3	2
22ECE63.5	3	2	-	-	2	-	-	2	-	-	-	2	3	2
22ECE63.6	3	2	-	-	-	-	-	-	-	-	-	2	3	2

MODULE-1	**Infrastructure Security in the Real World and Access-Control and Monitoring Systems**	**22ECE63.1**	**8 Hours**

Infrastructure Security in the Real World-Security Challenges, Understanding Access-Control and Monitoring Systems - Access Control-Security Policies-Physical Security Controls-Authentication Systems-Remote-Access Monitoring.

Self-Study	Biometric Authentication Systems and its Challenges
Text Book	Text Book 1: 1.1,2.1,2.2,2.3,2.4,2.5,2.6

MODULE-2	**Video Surveillance Systems, Intrusion-Detection and ReportingSystems and Securing Devices**	**22ECE63.2, 22ECE63.3**	**8 Hours**

Understanding Video Surveillance Systems-Video Surveillance Systems.Understanding Intrusion-Detection and Reporting Systems-Intrusion-Detection and Reporting Systems, Securing Devices The Three Layers of Security.

Case Study	The Integration of Video Surveillance and Intrusion Detection Systems.
Text Book	Text Book 1: 3.1,4.1,6.1

MODULE-3	**Protecting Remote Access, Network Transmission Media Security**	**22ECE63.4**	**8 Hours**

Protecting Remote Access - Protecting Local Computing Devices-Implementing Local Protection Tools-Using Local Intrusion-Detection Tools-Configuring Browser Security Options-Defending Against Malicious Software-Hardening Operating Systems, Understanding Network Transmission Media Security-The Basics of Network Transmission MEDIA-Transmission Media Vulnerabilities.

Text Book	Text Book 1: 9.1,9.2,9.3,9.4,9.5,9.6,16.1,16.2

MODULE-4	**Understanding the Environment and Protecting the Perimeter**	**22ECE63.5**	**8 Hours**

Understanding the Environment-The Basics of Internet Security-Understanding the Environment, Protecting the Perimeter-Understanding the Perimeter-Firewalls-Network Appliances-Proxy Servers-Honeypots-Extranets. Protecting Data Moving Through the Internet-Securing Data in Motion.

Application	Implementing a Secure VPN (Virtual Private Network) for Remote Workforce Data Transmission
Text Book	Text Book 1: 19.1, 19.2, 21.1, 21.2, 21.3, 21.4, 21.5, 21.6

MODULE-5	**Tools and Utilities, Identifying and Defending Against Vulnerabilities**	**22ECE65.6**	**8 Hours**

Tools and Utilities-Using Basic Tools-Monitoring Tools and Software-Identifying and Defending Against Vulnerabilities-Zero Day Vulnerabilities-Software Exploits-Network Threats and Attacks-Dictionary Attacks-Denial of Service (DoS) Attacks-Spam

Text Book	Text Book 1: 23.1,23.2,24.1,24.2,24.4,24.5,24.6

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Test (s)	Qualitative Assessment	MCQs
		25	15	10
L1	Remember	5	-	5
L2	Understand	5	5	5
L3	Apply	10	5	-
L4	Analyze	5	5	-
L5	Evaluate	-	-	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

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

Suggested Learning Resources:

Text Books:

1. Cyber security Essentials, Charles J. Brooks, Christopher Grow, Philip Craig, Donald Short, Sybex, October 2018

Reference Books:

1.Computer and Cyber Security: Principles, Algorithm, Applications, and Perspectives, B.B.Gupta, D.P.Agrawal, Haoxiang Wang, CRC Press, 2018

2.Cyber Security Essentials, James Graham, Richard Howard and Ryan Otson, CRC Press 2018.

Web links and Video Lectures (e-Resources):

- https://onlinecourses.nptel.ac.in/noc23_cs127/preview
- https://onlinecourses.swayam2.ac.in/nou19_cs08/preview
- https://www.w3schools.com/cybersecurity/index.php
- https://www.javatpoint.com/cyber-security-tutorial

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

- Industrial Visit to Cyber Security Based Companies.
- Demonstration of case studies related to cyber-attacks.
- Video demonstration of latest trends in Cyber threats and security measures.
- Contents related activities (Activity-based discussions)
  - For active participation of students, instruct the students to prepare Flowcharts and Handouts
  - Organizing Group wise discussions on processor developments
  - Seminars and Workshops

MACHINE LEARNING ALGORITHMS

Course Code	**22ECE641**	**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:

22ECE641.1	Understand the Core concepts of Machine learning
22ECE641.2	Analyze the Mathematical relationships within and across Machine learning algorithms
22ECE641.3	Categorize the paradigms of supervised and un-supervised learning
22ECE641.4	Apply the Machine learning techniques to solve the real-world problem
22ECE641.5	Understand analytical learning and reinforced learning
22ECE641.6	Construct a simulation environment of Reinforced Learning problem

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
22ECE641.1	3	-	-	-	-	-	-	-	-	-	-	2	3	-
22ECE641.2	3	3	-	-	2	-	-	-	-	-	-	2	3	3
22ECE641.3	3	3	2	-	2	-	-	-	-	-	-	2	3	3
22ECE641.4	3	3	2	-	2	-	-	-	-	-	-	2	3	3
22ECE641.5	3	-	-	-	-	-	-	-	-	-	-	2	3	3
22ECE641.6	3	3	2	-	2	-	-	-	-	-	-	2	3	3

MODULE-1	**LEARNING**	**22ECE641.1**	**8 Hours**

Designing Learning systems, Perspectives and Issues, Concept Learning, Version Spaces and Candidate Elimination Algorithm, Inductive bias.

Self-Study	Exploring the Role of Inductive Bias in the Performance of Concept Learning Algorithms
Text book	Text book 1: Chapter 1,2

MODULE-2	**DECISION TREE AND ANN**	**22ECE641.1 22ECE641.2**	**8 Hours**

Decision Tree Representation, Hypothesis Space Search, Inductive bias in decision tree, issues in Decision tree. Neural Network Representation, Perceptrons, Multilayer Networks and Back Propagation Algorithms.

Self-Study	Comparing Inductive Bias and Hypothesis Space Search in Decision Trees and Neural Networks
Text book	Text book 1: Chapter 3,4

MODULE-3	**BAYESIAN AND COMPUTATIONAL LEARNING**	**22ECE641.2, 22ECE641.3, 22ECE641.4**	**8 Hours**

Bayes Theorem, Bayes Theorem Concept Learning, Maximum Likelihood, Minimum Description Length Principle, Bayes Optimal Classifier, Gibbs Algorithm, Naïve Bayes Classifier.

Case Study	Applying Naïve Bayes Classifier for Email Spam Detection.
Text book	Text book 1: Chapter 6

MODULE-4	INSTANT BASED LEARNING AND LEARNING SET OF RULES	22ECE641.3, 22ECE641.4	8 Hours
K- Nearest Neighbour Learning, Locally Weighted Regression, Radial Basis Functions, Case-Based Reasoning. Sequential Covering Algorithms, Learning Rule Sets, Learning First Order Rules, Learning Sets of First Order Rules.			
Text book	Text book 1: Chapter 8,10		
MODULE-5	ANALYTICAL LEARNING AND REINFORCED LEARNING	22ECE641.5 22ECE641.6	8 Hours
Perfect Domain Theories, Explanation Based Learning, Inductive-Analytical Approaches, FOCL Algorithm, Reinforcement Learning.			
Application	Developing an Intelligent Tutoring System Using Explanation-Based Learning and Reinforcement Learning.		
Text book	Text book 1: Chapter 11,13, Text book 2 : chapter 7		

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution	
		Test (s)	NPTEL
		25	25
L1	Remember	5	-
L2	Understand	5	5
L3	Apply	10	10
L4	Analyze	5	10
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) Tom Mitchell, —Machine Learning, McGraw Hill, 1997, ISBN-13: 978-0070428072.
2) E. Alpaydin, —Introduction to Machine Learning, PHI, 2005, ISBN-13: 978-8120331946.

