ADVANCED DIGITAL SIGNAL PROCESSING			
Course Code	**22LDC12**	CIE Marks	50
Teaching Hours/Week (L:P: SDA)	3:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 10-12 Lab slots	Total Marks	100
Credits	04	Exam Hours	03

Course Learning objectives: This course will enable students:

- To Know the analysis of discrete time signals.
- To study the modern digital signal processing algorithms and applications.
- To Have an in-depth knowledge of use of digital systems in real time applications
- To Apply the algorithms for wide area of recent applications.

MODULE-1

Introduction to Digital Signal Processing: Review of Discrete time signals and systems and frequency analysis of discrete time linear time invariant systems, implementation of discrete time systems, correlation of discrete time systems Sampling, decimation by a factor 'D', Interpolation by a factor 'I', sampling rate conversion by a factor 'I/D', Implementation of sampling rate conversion, Multistage implementation of sampling rate conversion. (Text 1,Text2)**RBT Level: L1, L2, L3, L4**

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

MODULE-2

Multirate Digital Signal Processing: Multirate signal processing and its applications, Design of Digital filters, Design of FIR filters, Design of IIR filters, frequency transformations, Digital filter banks, two channel quadrature mirror filter banks, Mchannel QMF bank. (Text 1,Text 2)**RBT Level: L1, L2, L3, L4**

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

MODULE-3

Linear prediction and Optimum Linear Filters: Random signals, Correlation Functions and Power Spectra, Innovations Representation of a Stationary Random Process. Forward and Backward Linear Prediction. Solution of the Normal Equations. The Levinson-Durbin Algorithm. Properties of the Linear Prediction-Error Filters. (Text 1)**RBT Level: L1, L2, L3, L4**

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

MODULE 4

Adaptive filters:

Applications of Adaptive Filters-Adaptive Channel Equalization, Adaptive noise cancellation, Linear Predictive coding of Speech Signals, Adaptive direct form FIR filters-The LMS algorithm, Properties of LMS algorithm. Adaptive direct form filters- RLS algorithm. (Text 1)**RBT Level: L1, L2, L3, L4**

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

MODULE 5

Power Spectrum Estimation:

Non parametric Methods for Power Spectrum Estimation - Bartlett Method, Welch Method, Blackman &Tukey Methods.

Parametric Methods for Power Spectrum Estimation: Relationship between the auto correlation and the model parameters, Yule and Walker methods for the AR Model Parameters, Burg Method for the AR Model parameters, Unconstrained least-squares method for the AR Model parameters, Sequential estimation methods for the AR Model parameters, ARMA Model for Power Spectrum Estimation. (Text 1) **RBT Level: L1, L2**	
Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

PRACTICAL COMPONENT OF IPCC: Conduct the experiments using MATLAB/Scilab/TMS 320 C5X DSP Processors

Sl.No	Experiments
1	Generate various fundamental discrete time signals
2	Basic operations on signals (Multiplication, Folding, Scaling).
3	Find out the DFT & IDFT of a given sequence without using inbuilt instructions.
4	Interpolation & decimation of a given sequence.
5	Generation of DTMF (Dual Tone Multiple Frequency) signals
6	Estimate the PSD of a noisy signal using periodogram and modified periodogram
7	Estimation of PSD using different methods (Bartlett, Welch, Blackman-Tukey).
8	Design of Chebyshev Type I,II Filters.
9	Cascade Digital IIR Filter Realization.
10	Parallel Realization of IIR filter.
11	Estimation of power spectrum using parametric methods (YuleWalker &Burg).
12	Time-Frequency Analysis with the Continuous Wavelet Transform.
13	Signal Reconstruction from Continuous Wavelet Transform Coefficients.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CIE for the theory component of IPCC

1. Two Tests each of **20 Marks**
2. Two assignments each of **10 Marks/One Skill Development Activity of 20 marks**
3. Total Marks of two tests and two assignments/one Skill Development Activity added will be CIE for 60 marks, marks scored will be proportionally scaled down to **30 marks**.

CIE for the practical component of IPCC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The**15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of

the semester.

- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test at the end /after completion of all the experiments shall be conducted for 50 marks and scaled down to 05 marks**.**

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **20 marks**.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

The question paper will be set for 100 marks and marks scored will be scaled down proportionately to 50 marks.

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component).

- The minimum marks to be secured in CIE to appear for SEE shall be the 15 (50% of maximum marks-30) in the theory component and 10 (50% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included**.** The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.
- SEE will be conducted for 100 marks and students shall secure 40% of the maximum marks to qualify in the SEE. Marks secured will be scaled down to 50. (Student has to secure an aggregate of 50% of maximum marks of the course(CIE+SEE)

Suggested Learning Resources:

Text Books

1. Digital Signal Processing Principles, Algorithms, and Applications by John G. Proakis, Prentice-Hall International Inc., 4th Edition, 2012.
2. Theory and Application of Digital Signal Processing by Lawrence R.Rabiner and BernardGold.

Reference Books

1. Oppenheim, Alan V. Discrete-time signal processing. Pearson Education India, 1999.
2. Mitra, Sanjit Kumar, and Yonghong Kuo. Digital signal processing: a computer-basedapproach. Volume 2. New York: McGraw-Hill Higher Education, 2006.

Web links and Video Lectures (e-Resources):

- **https://ekeeda.com/degree-courses/electrical-engineering/advanced-digital-signal-processing**
- **https://dss-kiel.de/index.php/teaching/lectures/lecture-advanced-digital-signal-processing**

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

- **Mini Project in the area Advanced signal processing using modern tools like MATLAB, Python**

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Able to analyze and implement the frequency analysis & correlation of discrete-time linear time invariant systems.	Analyze
CO2	Able to implement sampling rate conversion by decimation & Interpolation process and design digital filter banks	Analyze
CO3	Able to analyze forward and backward linear prediction of a stationary random process using Levinson-Durbin Algorithm	Analyze
CO4	Able to understand and analyze adaptive filters and its application using LMS algorithm & RLS algorithm.	Analyze
CO5	Able to understand parametric & non-parametric methods for power spectrum estimation.	Understand

Program Outcome of this course

Sl. No.	Description	POs
1	An ability to independently carry out research /investigation and development work to solve practical problems	PO1
2	An ability to write and present a substantial technical report/document	PO2
3	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program	PO3
4	An ability to create, select, apply appropriate techniques, resources and modern tools to solve complex engineering activities with an understanding of their limitations.	PO4
5	An ability to apply Professional ethics, responsibilities and norms of the engineering.	PO5
6	An ability to recognize the need to engage in independent and life-long learning in Digital Communication and Networking domain.	PO6

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**1**	**1**	**1**	**2**	**1**	**1**
CO2	**1**	**1**	**1**	**2**	**1**	**1**
CO3	**2**	**1**	**2**	**2**	**1**	**1**
CO4	**1**	**1**	**1**	**2**	**1**	**1**
CO5	**1**	**1**	**1**	**2**	**1**	**1**

ADVANCED COMMUNICATION NETWORKS			
Course Code	**22LDC13**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	50
Total Hours of Pedagogy	40 Hours Theory+10 Hours SDA	Total Marks	100
Credits	4	Exam Hours	3

Course Learning objectives: This course will enable students:

- To Build an understanding of the fundamental concepts of basic networking.
- To Introduce the student to advanced internetworking concepts.
- To Understand the concepts to control the congestion , allocate resources and to provide QOS
- To Familiarize with the concepts of network security, authentication protocols and firewalls.
- To Identify the traditional and advanced application layer protocols.

Module-1

Foundation: Building a Network, Applications, Requirements, Network Architecture, Implementing Network Software, Performance, Basic Networking (IP), Routing, Implementation and Performance (Text 1: Chapter 1.1, 1.2, 1.3, 1.4, 1.5, 3.2, 3.3, 3.4).**RBT Level: L1,L2**

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Module-2

Advanced Internetworking: The Global Internet, Multicast, Multicast addresses, Multicast, Multiprotocol Label Switching (MPLS) End-to-End protocols: Simple Demultiplexer (UDP), Reliable Byte Stream (TCP) (Text 1: Chapter 4.1, 4.2, 4.3, 5.1, 5.2).**RBT Level: L1,L2**

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Module-3

Congestion Control and Resource Allocation: Allocating Resources, Issues in Resource allocation, Queuing Disciplines, TCP Congestion Control, Congestion-Avoidance Mechanisms, Quality of Service. (Text 1: Chapter 6.1, 6.2, 6.3, 6.4 and 6.5).**RBT Level: L1, L2,L3,L4**

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Module-4

End-to End data: Presentation formatting, Multimedia Data Network Security: Security attacks, Cryptographic building blocks, Key Predistribution, Authentication protocols, Transport Layer Security [TLS, SSL, HTTPS], IP Security,Wireless Security, Firewalls (Text 1: Chapter 7.1, 7.2, 8.1, 8.2, 8.3,8.4.3,8.4.4,8.4.5, 8.5). **RBT Level: L1, L2**

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Module-5

Applications: Traditional Applications: Electronic Mail (SMTP, POP, IMAP, And MIME), World Wide Web (HTTP), Multimedia Applications, Infrastructure Services (Domain Name System (DNS), Network Management (SNMP), Overlay Networks (Text 1: Chapter 9.1, 9.2, 9.3, 9.4. Text 2: Chapter 23.1 to 23.16, Chapter 24, Chapter 25, Chapter 27.1 to 27.8)**RBT Level: L1, L2, L3**

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks**to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books

Textbooks:

1. 'Computer Networks: A System Approach', Larry Peterson and Bruce S Davis, 5th Edition, Elsevier -2014.
2. 'Internetworking with TCP/IP, Principles, Protocols and Architecture', Douglas E Comer, 6th Edition, PHI – 2014

Reference Books:

1. 'Computer Networks, Protocols, Standards and Interfaces', Uyless Black, 2nd Edition, PHI.
2. 'TCP /IP Protocol Suite', Behrouz A Forouzan, 4th Edition, Tata McGraw-Hill

Web links and Video Lectures (e-Resources):

https://cseweb.ucsd.edu/classes/wi19/cse124-a/courseoverview/compnetworks.pdf

Skill Development Activities Suggested

- Develop a website and hosting it on the web.
- Present an email architectural and implementation solution for a small sized enterprise.
- Mini Projects can be suggested to improve the programming skills.
- Online certification course can be suggested on the related area.

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Classify network services, protocols, architectures and fundamentals of Internetworking.	Understand
CO2	Knowledge on Advanced Internetworking applications and their protocols, and ability to work on their own applications (e.g. Client Server applications, Web Services).	Understand
CO3	To analyze various techniques for Congestion avoidance and Resource Allocation.	Analyze
CO4	Understand the concept of Network Security through cryptographic blocks, authentication protocols, security and firewalls.	Understand
CO5	Gain the knowledge of application layer protocols.	Apply

Program Outcome of this course

Sl. No.	Description	POs
1	An ability to independently carry out research /investigation and development work to solve practical problems	PO1
2	An ability to write and present a substantial technical report/document	PO2
3	To demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program	PO3
4	An ability to create, select, apply appropriate techniques, resources and modern tools to solve complex engineering activities with an understanding of their limitations.	PO4
5	An ability to apply Professional ethics, responsibilities and norms of the engineering.	PO5
6	An ability to recognize the need to engage in independent and life-long learning in Digital Communication and Networking domain.	PO6

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**1**	**1**	**-**	**1**	**-**	**2**
CO2	**1**	**1**	**-**	**1**	**-**	**2**
CO3	**2**	**1**	**1**	**1**	**-**	**2**
CO4	**2**	**1**	**1**	**1**	**-**	**2**
CO5	**2**	**1**	**2**	**1**	**-**	**2**

WIRELESS COMMUNICATION			
Course Code	**22LDC14**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	(2:0:2)	SEE Marks	50
Total Hours of Pedagogy	30 hours Theory + 10 Hours SDA	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives: Thiscoursewillenablestudents:

- To apply knowledge about capacity of wireless channel and enhance it using MIMO.
- To understand channel impairment and its mitigation using space-time block and Trellis codes.
- To understand advanced MIMO system like layered space time codes, MU-MIMO System and MIMO OFDM systems.

