SEMESTER - II

ANTENNA THEORY AND DESIGN			
Course Code	MLDC201	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	4	Exam Hours	03

Course objectives: This course will enable students:

- 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. **RBT Level: L1, L2, L3**

MODULE-2

Arrays: Array factor for linear arrays, Uniformly excited equally spaced linear arrays, Pattern multiplication, Directivity of linear arrays, Non uniformly 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. **RBT Level: L1, L2, L3**

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.

RBT Level: L1, L2, L3, L4

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. **RBT Level: L1, L2, L3**

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.

RBT Level: L1, L2, L3

PRACTICAL COMPONENT OF IPCC: Conduct the experiments using MATLAB / 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/Yagi/dipole/Parabolic antennas.
5	Study of radiation pattern of E and H plane horns
6	Significance of Pocklington's integral equation.
7	Measurement of radiation pattern of reflector antennas
8	Design and simulation of Microstrip antenna
9	Performance analysis of Log periodic antenna
10	Performance analysis of Helix antenna

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 **25 Marks**
2. Two assignments each of **25 Marks/One Skill Development Activity of 50 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**.

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SEE for IPCC

Theory SEE will be conducted by the 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

'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	Analyse
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	-	-	-	-		-
CO2	-	-	-	-		-
CO3	-	-	-	-		-
CO4	-	-	-	-		-
CO5	-	-	-	-		-

ADVANCED COMMUNICATION SYSTEMS			
Course Code	MLDC202	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40 Hours Theory	Total Marks	100
Credits	3	Exam Hours	03

Course Objectives: This course will enable students:

- 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 throughideal and AWGN channels.
- To apply single carrier equalizers for various modulation schemes and detection methods for definedchannel 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

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

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

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

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 spread spectrum 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

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. Two Unit Tests each of **25 Marks**
2. Two assignments each of **25 Marks** or **one Skill Development Activity of 50 marks** to attain the COs and POs

The sum of two 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

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Suggested Learning Resources:

Books

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

- Mini projects carried out in groups based on latest trends in Industry and continue work to prepare aresearch 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 meetdesired rate and performance requirements.	Analyse
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 andlow power intercept environment.	Analyse

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 therequirements 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	-		-	-		-
CO2	-	-	-	-		-
CO3	-		-	-		-
CO4	-	-	-	-		-
CO5	-	-	-	-		-

CRYPTOGRAPHY AND NETWORK SECURITY			
Course Code	MLDC203	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40 Hours Theory	Total Marks	100
Credits	3	Exam Hours	03

Course Objectives: This course will enable students:

- 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

Module-2

More Number Theory: Prime Numbers, Fermat's and Euler's theorem, Testing for Primality, The ChineseRemainder 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 CurveArithmetic, Elliptic Curve Cryptography (Text 1: Chapter 8 , Chapter 9: Section 9.1, 9.3, 9.4).

RBT Level: L1, L2, L3

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

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**

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

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. Two Unit Tests each of **25 Marks**
2. Two assignments each of **25 Marks** or **one Skill Development Activity of 50 marks**

to attain the COs and POs

The sum of two 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

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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 PublicationsISBN: 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

1. Online certification courses.
2. Mini projects can be sugge*s*ted 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
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 therequirements 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	-	-	-	-	-	-
CO2	-	-	-	-	-	-
CO3	-	-	-	-	-	-
CO4	-	-	-	-	-	-
CO5	-	-	-	-	-	-

WIRELESS SENSOR NETWORKS			
Course Code	MLDC204	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40 Hours Theory	Total Marks	100
Credits	3	Exam Hours	03

Course Objectives: This course will enable students:

- 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**

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

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**

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**

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 spread spectrum 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

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. Two Unit Tests each of **25 Marks**
2. Two assignments each of **25 Marks** or **one Skill Development Activity of 50 marks**

to attain the COs and POs

The sum of two 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. 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):

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

Skill Development Activities Suggested

1. Online certification courses.
2. Mini projects can be sug*ge*sted 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	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 therequirements 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	-		-	-		-
CO2	-		-	-		-
CO3	-		-	-		-
CO4	-	-	-	-		-
CO5	-	-	-	-		-

PROFESSIONAL ELECTIVE III

MULTIMEDIA OVER COMMUNICATION LINKS			
Course Code	MLDC215A	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40 Hours Theory	Total Marks	100
Credits	3	Exam Hours	03

Course Objectives: This course will enable students:

- 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**

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**

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

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

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**

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. Two Unit Tests each of **25 Marks**
2. Two assignments each of **25 Marks** or **one Skill Development Activity of 50 marks**

to attain the COs and POs

The sum of two 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	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 therequirements 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	-	-	-			
CO2	-	-	-			-
CO3	-	-	-		-	-
CO4	-	-	-		-	-

STATISTICAL SIGNAL PROCESSING			
Course Code	MLDC215B	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40 Hours Theory	Total Marks	100
Credits	3	Exam Hours	03

Course Objectives: This course will enable students:

- Understand random processes and its properties
- Understand the basic theory of signal detection and estimation
- Identify the engineering problems that can be put into the frame of statistical signal processing
- Solve the identified problems using the standard techniques learned through this course.
- Make contributions to the theory and the practice of statistical signal processing.

Module-1

Random Processes: Random variables, random processes, white noise, filtering random processes, spectral factorization, ARMA, AR and MA processes (Text1).