Reference Books:

1)Aurolien Geron, "Hands-On Machine Learning with Scikit-Learn and TensorFlow, Shroff/O'Reilly",2017, ISBN-13: 978-1491962299.
2) Andreas Muller and Sarah Guido, "Introduction to Machine Learning with Python: A Guide for Data Scientists", Shroff/O'Reilly, 2016, ISBN-13: 978-1449369415.

Web links and Video Lectures (e-Resources):

- https://onlinecourses.nptel.ac.in/noc23_cs18/preview
- https://www.youtube.com/watch?v=JxgmHe2NyeY
- https://www.youtube.com/watch?v=ZftI2fEz0Fw&list=PLKnIA16_Rmvbr7zKYQuB-fsVkjoLcJgxHH
- https://developers.google.com/machine-learning/crash-course/ml-intro

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

BIOMEDICAL SIGNAL PROCESSING

Course Code	**22ECE642**	**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:

22ECE642.1	Describe the origin, properties and suitable models of biomedical signals such as ECG and EEG
22ECE642.2	Apply signal processing methods to extract relevant information from biomedical signal measurements
22ECE642.3	Develop the relevant mathematical and computational skills relevant in compression of biomedical signals
22ECE642.4	Analyze the ECG Signal behavior using signal processing methods
22ECE642.5	Analyze the rhythms and detection process in neurological signal processing
22ECE642.6	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	PO12	PSO1	PSO2
22ECE642.1	2	-	-	-	-	-	-	-	-	-	-	-	3	1
22ECE642.2	3	3	-	-	-	-	-	-	-	-	-	-	3	1
22ECE642.3	3	3	2	-	-	-	-	-	-	-	-	-	3	1
22ECE642.4	3	3	-	3	-	3	-	-	-	-	-	-	3	3
22ECE642.5	3	3	-	3	-	3	-	-	-	-	-	-	3	3
22ECE642.6	3	-	2	3	1	3	-	-	-	-	-	-	3	3

MODULE-1	**INTRODUCTION TO BIOMEDICAL SIGNALS**	22ECE642.1, 22ECE642.2	**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**	**22ECE642.2, 22ECE642.3**	**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**	**22ECE642.4**	**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**	**22ECE642.5**	**8 Hours**

Neurological signal processing: The brain and its potentials, The electrophysiological origin of brain waves, The EEG signal and itscharacteristics (EEG rhythms, waves, and transients), Correlation. Analysis of EEG channels: Detection of EEG rhythms, Templatematching 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	22ECE642.6	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	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)	NPTEL
		25	25
L1	Remember	5	-
L2	Understand	5	5
L3	Apply	10	10
L4	Analyze	5	10
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, ISBN 978-8120350860.
2. D. C. Reddy, "Biomedical Signal Processing: Principles and techniques," Tata McGraw-Hill, New Delhi, India, 2015, ISBN 978-0070633385.
3. J. L. Prince, and J. M. Links, "Medical Imaging Signals and Systems," PearsonEducation, Inc., New Delhi, India, 2015, ISBN 978-0131687406.

Reference Books:

1. R. Rangayyan, "Biomedical Signal Analysis," Wiley India Private Limited, New Delhi,India, 2015, ISBN 978-8126535226.
2. Bruce, "Biomedical Signal Processing & Signal Modeling," John Wiley and Sons,Singapore, 2001, ISBN 978-0471381983.
3. Sörnmo, "Bioelectrical Signal Processing in Cardiac & Neurological Applications,"Reed Elsevier Private Limited, New York, U.S.A., 2009, ISBN 978-0123748762.
4. Semmlow, "Biosignal and Biomedical Image Processing," Marcel Dekker, London,U.K., 2004, ISBN 978-0824709897.
5. Enderle, "Introduction to Biomedical Engineering," 2nd Edition, Reed Elsevier Private Limited, New York, U.S.A., 2005,ISBN 978-0122386621.

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.

RTL DESIGN AND VERIFICATION

Course Code	**22ECE643**	**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:

22ECE643.1	Apply digital design concepts for RTL design and address its design challenges
22ECE643.2	Analyze different data types and control structures in System Verilog for efficient implementation of digital systems design
22ECE643.3	Apply object-Oriented Programming concepts to create structured RTL verification
22ECE643.4	Construct the Verilog RTL codes using Tasks and Functions
22ECE643.5	Analyze a digital design to create and set up a UVM-based test bench and verification environment
22ECE643.6	Develop Universal Verification Methodology test benches to verify the functionality of different RTL designs

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
22ECE643.1	3	-	-	-	3	-	-	-	-	-	-	2	3	3
22ECE643.2	3	3	2	-	3	-	-	-	-	-	-	2	3	3
22ECE643.3	3	-	-	-	3	-	-	-	-	-	-	2	3	3
22ECE643.4	3	3	2	-	3	-	-	-	-	-	-	2	3	3
22ECE643.5	3	3	2	-	3	-	-	-	-	-	-	2	3	3
22ECE643.6	3	3	2	-	3	-	-	-	-	-	-	2	3	3

MODULE-1	**Introduction**	**22ECE643.1**	**8 Hours**

Digital design through Verilog: Overview of Combinational and Sequential circuits, Bus Structure, Simple processor design, RTL Designs, Goals and Constraints, RTL Based Chip Design Flow, Design Challenges.

Applications	Design basic combinational circuits and sequential circuits in Verilog.
Text Book	Text Book 1: Ch 4, 6,7. Text Book 2: Ch 1

MODULE-2	**System Verilog Basics**	**22ECE643.2**	**8 Hours**

Different Data Types, User-Defined and Enumerated Types: String Data Types, Event Data Types, User-Defined Types, Enumerated Types, Nets, Reg, Logic, Type Casting, Constants, Attributes, Packed Array and Unpacked Array, Dynamic, Associate Array, Its Methods, QUEUE Operators and Expressions, Control Structure: If-Else, Switch. Loop.

Self-study	Dynamic and Associative Arrays in System Verilog
Text Book	Text Book 3: Ch 2.