Module-1

CAPACITY OF WIRELESS CHANNELS: The crowded spectrum, need for high data rate, MIMO systems – Array Gain, Diversity Gain, Data Pipes, Spatial MUX, MIMO System Model. MIMO System Capacity – channel known at the TX, Channel unknown to the TX – capacity of deterministic channels, Random channels and frequency selective channels.**RBT Level: L1, L2**

Teaching-Learning Process	Chalk and Talk, YouTube videos

Module-2

RADIO WAVE PROPAGATION: Radio wave propagation – Macroscopic fading- free space and outdoor, small scale fading, fading measurements – Direct pulse measurements, spread spectrum correlation channel sounding frequency domain channel sounding, Antenna Diversity – Diversity combining methods.
RBT Level: L1, L2, L3

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Module-3

SPACE TIME BLOCK CODES: Delay Diversity scheme, Alamouti space time code – Maximum likelihood decoding maximum ratio combining. Transmit diversity space time block codes for real signal constellation and complex signal constellation - decoding of STBC.**RBT Level: L1, L2, L3, L4**

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Module-4

SPACE TIME TRELLIS CODES: Space time coded systems, space time code word design criteria, design of space time T C on slow fading channels, design of STTC on Fast Fading channels, performance analysis in slow and fast fading channels, effect of imperfect channel estimation and Antenna correlation on performance, comparison of STBC & STTC.**RBT Level: L1, L2**

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Module-5

LAYERED SPACE TIME CODES: LST transmitter – Horizontal and Vertical LST receiver – ML Rx, Zero forcing Rx; MMSE Rx, SIC Rx, ZF V-blast Rx- MMSE V-blast Rx, Iterative Rx - capacity of MIMO – OFDM systems – capacity of MIMO multi user systems.**RBT Level: L1, L2**

Teaching-Learning	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Process	

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **oneSkill Development Activity of 40 marks**to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books

1. Mohinder Jankiraman, Space-time codes and MIMO systems, Artech House, Boston, London . www.artech house.com,ISBN1-58053-865-7-2004
2. Paulraj Rohit Nabar, Dhananjay Gore, Introduction of space time wireless communication systems, CambridgeUniversity Press, 2003.
3. David Tse and Pramod Viswanath, ―Fundamentals of Wireless Communication‖, Cambridge University Press, 2005.
4. Sergio Verdu ― Multi User Detection‖ Cambridge University Press, 1998

Web links and Video Lectures (e-Resources):

Massive Open Online Courses:

1. Introduction to Wireless and Cellular Communications- By Prof.R. David Koilpillai | IIT Madras
2. Fundamentals of MIMO Wireless Communication- By Prof. Suvra Sekhar Das | IIT Kharagpur
3. Principles of Signal Estimation for MIMO/ OFDM Wireless Communication-By Prof. Aditya K. Jagannatham | IIT Kanpur

Skill Development Activities Suggested

- Miniprojects carried out in groups based on latest trends in Industry and continue work to prepare a research Article.
- Any new software tool can be used to implement the theory concepts.

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Comprehend the significance and role of this course in the present contemporary world	Understand
CO2	Apply the knowledge about the importance of MIMO in today's communication	Apply
CO3	Analyze the various methods for improving the data rate of wireless communication system.	Analyze
CO4	Understand advanced concepts in MIMO like space time block code, trellis code etc.	Understand

Program Outcome of this course

Sl. No.	Description	POs
1	An ability to independently carry out research /investigation and development work to solve practical problems	PO1
2	An ability to write and present a substantial technical report/document	PO2
3	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program	PO3
4	An ability to create, select, apply appropriate techniques, resources and modern tools to solve complex engineering activities with an understanding of their limitations.	PO4
5	An ability to apply Professional ethics, responsibilities and norms of the engineering.	PO5
6	An ability to recognize the need to engage in independent and life-long learning in Digital Communication and Networking domain.	PO6

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**1**	**-**	**1**	**3**	**2**	**2**
CO2	**1**	**1**	**1**	**3**	**2**	**2**
CO3	**1**	**-**	**1**	**3**	**2**	**2**
CO4	**1**	**1**	**1**	**2**	**2**	**2**

ADVANCED EMBEDDED SYSTEMS			
Course Code	**22LDC15**	CIE Marks	50
Teaching Hours/Week (L:P: SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	30 HoursTheory + 10 Hours SDA	Total Marks	100
Credits	3	Exam Hours	3

Course Learning objectives: This course will enable students:

- To perform effectively as entry level Embedded Systems professionals.
- To develop and maintain applications written using Embedded C.
- To design and develop a hardware platform encompassing a microcontroller and peripherals.

Module-1	
Embedded System: Embedded Vs General computing system, classification, application and purpose of ES. Core of an Embedded System, Memory, Sensors, Actuators, LED, Opto coupler, Communication Interface, Reset circuits, RTC, WDT, Characteristics and Quality Attributes of Embedded Systems (Text 1: Selected Topics from Ch -1, 2, 3).**RBT Level: L1, L2**	
Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar
Module-2	
Hardware Software Co-Design, embedded firmware design approaches, computational models, embedded firmware development languages, Integration and testing of Embedded Hardware and firmware, Components in embedded system development environment (IDE), Files generated during compilation, simulators, emulators and debugging (Text 1: Selected Topics from Ch-7, 9, 12, 13).**RBT Level: L1, L2, L3, L4**	
Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar
Module-3	
ARM-32 bit Microcontroller: Thumb-2 technology and applications of ARM, Architecture of ARM Cortex M3, Various Units in the architecture, General Purpose Registers, Special Registers, exceptions, interrupts, stack operation, reset sequence (Text 2: Ch 1, 2, 3).**RBT Level: L1, L2, L3, L4**	
Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar
Module-4	
Instruction Sets: Assembly basics, Instruction list and description, useful instructions, Memory Systems, Memory maps, Cortex M3 implementation overview, pipeline and bus interface (Text 2: Ch-4, 5, 6). **RBT Level: L1, L2**	
Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar
Module-5	
Exceptions, Nested Vector interrupt controller design, Systick Timer, Cortex- M3 Programming using assembly and C language, CMSIS (Text 2: Ch-7, 8, 10).**RBT Level: L1, L2, L3**	
Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks**to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

TextBooks

1. Introduction to embedded systems', K. V. Shibu, TMH education Pvt.Ltd.,2009
2. The Definitive Guide to the ARM Cortex-M3', Joseph Yiu, Newnes,(Elsevier),2nd edn, 2010.

ReferenceBooks:

1. Embedded systems - A contemporary design tool', James K. Peckol, John Wiley, 2008

Web links and Video Lectures (e-Resources):

- http://www.embeddedtechnology.com/
- https://www.edx.org/learn/embedded-systems
- http://www.realtime-info.be/magazine/98q4/1998q4_p014.pdf

Skill Development Activities Suggested

Students have to conduct the following experiments as a part of CIE marks along with other Activities:

ARM Cortex M3 Programs - Programming to be done using Keil uVision 4 and download the program on to a M3 evaluation board such as NXP LPC1768 or ATMEL ARM

a. Write an Assembly language program to calculate the sum and display the result for the addition of first ten numbers. SUM = 10+9+8+.....+1
b. Write an Assembly language program to store data in RAM
c. Write a C program to output the "Hello World" message using UART
d. Write a C program to operate a buzzer using Cortex M3
e. Write a C program to display the temperature sensed using Cortex M3.
f. Write a C program to control stepper motor using Cortex M3.

- ProgrammingAssignments/Miniprojectscanbegiventoimproveprogrammingskills.
- Online course certification on embedded systems may be suggested.

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Understand the basic hardware components and their selection method based on the characteristics and attributes of an embedded system.	Understand
CO2	Explain the hardware software co-design and firmware design approaches.	Analyze
CO3	Understand the suitability of the instruction sets of ARM processors to design of embedded systems.	Analyze
CO4	Acquire the knowledge of the architectural features of ARM CORTEX M3, a 32-bit microcontroller including memory map, interrupts and exceptions.	Understand
CO5	Apply the knowledge gained for Programming ARM CORTEX M3 for different applications.	Apply

Program Outcome of this course

Sl. No.	Description	POs
1	An ability to independently carry out research /investigation and development work to solve practical problems	PO1
2	An ability to write and present a substantial technical report/document	PO2
3	To demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program	PO3
4	An ability to create, select, apply appropriate techniques, resources and modern tools to solve complex engineering activities with an understanding of their limitations.	PO4
5	An ability to apply Professional ethics, responsibilities and norms of the engineering.	PO5
6	An ability to recognize the need to engage in independent and life-long learning in Digital Communication and Networking domain.	PO6

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**1**	**1**	**2**	**2**	**-**	**2**
CO2	**1**	**1**	**2**	**2**	**-**	**2**
CO3	**1**	**1**	**2**	**2**	**-**	**2**
CO4	**1**	**1**	**2**	**2**	**-**	**2**
CO5	**1**	**1**	**2**	**2**	**-**	**2**

COMMUNICATION NETWORK LABORATORY			
Course Code	**22LDCL17**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	1:2:0	SEE Marks	50
Credits	2	Exam Hours	03

Course objectives:

The course objectives include learning about computer network organization and implementation, obtaining a theoretical understanding of data communication and computer networks, and gaining practical experience in installation, monitoring, and troubleshooting of current LAN systems.

Sl.No	Experiments
1	Write a program to archive Traffic management at Flow level by implementing Closed Loop Control technique. (Leaky Bucket Algorithm)
2	Write a program to implement dynamic routing strategy in finding optimal path for data transmission. (Bellman ford algorithm).
3	Write a program to implement Link State Routing (Dijkstra Algorithm).
4	Write a program for providing security for transfer of data in the network. (RSA Algorithm)
5	Write a program for encrypting 64 bit playing text using DES algorithm.
6	Apply the RSA algorithm on a text file to produce cipher text file.
7	Develop a mechanism to setup a security channel using Diffie-Hellman Key Exchange between client and server
8	Implement secure hash algorithm for Data Integrity. Implement MD5 and SHA-1 algorithm, which accepts a string input, and produce a fixed size number - 128 bits for MD5; 160 bits for SHA-1, this number is a hash of the input. Show that a small change in the input results in a substantial change in the output.
	Demonstration Experiments (For CIE) if any
9	Simulate a 3 node point to point network with duplex links between them. Set the Queue size and vary the bandwidth and find the number of packets dropped.
10	Simulate a four-node point-to-point network, and connect the links as follows: n0->n2, n1- >n2 and n2->n3. Apply TCP agent changing the parameters and determine the number of packets sent/received by TCP/UDP
11	Simulate to Plot Congestion for Different Source/Destination
12	Simulate to Determine the Performance with respect to Transmission of Packets

Note: Conduct the experiments using C/NS2/Qualnet/OPNET/OMNET simulation tools

Course outcomes (Course Skill Set):

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

1. Apply key Internet applications and their protocols, and ability to develop their own applications (e.g. Client Server applications, Web Services) using the sockets API.
2. Design and evaluate application layer protocol.
3. Analyze the vulnerabilities in any computing system and hence be able to design a security solution.
4. Identify the security issues in the network and resolve it.
5. Evaluate security mechanisms using rigorous approaches, including theoretical.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 40% of maximum marks in the semester-end examination(SEE). In total of CIE and SEE student has to secure 50% maximum marks of the course.