RBT Level: L1, L2, L3, L4

Module-2

Signal Modeling: Least squares method, Pade approximation, Prony's method, finite data records, stochastic models, Levinson-Durbin recursion; Schur recursion; Levinson recursion (Text1). **RBT Level: L1, L2, L3**

Module-3

Spectrum Estimation: Non parametric methods, minimum-variance spectrum estimation, maximum entropy method, parametric methods, frequency estimation, principal components spectrum estimation (Text1). **RBT Level: L1, L2**

Module-4

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

Module-5

Array Processing: Array fundamentals, beam-forming, optimum array processing, performance considerations, adaptive beam-forming, linearly constrained minimum-variance beam-formers,side-lobe cancellers.(Text2). **RBT Level: L1, L2**

Assessment Details (both CIE and SEE)

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Continuous Internal Evaluation:

1. Two Unit Tests each of **25 Marks**
2. Two assignments each of **25 Marks** or **one Skill Development Activity of 50 marks**

to attain the COs and POs

The sum of two 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. Monson H. Hayes, "Statistical Digital Signal Processing and Modeling",John Wiley & Sons (Asia) Pvt. Ltd.,2002.
2. Dimitris G. Manolakis,Vinay K. Ingle, and Stephen M. Kogon, "Statistical and Adaptive Signal Processing : Spectral Estimation, Signal Modeling, Adaptive Filtering and Array Processing" ,McGraw-Hill International Edition, 2000.

Web links and Video Lectures (e-Resources):

Nptel.ac.in

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	Design statistical DSP algorithms to meet desired needs	Analyze
CO2	Apply vector space methods to statistical signal processing problems	Apply
CO3	Identify the engineering problems that can be put into the frame of statistical signal processing	Understand
CO4	Understand Wiener filter theory and design discrete and continuous Wiener filters	Understand
CO5	Understand Kalman Filter theory and design discrete Kalman filters	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 therequirements 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	-	-	-	-		-
CO2	-	-	-		-	-
CO3	-	-		-	-	-
CO4	-	-	-			-
CO5	-	-	-	-		-

PROBABILITY AND RANDOM PROCESS			
Course Code	MLDC215C	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40 Hours Theory	Total Marks	100
Credits	3	Exam Hours	03

Course Objectives: This course will enable students:

- 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 ProcessTechniques
- 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**

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, nonmonotonic transformations of continuous random variable, transformations of Discrete random variable.

RBT Level: L1, L2

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**

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**

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**

Assessment Details (both CIE and SEE)

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Continuous Internal Evaluation:

1. Two Unit Tests each of **25 Marks**
2. Two assignments each of **25 Marks** or **one Skill Development Activity of 50 marks**

to attain the COs and POs

The sum of two 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. 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

Web links and Video Lectures (e-Resources):

Nptel.ac.in

Skill Development Activities Suggested

- Online certification courses on probability and random process.
- Mini projects 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	Analyse about the correlation Functions	Analyse

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 therequirements 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	-		-	-		-
CO2	-		-	-		-
CO3	-		-	-		-
CO4	-		-	-		-

SIMULATION, MODELLING AND ANALYSIS			
Course Code	MLDC215D	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40 Hours Theory	Total Marks	100
Credits	3	Exam Hours	03

Course Objectives: This course will enable students:

- 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, and Other 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

Module-2

Review of Basic Probability and Statistics: Random Variables and their properties, Simulation Output Data and Stochastic Processes, Estimation of Means, Variances and Correlations, Confidence Intervals 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

Module-3

Selecting Input Probability Distributions: Useful probability distributions, activity I, II and III. Shifted and truncated distributions; Specifying multivariate distribution, correlations, and stochastic 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**

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**

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**

Assessment Details (both CIE and SEE)

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Continuous Internal Evaluation:

1. Two Unit Tests each of **25 Marks**
2. Two assignments each of **25 Marks** or **one Skill Development Activity of 50 marks**

to attain the COs and POs

The sum of two 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):

Nptel.ac.in

Skill Development Activities Suggested

- Online certification courses.
- Mini projects 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	Describe the role of important elements of discrete event simulation and modelingparadigm	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-drivensystem models.	Analyze
CO4	Interpret the model and apply the results to resolve critical issues in a real worldenvironment.	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 therequirements 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	-	-	-	-		
CO2	-	-	-	-		-
CO3	-	-	-			-
CO4	-	-	-	-		-

PROFESSIONAL ELECTIVE IV

HIGH SPEED COMMUNICATION NETWORKS			
Course Code	MLDC216A	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40 Hours Theory	Total Marks	100
Credits	3	Exam Hours	03

Course Objectives: This course will enable students:

- 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**

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**

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**

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**

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**

Assessment Details (both CIE and SEE)

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to attain the COs and POs

The sum of two 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. 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 kaufmannPublishers, 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):

- https://www.classcentral.com/course/swayam-communication-networks-58423
- http://nptel.iitm.ac.in
- Communication NetworksBy G**outam Das, IIT Kharagpur .**
- Lecture Series on Data Communication by Prof.A. Pal, Department of Computer Science Engineering, IIT, Kharagpur.