MODULE-3	**System function and Inter Process communication**	**22ECE643.3**	**8 Hours**

		22ECE643.4	
System Tasks and System Functions, Processes: Combinational Logic, Latch Logic, Sequential Logic, Fork Join (Join, Join_Any, Join_None), Event Controls, Process Control Inter process Communication: OOPS, Constraints, Randomization.			
Self-study	Analyze how constraints and randomization are used in creating efficient and robust testbenches for verification.		
Text Book	Text Book 3 : Ch 3.1,3.2,3.3,5.5-5.11,6.2-6.4,7.1		
MODULE-4	**UVM Overview**	**22ECE643.5**	**8 Hours**
UVM Test Bench and Environment, Interface UVCs, Module and System UVCs, Test Benches, System Verilog UVM Class Library, UVM Library Basics, UVM Sequences, UVM Sequencers			
Case Study	Develop a UVM test bench environment for verifying the functionality and performance of a UART (Universal Asynchronous Receiver/Transmitter) communication protocol.		
Text Book	Text Book 4: Ch 2,4,5		
MODULE-5	**Simple Test Bench Integration**	**22ECE643.5, 22ECE643.6**	**8 Hours**
Test Benches and Test, creating a simple test bench, Virtual sequencer, Test bench Configuration, creating a test, Virtual sequences, Checking DUT Correctness, Implementing a coverage model.			
Self-Study	Understand the purpose and function of each component in the test bench, and how they interact to test a digital design.		
Text Book	Text Book 4: Ch 7		

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution	
		Test (s)	NPTEL
		25	25
L1	Remember	5	-
L2	Understand	5	5
L3	Apply	10	10
L4	Analyze	5	10
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) Fundamentals of Digital Logic with Verilog design, Stephen Brown and Zvonko Vranesic, McGraw Hill, 2014, 3rd edition, 978–0–07–338054–4.
2) Principles of VLSI RTL Design, A Practical Guide, Sanjay Churiwala and Sapan Garg, Springer 2011, 1st edition, 978-1-4419-9295-6
3) System Verilog for Verification, A Guide to Learning the Testbench Language Features, Chris Spear and Greg Tumbush, Springer 2012, 3rd edition 978-1-4614-0714-0.
4) A practical guide to adopting the Universal Verification Methodology, Kathleen A Meade and Sharon Rosenberg, 2013, 2nd edition, lulu Publisher, 978-1-300-53593-5.

Reference Books:

1) R. Salemi, "The UVM Primer: A Step-By-Step Introduction to The Universal Verification Methodology" Boston Light Press, 2013, 1st edition, 978-0991160402.
2) Navabi, Zainalabedin, and Yuwen Xia. "Verilog Digital System Design: Register Transfer Level Synthesis, Testbench, and Verification", McGraw-Hill, 2006,1st edition, 978-0071475457.

Web links and Video Lectures (e-Resources):

1. https://cse.iitkgp.ac.in/~debdeep/deb/course/index.htm
2. https://nptel.ac.in/courses/108106191
3. https://onlinecourses.nptel.ac.in/noc21_ee97/preview

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

- Digital circuit Simulation to test and debug verilog design.
- Video demonstration of end-to-end process of RTL 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

LOW POWER VLSI DESIGN

Course Code	**22ECE644**	**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:

22ECE644.1	Examine the sources of power dissipation in CMOS circuits
22ECE644.2	Investigate the Impact of device and technology scaling on Low Power Electronics
22ECE644.3	Inspect different low power circuit & Module techniques to design digital circuits
22ECE644.4	Distinguish various architectural techniques for minimizing power in microprocessor & SRAM
22ECE644.5	Analyze various energy recovery techniques in low power VLSI Design
22ECE644.6	Survey research articles on low power design methodologies in VLSI Design

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
22ECE644.1	3	3	-	-	2	-	-	-	-	-	-	1	3	2
22ECE644.2	3	3	2	-	2	2	-	-	-	-	-	1	3	2
22ECE644.3	3	3	2	-	2	2	2	-	-	-	-	1	3	2
22ECE644.4	3	3	2	-	2	-	-	-	-	-	-	1	3	2
22ECE644.5	3	3	2	-	2	-	2	-	-	-	-	1	3	2
22ECE644.6	3	3	2	-	2	2	2	-	-	-	-	1	3	2

MODULE-1	**INTRODUCTION TO LOW POWER VLSI DESIGN**	**22ECE644.1**	**8 Hours**

Need for Low Power VLSI Chips, Charging and Discharging Capacitances, Short circuit current in CMOS Circuits (Inverter), CMOS Leakage Current.
Sources of Dissipation in Digital Integrated Circuits, Degrees of Freedom, Emerging Low Power Approaches – An Overview.

Self-study	Design Constraints in IC technology, Investigate the battery capacity trends, Different types of Leakage current in CMOS Circuits.
Text Book	Text Book 1: 1.1, 1.2, 1.3.1, 1.4. Text Book 2: 1.2, 1.3, 1.5

MODULE-2	**DEVICE AND TECHNOLOGY IMPACT ON LOW POWER ELECTRONICS**	**22ECE644.2**	**8 Hours**

Introduction, Dynamic Dissipation in CMOS, Effects of and on Speed, Constraints on Reduction, Transistor Sizing and Optimal Gate Oxide Thickness, Impact of Technology Scaling, Technology and Device Innovation.

Applications	*Simulation Power Analysis, SPICE Circuit Simulation TEXT 1: 2*
Text Book	Text Book 2: 2.1to 2.7

MODULE-3	**LOW POWER CIRCUIT AND MODULE TECHNIQUES**	**22ECE644.3**	**8 Hours**

Introduction, Power Consumption in Circuits, Flipflops and Latches, Logic, High capacitance Nodes. Low Power Arithmetic Components, Adder.

Self-study	Low Power Arithmetic Components, Multipliers, Division
Text Book	Text Book 2:3.1-3.5, 7.3

MODULE-4	**ARCHITECTURE AND SYSTEM**	**22ECE644.4**	**8 Hours**

Power and Performance management, Switching activity reduction, Parallel architecture with voltage reduction,
Low Power SRAM Architecture, MOS Static RAM Memory Cell, Banked Organization of SRAMs, Reducing Voltage Swing on Bit lines.

Self-study /	Reducing Power in Write Driver Circuits, Reducing Power in Sense Amplifier Circuits.		
Text Book	Text Book 1:7.1.1,7.2,7.3 Text Book 3: 6.1-6.5		
MODULE-5	**LOW ENERGY COMPUTING USING ENERGY RECOVERY TECHNIQUES**	**22ECE644.5, 22ECE644.6**	**8 Hours**
Energy Dissipation in Transistor channel using an RC Model, Energy Recovery Circuit Design, Design with Partially reversible Logic, Supply Clock Generation.			
Self-study	Energy recovery SRAM Core, Energy Dissipation in Memory Core		
Text Book	Text Book 3: 7.1, 7.2, 7.3, 7.3.1, 7.3.2,7.3.3, 7.4		

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution	
		Test (s)	NPTEL
		25	25
L1	Remember	5	-
L2	Understand	5	5
L3	Apply	10	10
L4	Analyze	5	10
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. Practical Low Power Digital Low Power VLSI Design, Gary Yeap, 4th edition, 2014, Springer International Edition, ISBN 978-3319077631.
2. Low Power Design Methodologies, Jan M. Rabaey, Massoud Pedram, 2nd edition 2014, Springer Science + Business Media, LLC, ISBN 978-1461490895.
3. Low Power CMOS VLSI Circuit Design, Kaushik Roy, Sharat C. Prasad, 2015, Wiley India Pvt.Ltd, ISBN 978-8126548721.

Reference Books:

1. CMOS VLSI Design: A Circuit and System perspective, Neil H.E. Weste, David Harris, 4th Edition 2015, Pearson, ISBN 978-0137142516.