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.
The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of **scaled-down** marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

- SEE marks for the practical course is 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University.
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.
- General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
- Change of experiment is allowed only once and 10% Marks allotted to the procedure part to be made zero.

The duration of SEE is 03 hours

Suggested Learning Resources:

- http://www.ciscopress.com/articles/
- GeeksforGeeks | A computer science portal for geeks
- https://www.amazon.com/Computer-Networking-James-Kurose-Keith/dp/0273768964

M.TECH IN DIGITAL COMMUNICATION ENGINEERING
(LDC)

Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
(Effective from the academic year 2022-23)

SEMESTER -II

ADVANCED COMMUNICATION SYSTEMS			
Course Code	**22LDC21**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	(2:0:2)	SEE Marks	50
Total Hours of Pedagogy	30 hours Theory + 10 hours SDA	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives: Thiscoursewillenablestudents:

- To understand the concept of low pass and Band pass signals during modulation at the Transmitter.
- To analyze the Receiver performance for various types of single carrier symbol modulations through ideal and AWGN channels.
- To apply single carrier equalizers for various modulation schemes and detection methods for defined channel models
- To understand the concepts of synchronization for carrier and symbol timing recovery at receiver.
- To understand the concepts of spread spectrum systems for communications in a Jamming, multiuser and low power intercept environment.

Module-1

SIGNAL REPRESENTATION: Low pass representation of band pass signals, Low pass representation of band pass random process [Text 1, Chapter 2:2.1, and 2.9 only].
Modulation: Representation of digitally modulated Signals, Modulation Schemes without memory (Band Limited Schemes - PAM, BPSK, QPSK, MPSK, MQAM, Power Limited Schemes – FSK, MFSK, DPSK, DQPSK), modulation schemes with memory (Basics of CPFSK and CPM – Full Treatment of MSK), Transmit PSD for Modulation Schemes. (Section 3.4) [Text 1, Chapter 3:3.1, 3.2 and 3.3].
RBT Level: L1, L2

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Module-2

DEMODULATION: Vector Channel, Vector Channel +AWGN, Performance parameters, Optimum Coherent Detection for power limited and Band limited schemes, Optimal Coherent detection for schemes with memory, Optimal Non– Coherent detection for schemes without and with memory (FSK, DPSK,DQPSK), Comparison of detection schemes [Text 1, Chapter 4: 4.1, 4.2.- 4.2.2,4.3, 4.4, 4.5.1, 4.5.2, 4.5.5 and 4.6].**RBT Level: L1, L2, L3**

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Module-3

BANDLIMITED CHANNELS: Band limited channel characterization, signaling through band limited linear filter channels, Sinc, RC, Duobinary and Modified Duobinary signaling schemes.
Linear Equalizers: Zero forcing Equalizer, MSE and MMSE. **Non-Linear Equalizers**: Decision - feedback equalization, Predictive DFE, Performance of DFE [Text 1, Chapter 9].
Adaptive equalization: Adaptive linear equalizer, adaptive decision feedback equalizer, [Text 1, Chapter

10].**RBT Level: L1, L2, L3, L4**	
Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Module-4

SYNCHRONIZATION – Signal Parameter estimation, Carrier Phase Estimation, Symbol Timing Recovery, Performance of ML estimators. [Text 1, Chapter 5] Fading – Large scale, small scale; Statistical characterization of multipath channels – Delay and Doppler spread, classification of multipath channels, Binary signalling over frequency non selective Rayleigh fading channel [Text 1, Chapter 13].**RBT Level: L1, L2**

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Module-5

SPREAD SPECTRUM SIGNALS FOR DIGITAL COMMUNICATION: Model of spread spectrum digital communication system, Direct sequence spread spectrum signals, some applications of DS spread spectrum signals, generation of PN sequences, Frequency hopped spreadspectrum signals, Time hopping SS, Synchronization of SS systems[Text 1, Chapter 12: 12.1, 12.2 (except 12.2.1),12.2.2, 12.2.5, 12.3, 12.4, 12.5].
RBT Level: L1, L2, L3, L4

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks**to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books

1.'Digital Communications', John G. Proakis, Masoud Salehi, Pearson Education, ISBN:978-9332535893, 5th edition, 2014

2. Digital Communications: Fundamentals and Applications: Fundamentals & Applications', Bernard Sklar, Pearson Education,ISBN:9788131720929, 2nd edition, 2009

3.'Digital Communications Systems', Simon Haykin, Wiley,ISBN:9788126542314, 1st edition, 2014

Web links and Video Lectures (e-Resources):

Massive Open Online Courses:

1. Modern Digital Communication Techniques-By Prof. Suvra Sekhar Das | IIT Kharagpur
2. Principles of Signal Estimation for MIMO/ OFDM Wireless Communication**-By Prof. Aditya K. Jagannatham | IIT Kanpur**

Skill Development Activities Suggested

- Miniprojects carried out in groups based on latest trends in Industry and continue work to prepare a research Article.
- Any new software tool can be used to implement the theory concepts.

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Explain the concept of low pass and Bandpass signals representations at the Transmitter, process of Detection and Estimation at the receiver in the presence of AWGN only.	Understand
CO2	Evaluate Receiver performance for various types of single carrier symbol modulations through ideal and AWGN Non-bandlimited and bandlimited channels.	Apply
CO3	Design single carrier equalizers for various symbol modulation schemes and detection methods for defined channel models, and compute parameters to meet desired rate and performance requirements.	Analyze
CO4	Explain the concepts of multi-channel signaling scheme and synchronization for carrier and symbol timing recovery at receiver.	Understand
CO5	Design and Evaluate Non band limited and Non power limited spread spectrum systems for communications in a Jamming environment, multiuser situation and low power intercept environment.	Analyze

Program Outcome of this course

Sl. No.	Description	POs
1	An ability to independently carry out research /investigation and development work to solve practical problems	PO1
2	An ability to write and present a substantial technical report/document	PO2
3	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program	PO3
4	An ability to create, select, apply appropriate techniques, resources and modern tools to solve complex engineering activities with an understanding of their limitations.	PO4
5	An ability to apply Professional ethics, responsibilities and norms of the engineering.	PO5
6	An ability to recognize the need to engage in independent and life-long learning in Digital Communication and Networking domain.	PO6

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**1**	**-**	**1**	**2**	**-**	**2**
CO2	**1**	**1**	**1**	**2**	**-**	**2**
CO3	**1**	**-**	**1**	**2**	**-**	**2**
CO4	**1**	**1**	**1**	**2**	**-**	**2**
CO5	**1**	**1**	**1**	**2**	**-**	**2**

ANTENNA THEORY AND DESIGN			
Course Code	**22LDC22**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	(3:0:2)	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 10-12 Lab slots	Total Marks	100
Credits	4	Exam Hours	3

Course Learning objectives: Thiscoursewillenablestudents:

- To classify different types of antennas
- To define and illustrate various types of array antennas
- To design antennas like Yagi-Uda, Helical antennas and other broad band antennas
- To describe different antenna synthesis methods
- To apply methods like Method of Moments, Pocklington's integral equation, Source modeling.

Module-1

Antenna Fundamentals and Definitions: Radiation Mechanisms, Overview, EM Fundamentals, Solution of Maxwell's Equations for Radiation Problems, Ideal Dipole, Radiation patterns, Directivity and Gain, Antenna impedance, Radiation efficiency, Antenna polarization. TEXT(1)**RBT Level: L1, L2**

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Module-2

Arrays: Array factor for linear arrays, Uniformly excited equally spaced linear arrays, Pattern multiplication, Directivity of linear arrays, Nonuniformly excited equally spaced linear arrays, Mutual coupling. Antenna Synthesis: Formulation of the synthesis problem, Synthesis principles, Line sources shaped beam synthesis, Linear array shaped beam synthesis, Fourier series, Woodward - Lawson sampling method, Comparison of shaped beam synthesis methods, low side lobe narrow main beam synthesis methods, Dolph Chebyshev linear array, Taylor line source method. TEXT(1) **RBT Level: L1, L2**

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Module-3

Resonant Antennas: Wires and Patches, Dipole antenna, Yagi-Uda antennas, Micro-strip antenna.
Broadband antennas: Traveling wave antennas Helical antennas, Biconical antennas, Sleeve antennas, and Principles of frequency independent antennas, Spiral antennas, and Log - periodic antennas. TEXT(1)
RBT Level: L1, L2, L3, L4

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Module-4

Aperture antennas: Techniques for evaluating gain, Reflector antennas, Parabolic reflector antenna principles, Axi-symmetric parabolic reflector antenna, Offset parabolic reflectors, Dual reflector antennas, Gain calculations for reflector antennas, Feed antennas for reflectors, Field representations, Matching the feed to the reflector, General feed model, Feed antennas used in practice. TEXT(1)**RBT Level: L1, L2**

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Module-5

Antenna in systems & Measurements: Receiving properties of antennas, Antenna temperature & radiometry. **CEM for antennas:** The method of moments: Introduction of the methods moments, Pocklington's integral equation, Integral equation and Kirchhoff's networking equations, Source modeling weighted residual formulations and computational consideration, Calculation of antenna and scatter characteristics. TEXT(1). **RBT Level: L1, L2, L3**	
Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

PRACTICAL COMPONENT OF IPCC: Conduct the experiments usingMATLAB/Scilab/any antenna simulation tool

Sl.No	Experiments
1	MATLAB/C implementation to obtain the radiation pattern of an antenna
2	Study of radiation pattern of different antennas.
3	Determine the directivity and gains of Horn/ Yagi/ dipole/ Parabolic antennas.
4	Impedance measurements of Horn antennas.
5	Study of radiation pattern of E plane horns
6	Significance of Pocklington's integral equation.
7	Determine the directivity and gains of dipole antennas.
8	Impedance measurements of Yagi antennas.
9	Determine the directivity and gains of Parabolic antennas.
10	Study of radiation pattern of E plane horns

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CIE for the theory component of IPCC

1. Two Tests each of **20 Marks**
2. Two assignments each of **10 Marks/One Skill Development Activity of 20 marks**
3. Total Marks of two tests and two assignments/one Skill Development Activity added will be CIE for 60 marks, marks scored will be proportionally scaled down to **30 marks**.

CIE for the practical component of IPCC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The**15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test at the end /after completion of all the experimentsshall be conducted for 50 marks and scaled down to 05 marks**.**

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **20 marks**.