Skill Development Activities Suggested

1. Mini projects carried out in groups based on latest trends in Industry and continue work to prepare aresearch Article.
2. 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 therequirements 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	-		-	-	-	-
CO2	-	-	-	-	-	-
CO3	-	-	-	-	-	-
CO4	-		-	-	-	-
CO5	-		-	-	-	-

APPLIED CYBER SECURITY			
Course Code	MLDC216B	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40 Hours Theory	Total Marks	100
Credits	3	Exam Hours	03

Course Objectives: This course will enable students:

- 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**

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**

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**

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

Module-5

Introduction to Computer Forensics-what is Forensics? The Growing Problem of Computer Crime WhatExactly 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**

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. Two Unit Tests each of **25 Marks**
2. Two assignments each of **25 Marks** or **one Skill Development Activity of 50 marks**

to attain the COs and POs

The sum of two 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):

Massive Open Online Courses:

1. https://onlinecourses.nptel.ac.in/noc22_cs13.
2. 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 aresearch 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 therequirements 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	-	-	-	-	-	-
CO2	-	-	-	-	-	-
CO3	-	-	-	-	-	-
CO4	-	-	-	-	-	-
CO5	-	-	-	-	-	-

OPTICAL COMMUNICATION AND NETWORKING			
Course Code	MLDC216C	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40 Hours Theory	Total Marks	100
Credits	3	Exam Hours	03

Course Objectives: This course will enable students:

- 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**

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**

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 (5.1up 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**

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**

Module-5

Control and Management (Part-1): Network management functions, management framework, Information model, management protocols, **Layers within the optical layer.** 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**

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. Two Unit Tests each of **25 Marks**
2. Two assignments each of **25 Marks** or **one Skill Development Activity of 50 marks**

to attain the COs and POs

The sum of two 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. ''Optical Networks', Rajiv Ramaswami, Kumar N. Sivarajan and Galan H Sasaki, Morgan KaufmanPublishers, 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	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 therequirements 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	-	-		-		-
CO2	-	-		-		-
CO3	-	-	-	-		-
CO4	-	-	-	-		-
CO5	-	-	-	-		-

ERROR CONTROL CODING			
Course Code	MLDC216D	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40 Hours Theory	Total Marks	100
Credits	3	Exam Hours	03

Course Objectives: This course will enable students:

- Understand the concept of the Entropy, information rate and capacity for the Discrete memoryless channel.
- Apply modern algebra and probability theory for the coding.
- Compare Block codes such as Linear Block Codes, Cyclic codes, etc. and Convolutional codes.
- Detect and correct errors for different data communication and storage systems.
- Analyze and implement different Block code encoders and decoders, and also convolutional encoders and decoders including soft and hard Viterbi algorithm.

Module-1

Information theory: Introduction, Entropy, Source coding theorem, discrete memoryless channel, Mutual Information, Channel Capacity Channel coding theorem (Chap. 5 of Text 1).

Introduction to algebra: Groups, Fields, binary field arithmetic, Construction of Galois Fields GF (2m) and its properties, (Only statements of theorems without proof) Computation using Galois field GF (2m) arithmetic, Vector spaces and Matrices (Chap. 2 of Text 2). **RBT Level: L1, L2, L3**

Module-2

Linear block codes: Generator and parity check matrices, Encoding circuits, Syndrome and error detection, Minimum distance considerations, Error detecting and error correcting capabilities, Standard array and syndrome decoding, Single Parity Check Codes (SPC), Repetition codes, Self-dual codes, Hamming codes, Reed-Muller codes. Product codes and Interleaved codes (Chap. 3 of Text 2). **RBT Level: L1, L2, L3**

Module-3

Cyclic codes: Introduction, Generator and parity check polynomials, Encoding of cyclic codes, Syndrome computing and error detection, Decoding of cyclic codes, Error trapping Decoding, Cyclic hamming codes, Shortened cyclic codes (Chap. 4 of Text2). **RBT Level: L1, L2, L3**

Module-4

BCH codes: Binary primitive BCH codes, Decoding procedures, Implementation of Galois field arithmetic. (6.1,6.2,6.7 of Text 2) Primitive BCH codes over GF (q),

Reed -Solomon codes (7.2,7.3 of Text 2).

Majority Logic decodable codes: One -step majority logic decoding, Multiplestep majority logic (8.1,8.4 of Text 2). **RBT Level: L1, L2, L3**

Module-5

Convolution codes: Encoding of convolutional codes: Systematic and Nonsystematic Convolutional Codes, Feedforward encoder inverse, Acatastrophic encoder, **Structural properties of convolutional codes:** state diagram, state table, state transition table, tree diagram, trellis diagram. Viterbi algorithm, **Sequential decoding:** Log Likelihood Metric for Sequential Decoding (11.1,11.2, 12.1,13.1 of Text 2).

RBT Level: L1, L2, L3

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. Two Unit Tests each of **25 Marks**
2. Two assignments each of **25 Marks** or **one Skill Development Activity of 50 marks**

to attain the COs and POs

The sum of two 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. Digital Communication systems', Simon Haykin, Wiley India Private. Ltd, ISBN 978-81-265-4231-4, First edition, 2014
2. 'Error control coding', Shu Lin and Daniel J. Costello. Jr, Pearson, Prentice Hall, 2nd edition, 2004

Reference Books:

1. 'Theory and practice of error control codes', Blahut. R. E, Addison Wesley, 1984
2. 'Introduction to Error control coding', Salvatore Gravano, Oxford University Press, 2007
3. 'Digital Communications - Fundamentals and Applications', Bernard Sklar, Pearson Education (Asia) Pvt. Ltd., 2nd Edition, 2001

Web links and Video Lectures (e-Resources):