Web links and Video Lectures (e-Resources):

- **https://archive.nptel.ac.in/courses/106/105/106105034/**
- **https://archive.nptel.ac.in/courses/106/105/106105161/**

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

- SPICE Simulation of VLSI Circuits to estimate the Power.
- Video demonstration of the latest trends in VLSI Technology.
- 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

OPTICAL COMMUNICATION

Course Code	**22ECE645**	**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:

22ECE645.1	Apply the fundamentals of optical fiber communication in modern communication system
22ECE645.2	Identify suitable Optical fiber structure for a specific application
22ECE645.3	Analyze the effect of channel impairments in Optical Fiber communication systems
22ECE645.4	Assess the performance of optical receivers
22ECE645.5	Utilize the theory of optical multiplexers for networking applications
22ECE645.6	Illustrate different concepts for creating optical amplification

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12	PSO 1	PSO 2
22ECE645.1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
22ECE645.2	3	3	3	-	-	-	-	-	-	-	-	-	-	-
22ECE645.3	3	3	3	3	-	-	-	-	-	-	-	-	3	3
22ECE645.4	3	3	3	3	2	1	-	-	-	-	-	-	3	3
22ECE645.5	3	3	-	-	-	-	-	-	-	-	-	-	-	-
22ECE645.6	3	3	3	3	-	1	1	-	-	-	-	-	3	3

MODULE-1	**OVERVIEW OF OPTICAL FIBER COMMUNICATION**	**22ECE645.1**	**8 Hours**

Historical development, The General System, advantages, disadvantages, and applications of optical fiber communication, Ray theory, Electromagnetic mode theory, cylindrical fiber (no derivations in section 2.4.4), single mode fiber, cutoff wave length, mode filed diameter.

Self-Study	Historical Development of Optical Fiber Communication
Text Book	Text Book 1: 1.1, 1.2, 1.3, 2.1, 2.2, 2.3.1,2.3.2,2.3.3,2.4, 2.5.1, 2.5.2

MODULE-2	**OPTICAL SOURCES AND TRANSMISSION CHARACTERISTICS OF OPTICAL FIBERS**	**22ECE645.2, 22ECE645.3**	**8 Hours**

Optical sources: LED, power and efficiency, LED structures, LED characteristics, LASER basic concepts, The Semiconductor Injection LASER

Attenuation, absorption, scattering losses, bending loss, dispersion, Chromatic dispersion, Inter model dispersion.

Case Study	Impact of Optical Sources and Transmission Characteristics on High-Speed Fiber-Optic Communication Systems
Text Book	Text Book 1: 7.2,7.3.1,7.3.2,7.3.3,7.3.4, 7.4, 6.2,6.4, 3.1, 3.2 3.3, 3.4, 3.6, 3.8, 3.9, 3.10

MODULE-3	**OPTICAL RECEIVER**	**22ECE645.4 22ECE645.5**	**8 Hours**

Physical Principles of Photo diodes, PIN and APD, Photo detector noise. Optical Receiver Operation, receiver sensitivity, quantum limit, eye diagrams, coherent detection

Self-Study	Address issues such as noise, dispersion, and nonlinearities that affect receiver performance.
Text Book	Text Book2: 6.1.1,6.1.2, 6.2, 7.1, 7.2.2, 7.2.3,7.3, 7.4

MODULE-4	**OPTICAL AMPLIFIERS**	**22ECE645.5 22ECE645.6**	**8 Hours**

Basic Applications and types of Optical amplifiers, semiconductor optical amplifiers, EDFA, Amplifier Noise, Optical SNR

Text Book	Text Book 2: 11.1, 11.2,11.3, 11.4,11.5		
MODULE-5	**WDM CONCEPTS AND OPTICAL NETWORKS**	**22ECE645.5**	**8 Hours**
Overview of WDM- operation principles, WDM standards, Mach-Zehender interferometer multiplexer, Isolators and circulators, Optical network concepts, network topologies, SONET/SDH, Optical Add/Drop Multiplexing			
Text Book	Text Book2: 10.1.1, 10.1.2,10.2.5,10.3,13.1,13.2,13.3,13.5		

CIE Assessment Pattern (50 Marks – Theory)

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

SEE Assessment Pattern (50 Marks – Theory)

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

Suggested Learning Resources:

Text Books:

1) "Optical Fiber Communications", John M. Senior, Pearson Education, Second Edition, 7th Impression, 2010, ISBN 978-0135040659.

2) "Optical Fiber Communication", Gerd Keiser, 4th Ed., MGH, 2008, ISBN 978-0073380719.

Reference Books:

1) Fiber Optic Communication - Joseph C Palais: 4th Edition, Pearson Education,ISBN 978-0134607647.

Web links and Video Lectures (e-Resources):

- **https://onlinecourses.nptel.ac.in/noc23_ee80/preview**
- **https://www.tutorialspoint.com/optical-networks-and-laser-course/index.asp**
- **https://www.youtube.com/watch?v=pavBq7HIoIE&list=PLgwJf8NK-2e4d2AyXC7pvXtgJ51qz-HWV**

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

- Industrial Visit to Electronics Based Companies
- Demonstration of Optical Fiber Cable
- Video demonstration of latest trends in Optical Networks
- Contents related activities (Activity-based discussions)
  - For active participation of students, instruct the students to prepare Flowcharts and Handouts
  - Organizing Group wise discussions on Fiber Optic Technology
  - Seminars and Workshops

PROJECT PHASE - I

Course Code	22ECE65	CIE Marks	50
L:T:P:S	0:0:2:0	SEE Marks	50
Hrs / Week	00	Total Marks	100
Credits	02	Exam Hours	03

Course outcomes:

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

22ECE65.1	Identify societal problems under sustainable development goals and classify them under differentdomains of Electronics and Communication Engineering and interdisciplinary perspective.
22ECE65.2	Demonstrate the ability to conduct comprehensive literature reviews using appropriate researchdatabases, search strategies, and citation management tools to identify relevant sources of information.
22ECE65.3	Analyze existing literature and formulate the problem statement.
22ECE65.4	Formulate an idea and share the idea in a suitable platform
22ECE65.5	Organize the article logically, following a structured format with well-defined sections such asintroduction, background, methodology, Analysis discussion, and conclusion.
22ECE65.6	Demonstratetheircommunicationskilleffectivelywiththetechnicalpresentation.

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
22ECE65.1	3	3	2	-	-	3	2	-	3	3	1	2	-	2
22ECE65.2	3	3	3	2	-	3	2	-	3	3	1	2	-	2
22ECE65.3	3	3	3	2	1	3	-	2	3	3	-	2	2	2
22ECE65.4	3	3	3	2	2	-	-		3	3	-	2	2	2
22ECE65.5	3	3	3	2	2	-	1	-	3	3	-	2	2	2
22ECE65.6	3	-	-	-	2	-	-	-	3	3	-	2	2	2

Project Phase I : Roadmap, activities, and deliverables

Goal Selection and Project Planning:

- *Identification of suitable topic based on Sustainable Development Goals.*
- *Forming project teams based on common interests and skill sets.*
- *Teams' involvement in developing project proposals outlining objectives, strategies, and expected outcomes.*

Research and Needs Assessment:

- *Survey conduction by thorough research on the chosen SDGs, including global and local context, challenges, andopportunities.*
- *Conduct needs assessments to identify specific issues or gaps that student projects can address*

Interdisciplinary approaches:

- *Applying interdisciplinary approaches and innovative solutions to tackle sustainability challenges.*

Knowledge Sharing and Communication:

- *students to share their project experiences and insights through presentations, reports, and social media.*
- *Foster peer-to-peer learning and collaboration by creating platforms for knowledge exchange and networking.*

CIE Assessment Pattern (50 Marks – Theory) –

RBT Levels		Marks Distribution	
		Review 1 (25 Marks)	Review 2 (25 Marks)
		25	25
L1	Remember	-	-
L2	Understand	5	5
L3	Apply	5	5
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	--
L2	Understand	10
L3	Apply	10
L4	Analyze	10
L5	Evaluate	10
L6	Create	10