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SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

1. The question paper will be set for 100 marks and marks scored will be scaled down proportionately to 50 marks.
2. The question paper will have ten questions. Each question is set for 20 marks.
3. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
4. The students have to answer 5 full questions, selecting one full question from each module.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component).

- The minimum marks to be secured in CIE to appear for SEE shall be the 15 (50% of maximum marks-30) in the theory component and 10 (50% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included**.** The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.
- SEE will be conducted for 100 marks and students shall secure 40% of the maximum marks to qualify in the SEE. Marks secured will be scaled down to 50. (Student has to secure an aggregate of 50% of maximum marks of the course(CIE+SEE)

Suggested Learning Resources:

Textbook:

1. 'Antenna Theory and Design', Stutzman and Thiele, John Wiley, 2nd Edition, 2010

Reference Books:

1. 'Antenna Theory Analysis and Design', C. A. Balanis, John Wiley, 2nd Edition, 2007
2. 'Antennas and Wave Propagation', J. D. Krauss, McGraw Hill TMH, 4th Edition, 2010
3. 'Antennas and propagation', A.R.Harish, M.Sachidanada, Pearson Education, 2015

Web links and Video Lectures (e-Resources):

https://www.youtube.com/watch?v=fIbdW0NGIU0
https://nptel.ac.in/courses/117107035

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

- Different types of antenna synthesis or technical seminar on advanced types of antennas.

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Classify different types of antennas	Understand
CO2	Define and illustrate various types of array antennas	Understand
CO3	Design antennas like Yagi-Uda, Helical antennas and other broad band antennas	Analyze
CO4	Describe different antenna synthesis methods	Understand
CO5	Apply methods like Method of Moments, Pocklington's integral equation, Source modeling.	Apply

Program Outcome of this course

Sl. No.	Description	POs
1	An ability to independently carry out research /investigation and development work to solve practical problems	PO1
2	An ability to write and present a substantial technical report/document	PO2
3	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program	PO3
4	An ability to create, select, apply appropriate techniques, resources and modern tools to solve complex engineering activities with an understanding of their limitations.	PO4
5	An ability to apply Professional ethics,responsibilities and norms of the engineering	PO5
6	An ability to recognize the need to engage in independent and life-long learning in Digital Communication and Networking domain	PO6

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**1**	**2**	**2**	**1**	**-**	**1**
CO2	**1**	**2**	**3**	**1**	**-**	**3**
CO3	**1**	**2**	**2**	**1**	**-**	**3**
CO4	**1**	**2**	**2**	**1**	**-**	**3**
CO5	**1**	**2**	**3**	**1**	**-**	**3**

Professional Elective 1

WIRELESS SENSOR NETWORKS			
Course Code	**22LDC231**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	(2:0:2)	SEE Marks	50
Total Hours of Pedagogy	30 Hours Theory+10 Hours SDA	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives: Thiscoursewillenablestudentsto:

- Learn the basic concepts of Wireless sensor networks architecture and protocols.
- Understand the challenges in designing a Wireless sensor networks.
- Understand the function of Data link and Network layer Protocols.
- Understand the function of Transport layer Protocols.
- Analyze wireless sensor network system for different applications under consideration

Module-1

INTRODUCTION: Sensor Mote Platforms, WSN Architecture and Protocol Stack (Chap.1Text 1). WSN Applications: Military Applications, Environmental Applications, Health Applications, Home Applications, Industrial Applications (Chap. 2 Text 1).**RBT Level: L1, L2**

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Module-2

FACTORS INFLUENCING WSN DESIGN: Hardware Constraints Fault Tolerance Scalability Production Costs WSN Topology, Transmission Media, Power Consumption (Chap. 3 Text 1). Physical Layer: Physical Layer Technologies, Overview of RF Wireless Communication, Channel Coding (Error Control Coding), Modulation, Wireless Channel Effects, PHY Layer Standards (Chap. 4 of Text 1).**RBT Level: L1, L2, L3**

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Module-3

MEDIUM ACCESS CONTROL: Challenges for MAC, CSMA Mechanism, Contention-Based Medium Access, Reservation-Based Medium Access, Hybrid Medium Access (Chap. 5 of Text 1). Network Layer: Challenges for Routing, Data-centric and Flat Architecture Protocols, Hierarchical Protocols, Geographical Routing Protocols (Chap. 7 of Text 1).**RBT Level: L1, L2**

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Module-4

Transport Layer: Challenges for Transport Layer, Reliable Multi Segment Transport (RMST) Protocol, Pump Slowly, Fetch Quickly (PSFQ) Protocol, Congestion Detection and Avoidance (CODA) Protocol, Event-to-Sink Reliable Transport (ESRT) Protocol, GARUDA
(Chap.8 Text 1).
Application Layer: Source Coding (Data Compression), Query Processing, Network Management (Chap. 9 Text 1).**RBT Level: L1, L2, L3, L4**

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Module-5

SPREAD SPECTRUM SIGNALS FOR DIGITAL COMMUNICATION: Model of spread spectrum digital communication system, Direct sequence spread spectrum signals, some applications of DS spread spectrum signals, generation of PN sequences, Frequency hopped spreadspectrum signals, Time hopping SS,

Synchronization of SS systems[Text 1, Chapter 12: 12.1, 12.2 (except 12.2.1),12.2.2, 12.2.5, 12.3, 12.4, 12.5]. **RBT Level: L1, L2**	
Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks**to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**
CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books:

1.Wireless Sensor Networks, Ian F. Akyildiz and Mehmet Can Vuran, John Wiley & Sons Ltd. ISBN 978-0-470-3601-3 (H/B),2010

2. Wireless Sensor Networks: Signal Processing and Communications Perspectives', Ananthram Swami, et.al,John Wiley & Sons Ltd., ISBN 978-0470-03557-3, 2007.

Web links and Video Lectures (e-Resources):

Massive Open Online Courses:

https://archive.nptel.ac.in/courses/106/105/106105160/#-**Wireless** Ad Hoc and **Sensor Networks** -BY Prof. SUDIP MISHRA,IITKGP

Skill Development Activities Suggested

- Mini projects carried out in groups based on latest trends in Industry and continue work to prepare a research Article.
- Implement Networking concepts using NS2/NS3/OMNET/OPNET/QUALNET software tool.

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Acquire knowledge of characteristics of mobile/wireless communication channels	Understand
CO2	Apply statistical models of multipath fading	Apply
CO3	Understand the multiple radio access techniques, radio standards and communication protocols to be used for wireless sensor	Understand
CO4	Design wireless sensor network system for different applications under consideration.	Analyze
CO5	Understand the hardware details of different types of sensors and select right type of sensor for various applications.	Understand

Program Outcome of this course

Sl. No.	Description	POs
1	An ability to independently carry out research /investigation and development work to solve practical problems	PO1
2	An ability to write and present a substantial technical report/document	PO2
3	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program	PO3
4	An ability to create, select, apply appropriate techniques, resources and modern tools to solve complex engineering activities with an understanding of their limitations.	PO4
5	An ability to apply Professional ethics, responsibilities and norms of the engineering.	PO5
6	An ability to recognize the need to engage in independent and life-long learning in Digital Communication and Networking domain.	PO6

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**1**	**-**	**1**	**3**	**-**	**2**
CO2	**1**	**-**	**1**	**3**	**-**	**2**
CO3	**1**	**-**	**1**	**3**	**-**	**2**
CO4	**1**	**1**	**1**	**3**	**-**	**2**
CO5	**1**	**1**	**1**	**3**	**-**	**2**

PROBABILITY THEORY and RANDOM PROCESS			
Course Code	**22LDC232**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	(2:0:2)	SEE Marks	50
Total Hours of Pedagogy	30 Hours Theory+10 Hours SDA	Total Marks	100
Credits	03	Exam Hours	3

Course learning objectives: This course will enable students to:

- To understand Discrete and Continuous Random variables, Random Processes and their applications in Electronic Transmissions.
- To apply concepts of Probability to solve problems in communication Engineering.
- To find functional relationship between random inputs and outputs with the use of Random Process Techniques
- Analyze about the correlation Functions.

Module-1

Probability and Random Variable Probability: Set theory, Experiments and Sample Spaces, Discrete and Continuous Sample Spaces, Events, Probability Definitions and Axioms, Mathematical Model of Experiments, Joint Probability, Conditional Probability, Total Probability, Bayes‘ Theorem, and Independent Events, Bernoulli‘s trials. The Random Variable: Definition of a Random Variable, Conditions for a Function to be a Random Variable, Discrete and Continuous, Mixed Random Variable.**RBT Level: L1, L2**

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Module-2

Distribution and density functions and Operations on One Random Variable Distribution and density functions: Distribution and Density functions, Properties, Binomial, Poisson, Uniform, Exponential Gaussian, Rayleigh and Conditional Distribution, Methods of defining Conditioning Event, Conditional Density function and its properties, problems. Operation on One Random Variable: Expected value of a random variable, function of a random variable, moments about the origin, central moments, variance and skew, characteristic function, moment generating function, transformations of a random variable, monotonic transformations for a continuous random variable, non monotonic transformations of continuous random variable, transformations of Discrete random variable.**RBT Level: L1, L2**

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Module-3

Multiple Random Variables and Operations on Multiple Random Variables Multiple Random Variables: Vector Random Variables, Joint Distribution Function and Properties, Joint density Function and Properties, Marginal Distribution and density Functions, conditional Distribution and density Functions, Statistical Independence, Distribution and density functions of Sum of Two Random Variables and Sum of Several Random Variables, Central Limit Theorem - Unequal Distribution, Equal Distributions Operations on Multiple Random Variables: Expected Value of a Function of Random Variables, Joint Moments about the Origin, Joint Central Moments, Joint Characteristic Functions, and Jointly Gaussian Random Variables: Two Random Variables case and N Random Variable case, Properties, Transformations of Multiple Random Variables.**RBT Level: L1, L2, L3**

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Module-4

Stochastic Processes-Temporal Characteristics: The Stochastic process Concept, Classification of Processes, Deterministic and Nondeterministic Processes, Distribution and Density Functions, Statistical Independence and concept of Stationarity: First-Order Stationary Processes, Second Order and Wide-Sense Stationarity, Nth-Order and Strict-Sense Stationarity, Time Averages and 1 Ergodicity, Mean-Ergodic Processes, Correlation-Ergodic Processes Autocorrelation Function and Its Properties, Cross-Correlation Function and Its Properties, Covariance Functions and its properties, Gaussian Random Processes. Linear system Response: Mean and Mean-squared value, Autocorrelation, Cross-Correlation Functions. **RBT Level: L1, L2, L3**	
Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar
Module-5	
Stochastic Processes-Spectral Characteristics: The Power Spectrum and its Properties, Relationship between Power Spectrum and Autocorrelation Function, the Cross-Power Density Spectrum and Properties, Relationship between Cross-Power Spectrum and Cross-Correlation Function. Spectral characteristics of system response: power density spectrum of response, cross power spectral density of input and output of a linear system.**RBT Level: L1, L2, L3, L4**	
Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks**to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

TEXT BOOKS:

1. Probability, Random Variables & Random Signal Principles -Peyton Z. Peebles, TMH, 4th Edition, 2001.
2. Probability and Random Processes-Scott Miller, Donald Childers,2nd Edn, Elsevier,2012

Skill Development Activities Suggested

- Online certification course on probability and random process.
- Miniprojects can be suggested on the related area.