- NPTEL Course on Information Theory and Coding

Skill Development Activities Suggested

- Mini Projects can be suggested to improve the coding 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	Understand the concept of the Entropy, information rate and capacity for the Discrete memoryless channel.	Apply
CO2	Apply modern algebra and probability theory for the coding.	Apply
CO3	Compare Block codes such as Linear Block Codes, Cyclic codes, etc. and Convolutional codes.	Apply
CO4	Detect and correct errors for different data communication and storage systems.	Apply
CO5	Analyze and implement different Block code encoders and decoders, and also convolutional encoders and decoders including soft and hard Viterbi algorithm.	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 therequirements 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	-		-	-		-
CO2	-		-	-		-
CO3	-		-	-		-
CO4	-		-	-		-
CO5	-		-	-		-

Cryptography and Network Security Lab			
Course Code	MLDCL207	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:4:0:0	SEE Marks	50
Credits	2	Exam Hours	03

Course objectives:

- Identify and classify various Attacks and explain the same.
- Compare and contrast symmetric and asymmetric encryption systems and their vulnerability to various attacks.
- Comprehend and apply authentication, email security, web security services and mechanisms.
- Explain the role of third-party agents in the provision of authentication services.
- Distinguish and explain different protocol like SSL, and their applications

Sl.NO	Experiments
1	Write a C program that contains a string (char pointer) with a value \Hello World'. The program should XOR each character in this string with 0 and displays the result.
2	Write a C program that contains a string (char pointer) with a value \Hello World'. The program should AND or and XOR each character in this string with 127 and display the result
3	Write a C/Java program to perform encryption and decryption 3 using the following algorithms: a) Ceaser Cipher b) Substitution Cipher c) Hill Cipher
4	Implementation and Performance evaluation of DES algorithm in C/C++/Java algorithm logic
5	Implementation and Performance evaluation of AES algorithm in C/C++/Java algorithm logic
6	Implementation and Performance evaluation of RSA algorithm in C/C++/Java algorithm logic
7	Implement the Diffie-Hellman Key Exchange algorithm for a given problem.
8	Calculate the message digest of a text using the SHA-1 algorithm.
9	Calculate the message digest of a text using the MD5 algorithm.
	Demonstration Experiments (For CIE) if any
10	Implement the SIGNATURE SCHEME – Digital Signature Standard.
11	Using open SSL for web server - browser communication
12	Configuring S/MIME for e-mail communication

Course outcomes (Course Skill Set):

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

- Develop code for classical Encryption Techniques to solve the problems.
- Build cryptosystems by applying symmetric and public key encryption algorithms.
- Construct code for authentication algorithms.
- Develop a signature scheme using Digital signature standard.
- Set up secure mail and web communication channels

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 an 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 down to 30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 01 tests for 100 marks, test shall be conducted after the 14th week of the semester.
- In 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 test marksis scaled down to 20 marks** (40% of the maximum marks).

The Sum of **scaled-down** marks scored in the report write-up/journal and marks of test 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:

- https://online.stanford.edu/courses/xacs130-using-cryptography-correctly
- https://www.coursera.org/learn/crypto
- https://www.coursera.org/courses?query=cryptography
- https://www.coursera.org/professional-certificates/ibm-cybersecurity-analyst
- https://www.udemy.com/topic/cryptography

ABILITY/SKILL ENHANCEMENT COURSE (OFFLINE/ONLINE)

Modeling and Simulation of Antenna Using Simulation Tool			
Course Code	MLDC258A	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:2:0:0 / 1:0:0:0	SEE Marks	50
Credits	1	Exam Hours	02 / 01

Course objectives:

- Understand the basic concepts of antenna theory.
- Identify antenna types for specific applications.
- To design antennas like dipole, Yagi-Uda, Microstrip patch antenna, MIMO antenna, Helical antennas and other broad band antennas
- To describe different antenna synthesis methods.

Sl.NO	Experiments
1	Design and simulate 1 GHz dipole antenna using suitable high frequency simulation tool, for return loss and gain characteristics.
2	Create and simulate a 5 element Yagi-Uda antenna using a copper wire with given data (a) Resonance frequency of 3 GHz (b) wire diameter of 1 mm. Study return Loss (RL) and gain characteristics
3	Design, model and simulate microstrip patch antenna at 2.45 GHZ for blue-tooth applications. Study its radiation pattern in terms of E and H plane.
4	Design, model and simulate 2 element MIMO antennas for 5G applications in Frequency Range-1. Perform isolation analysis and return loss characterization.
5	Design, model and simulate 4 element array antennas for a suitable frequency and study (a) Return loss characteristics (b) gain (c) radiation pattern.
6	Design, model and simulate normal mode helical antenna (NMHA) at 1.8 GHz. Study its return loss characteristics and effect of wire radius (between $\lambda/180$ to $\lambda/120$) on Bandwidth.
7	Design and simulate horn antenna at 2 GHz with a suitable simulator. Study its return loss Characteristics. Observe E-field, H-field and surface current distribution.
8	Design and simulate a parabolic reflector antenna for a suitable frequency with efficiency at 50%. Find reflection coefficient and gain in DB by plotting radiation pattern.
9	Design, Model and Simulate a log periodic (or planar) antenna at 5 GHz. Study its radiation characteristics and gain.
10	Design and Analyze VHF/UHF Biconical Antenna. Study its reflection coefficient, bandwidth and Radiation pattern at 300MHz, 600 MHz and 1000 MHz.

Course outcomes (Course Skill Set):

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

- Analyze various antenna parameters and their significance in building the RF system.
- Identify various antenna configurations for suitable applications.
- Design antennas like Yagi-Uda, Helical antennas and other broad band antennas
- Describe different antenna synthesis methods

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 an 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 down to 30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 01 tests for 100 marks, test shall be conducted after the 14th week of the semester.
- In 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 test marksis scaled down to 20 marks** (40% of the maximum marks).