PROBLEM SOLVING SKILLS

Course Code	**22SDK66**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**-**
Hrs / Week	**2**	**Total Marks**	**50**
Credits	**1**	**Exam Hours**	**1**

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

22SDK66.1	Infer the complex problems using the concepts of data structures and C programming
22SDK66.2	Apply object-oriented programming concepts in C++and Java to solve real time problem statements.
22SDK66.3	Solve real-world problem using python and C#
22SDK66.4	Develop the skills of handling data base queries and procedures

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
22SDK66.1	3	3	3	2	2	-	-	-	-	-	-	2	2	2
22SDK66.2	3	3	3	2	2	-	-	-	-	-	-	2	2	2
22SDK66.3	3	3	3	2	2	-	-	-	-	-	-	2	2	2
22SDK66.4	3	3	3	2	2	-	-	-	-	-	-	2	2	2

MODULE-1	**PROBLEM SOLVING ON DATA STRUCTURES AND C**	**22SDK66.I**	**6 Hours**

Data Structures using C: Stack and queues, list, graph, tree, sorting and searching, Hash functions
Advanced C programming: Pointers, Recursion, Functions, Structure, Union, C Preprocessor

MODULE-2	**PROBLEM SOLVING ON OBJECT ORIENTED PROGRAMMING USING CPP**	**22SDK66.2**	**6 Hours**

Object Oriented Programming: Inheritance, Polymorphism, Exception handling, File Handling, Predefined function, Void function, Name spaces, Input and output streams.

MODULE-3	**PROBLEM SOLVING ON JAVA AND XML**	**22SDK66.2**	**6 Hours**

Object oriented programming using Java: Inheritance, Polymorphism, Abstract class and Interface, Collections, Exception handling, Streams, Functional Interface.
XML: DTD, Schema, Server Path, DOM, XSLT, Name Space, AJAX.

MODULE-4	**PROBLEM SOLVING USING C # AND PYTHON**	**22SDK66.3**	**6 Hours**

Python: Functions, iterators, Object oriented Programming, Exception Handling, Packages, Frame works- Django, Collections.
C#: Object oriented Programming, Delegate, Collections and generic, Name space.

MODULE-5	**SCENARIO BASED PROBLEMS ON DBMS**	**22SDK66.4**	**6 Hours**

ER Model, SQL- DDL, DML, TCL, DCL, Joins, subquery, PL/SQL-Index, Sequence, procedures and functions, normalization, B tree, B+ tree, Forms.

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		**Test (s)**
		50
L1	**Remember**	5
L2	**Understand**	10
L3	**Apply**	20

L4	**Analyze**	15
L5	**Evaluate**	-
L6	**Create**	-

Suggested Learning Resources:

Reference Books:

1. Martin C Brown, "Python-The Complete Reference", Mc Graw Hill, 4th edition, 2020
2. Reema Tharega, "Data Structures using C", Oxford University Press, 2020
3. Ullakirch-Prinz, "A complete guide to program in C++", Jonas and Bartlett Learning, 2022
4. Kathy Sierra, "Headfirst Java", O'reilly Media, 2021
5. Andrew Stellman, "Headfirst C#", O'reilly Media, 2021

Web links and Video Lectures (e-Resources):

1. **https://www.learncpp.com/**
2. **https://www.programiz.com/dsa**
3. **https://code.visualstudio.com/Docs/languages/csharp**
4. **https://www.udemy.com/course/the-complete-java-course-from-basics-to-advanced/?couponCode=ST16MT70224**
5. **https://www.codecademy.com/learn/paths/c**

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

- Analysis of industry relevant use cases
- Problem solving on scenario-based questions
- Placement portal practice sessions

ANTENNA SIMULATION USING ANSYS			
Course Code	**22ECE671**	**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:

22ECE671.1	Analyze the fundamental principles and concepts of different types of antennas
22ECE671.2	Demonstrate proficiency in using ANSYS HFSS for antenna modeling and simulation
22ECE671.3	Measure the radiation pattern of wired, aperture, planar and array antennas
22ECE671.4	Optimize antenna designs to achieve desired specifications

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
22ECE671.1	3	-	-	-	2	-	-	-	1	1	-	2	3	3
22ECE671.2	3	3	2	2	2	-	-	-	1	1	-	2	3	3
22ECE671.3	3	3	2	2	2	-	-	-	1	1	-	2	3	3
22ECE671.4	3	3	2	2	2	-	-	-	1	1	-	2	3	3

Exp. No.	List of Experiments / Programs	Hours	Cos
	Prerequisite Experiments / Programs / Demo		
	Electromagnetics Fundamentals: A solid understanding of electromagnetic theory, including concepts such as Maxwell's equations, wave propagation, and electromagnetic fields, is essential for comprehending the underlying principles of antenna simulation.	2	NA
	PART-A		
1	Introduction of HFSS Ansys simulation tool for antenna design	2	22ECE671.1
2	Design a Monopole (Quarter wave) antenna for 88 MHZ-108MHz application using Ansys.	2	22ECE671.1
3	Design a dipole (Half-wave) antenna analyze its radiation pattern, gain, and impedance characteristics.	2	22ECE671.1
4	Design a rectangular microstrip patch antenna for a specific frequency and optimize its performance by adjusting parameters like substrate material, patch dimensions.	2	22ECE671.2
5	Design a rectangular microstrip patch antenna for a specific frequency and optimize its performance using CPW feed line	2	22ECE671.2
6	Design a circular microstrip patch antenna for a specific frequency and optimize its performance by adjusting parameters like substrate material, patch dimensions	2	22ECE671.2
	PART-B		
7	Design of probe feed microstrip patch antenna and optimize its performance.	2	22ECE671.3
8	Helical Antenna Simulation: Simulate a helical antenna and analyze its circular polarization characteristics and axial ratio.	2	22ECE671.3
9	Broadband Antenna Design**:** Design and simulate a broadband antenna capable of covering a wide frequency range. Optimize the antenna's impedance matching and radiation patterns.	2	22ECE671.3 22ECE671.4

10	Antenna Array Pattern Synthesis: Implement pattern synthesis techniques to achieve specific radiation patterns	2	22ECE671.3 22ECE671.4
11	Design and analysis of a 2x2 antenna array using Ansys simulation software for 3.5 GHz.	2	22ECE671.3 22ECE671.4
12	Design and analysis of 5G array antenna using Ansys simulation software.	2	22ECE671.3 22ECE671.4

PART-C

Beyond Syllabus Virtual Lab Content

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

1.Introduction to HFSS.
https://www.youtube.com/watch?v=2ADK971gKKU

2.To plot the radiation pattern of Dipole Antenna in E & H planes on log & linear scales on polar and Cartesian plots.
https://vlab.amrita.edu/?sub=3&brch=179&sim=400&cnt=1

3. Radiation Pattern of Horn Antenna.
http://eem-iitd.vlabs.ac.in/exp7.html

4. PCB Antenna design and Optimization.
https://www.mathworks.com/videos/pcb-antenna-design-and-optimization-1663652506751.html?s_tid=vid_pers_recs

CIE Assessment Pattern (50 Marks – Lab)

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

SEE Assessment Pattern (50 Marks – Lab)

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

Reference Books:

1) Balanis, C. A. (2005). Antenna theory: Analysis and design (3rd ed.). John Wiley.
2) Frank Gross, Smart antennas for wireless communications, McGra-Hill, 2006.
3) S. Chandran, Adaptive antenna arrays, trends and applications, Springer, 2009.
4) NPTEL online course.
https://www.youtube.com/watch?v=wx_tIvaajAI&list=PL3UZlxOnyu9CRoBFsG5x-VqYeC69FmMZT&ab_channel=Antennas

NETWORK SIMULATION USING NS-2

Course Code	**22ECE672**	**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:

22ECE672.1	Use the network simulator for learning and practice of network algorithms
22ECE672.2	Illustrate the operations of network protocols and algorithms using C programming
22ECE672.3	Simulate the network with different configurations to measure the performance parameters
22ECE672.4	Implement the data link and routing protocols using C programming

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
22ECE672.1	3	3	3	2	2	-	-	-	1	1	-	2	3	3
22ECE672.2	3	3	3	2	2	-	-	-	1	1	-	2	3	3
22ECE672.3	3	3	3	2	2	-	-	-	1	1	-	2	3	3
22ECE672.4	3	3	3	2	2	-	-	-	1	1	-	2	3	3

Exp. No. / Pgm. No.	List of Experiments / Programs	Hours	Cos
	Prerequisite Experiments / Programs / Demo		
	➢ Experiments on different network topologies. ➢ Demo on packet formats.	2	NA
	PART-A		
1	Implement a point-to-point network with four nodes and duplex links between them. Analyze the network performance by setting the queue size and varying the bandwidth.	2	22ECE672.1
2	Implement a four-node point-to-point network with links n0-n2, n1-n2 and n2-n3. Apply TCP agent between n0-n3 and UDP between n1-n3. Apply relevant applications over TCP and UDP agents changing the parameter and determining the number of packets sent by TCP/UDP.	2	22ECE672.1
3	Implement Ethernet LAN using n (6-10) nodes. Compare the throughput by changing the error rate and data rate.	2	22ECE672.1
4	Implement Ethernet LAN using n nodes and assign multiple traffic to the nodes and obtain congestion window for different sources/ destinations.	2	22ECE672.3
5	Implement ESS with transmission nodes in Wireless LAN and obtain the performance parameters.	2	22ECE672.3
6	Implementation of Link state routing algorithm.	2	22ECE672.3
	PART-B		
7	Write a program for a HLDC frame to perform the following. i) Bit stuffing	2	22ECE672.2

	ii) Character stuffing.		
8	Write a program for a distance vector algorithm to find a suitable path for transmission.	2	22ECE672.2
9	For the given data, use the CRC-CCITT polynomial to obtain the CRC code. Verify the program for the cases a. Without error b. With error	2	22ECE672.2
10	Implementation of Stop and Wait Protocol and Sliding Window Protocol	2	22ECE672.4
11	Write a program for congestion control using a leaky bucket algorithm.	2	22ECE672.4
12	Implement Dijkstra's algorithm to compute the shortest routing path.	2	22ECE672.4

PART-C

Beyond Syllabus Virtual Lab Content

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

1. Basics of Network Simulation.
   http://vlabs.iitkgp.ernet.in/ant/1/
2. Simulating a Local Area Network.
   http://vlabs.iitkgp.ernet.in/ant/2/
3. Concept of network performance evaluation, and different related metrics
   http://vlabs.iitkgp.ernet.in/ant/3/theory/
4. Simulating a Mobile Adhoc Network.
   http://vlabs.iitkgp.ernet.in/ant/7/
5. Implement OSPF protocol using 5 routers scenario.
   http://www.nitttrkol.ac.in/vlab-cse-nl-exp-1.php#top

CIE Assessment Pattern (50 Marks – Lab)

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

SEE Assessment Pattern (50 Marks – Lab)

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

Suggested Learning Resources:

Text Books:

1) Computer Networking. Textbooks B.A. Forouzan, Data Communications, and Networking, 4th Edition, McGraw Hill, 2007 Peterson and Davie, Computer Networks

2) Andrew S. Tanenbaum, Computer Networks, Third Edition, Prentice Hall of India Private Limited, New Delhi.

Reference Books:

1) Data Communication & Computer Networks (First Edition) by Tanmaya Kumar Das and Dili Kumar Mahapatra.
2) Stallings W., Data and Computer Communications, Pearson Education, 7th Edition, 2003.

LINUX AND SHELL PROGRAMMING

Course Code	**22ECE673**	**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:

22ECE673.1	Apply filter commands and regular expressions for efficient data retrieval from files or databases
22ECE673.2	Examine process creation mechanisms and kernel support
22ECE673.3	Implement filter commands to extract data from files or databases
22ECE673.4	Create and refine shell scripts using shell programming concepts

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
22ECE673.1	3	3	2	2	3	-	-	-	-		-	-	3	-
22ECE673.2	3	3	2	2	3	-	-	-	-		-	-	3	-
22ECE673.3	3	3	2	2	3	-	-	-	-		-	-	3	-
22ECE673.4	3	3	2	2	3	-	-	-	-		-	-	3	-

Exp. No. / Pgm. No.	List of Experiments / Programs	Hours	Cos
	Prerequisite Experiments / Programs / Demo		
	➢ Basic Operating systems and Basic Networking concepts	2	-
	Procedure to Install ubuntu on windows system		
1	Perform the following commands, including their respective options, if available: Date with all available options, cal, calendar, who, whoami, tty, stty, clear, and tput.	2	22ECE673.1
2	Run the following commands along with their respective options, if applicable: Man, echo, whatis, and Uname with all available options.	2	22ECE673.1
3	Execute the following commands: bc with a specified scale factor for precision, base conversion using bc (e.g., binary to decimal, decimal to octal, decimal to hexadecimal, etc.), password management, viewing command history, managing aliases, and using the script utility.	2	22ECE673.1
4	Execute the "ls" command to display comprehensive file attributes with all available options, view the file's contents, perform file copying and moving operations between locations, and subsequentlyremove the file.	2	22ECE673.2
5	Execute the following directory-related commands: (i) Create a new directory, navigate between directories, print the current directory path, check disk space usage, compress file content, and archive files.	2	22ECE673.2
6	Establish a student database consisting of 10 records, each containing five fields, and employ the following commands to	2	22ECE673.2

	present the records as per your requirements: head, tail, cut, paste, sort, uniq, tee, nl, and tr, making use of all available options.		
7	Establish a student database consisting of 10 records, each containing five fields, and employ the following commands to present the records as per your requirements: head, tail, cut, paste, sort, uniq, tee, nl, and tr, making use of all available options.	2	22ECE673.3
8	Construct a student/employee database encompassing 5 fields, and employ the grep command along with its full range of options to exhibit records or patterns using regular expressions.	2	22ECE673.3
9	Show both user and system processes, and terminate specific processes by their process IDs.	2	22ECE673.3
10	Create a shell script that prompts the user for a pattern and a filename, then searches for the patternwithin the specified file.	2	22ECE673.4
11	Develop a shell script that requests a filename, starting line number, and ending line number from theuser. It will then display the lines within that range from the specified file.	2	22ECE673.4
12	Design a login shell script that greets the user with "Good Morning," "Good Afternoon," or "GoodEvening" based on the time of login.	2	22ECE673.4

PART-C

Beyond Syllabus Virtual Lab Content

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

- Linux Full Course In 5 Hours | Linux Tutorial For Beginners | Linux Training | Edureka - YouTube
- https://www.udemy.com/course/learn-linux-in-5-days/
- Linux Operating System - Crash Course for Beginners - YouTube
- The Complete Linux Course: Beginner to Power User! - YouTube
- **NPTEL or https://nptel.ac.in/courses/117106113/**