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	understand Discrete and Continuous Random variables, Random Processes and their applications in Electronic Transmissions	Understand
CO2	To apply concepts of Probability to solve problems in communication Engineering.	Apply
CO3	To find functional relationship between random inputs and outputs with the use of Random Process Techniques	Apply
CO4	Analyze about the correlation Functions	Analyze

Program Outcome of this course

Sl. No.	Description	POs
1	An ability to independently carry out research /investigation and development work to solve practical problems	PO1
2	An ability to write and present a substantial technical report/document	PO2
3	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program	PO3
4	An ability to create, select, apply appropriate techniques, resources and modern tools to solve complex engineering activities with an understanding of their limitations.	PO4
5	An ability to apply Professional ethics, responsibilities and norms of the engineering.	PO5
6	An ability to recognize the need to engage in independent and life-long learning in Digital Communication and Networking domain.	PO6

Mapping of COS and POs:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**1**	**-**	**1**	**1**	**-**	**2**
CO2	**1**	**-**	**1**	**1**	**-**	**2**
CO3	**1**	**-**	**1**	**1**	**-**	**2**
CO4	**1**	**-**	**1**	**1**	**-**	**2**

NANOELECTRONICS			
Course Code	**22LDC233**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	(2:0:2)	SEE Marks	50
Total Hours of Pedagogy	30 Hours Theory+10 Hours SDA	Total Marks	100
Credits	03	Exam Hours	3

Course Learning objectives: This course will enable students to:

- Know the principles behind Nanoscience engineering and Nanoelectronics.
- Apply the knowledge to prepare and characterize nanomaterials.
- Know the effect of particles size on mechanical, thermal, optical and electrical properties of nanomaterials.
- Design the process flow required to fabricate state of the art transistor technology.
- Analyze the requirements for new materials and device structure in the future technologies.

Module-1

Introduction: Overview of nanoscience and engineering. Development milestones in microfabrication and electronic industry. Moores' law and continued miniaturization, Classification of Nanostructures, Electronic properties of atoms and solids: Isolated atom, Bonding between atoms, Giant molecular solids, Free electron models and energy bands, crystalline solids, Periodicity of crystal lattices, Electronic conduction, effects of nanometer length scale, Fabrication methods: Top down processes, Bottom up processes methods for templating the growth of nanomaterials, ordering of nanosystems. **RBT Level: L1, L2**

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Module-2

Characterization: Classification, Microscopic techniques, Field ion microscopy, scanning probe techniques, diffraction techniques: bulk and surface diffraction techniques, spectroscopy techniques: photon, radiofrequency, electron, surface analysis and dept profiling: electron, mass, Ion beam, Reflectometry, Techniques for property measurement: mechanical, electron, magnetic, thermal properties.
RBT Level: L1, L2, L3

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Module-3

Inorganic semiconductor nanostructures: overview of semiconductor physics. Quantum confinement in semiconductor nanostructures: quantum wells, quantum wires, quantum dots, super-lattices, band offsets, electronic density of states.
CarbonNanostructures: Carbon molecules, Carbon Clusters, Carbon Nanotubes, application of Carbon Nanotubes. **RBT Level: L1, L2**

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Module-4

Fabrication techniques: requirements of ideal semiconductor, epitaxial growth of quantum wells, lithography and etching, cleaved-edge over growth, growth of vicinal substrates, strain induced dots and wires, electrostatically induced dots and wires, Quantum well width fluctuations, thermally annealed quantum wells, semiconductor nanocrystals, colloidal quantum dots, self-assembly techniques.
Physical processes: modulation doping, quantum hall effect, resonant tunneling, charging effects, ballistic carrier transport, Inter band absorption, intra band absorption, Light emission processes, phonon bottleneck,

quantum confined stark effect, nonlinear effects, coherence and dephasing, characterization of semiconductor nanostructures: optical electrical and structural (Text1).**RBT Level: L1, L2, L3**	
Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Module-5

Methods of measuring properties: atomic, crystallography, microscopy, spectroscopy
Applications: Injection lasers, quantum cascade lasers, single-photon sources, biological tagging, optical memories, coulomb blockade devices, photonic structures, QWIPs, NEMS, MEMS. **RBT Level: L1, L2, L3**

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks**or**oneSkill Development Activity of 40 marks**to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**
CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Textbooks:

1. 'Nanoscale Science and Technology', Ed Robert Kelsall, Ian Hamley, Mark Geoghegan, John Wiley, 2007
2. 'Introduction to Nanotechnology', Charles P Poole, Jr, Frank J Owens, John Wiley, Copyright 2006, Reprint 2011.

Reference Book:

1. 'Hand Book of Nanoscience Engineering and Technology', Ed William A Goddard III, Donald W Brenner, Sergey E. Lyshevski, Gerald J Iafrate, CRC press, 2003

Web links and Video Lectures (e-Resources):

- https://www.digimat.in/nptel/courses/video/117108047/L01.html
- https://archive.nptel.ac.in/courses/117/108/117108047/

Skill Development Activities Suggested

- Seminar on recent applications of Carbon nano tubes

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Know the principles behind Nanoscience engineering and Nanoelectronics.	Understand
CO2	Apply the knowledge to prepare and characterize nanomaterials.	Apply
CO3	Know the effect of particles size on mechanical, thermal, optical and electrical properties of nanomaterials	Understand
CO4	Design the process flow required to fabricate state of the art transistor technology	Apply
CO5	Analyze the requirements for new materials and device structure in the future technologies.	Apply

Program Outcome of this course

Sl. No.	Description	POs
1.	An ability to independently carry out research /investigation and development work to solve practical problems	PO1
2.	An ability to write and present a substantial technical report/document	PO2
3.	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program	PO3
4.	An ability to create, select, apply appropriate techniques, resources and modern tools to solve complex engineering activities with an understanding of their limitations.	PO4
5.	An ability to apply Professional ethics, responsibilities and norms of the engineering	PO5
6.	An ability to recognize the need to engage in independent and life-long learning in Digital Communication and Networking domain	PO6

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**-**	**1**	**2**	**2**	**-**	**-**
CO2	**2**	**1**	**2**	**2**	**-**	**-**
CO3	**2**	**1**	**2**	**2**	**-**	**-**
CO4	**2**	**1**	**2**	**2**	**-**	**-**
CO5	**-**	**1**	**2**	**2**	**-**	**-**

CRYPTOGRAPHY AND NETWORK SECURITY			
Course Code	**22LDC234**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	(2:0:2)	SEE Marks	50
Total Hours of Pedagogy	30 Hours Theory+10 Hours SDA	Total Marks	100
Credits	03	Exam Hours	3

Course outcomes: This course will enable students to:

- Understand the basics of symmetric key.
- Use basic cryptographic algorithms to encrypt the data.
- Generate some pseudorandom numbers required for cryptographic applications.
- Provide authentication and protection for encrypted data.
- Understand the techniques and features of Email, IP and Web security.

Module-1

Foundations: Terminology, Steganography, substitution ciphers and transpositions ciphers, Simple XOR, One-Time Pads, Computer Algorithms (Text 2: Chapter 1: Section 1.1 to 1.6).
SYMMETRIC CIPHERS: Traditional Block Cipher structure, Data Encryption Standard (DES), The AES Structure, AES Key Expansion (Text 1: Chapter 2: Section 1 & 2, Chapter 4: 2 & 4). **RBT Level: L1, L2**

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Module-2

More Number Theory: Prime Numbers, Fermat's and Euler's theorem, Testing for Primality, The Chinese Remainder theorem, Discrete Logarithms. (Text 1: Chapter 7: Section 1, 2, 3, 4, 5).
Principles of Public-Key Cryptosystems, The RSA algorithm, Diffie - Hellman Key Exchange, Elliptic Curve Arithmetic, Elliptic Curve Cryptography (Text 1: Chapter 8 , Chapter 9: Section 9.1, 9.3, 9.4).

RBT Level: L1, L2, L3

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Module-3

Pseudo-Random-Sequence Generators and Stream Ciphers: Linear Congruential Generators, Linear Feedback Shift Registers, Design and analysis of stream ciphers, Stream ciphers using LFSRs, A5, Hughes XPD/KPD, Nanoteq, Rambutan, Additive generators, Gifford, Algorithm M, PKZIP (Text 2: Chapter 16).

RBT Level: L1, L2, L3

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Module-4

One-Way Hash Functions: Background, Snefru, N-Hash, MD4, MD5, Secure Hash Algorithm [SHA], One way hash functions using symmetric block algorithms, Using public key algorithms, Choosing a one-way hash functions, Message Authentication Codes.
Digital Signature Algorithm, Discrete Logarithm Signature Scheme
(Text 2: Chapter 18: Section 18.1 to 18.5, 18.7, 18.11 to 18.14 and Chapter 20: Section 20.1, 20.4).

RBT Level: L1, L2, L3

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Module-5

E-mail Security: Pretty Good Privacy-S/MIME (Text 1: Chapter 17: Section 17.1, 17.2). **IP Security**: IP Security Overview, IP Security Policy, Encapsulation Security Payload (ESP) (Text 1: Chapter 18: Section 18.1 to 18.4). **Web Security**: Web Security Considerations, SSL (Text 1: Chapter 15: Section 15.1, 15.2). **RBT Level: L1, L2**	
Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Assessment Details (both CIE and SEE)

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Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Textbooks:

1. "Cryptography and Network Security Principles and Practice", William Stallings, Pearson Education Inc., ISBN: 978-93325-1877-3, 6th Edition, 2015

2. "Applied Cryptography Protocols, Algorithms, and Source code in C", Bruce Schneier, Wiley Publications ISBN: 9971-51348-X, 2nd Edition

Reference Books:

1. "Cryptography and Network Security", Behrouz A. Forouzan, TMH, 2007

2. "Cryptography and Network Security", Atul Kahate, TMH, 200

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/106105162
- Cryptography & Network Security, IIT Kharagpur, Prof. Sourav Mukophadhyay

Skill Development Activities Suggested

- Online certification course on probability and random process.
- Miniprojects can be suggested on the related area.

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Understand the basics of symmetric key.	Understand
CO2	Use basic cryptographic algorithms to encrypt the data.	Apply
CO3	Generate some pseudorandom numbers required for cryptographic applications.	Apply
CO4	Provide authentication and protection for encrypted data.	Apply
CO5	Understand the techniques and features of Email, IP and Web security.	Understand

Program Outcome of this course

Sl. No.	Description	POs
1	An ability to independently carry out research /investigation and development work to solve practical problems	PO1
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4	An ability to create, select, apply appropriate techniques, resources and modern tools to solve complex engineering activities with an understanding of their limitations.	PO4
5	An ability to apply Professional ethics, responsibilities and norms of the engineering.	PO5
6	An ability to recognize the need to engage in independent and life-long learning in Digital Communication and Networking domain.	PO6

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**1**	**1**	**2**	**1**	**1**	**1**
CO2	**1**	**1**	**2**	**1**	**1**	**1**
CO3	**1**	**1**	**2**	**1**	**1**	**1**
CO4	**1**	**1**	**2**	**1**	**1**	**1**
CO5	**1**	**1**	**2**	**1**	**1**	**1**

OPTICAL COMMUNICATION AND NETWORKING			
Course Code	**22LDC235**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	(2:0:2)	SEE Marks	50
Total Hours of Pedagogy	30 Hours Theory+10 Hours SDA	Total Marks	100
Credits	03	Exam Hours	3

Course Learning objectives: This course will enable students to:

- Understand the various optical devices and how they operate.
- Recognize and choose various components for optical networking in accordance with the established design requirements
- Acquire knowledge of the elements of data transmission, loss obstacles, and other network operating artifacts.
- Acquire knowledge of the problems associated with setting up and maintaining the optical network's access component while keeping up with current data transmission trends.
- Build a WDM network and explore the management of components and networks.