The Sum of **scaled-down** marks scored in the report write-up/journal and marks of test 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:

- https://pe.gatech.edu/courses/modeling-and-simulation-antennas
- https://www.eledia.org/eledia-unitn/news/antenna-modeling-and-simulation-made-easy-fundamentals-and-hands-on-exercises-2/
- https://www.tonex.com/training-courses/modeling-and-simulation-of-modern-antennas/
- https://innovationspace.ansys.com/product/electromagnetic-simulation-of-an-antenna-using-ansys-discovery/

MATLAB and Simulink			
Course Code	MLDC258B	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:2:0:0 / 1:0:0:0	SEE Marks	50
Credits	1	Exam Hours	02 / 01

Course objectives:

- To provide skills for modelling and simulation of communication systems & networks on MatLab platform.
- To provide skills for writing MatLab programs and use communication and signal processing toolboxes.
- To enable the students to implement and validate the algorithms studied in Communication.

Sl. No	Experiments
1	Familiarity with MatLab communication and signal processing toolbox.
2	Programs to generate uniformly distributed random variables between [0, 1] using Linear Congruential Generator.
3	Programs to generate discrete random variables based on inverse transform technique.
4	Programs to generate discrete random variables based on acceptance rejection technique.
5	Programs to validate random variable generators based on KS test.
6	Programs to validate random variable generators based on Chi square test.
7	Programs to validate independence of random variable generators based on Runs test.
8	Programs to validate independence of random variable generators based on Autocorrelation test.
9	Programs to use Monte Carlo techniques to estimate parameters of quantities used in communication system.
10	Designing the digital communication system to evaluate BER vs. SNR performance

Course outcomes (Course Skill Set):

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

- Identify and abstract the simulation model design of communication systems.
- Design and develop modular programming skills on MatLab platform.
- Trace, debug and validate simulation models.
- Able to implement the algorithms required for discrete event simulation.
- Able to implement the validation tests for discrete event simulation models.

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 an 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 down to 30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 01 tests for 100 marks, test shall be conducted after the 14th week of the semester.
- In 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 test marksis scaled down to 20 marks** (40% of the maximum marks).

The Sum of **scaled-down** marks scored in the report write-up/journal and marks of test 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:

- https://www.udemy.com/course/simulink/
- https://in.mathworks.com/learn/training.html
- https://www.nielit.gov.in/calicut/content/online-course-matlab-simulink
- https://www.coursera.org/courses?query=matlab%20simulink

Programming in JAVA			
Course Code	MLDC258C	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:2:0:0 / 1:0:0:0	SEE Marks	50
Credits	1	Exam Hours	02 / 01

Course objectives:

- To introduce Java compiler and eclipse platform.
- To make the students to learn an object oriented way of solving problems using java and write programs using multithreading concepts and handle exceptions.
- To make the students to write programs that connects to a database and be able to perform various operations.
- To make the students to create the Graphical User Interface using Applets, AWT Components & Swing Components.

Sl. No	Experiments
1	Write a Java program that works as a simple calculator. Use a grid layout to arrange buttons for the digits and for the +, -,*, % operations. Add a text field to display the result. Handle any possible exceptions like divide by zero.
2	Use eclipse or Netbean platform and acquaint with the various menus, create a test project, add a test class and run it see how you can use auto suggestions, auto fill. Try code formatter and code refactoring like renaming variables, methods and classes. Try debug step by step with a small program of about 10 to 15 lines which contains at least one if else condition and a for loop.
3	a) Develop an applet that displays a simple message. b) Develop an Applet that receives an integer in one text field & compute its factorial value & returns it in another text filed when the button "Compute" is clicked
4	Write a program that creates a user interface to perform integer divisions. The user enters two numbers in the text fields, Num1 and Num2. The division of Num1 and Num2 is displayed in the Result field when the Divide button is clicked. If Num1 or Num2 were not an integer, the program would throw a NumberFormatException. If Num2 were Zero, the program would throw an Arithmetic Exception Display the exception in a message dialog box
5	Write a java program that implements a multi-thread application that has three threads. First thread generates random integer every 1 second and if the value is even, second thread computes the square of the number and prints. If the value is odd, the third thread will print the value of cube of the number
6	Write a java program that connects to a database using JDBC and does add, deletes, modify and retrieve operations
7	Write a java program that simulates a traffic light. The program lets the user select one of three lights: red, yellow, or green with radio buttons. On selecting a button, an appropriate message with "stop" or "ready" or "go" should appear above the buttons in a selected color. Initially there is no message shown.
8	Write a java program to create an abstract class named Shape that contains two integers and an empty method named printArea(). Provide three classes named Rectangle, Triangle and Circle such that each one of the classes extends the class Shape. Each one of the classes contain only the method printArea( ) that prints the area of the given shape.
9	Write a java program that loads names and phone numbers from a text file where the data is organized as one line per record and each field in a record are separated by a tab (\t).it takes a name or phone number as input and prints the corresponding other value from the hash table(hint: use hash tables)
10	Write a java program that takes tab separated data 51-54 (one record per line) from a text file and inserts them into a database
11	Write a Java program that reads on file name from the user, then displays information about whether the file exists, whether the file is readable, whether the file is writable, the type of file and the length of the file in bytes?