CIE Assessment Pattern (50 Marks – Lab)

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

SEE Assessment Pattern (50 Marks – Lab)

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

Text Books:

1. Your UNIX /Linux The Ultimate Guide Third Edition by sumitabha das Published by McGraw-Hill,ISBN 978-0-07-337620-2 (alk. paper), ISBN-10: 0-07-337620-5 (alk. paper)
2. UNIX System Programming Using C++, Terrence Chan, Prentice-Hall of India Private Limited, ISBN0-13-331562-2

Reference Books:

1. UNIX – Concepts & Applications, SUMITABHA DAS, TATA McGraw Hill Edition, Fourth edition, 26th reprint 2015, McGraw Hill

2. Advanced Programming in the UNIX Environment, W Richard Stevens and Stephen A Rago, Addison Wesley Publications, Third Edition
3. **UNIX and SHELL Programming , Richard F Gilberg and Behrouz A Forouzan, 15th impression, 2015,Cengage Learning.**

ALP WITH MICROCONTROLLERS

Course Code	**22ECE674**	**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:

22ECE674.1	Write 8051 assembly level programs to perform arithmetic and logical operations, code conversion programs
22ECE674.2	Apply the basic knowledge of addressing modes and instructions to write assembly language program in 8051 Microcontroller
22ECE674.3	Analyze the code in assembly level for application of 8051 Timers, Interrupts and Serial Communication interface
22ECE674.4	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	PO12	PSO1	PSO2
22ECE674.1	3	3	3	2	3	-	-	-	3	-	-	-	3	3
22ECE674.2	3	3	3	-	3	-	-	-	3	-	-	-	3	3
22ECE674.3	3	3	3	2	3	-	-	-	3	3	2	2	3	3
22ECE674.4	3	3	3	2	3	-	-	-	3	3	2	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 projects	2	NA
	PART-A		
1	Data Transfer - Block move, Exchange	2	22ECE674.1
2	Arithmetic Instructions – Addition, subtraction, multiplication and division, square, Cube – (16 bits Arithmetic operations – bit addressable)	2	22ECE674.1
3	Boolean & Logical Instructions (Bit manipulations).	2	22ECE674.1 22ECE674.2
4	Code conversion: BCD – ASCII; ASCII – Decimal; Decimal - ASCII; HEX - Decimal and Decimal - HEX .	2	22ECE674.2
5	Sorting and finding largest/smallest element in an array.	2	22ECE674.2
6	Counters	2	22ECE674.3
	PART-B		
7	Programs to generate delay, Programs using serial port and on-Chip timer / counter.	2	22ECE674.3
8	Assembly Level Programming to illustrate the interfacing of stepper motor in clockwise /anti –clockwise rotation with the microcontroller 8051.	2	22ECE674.4
9	Assembly Level Programming to illustrate the interfacing of simple switches with the microcontroller 8051	2	22ECE674.4
10	Assembly Level Programming to illustrate the interfacing of LCD modules with the microcontroller 8051	2	22ECE674.4
11.	Assembly Level Programming to illustrate the interfacing of LED modules with the microcontroller 8051	2	22ECE674.4
12.	Write a Assembly Level Program to transfer letter “A” serially at 4800 baud , continuously	2	22ECE674.4

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

CIE Assessment Pattern (50 Marks – Lab)

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

SEE Assessment Pattern (50 Marks – Lab)

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

Suggested Learning Resources:

Reference Books:

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

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

NATIONAL SERVICE SCHEME (NSS)

Course Code	**22NSS30, 22NSS40, 22NSS50, 22NSS60**	**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:

22NSSX0.1	Understand the importance of his / her responsibilities towards society.
22NSSX0.2	Analyse the environmental and societal problems/issues and will be able to design solutions for the same.
22NSSX0.3	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.
22NSSX0.4	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	PO12
22NSSX0.1	-	-	-	-	-	3	3	-	2	-	-	1
22NSSX0.2	-	-	-	-	-	3	3	-	2	-	-	1
22NSSX0.3	-	-	-	-	-	3	3	-	2	-	-	1
22NSSX0.4	-	-	-	-	-	3	3	-	2	-	-	1

Semester/ Course Code	CONTENT	COs	HOURS
3RD 22NSS30	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.	22NSS30.1, 22NSS30.2, 22NSS30.3, 22NSS30.4	30 HRS
4TH 22NSS40	1. Water conservation techniques – Role of different stakeholders– Implementation. 2. Preparing an actionable business proposal for enhancing the village income and approach forimplementation. 3. Helping local schools to achieve good results and enhance their enrolment in Higher/ technical/ vocational education.	22NSS40.1, 22NSS40.2, 22NSS40.3, 22NSS40.4	30 HRS
5TH 22NSS50	1. Developing Sustainable Water management system for rural areas and implementationapproaches. 2. 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. 3. Spreading public awareness under rural outreach programs. (minimum 5 programs).	22NSS50.1, 22NSS50.2, 22NSS50.3, 22NSS50.4	30 HRS
6TH 22NSS60	1. Organize National integration and social harmony events / workshops / seminars. (Minimum TWO programs). 2. Govt. school Rejuvenation and helping them to achieve good	22NSS60.1, 22NSS60.2, 22NSS60.3,	30 HRS

	infrastructure.	22NSS60.4	

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/ Continuous monitoring/ Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
3.	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/Government Schemes officers	School selection/proper consultation/ Continuous monitoring/ Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
7.	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/proper consultation/ Continuous monitoring/ Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
8.	Contribution to any national level initiative of Government of India.For eg. Digital India, Skill India, Swachh Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme,Skill development programs etc.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemes officers/ campus	Group selection/proper consultation/ Continuous monitoring / Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
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/proper consultation/ Continuous monitoring / Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
10.	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 (PE) (SPORTS AND ATHLETICS)

Course Code	**22PED30, 22PED40, 22PED50, 22PED60**	**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:

22PEDX0.1	Understand the fundamental concepts and skills of Physical Education, Health, Nutrition and Fitness
22PEDX0.2	Create consciousness among the students on Health, Fitness and Wellness in developing and maintaining a healthy lifestyle
22PEDX0.3	Perform in the selected sports or athletics of student's choice and participate in the competition at regional/state / national / international levels.
22PEDX0.4	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	PO12
22PEDX0.1	-	-	-	-	-	2	-	3	3	-	-	2
22PEDX0.2	-	-	-	-	-	2	-	3	3	-	-	2
22PEDX0.3	-	-	-	-	-	2	-	3	3	-	-	2
22PEDX0.4	-	-	-	-	-	2	-	3	3	-	-	2

Semester	CONTENT	COs	HOURS
3RD 22PED30	**Module 1: Orientation** A. Lifestyle, B. Fitness C. Food & Nutrition D. Health & Wellness E. Pre-Fitness test.	22PED30.1, 22PED30.2	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	22PED30.2, 22PED30.3	15 HRS
	Module 3: Recreational Activities A. Postural deformities. B. Stress management. C. Aerobics. D. Traditional Games.	22PED30.3, 22PED30.4	10 HRS
4TH 22PED40	**Module 1: Ethics and Moral Values** C. Ethics in Sports D. Moral Values in Sports and Games	22PED40.1, 22PED40.2	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	22PED40.3	20 HRS

	throw. C. Kabaddi – Hand touch, Toe Touch, Thigh Hold, Ankle hold and Bonus. D. Kho-Kho – Giving Kho, Single Chain, Pole dive, Pole turning, 3-6 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	22PED40.4	5 HRS
5TH 22PED50	**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:** B. Fundamental Skills 1. Catching, Throwing and Ball control, 2. Goal Throws: Jumpshot, Centershot, Diveshot, Reverse-shot. 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. C. Rules and their interpretations and duties of officials **Ball badminton:** B. 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.	22PED50.1, 22PED50.2, 22PED50.3, 22PED50.4	Total 30 Hrs/ Semester 2 Hrs/week
6TH 22PED60	**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.	22PED60.1, 22PED60.2, 22PED60.3, 22PED60.4	Total 30 Hrs/ Semester 2 Hrs/week