Module-1

Introduction to optical networks: Optical Networks, optical packet switching, Propagation of signals in optical fiber: Different losses, Nonlinear effects, Solitons. Optical Components (Part-1): Couplers, Isolators, and Circulators (1.3, 1.6, 2.1 up to 2.6, 3.1, 3.2 of Text).**RBT Level: L1, L2**

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Module-2

Optical Components (Part-2): Multiplexers and Filters, Optical Amplifiers, detectors. Modulation - Demodulation: Formats, Ideal receivers, Practical direct detection receivers, Optical preamplifiers, Bit error rates, Coherent detection (3.3, 3.4, 3.6, 4.1, 4.4.1, 4.4.2, 4.4.5, 4.4.6, 4.4.7 of Text).**RBT Level: L1, L2**

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Module-3

Transmission System Engineering: System model, Power penalty, Transmitter, Receiver, Crosstalk. Client Layers of optical layer: SONET/SDH: Multiplexing, layers, Frame structure. Asynchronous Transfer Mode: ATM functions, Adaptation layers, Quality of Service (QoS) and flow control, Signaling and Routing (5.1 up to 5.4, 5.6, 6(introduction), 6.1(introduction), 6.1.1, 6.1.3, 6.1.4, J.1 up to J.5 of Text).
RBT Level: L1, L2

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Module-4

WDM network elements: Optical line terminals, Optical line amplifiers, Optical Add/ Drop Multiplexers, Optical cross-connects. WDM Network Design: Cost trade-offs, LTD and RWA problems, Routing and wavelength assignment, Wavelength conversion (Chapter 7 (full), 10 (introduction), 10.1, 10.2 of Text).
RBT Level: L1, L2

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Module-5

Control and Management (Part-1): Network management functions, management framework, Information model, management protocols, Layers within the optical layer. 37 Control and Management (Part-2): Performance and fault management, Impact of transparency, BER measurement, Optical trace, Alarm management, Configuration management, Optical Safety (8(introduction), 8.1, 8.3, 8.5 (introduction), 8.5.1 up to 8.5.4, 8.6, 8.7 of Text). **RBT Level: L1, L2, L3, L4**	
Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

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Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Textbooks:

1. ''Optical Networks', Rajiv Ramaswami, Kumar N. Sivarajan and Galan H Sasaki, Morgan Kaufman Publishers, 3rd edition, 2010.

Reference Books:

1. 'Optical fiber communication', John M. Senior, Pearson edition, 2000.
2. 'Optical fiber Communication', Gerd Keiser, John Wiley, New York, 5th Edition, 2017.
3. 'Fiber Optic Networks', P. E. Green, Prentice Hall, 1994.

Web links and Video Lectures (e-Resources):

https://onlinecourses.nptel.ac.in/noc20_ph07/preview
https://www.classcentral.com/course/swayam-optical-communications-6699

Skill Development Activities Suggested

- Mini Projects can be suggested to improve the programming skills.
- Online certification courses can be suggested in the related area.

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Comprehend the various optical devices and their working strategies	Understand
CO2	Recognize and select various optical networking components according to the prescribed design specifications	Understand
CO3	Learn the aspects of data transmission, loss hindrances, and other artifacts affecting the network operation	Understand
CO4	Learn the issues involved in setting up and maintaining access part of the optical network with the latest trends in the data communication	Understand
CO5	Design a WDM network and study the component and network management aspects	Analyze

Program Outcome of this course

Sl. No.	Description	POs
1	An ability to independently carry out research /investigation and development work to solve practical problems	PO1
2	An ability to write and present a substantial technical report/document	PO2
3	To demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor's program	PO3
4	An ability to create, select, and apply appropriate techniques, resources, and modern tools to solve complex engineering activities with an understanding of their limitations.	PO4
5	An ability to apply Professional ethics, responsibilities, and norms of engineering.	PO5
6	An ability to recognize the need to engage in independent and lifelong learning in Digital Communication and Networking domain.	PO6

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	1	-	1	-	2
CO2	1	1	-	1	-	2
CO3	2	1	1	1	-	2
CO4	2	1	1	1	-	2
CO5	2	1	2	1	-	2

Professional Elective 2

MULTIMEDIA OVER COMMUNICATION LINKS			
Course Code	**22LDC241**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	(2:0:2)	SEE Marks	50
Total Hours of Pedagogy	30 Hours Theory+10 Hours SDA	Total Marks	100
Credits	03	Exam Hours	3

Course Learning objectives: This course will enable students to:

- Gain fundamental knowledge in understanding the basics of different multimedia networks, applications, media types like text and image.
- Analyze media types like audio and video and gain knowledge on multimedia systems.
- Analyze Audio compression techniques required to compress Audio.
- Analyze compression techniques required to compress video.
- Gain fundamental knowledge about the Multimedia Communications in different Networks.

Module-1

Multimedia Communications: Introduction, Multimedia information representation, multimedia networks, multimedia applications, Application and networking terminology. (Chapter 1,Text 1)
RBT Level: L1, L2

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Module-2

Information Representation: Introduction, Text, Images, Audio and Video.
Distributed multimedia systems: Introduction, main Features of a DMS, Resource management of DMS, Networking, Multimedia operating systems. (Chap. 2- Sections 2.2, 2.3, 2.4 and 2.5 of Text 1
Chap. 4 - Sections 4.1 to 4.5 of Text 2) **RBT Level: L1, L2, L3, L4**

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Module-3

Multimedia Processing in Communication: Introduction, Perceptual coding of digital Audio signals, Transform Audio Coders, Audio Sub band Coders. (Chap. 3 - Sections 3.1, 3.2, 3.6, 3.7 of Text 2)
RBT Level: L1, L2

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Module-4

Multimedia Communication Standards: Introduction, MPEG approach to multimedia standardization, MPEG-1, MPEG-2, Overview of MPEG-4.(Chap. 5 - Sections 5.1 to 5.4 and 5.5.1 of Text 2)
RBT Level: L1, L2, L3

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Module-5

Multimedia Communication Across Networks: Packet audio/video in the network environment, Video transport across generic networks, Multimedia Transport across ATM Networks. Chap. 6 - Sections 6.1, 6.2, 6.3 of Text 2) **RBT Level: L1, L2, L3**	
Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Textbooks:

1. Fred Halsall, "Multimedia Communications", Pearson education, 2001, ISBN -9788131709948.
2. K. R. Rao, Zoran S. Bojkovic, Dragorad A. Milovanovic, "Multimedia Communication Systems", Pearson education, 2004. ISBN - 9788120321458.

Reference Books:

1. Raif steinmetz, Klara Nahrstedt, "Multimedia: Computing, Communications and Applications", Pearson education, 2002, ISBN -9788177584417.

Web links and Video Lectures (e-Resources):

https://onlinecourses.nptel.ac.in/noc20_ph07/preview
https://www.classcentral.com/course/swayam-optical-communications-6699

Skill Development Activities Suggested

1. Features of Promodel Package and Input Modeling
2. Simulation of Manufacturing System I
3. Simulation of Manufacturing System II
4. Simulation of Service Operations I
5. Simulation of Service Operations II

Suggested Simulation Packages;

- Promodel

Note: A minimum of 5 exercises to be executed covering the entire syllabus in SDA

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Understand basics of different multimedia networks and applications	Understand
CO2	Analyze media types like audio and video to represent in digital form.	Analyze
CO3	Understand different compression techniques to compress audio & video.	Understand
CO4	Describe the basics of Multimedia Communication Across Networks	Apply

Program Outcome of this course

Sl. No.	Description	POs
1	An ability to independently carry out research /investigation and development work to solve practical problems	PO1
2	An ability to write and present a substantial technical report/document	PO2
3	To demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor's program	PO3
4	An ability to create, select, and apply appropriate techniques, resources, and modern tools to solve complex engineering activities with an understanding of their limitations.	PO4
5	An ability to apply Professional ethics, responsibilities, and norms of engineering.	PO5
6	An ability to recognize the need to engage in independent and lifelong learning in Digital Communication and Networking domain.	PO6

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**2**	**2**	**2**	**-**	**-**	**-**
CO2	**2**	**2**	**2**	**-**	**-**	**2**
CO3	**2**	**2**	**1**	**-**	**1**	**2**
CO4	**2**	**2**	**1**	**-**	**1**	**2**

STATISTICAL SIGNAL PROCESSING			
Course Code	**22LDC242**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	(2:0:2)	SEE Marks	50
Total Hours of Pedagogy	30 Hours Theory+10 Hours SDA	Total Marks	100
Credits	03	Exam Hours	3

Course Learning objectives: Thiscoursewillenablestudentsto

- Understandrandomprocessesanditsproperties
- Understandthebasictheoryofsignaldetectionandestimation
- Identifytheengineeringproblemsthatcanbeputintotheframeofstatisticalsignal processing
- Solvetheidentifiedproblemsusingthestandardtechniqueslearnedthroughthiscourse.
- Makecontributionstothetheoryandthepracticeofstatisticalsignalprocessing.

Module-1

RandomProcesses: Randomvariables,randomprocesses,white noise, filtering random processes, spectral factorization,ARMA,ARandMAprocesses (Text1).**RBT Level: L1, L2, L3, L4**

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Module-2

Signal Modeling: Least squares method, Pade approximation,Prony'smethod,finitedatarecords,stochasticmodels,Levinson-Durbinrecursion;Schurrecursion;Levinson recursion (Text1).**RBT Level: L1, L2, L3**

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Module-3

SpectrumEstimation: Nonparametricmethods,minimum-variancespectrumestimation,maximumentropymethod,parametricmethods,frequencyestimation,principalcomponentsspectrumestimation (Text1).**RBT Level: L1, L2**

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Module-4

Optimal and Adaptive Filtering: FIR and IIR Wiener filters, Discrete Kalman filter, FIR Adaptive filters: Steepest descent, LMS, LMS-based algorithms, adaptive recursive filters, RLS algorithms (Text 1).**RBT Level: L1, L2**

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Module-5

ArrayProcessing: Arrayfundamentals,beam-forming,optimumarrayprocessing,performanceconsiderations,adaptivebeam-forming,linearlyconstrainedminimum-variancebeam-formers,side-lobecancellers.(Text2).**RBT Level: L1, L2**

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks**or**oneSkill Development Activity of 40 marks**to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Text Books

1. MonsonH.Hayes,"StatisticalDigitalSignalProcessingandModeling",JohnWiley&Sons(Asia)Pvt.Ltd.,2002.
2. DimitrisG.Manolakis,VinayK.Ingle,andStephenM.Kogon,"StatisticalandAdaptiveSignal Processing:SpectralEstimation,Signal Modeling, Adaptive Filtering and Array Processing" ,McGraw-HillInternationalEdition,2000.