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

- Able to use Java compiler and eclipse platform to write and execute java program.
- Understand and Apply Object oriented features and Java concepts.
- Able to apply the concept of multithreading and implement exception handling.
- Able to access data from a Database with java program.
- Develop applications using Console I/O and File I/O,GUI applications

Assessment Details (both CIE and SEE)

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Continuous Internal Evaluation (CIE):

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- **The test marksis scaled down to 20 marks** (40% of the maximum marks).

The Sum of **scaled-down** marks scored in the report write-up/journal and marks of test 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:

- https://onlinecourses.nptel.ac.in/noc22_cs47/preview
- https://java-iitd.vlabs.ac.in/
- https://ocw.mit.edu/courses/6-092-introduction-to-programming-in-java-january-iap-2010/
- https://www.coursera.org/learn/java-introduction

Python Programming			
Course Code	MLDC258D	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:2:0:0 / 1:0:0:0	SEE Marks	50
Credits	1	Exam Hours	02 / 01

Course objectives:

- Enable students to write and execute Python programs that solve real-world problems, focusing on mathematical operations, file manipulation, matrix computations, and building graphical user interfaces (GUIs).
- Provide hands-on experience in working with data structures such as arrays and dataframes using libraries like NumPy and Pandas, with an emphasis on data manipulation, grouping, and visualization techniques.
- Equip students with the skills to connect Python applications to MySQL databases, perform essential operations such as creating tables, inserting, updating, and deleting records, and manage data efficiently.
- Facilitate the understanding and application of object-oriented programming concepts, including inheritance and abstraction.

Sl. No	Experiments
1	Write a Python program that calculates the sum of the first n terms of the following mathematical series: $1 - x^2 / 2! + x^4 / 4! - x^6 / 6! + \ldots\ldots x^n / n!$
2	Write a Python program that reads a file and calculates the number of characters, words, and lines in it.
3	Write a Python program to compute various matrix and vector operations such as dot product, inner product, outer product, and matrix exponentiation.
4	a) Write a Python program that uses Pandas' built-in visualization tools to create the following plots: o i. Bar plots o ii. Histograms o iii. Line plots o iv. Scatter plots b) Write a program to demonstrate the use of the groupby() method in Pandas. c) Write a program that shows how to merge, join, and concatenate dataframes in Pandas. d) Write a Python program to create dataframes from CSV and Excel files.
5	Write a python program to check the validity of a password given by the user. The password should satisfy the following criteria: i) Contain at least 1 letter between a and z ii) Contain at least 1 number between 0 and 9 iii) Contain at least 1 letter between A and Z iv) Contain at least 1 character from $, #, @ v) Minimum length of password: 6 vi) Maximum length of password: 12
6	Write a Python program that performs basic database operations (create, insert, delete, update) using MySQL and its corresponding Python adapter.
7	Write a Python program that accepts a space-separated sequence of words as input and outputs the words in a hyphen-separated sequence after sorting them alphabetically.
8	Write a Python program that demonstrates data indexing, selection, and filtering using Pandas.
9	a) Write a Python GUI application that simulates traffic lights with appropriate colors and text for "Stop", "Wait", and "Go" signals. b) Write a python program for simple GUI calculator using Tk
10	Create a Python class named Person with attributes for name, age, weight (in kg), and height (in feet). The class should have a method get_bmi_result() that calculates the BMI and returns whether the person is "underweight", "healthy", or "obese".
11	Write a Python program to demonstrate various types of inheritance

12	Write a Python program that creates abstract classes and implements abstract methods.

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

1. Students will be able to design and implement Python programs that solve complex problems, including mathematical series, file handling, matrix operations, and more.
2. Students will be capable of effectively managing and analyzing datasets using Python libraries like Pandas and NumPy, and visualizing the data through bar plots, histograms, line plots, and scatter plots.
3. Students will demonstrate the ability to connect Python programs to MySQL databases, perform CRUD (Create, Read, Update, Delete) operations, and manage database interactions proficiently.
4. Students will be able to apply object-oriented programming concepts like inheritance and abstraction, and develop interactive GUI applications using Tkinter, enhancing the user experience in software solutions.

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 an 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 down to 30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 01 tests for 100 marks, test shall be conducted after the 14th week of the semester.
- In 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 test marksis scaled down to 20 marks** (40% of the maximum marks).

The Sum of **scaled-down** marks scored in the report write-up/journal and marks of test 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.

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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:

- R. Nageswara Rao , "Core Python Programming" Dreamtech Press India Pvt Ltd 2018.
- https://onlinecourses.nptel.ac.in/noc19_cs40/preview
- https://onlinecourses.nptel.ac.in/noc19_cs41/preview

M.TECH IN DIGITAL COMMUNICATION ENGINEERING
(LDC)
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
(Effective from the academic year 2024-25)

SEMESTER – III (A)

PROFESSIONAL ELECTIVE V & VI			
Course Code	**MLDC311 & MLDC312**	CIE Marks	100
Teaching Hours/Week (L:P:SDA)	(3:0:0)	SEE Marks	---
Total Hours of Pedagogy	12 WEEKS	Total Marks	100
Credits	3	Exam Hours	---

Course Learning objectives: This course will enable students to:

- Develop a foundational understanding of key concepts, theories, and principles relevant to the course subject.
- Enhance analytical skills by evaluating information, identifying biases, and making informed decisions based on evidence.
- Apply learned theories and concepts to real-world scenarios through projects, case studies, or simulations.
- Cultivate the ability to locate, evaluate, and utilize credible sources for academic writing and projects.
- Improve written and verbal communication skills through discussions, presentations, and collaborative projects.
- Gain proficiency in utilizing various digital tools and platforms relevant to the course content.
- Foster the ability to work effectively in virtual teams, respecting diverse perspectives and contributions.
- Encourage independent study habits and self-motivation to pursue additional resources beyond the course material.
- Understand and apply ethical principles related to the field of study, including issues of integrity and responsibility.
- Develop skills in giving and receiving constructive feedback, and engage in self-reflection to enhance personal and academic growth.