	3. Throws- Discus Throw: Holding the Discus, Initial Stance Primary Swing, Turn, Release and Recovery (Rotation in the circle). **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	**22YOG30, 22YOG40, 22YOG50, 22YOG60**	**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:

22YOGX0.1	Understanding the origin, history, aim and objectives of Yoga
22YOGX0.2	Become familiar with an authentic foundation of Yogic practices
22YOGX0.3	Practice different Yogic methods such as Suryanamaskara, Pranayama and some of the Shat
22YOGX0.4	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	PO12
22YOGX0.1	-	-	-	-	-	3	-	-	-	-	-	1
22YOGX0.2	-	-	-	-	-	3	-	-	-	-	-	1
22YOGX0.3	-	-	-	-	-	3	-	-	-	-	-	1
22YOGX0.4	-	-	-	-	-	3	-	-	-	-	-	1

Semester / Course Code	CONTENT	COs	HOURS
3rd 22YOG30	**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	22YOG30.1, 22YOG30.2, 22YOG30.3, 22YOG30.4	Total 32 Hrs/ Semester 2 Hrs/week
4TH 22YOG40	**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, Has-tapadasana 3. Prone line: Dhanurasana 4. Supine line: Karna Peedasana, Sarvangasana, Chakraasana **Patanjali's Ashtanga Yoga**: Asana, Pranayama **Pranayama:** Chandra Bhedana, Nadishodhana, Surya Bhedana	22YOG40.1, 22YOG40.2, 22YOG40.3, 22YOG40.4	Total 32 Hrs/ Semester 2 Hrs/week

5TH 22YOG50	**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, Parsh-vakonasana 3. Prone line: Padangushtha Dhanurasana, Poorna Bhujan-gasana / Rajakapotasana 4. Supine line: Navasana/Noukasana, Pavanamuktasana, Sarvanga **Patanjali's Ashtanga Yoga**: Pratyahara, Dharana **Pranayama:** Ujjayi, Sheetali, Sheektari	22YOG50.1, 22YOG50.2, 22YOG50.3, 22YOG50.4	Total 32 Hrs/ Semester 2 Hrs/week
6TH 22YOG60	**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, Parsh-vakonasana 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	22YOG60.1, 22YOG60.2, 22YOG60.3, 22YOG60.4	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**

APPENDIX A

List of Assessment Patterns

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

APPENDIX B

Outcome Based Education

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

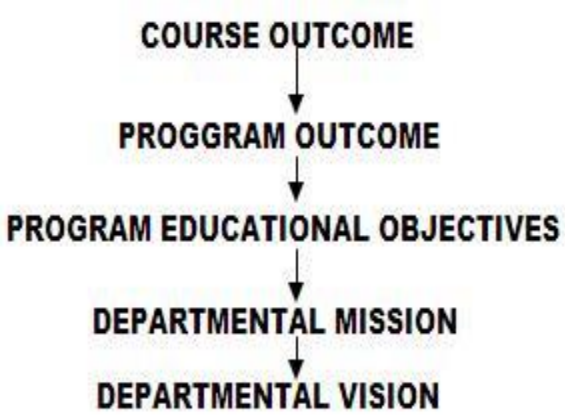
There are three educational Outcomes as defined by the National Board of Accreditation:

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

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

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

Mapping of Outcomes



APPENDIX C

The Graduate Attributes of NBA

Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

Problem analysis: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

Conduct investigations of complex problems: The problems that cannot be solved by straightforward application of knowledge, theories and techniques applicable to the engineering discipline that may not have a unique solution. For example, a design problem can be solved in many ways and lead to multiple possible solutions that require consideration of appropriate constraints/requirements not explicitly given in the problem statement (like: cost, power requirement, durability, product life, etc.) which need to be defined (modeled) within appropriate mathematical framework that often require use of modern computational concepts and tools.

Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and

write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

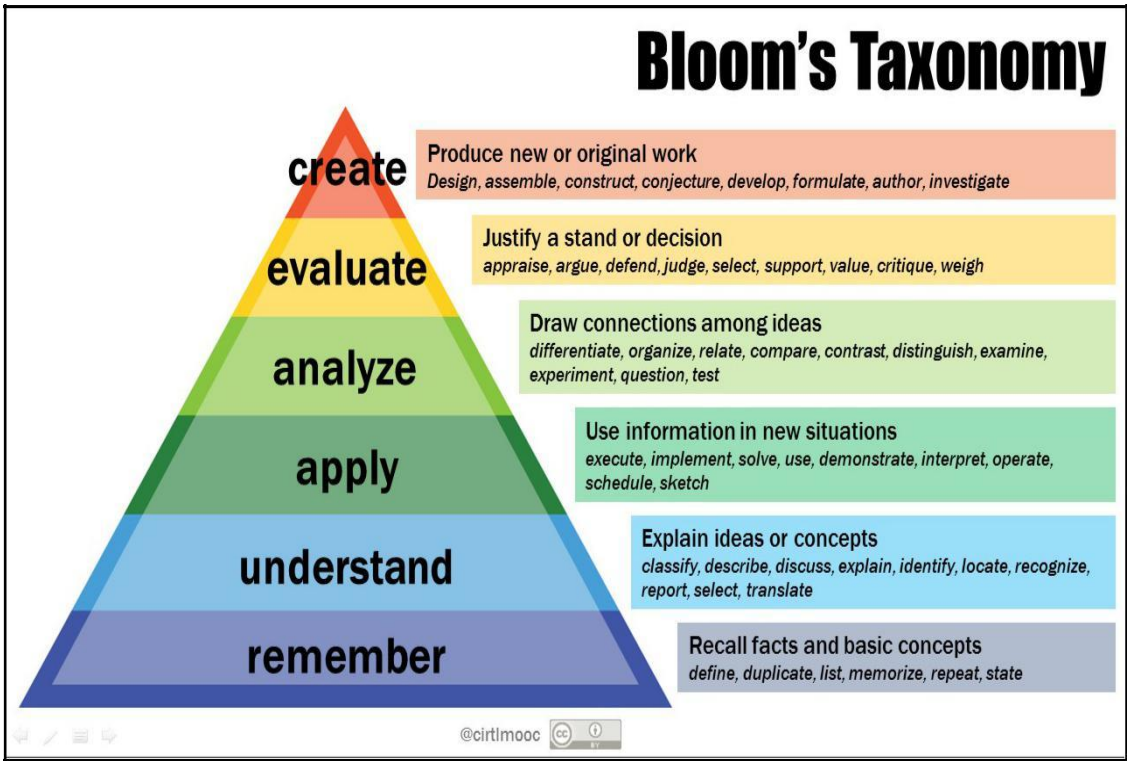
Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

APPENDIX D

BLOOM'S TAXONOMY

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



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