Web links and Video Lectures (e-Resources):

Skill Development Activities Suggested

- Mathematical modeling of signals: linear vs. nonlinear, deterministic signals, random signals, unknown parameters.
- Mathematical modeling of noise: white Gaussian noise, coloured Gaussian noise, general Gaussian noise, IID non-Gaussian noise.
- Specific algorithms for estimation, detection, and spectral estimation: parameter estimation, signal extraction, adaptive filtering, sinusoidal estimation, matched filters, estimator-correlator, spectral estimation via Fourier and high-resolution methods.

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	DesignstatisticalDSPalgorithmstomeetdesiredneeds	Analyze
CO2	Applyvectorspacemethodstostatisticalsignalprocessingproblems	Apply
CO3	Identifytheengineeringproblemsthatcanbeputintotheframeofstatistic alsignal processing	Understand
CO4	UnderstandWienerfiltertheoryanddesigndiscreteandcontinuousWiene rfilters	Understand
CO5	UnderstandKalmanFiltertheoryanddesigndiscreteKalmanfilters	Understand

Program Outcome of this course

Sl. No.	Description	POs
1	An ability to independently carry out research /investigation and development work to solve practical problems	PO1
2	An ability to write and present a substantial technical report/document	PO2
3	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program	PO3
4	An ability to create, select, apply appropriate techniques, resources and modern tools to solve complex engineering activities with an understanding of their limitations.	PO4
5	An ability to apply Professional ethics, responsibilities and norms of the engineering.	PO5
6	An ability to recognize the need to engage in independent and life-long learning in Digital Communication and Networking domain.	PO6

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**3**	**2**	**2**	**3**	**-**	**3**
CO2	**2**	**3**	**3**	**-**	**3**	**3**
CO3	**2**	**2**	**-**	**3**	**3**	**2**
CO4	**3**	**2**	**3**	**-**	**-**	**3**
CO5	**3**	**3**	**3**	**3**	**-**	**3**

HIGH SPEED COMMUNICATION NETWORKS			
Course Code	**22LDC243**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	(2:0:2)	SEE Marks	50
Total Hours of Pedagogy	30 Hours Theory+10 Hours SDA	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives: Thiscoursewillenablestudentsto:

- Develop an in-depth understanding, in terms of architecture, protocols and applications of major high-speed networking technologies.
- Compare and contrast high speed access and admission control, shaping and scheduling algorithms.
- Discuss queuing and congestion control for high speed architectures.

Module-1

HIGH SPEED NETWORK ARCHITECTURE: Frame Relay Networks – Asynchronous transfer mode – ATM Protocol Architecture, ATM logical Connection, ATM Cell – ATM Service Categories – AAL, High Speed LANs: Emergence of High-Speed LANs, Gigabit Ethernet, WDM systems, Optical LANs, SONET.
RBT Level: L1, L2

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Module-2

ADMISSION AND ACCESS CONTROL:CAC for ATM VBR Services - Worst-Case Traffic Model and CAC, Effective Bandwidth, Lucent's CAC, NEC's CAC, Tagged-Probability-Based CAC, CAC for Integrated Services Internet - Guaranteed Quality of Service, Controlled-Load Service, ATM Traffic Contract and Control Algorithms - Traffic Contract, PCR Conformance, SCR, and BT, Cell Delay Variation Tolerance, Generic Cell Rate Algorithm.**RBT Level: L1, L2, L3**

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Module-3

SHAPING AND SCHEDULING: An ATM Shaping Multiplexer - Regularity Condition-Dual Leaky Bucket, Algorithm, Implementation Architecture, Finite Bits Overflow Problem, An Integrated Packet Shaper - Basics, Integrating Traffic Shaping and WFI Scheduling, Logical Structure and implementation of the WFI Packet Shaper Packet Scheduling – FIFO, RR, Stop-and-Go, HRR, EDD, Rate-Controlled Static Priority, GPS-WFQ, Virtual Clock, Self-Clocked Fair Queuing, Worst-case Fair Weighted Fair Queuing, Scheduling Algorithm - Shaped Virtual Clock Algorithm, Core-Stateless Shaped Virtual Clock Algorithm.
RBT Level: L1, L2, L3, L4

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Module-4

QUEUING & BUFFER MANAGEMENT: Conceptual Framework and Design Issues, Sequencer - Store Cells in Logical Queues, Sort Priorities Using a Sequencer, Priority Content-Addressable Memory - Searching by the PCAM Chip, Connecting Multiple PCAM Chips, RAM-Based Searching Engine - Hierarchical Searching, Timestamp Overflow, Design of the RSE, RSE Operations, Write-in Operation, Reset Operation, Search Operation, General Shaper - Scheduler - Slotted Updates of System Virtual Time, Implementation Architecture, Timestamp Aging Problem Buffer Management: A Look at ATM Networks - Self-Calibrating Pushout, TCP/IP over ATM_UBR, Dynamic Threshold with Single Loss Priority, A Look at the Internet - Tail Drop, Drop on Full, Random Early Detection, Differential Dropping: RIO, FRED, SRED, LQD.

RBT Level: L1, L2	
Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Module-5

FLOW AND CONGESTION CONTROL : Window-Based Flow Control, Rate-Based Flow Control, Predictive Control Mechanism, ATM Networks - Backlog Balancing Flow Control - ABR Flow Control, TCP/IP Networks - TCP Congestion Control - Other TCP Variants - TCP with Explicit Congestion Notification, Rate-Based Flow Control Scheme.**RBT Level: L1, L2**

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1.Three Unit Tests each of **20 Marks**

2.Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books

1.H. Jonathan Chao and XiaoleiGuo, "Quality of Service Control in High-Speed Networks", John Wiley & Sons, Inc., First Edition, 2002.

2. William Stallings, "High Speed Networks and Internet", Pearson Education, Second Edition, 2002.

3. Jean Walrand and PravinVariaya, "High Performance Communication Networks", Morgan kaufmann Publishers, Second Edition, 2000.

4. Leon Garcia and Widjaja, "Communication Network", Tata McGraw Hill, New Delhi, Second Edition, 2003.

Web links and Video Lectures (e-Resources):

Massive Open Online Courses:

1.https://www.classcentral.com/course/swayam-communication-networks-58423 - Communication Networks By G**outamDas,IIT Kharagpur .**

2.Lecture Series on Data Communication by Prof.A. Pal, Department of Computer Science Engineering,IIT Kharagpur. For more details on NPTEL visit http://nptel.iitm.ac.in

Skill Development Activities Suggested

- Mini projects carried out in groups based on latest trends in Industry and continue work to prepare a research Article.
- Industrial Visit or Seminar on any new topic.

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Differentiate architectures of Frame Relay, ATM, Gigabit Ethernet and SONET	Understand
CO2	Apply techniques involved to support real-time traffic and congestion control	Apply
CO3	Evaluate different techniques employed to support high speed architectures	Analyze
CO4	Select the right framework required to solve the issues involved in high speed networks.	Understand
CO5	Compare the different mechanisms available for provision of QoS in high speed architectures.	Understand

Program Outcome of this course

Sl. No.	Description	POs
1	An ability to independently carry out research /investigation and development work to solve practical problems	PO1
2	An ability to write and present a substantial technical report/document	PO2
3	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program	PO3
4	An ability to create, select, apply appropriate techniques, resources and modern tools to solve complex engineering activities with an understanding of their limitations.	PO4
5	An ability to apply Professional ethics, responsibilities and norms of the engineering.	PO5
6	An ability to recognize the need to engage in independent and life-long learning in Digital Communication and Networking domain.	PO6

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**1**	**-**	**1**	**2**	**1**	**2**
CO2	**1**	**1**	**1**	**2**	**1**	**2**
CO3	**1**	**1**	**1**	**2**	**1**	**2**
CO4	**1**	**-**	**1**	**2**	**1**	**2**
CO5	**1**	**-**	**1**	**2**	**1**	**2**

APPLIED CYBER SECURITY			
Course Code	**22LDC244**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	(2:0:2)	SEE Marks	50
Total Hours of Pedagogy	30 Hours Theory+10 Hours SDA	Total Marks	100
Credits	03	Exam Hours	3

Course Learning objectives: Thiscoursewillenablestudentsto:

- Understand the basics of cyber security.
- Understand the basics architecture of cyber security.
- Understand the basics of ethical Hacking.
- Understand the concepts of web Hacking.
- Understand the concepts of Computer Forensics and encryption Forensics.

Module-1

Introduction Cyber network security concepts: Security Architecture, antipattern: signature based malware detection versus polymorphic threads, document driven certification and accreditation, policy driven security certifications. Refactored solution: reputational, behavioral and entropy based malware detection. The problems: cyber antipatterns concept, forces in cyber antipatterns, cyber anti pattern templates, cyber security antipattern catalog (Text-1: Chapter1 & 2). **RBT Level: L1, L2**

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Module-2

Cyber network security concepts contd. : Enterprise security using Zachman framework Zachman framework for enterprise architecture, primitive models versus composite models, architectural problem solving patterns, enterprise workshop, matrix mining, mini patterns for problem solving meetings. (Text-1: Chapter 3).**RBT Level: L1, L2, L3**

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Module-3

Introduction To Hacking: Introduction to Hacking – Important Terminologies – Penetration Test – Vulnerability Assessments versus Penetration Test – Pre-Engagement – Rules of Engagement -Penetration Testing Methodologies – OSSTMM – NIST – OWASP – Categories of Penetration Test – Types of Penetration Tests – Vulnerability Assessment Summary -Reports(Text-2: Chapter 1).**RBT Level: L1, L2**

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Module-4

Web Hacking – Attacking the Authentication – Brute Force and Dictionary Attacks – Types of Authentication – Log-In Protection Mechanisms – Captcha Validation Flaw – Captcha RESET Flaw – Manipulating User-Agents to Bypass Captcha and Other Protection (Text-2: Chapter 12).**RBT Level: L1, L2, L3**

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Module-5

Introduction to Computer Forensics-what is Forensics? The Growing Problem of Computer Crime What Exactly Is Computer Forensics?

Encryption & Forensics Cryptographic Integrity Services , Cryptographic Privacy Services , Time Stamping

(Text 3 Chapter 1 and Chapter 4)**RBT Level: L1, L2, L3**	
Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks**or**oneSkill Development Activity of 40 marks**to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books

1. Thomas J. Mowbray, ―Cyber Security – Managing Systems, Conducting Testing, and Investigating Intrusions‖, Wiley.
2. Rafay Baloch, "Ethical Hacking and Penetration Testing Guide", CRC Press, 2014.
3. Warren G. Kruse II and Jay G. Heiser, "Computer Forensics: Incident Response Essentials", Addison Wesley, 2002.

Web links and Video Lectures (e-Resources):

- https://onlinecourses.nptel.ac.in/noc22_cs13.
- https://onlinecourses.swayam2.ac.in/cec20_cs15

Skill Development Activities Suggested

- Mini projects carried out in groups based on latest trends in Industry and continue work to prepare a research Article.
- Industrial Visit or Seminar on any new topic.