- **MLDC311 & MLDC312:** MOOC courses of 12 weeks duration are the courses suggested by the Board of Studies of the University and will be displayed on www.online.vtu.ac.in. The online courses selected should not be the same as those studied in the first and second semesters of the program. The student will not be eligible to get their degree if they unintentionally select online courses that match previously finished courses. These courses are not considered for the vertical progression; however, qualifying for these courses and earning the credits is a must for the award of the degree. It is permitted to complete these online MOOC courses either in 3rd semester or in 4th semester.

RBT Level: L1, L2, L3

Research Internship /Industry-Internship leading to project work/ Startup			
Course Code	**24INT303**	CIE Marks	100
Teaching Hours/Week (L:P:SDA)	Two-semester duration, SEE in the IV semester which leads to project work /start-up.	SEE Marks	---
Total Hours of Pedagogy		Total Marks	100
Credits	06	Exam Hours	3

Course Learning objectives: This course will enable students to:

- Internship provide students the opportunity of hands-on experience that include personal training, time and stress management, interactive skills, presentations, budgeting, marketing, liability and risk management, paperwork, equipment ordering, maintenance, responding to emergencies etc. The objectives are further,
- To put theory into practice.
- To expand thinking and broaden the knowledge and skills acquired through course work in the field.
- To relate to, interact with, and learn from current professionals in the field.
- To gain a greater understanding of the duties and responsibilities of a professional.
- To understand and adhere to professional standards in the field.
- To gain insight to professional communication including meetings, memos, reading, writing, public speaking, research, client interaction, input of ideas, and confidentiality.
- To identify personal strengths and weaknesses.
- To develop the initiative and motivation to be a self-starter and work independently

Taking up a two-semester Industry/Research Internship that leads to project work or a start-up can be a highly rewarding experience for students. It allows them to apply theoretical knowledge in practical settings, gain valuable industry or research experience, and potentially develop innovative solutions or business ideas. Here are some key steps and considerations for students pursuing such an internship:

Industry Internship: The main objective of the industry internship is to ensure that the intern is exposed to a real-world environment and gain practical experience. Often, it may be a practical exposure to the theory that has been learned during the academic period. The industry internship helps students understand of analytical concepts and tools, hone their skills in real-life situations, and build confidence in applying the skills learned.

Research Internship: A research internship is an opportunity for students or early career professionals to gain hands-on experience in conducting research under the guidance of a mentor or within a research team. These internships can take place in academic institutions, research organizations, government agencies, or private companies

Research /Industry Internship: In the third-semester Students have to be in touch with a guide/mentor/coordinator and regularly submit the report referred to the progress internship. Based on the progress report the Guide/Mentor/coordinator has to enter the CIE marks at the end of the 3rd semester. At the beginning of the 4th semester, students have to define the project topic out of the learning due to the Internship, upon completion of the project work he/she has to attend the SEE

at the parent Institute.

Internship Leading to Start-up: An internship that leads to a startup is an exciting pathway, blending real-world experience with entrepreneurial ambition. Here's a comprehensive guide to transitioning an internship experience into launching your startup: 1) Maximize your internship experience, 2) Identifying Viable Business Ideas, 3) Research and Validation 4) Building a Business Plan 5) Networking and Mentorship 6) Securing Funding 7) Establishing Startup 8) Launching and Marketing. By following these steps, you can effectively transition from an internship to launching a successful startup. This journey requires dedication, resilience, and a willingness to learn and adapt.

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

- Gain practical experience within industry in which the internship is done.
- Acquire knowledge of the industry in which the internship is done.
- Apply knowledge and skills learned to classroom work.
- Develop a greater understanding about career options while more clearly defining personal career goals.
- Experience the activities and functions of professionals.
- Develop and refine oral and written communication skills.
- Identify areas for future knowledge and skill development.
- Expand intellectual capacity, credibility, judgment, intuition.
- Acquire the knowledge of administration, marketing, finance and economics

RBT Level: L3, L4, L5, L6

PROJECT WORK PHASE - I			
Course Code	**24PROJ304**	CIE Marks	100
Teaching Hours/Week (L:P:SDA)	(0:6:0)	SEE Marks	-
Total Hours of Pedagogy	40 hours Practical	Total Marks	100
Credits	03	Exam Hours	-

Course Learning objectives: This course will enable students to:

- To encourage independent learning and the innovative attitude of the students.
- To develop an interactive attitude, communication skills, organization, time management, and presentation skills.
- To impart flexibility and adaptability.
- To inspire team work.
- To expand intellectual capacity, credibility, judgment, and intuition.
- To adhere to punctuality, setting and meeting deadlines.
- To instill responsibilities to oneself and others.
- To train students to present the topic of project work in a seminar without any fear, face the audience confidently, enhance communication skills, involved in group discussions to present and exchange ideas.

Project Work Phase-1: The project work shall be carried out individually. However, in case a disciplinary or interdisciplinary project requires more participants, then a group consisting of not more than three shall be permitted. Students in consultation with the guide/co-guide (if any) in disciplinary project or guides/co-guides (if any) of all departments in case of multidisciplinary projects, shall pursue a literature survey and complete the preliminary requirements of the selected Project work. Each student shall prepare a relevant introductory project document, and present a seminar.