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Understand the basics of cyber security.	Understand
CO2	Understand the basics architecture of cyber security	Apply
CO3	Understand the basics of ethical Hacking	Understand
CO4	Understand the concepts of web Hacking	Apply
CO5	Understand the concepts of Computer Forensics and encryption Forensics.	Apply

Program Outcome of this course

Sl. No.	Description	POs
1	An ability to independently carry out research /investigation and development work to solve practical problems	PO1
2	An ability to write and present a substantial technical report/document	PO2
3	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program	PO3
4	An ability to create, select, apply appropriate techniques, resources and modern tools to solve complex engineering activities with an understanding of their limitations.	PO4
5	An ability to apply Professional ethics, responsibilities and norms of the engineering.	PO5
6	An ability to recognize the need to engage in independent and life-long learning in Digital Communication and Networking domain.	PO6

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**1**	**1**	**2**	**1**	**1**	**1**
CO2	**1**	**1**	**2**	**1**	**1**	**1**
CO3	**1**	**1**	**2**	**1**	**1**	**1**
CO4	**1**	**1**	**2**	**1**	**1**	**1**
CO5	**1**	**1**	**2**	**1**	**1**	**1**

SIMULATION, MODELLING AND ANALYSIS			
Course Code	**22LDC245**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	(2:0:2)	SEE Marks	50
Total Hours of Pedagogy	30 Hours Theory+10 Hours SDA	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives: Thiscoursewillenablestudentsto:

- Define the basics of simulation modelling and replicating the practical situations in organizations
- Generate random numbers and random variates using different techniques.
- Develop simulation model using heuristic methods.
- Analysis of Simulation models using input analyzer, and output analyzer.
- Explain Verification and Validation of simulation model.

Module-1

Basic Simulation Modeling:
Nature of simulation, Systems, Models and Simulation, Discrete- Event Simulation, Simulation of Single Server Queuing System, Simulation of inventory system, Parallel and distributed simulation and the high level architecture, Steps in sound simulation study, andOther types of simulation, Advantages and disadvantages.(1.1, 1.2, 1.3, 1.4, 1.4.1, 1.4.2, 1.4.3, 1.5, 1.5.1,1.5.2, 1.6, 1.7, 1.8, 1.9)
RBT Level: L1, L2

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Module-2

Review of Basic Probability and Statistics: Random Variables and their properties, SimulationOutput Data and Stochastic Processes, Estimationof Means, Variances and Correlations, ConfidenceIntervals and Hypothesis tests for the Mean**.**
Building valid, credible and appropriately detailed simulation models: Introduction and definitions, Guidelines for determining the level of models detail, Management's Role in the Simulation Process, Techniques for increasing model validity and credibility, Statistical procedure for comparing the real world observations and simulation output data.(4.2, 4.3, 4.4, 4.5, 5.1, 5.2, 5.4, 5.5, 5.6, 5.6.1, 5.6.2)
RBT Level: L1, L2, L3, L4

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Module-3

Selecting Input Probability Distributions: Useful probability distributions, activity I, II andIII. Shifted and truncated distributions; Specifyingmultivariate distribution, correlations, andstochastic processes; Selecting the distribution in the absence of data, Models of arrival process**.** (6.2, 6.4, 6.5, 6.6, 6.8, 6.10, 6.11, 6.12)
RBT Level: L1, L2, L3, L4

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Module-4

Random Number Generators:
Linear congruential Generators, Other kinds, Testing number generators,
Generating the Random Variates:
General approaches, Generating continuous random variates, Generating discrete random variates, Generating random vectors, and correlated random variates; Generating arrival processes. (7.2, 7.3, 7.4, 8.2, 8.3, 8.4, 8.5, 8.6) **RBT Level: L1, L2, L3**

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Module-5

Output data analysis for a single system:
Transient and steady state behavior of a stochastic process; Types of simulations with regard to analysis; Statistical analysis for terminating simulation; Statistical analysis for steady state parameters; Statistical analysis for steady state cycle parameters; Multiple measures of performance, Time plots of important variables. **RBT Level: L1, L2, L3**

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, You tube videos, Brain storming, Activity based method, Seminar

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1.Three Unit Tests each of **20 Marks**

2.Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

TextBooks

1. Averill Law, "Simulation modeling and analysis", McGraw Hill 4th edition, 2007.

Reference Books:

1. Tayfur Altiok and Benjamin Melamed, "Simulation modeling and analysis with ARENA", Elsevier, Academic press, 2007.
2. Jerry Banks, "Discrete event system Simulation", Pearson, 2009
3. Seila Ceric and Tadikamalla, "Applied simulation modeling", Cengage, 2009.
4. George. S. Fishman, "Discrete event simulation", Springer, 2001.
5. Frank L. Severance, "System modeling and simulation", Wiley, 2009..

Web links and Video Lectures (e-Resources):

Skill Development Activities Suggested

1. Features of Promodel Package and Input Modeling
2. Simulation of Manufacturing System I
3. Simulation of Manufacturing System II
4. Simulation of Service Operations I
5. Simulation of Service Operations II

Suggested Simulation Packages;

- Promodel

Note: A minimum of 5 exercises to be executed covering the entire syllabus in SDA

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Describe the role of important elements of discrete event simulation and modeling paradigm	Understand
CO2	Conceptualize real world situations related to systems development decisions, originating from source requirements and goals.	Analyze
CO3	Develop skills to apply simulation software to construct and execute goal-driven system models.	Analyze
CO4	Interpret the model and apply the results to resolve critical issues in a real world environment.	Apply

Program Outcome of this course

Sl. No.	Description	POs
1	An ability to independently carry out research /investigation and development work to solve practical problems	PO1
2	An ability to write and present a substantial technical report/document	PO2
3	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program	PO3
4	An ability to create, select, apply appropriate techniques, resources and modern tools to solve complex engineering activities with an understanding of their limitations.	PO4
5	An ability to apply Professional ethics, responsibilities and norms of the engineering.	PO5
6	An ability to recognize the need to engage in independent and life-long learning in Digital Communication and Networking domain.	PO6

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**2**	**2**	**2**	**2**	**-**	**-**
CO2	**2**	**2**	**2**	**2**	**-**	**2**
CO3	**2**	**1**	**1**	**-**	**-**	**2**
CO4	**2**	**1**	**1**	**2**	**-**	**2**

MINI PROJECT WITH SEMINAR			
Course Code	**22LDC25**	CIE Marks	100
Teaching Hours/Week (L:P:SDA)	(0:4:2)	SEE Marks	-
Total Hours of Pedagogy	30 hours Practical+10 Hours SDA	Total Marks	100
Credits	03	Exam Hours	-

Course Learning objectives: Thiscoursewillenablestudentsto:

- To support independent learning and innovative attitude.
- To guide to select and utilize adequate information from varied resources upholding ethics.
- To guide to organize the work in the appropriate manner and present information (acknowledging the sources) clearly.
- To develop interactive, communication, organisation, time management, and presentation skills.
- To impart flexibility and adaptability.
- To inspire independent and team working.
- To expand intellectual capacity, credibility, judgement, intuition.
- To adhere to punctuality, setting and meeting deadlines.
- To instil responsibilities to oneself and others.
- To train students to present the topic of project work in a seminar without any fear, face audience confidently, enhance communication skill, involve in group discussion to present and exchange ideas.

Mini Project With Seminar: This may be hands-on practice, survey report, data collection and analysis, coding, mobile app development, field visit and report preparation, modelling of system, simulation, analysing and authenticating, case studies, etc.Each student of the project batch shall involve in carrying out the project work jointly in constant consultation with internal guide, co-guide, and external guide and prepare the project report as per the norms avoiding plagiarism.

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

1. Present the mini-project and be able to defend it.
2. Make links across different areas of knowledge and to generate, develop and evaluate ideas and information so as to apply these skills to the project task.
3. Habituated to critical thinking and use problem solving skills.
4. Communicate effectively and to present ideas clearly and coherently in both the written and oral forms.
5. Work in a team to achieve common goal.
6. Learn on their own, reflect on their learning and take appropriate actions to improve it.

Continuous Internal Evaluation

CIE marks shall be awarded by a committee comprising of HoD as Chairman, Guide/co-guide, if any, and a senior faculty of the department. Students can present the seminar based on the completed mini-project. Participation in the seminar by all postgraduate students of the program shall be mandatory.

The CIE marks awarded for Mini-Project work and Seminar shall be based on the evaluation of Mini Project work and Report, Presentation skill and performance in Question and Answer session in the ratio **50:25:25**. Mini-Project with Seminar shall be considered as a head of passing and shall be considered for vertical progression as well as for the award of degree. Those, who do not take-up/complete the Mini Project and Seminar shall be declared as fail in that course and have to complete the same during the subsequent semester. There is no SEE for this course.**RBT Level: L3, L4, L5, L6**

ADVANCED COMMUNICATION LABORATORY			
Course Code	**22LDCL26**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(1:2:0)	SEE Marks	50
Credits	02	Exam Hours	03

Course objectives: Thiscoursewillenablestudentsto:

- Understand and plot the radiation pattern of specified antennas using MATLAB and wave guide setup.
- Determine characteristics of a given antenna.
- Compute the S-parameters of Magic tee and directional couplers.
- Test the IC CD4051 for modulation techniques.
- 5. Understand the multiplexing techniques using OFC kit.

Sl.No	Experiments
1	MATLAB/C implementation to obtain the radiation pattern of an antenna.
2	Study of radiation pattern of different antennas.
3	Determine the directivity and gains of Horn/ Yagi/ dipole/ Parabolic antennas.
4	Impedance measurements of Horn/Yagi/dipole/Parabolic antennas.
5	Study of radiation pattern of E& H plane horns.
6	Significance of Pocklington's integral equation.
7	Study of digital modulation techniques using CD4051 IC.
8	Conduct an experiment for Voice and data multiplexing using Optical fiber.
	Demonstration Experiments (For CIE) if any
9	Determination of the modes transit time, electronic timing range and sensitivity of Klystron source.
10	Determination of VI characteristics of GUNN diode, and measurement of guide wave length, frequency and VSWR.
11	Determination of coupling coefficient and insertion loss of directional couplers and Magic tee.
12	Build a hardware pseudo-random signal source and determine statistics of the generated signal source.

Note: Conduct the experiments using MATLAB/Scilab/any antenna simulation tool

Course outcomes (Course Skill Set): At the end of the course the student will be able to:

1. Plot the radiation pattern of specified antennas using MATLAB and wave guide setup.
2. Determine gain and directivity of a given antenna.
3. Obtain the S-parameters of Magic tee and directional couplers.
4. Test the IC CD4051 for modulation techniques.
5. Comprehend the multiplexing techniques using OFC kit.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 40%of maximum marks in the semester-end examination(SEE). In total of CIE and SEE student has to secure 50% maximum marks of the course.

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of **scaled-down** marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University.

- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.
- General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
- Change of experiment is allowed only once and 10% Marks allotted to the procedure part to be made zero.

The duration of SEE is 03 hours

Suggested Learning Resources:

Books:

1. 1.'Digital Communications', John G. Proakis, Masoud Salehi, Pearson Education, ISBN:978-9332535893, 5th edition, 2014
2. Digital Communications: Fundamentals and Applications: Fundamentals & Applications',Bernard Sklar, Pearson Education,ISBN:9788131720929, 2nd edition, 2009
3. 'Digital Communications Systems', Simon Haykin, Wiley,ISBN:9788126542314, 1st edition, 2014