Project Phase-I, typically the initial phase in any project, is crucial as it lays the foundation for the entire project. This phase involves defining the project's scope, objectives, and initial planning. Here's a structured approach to effectively carry out Project Phase-I:

- **Project Charter:** Outlines the project's purpose, objectives, and stakeholders.
- **Scope Statement:** Defines the project boundaries and deliverables.
- **Requirements Document:** Captures all project requirements.
- **Project Plan:** Details the approach, timeline, and resource allocation.
- **Risk Management Plan:** Identifies and plans for potential risks.
- **Feasibility Study Report:** Assesses technical, economic, and operational feasibility.

Students in consultation with the guide shall carry out literature survey/visit industries to finalize the topic of the Project. Subsequently, the students shall collect the material required for the selected project, prepare a synopsis, and narrate the methodology to carry out the project work. Each student, under selected project orally and/or through power point slides.

- Answer the queries and be involved in debate/discussion.
- Submit two copies of the typed report with a list of references.
- The participants shall take part in discussions to foster a friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident.

Continuous Internal Evaluation (100 Marks).

CIE marks for the project report (60 marks), seminar (20 marks) and question and answer

(20marks) shall be awarded (based on the quality of report and presentation skill, participation in the question and answer session by the student) by the committee constituted for the purpose by the Principal. The committee shall consist of an internal guide and a faculty from the department with the senior most acting as the Chairperson.

RBT Level: L3, L4, L5, L6

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SEMESTER – IV (A)

Research Internship /Industry-Internship leading to project work/ Startup			
Course Code	**24INT401**	CIE Marks	100
Teaching Hours/Week (L:P:SDA)	Two-semester duration, SEE in the IV semester which leads to project work /start-up.	SEE Marks	100
Total Hours of Pedagogy		Total Marks	200
Credits	06	Exam Hours	3

Course Learning objectives: This course will enable students to:

- Internship provide students the opportunity of hands-on experience that include personal training, time and stress management, interactive skills, presentations, budgeting, marketing, liability and risk management, paperwork, equipment ordering, maintenance, responding to emergencies etc. The objectives are further,
- To put theory into practice.
- To expand thinking and broaden the knowledge and skills acquired through course work in the field.
- To relate to, interact with, and learn from current professionals in the field.
- To gain a greater understanding of the duties and responsibilities of a professional.
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Internship Leading to Start-up: An internship that leads to a startup is an exciting pathway, blending real-world experience with entrepreneurial ambition. Here's a comprehensive guide to transitioning an internship experience into launching your startup: 1) Maximize your internship experience, 2) Identifying Viable Business Ideas, 3) Research and Validation 4) Building a Business Plan 5) Networking and Mentorship 6) Securing Funding 7) Establishing Startup 8) Launching and Marketing. By following these steps, you can effectively transition from an internship to launching a successful startup. This journey requires dedication, resilience, and a willingness to learn and adapt.

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

- Gain practical experience within industry in which the internship is done.
- Acquire knowledge of the industry in which the internship is done.
- Apply knowledge and skills learned to classroom work.
- Develop a greater understanding about career options while more clearly defining personal career goals.
- Experience the activities and functions of professionals.
- Develop and refine oral and written communication skills.
- Identify areas for future knowledge and skill development.
- Expand intellectual capacity, credibility, judgment, intuition.
- Acquire the knowledge of administration, marketing, finance and economics

RBT Level: L3, L4, L5, L6

PROJECT WORK PHASE - II			
Course Code	**24PROJ402**	CIE Marks	100
Teaching Hours/Week (L:P:SDA)	(0:6:0)	SEE Marks	100
Total Hours of Pedagogy	40 hours Practical	Total Marks	200
Credits	03	Exam Hours	03

Course Learning objectives: This course will enable students to:

- To encourage independent learning and the innovative attitude of the students.
- To develop an interactive attitude, communication skills, organization, time management, and presentation skills.
- To impart flexibility and adaptability.
- To inspire team work.
- To expand intellectual capacity, credibility, judgment, and intuition.
- To adhere to punctuality, setting and meeting deadlines.
- To instill responsibilities to oneself and others.
- To train students to present the topic of project work in a seminar without any fear, face the audience confidently, enhance communication skills, involved in group discussions to present and exchange ideas.

Project Work: Students in consultation with the guide shall carry out literature survey/ visit industries to finalize the topic of the Project. Subsequently, the students shall collect the material required for the selected project, prepare a synopsis, and narrate the methodology to carry out the project work. Each student, under the guidance of a Faculty, is required to

- Present the seminar on the selected project orally and/or through Power Point slides.
- Answer the queries and be involved in debate/discussion.
- Submit two copies of the typed report with a list of references.
- The participants shall take part in discussions to foster a friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident

CIE marks for the project report (20 marks), seminar (20 marks) and question and answer (10 marks) shall be awarded (based on the quality of report and presentation skill, participation in the question and answer session by the student) by the committee constituted for the purpose by the Principal. The committee shall consist of internal guide and a faculty from the department with the senior most acting as the Chairperson.

Semester End Examination SEE marks for the project report (30 marks), seminar (10 marks) and question and answer session (10 marks) shall be awarded (based on the quality of the report and presentation skill, participation in the question and answer session) by the examiners appointed by the University.

RBT Level: L3, L4, L5, L6