Semester- II

Antenna Theory and Design

Course Code	**MLEC201**	CIE Marks	50
Lecture Hours/Week (L:P:SDA)	**3:2:0**	SEE Marks	50
Total Number of Lecture Hours	**40 hours Theory+10 Lab slots**	Total Marks	**100**
Credits	**04**	Exam Hours	**03**

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. [Chapter 2 Text 1]

RBT levels: 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. [Chapter 8 Text 1]

RBT levels: 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 levels: L2, L3

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. [Chapter 9 Text 1]

RBT levels: L2, L3

Module-5

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. [Chapter 14 Text 1]

RBT levels: L2, L3

Course outcomes:

COs	**Description**	Blooms Level
CO1	Able to Classify the different types of antennas	Understand
CO2	Able to Define and illustrate various types of array antennas	Understand
CO3	Able to Design antennas like Yagi-Uda, Helical antennas and other broad band antennas	Analyse
CO4	Able to understand the different antenna synthesis methods	Analyse
CO5	Able to Apply methods like Method of Moments, Pocklington's integral equation, Source modelling.	Understand

Question paper pattern:

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.
4. There will be two full questions (with a maximum of four sub questions) from each module.
5. Each full question will have sub question covering all the topics under a module.
6. The students will have to answer five full questions, selecting one full question from each module.

Laboratory Experiments:

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& 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.

Textbook:

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

Reference Books:

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

Web links and Video Lectures (e-Resources):

https://www.youtube.com/watch?v=GWKNKxERoyk
https://www.youtube.com/watch?v=66cOzMYWmWc

Advanced Communication Systems

Course Code	**MLEC202**	CIE Marks	50
Lecture Hours/Week (L:P:SDA)	**3:0:0**	SEE Marks	50
Total Number of Lecture Hours	**40 hours Theory**	Exam Hours	**03**
Credits - 03			

Module-1

Signal Representation: Low pass representation of bandpass signals, Low pass representation of bandpass 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 levels: L2, L3

Module-2

Demodulation: Vector Channel, Vector Channel +AWGN, Performance parameters, Optimum Coherent Detection for power limited and Bandlimited 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 levels: L2, L3

Module-3

Bandlimited Channels: Bandlimited channel characterization, signaling through band limited linear filter channels, Sinc, RC, Duobinary and Modified Duobinary signaling schemes, Optimum receiver for channel with ISI and AWGN. **Linear Equalizers**: Zero forcing Equalizer, MSE and MMSE, Baseband and Passband Linear Equalizers. Performance of ZFE and MSE (Excluding 9.4-3, 9.4-4) [Text 1, Chapter 9: 9.1, 9.2 - 9.2.1, 9.2.2, 9.2.3, 9.3-9.3.1, 9.3.2 and 9.4].

RBT levels: L2, L3

Module-4

Non-Linear Equalizers: Decision - feedback equalization, Predictive DFE, Performance of DFE [Text 1, Chapter 9: 9.5: 9.5-1 only] .

Adaptive equalization: Adaptive linear equalizer, adaptive decision feedback equalizer, Adaptive Fractionally spaced Equalizer (Tap Leakage Algorithm), Adaptive equalization of Trellis - coded signals [Text 1, Chapter 10: 10.1, 10.1- 1, 10.1-2, 10.1-3, 10.1-6,10.1-7, 10.2, 10.3].

RBT levels: L2, L3

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 levels: 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.

CIE for the theory component of IPCC

1. Three Tests to be conducted with each of 20 Marks
2. Two assignments each of 20 Marks or One Skill Development Activity of 40 marks to attain COs and POs

The sum three Tests and two assignments/one Skill Development Activity will be scaled down to 50 marks

CIE question paper is designed to attain the different levels of Bloom's taxonomy as per the COs

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.
4. There will be two full questions (with a maximum of four sub questions) from each module.
5. Each full question will have sub questions covering all the topics under a module.
6. The students will have to answer five full questions, selecting one full question from each module.

Textbook:

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

Reference Books:

1. 'Digital Communications: Fundamentals and Applications: Fundamentals & Applications', Bernard Sklar, Pearson Education, ISBN:9788131720929, 2nd edition, 2009
2. 'Digital Communications Systems', Simon Haykin, Wiley, ISBN:9788126542314, 1st edition, 2014

Web links and Video Lectures (e-Resources):

- **https://www.youtube.com/watch?v=atUKokLXt3k**
- **https://www.youtube.com/watch?v=4oQBM94-jGs**
- **https://www.youtube.com/watch?v=gP09GMjZ6q4**
- **https://www.youtube.com/watch?v=lHSzoWmyynQ**
- **https://www.youtube.com/watch?v=lHSzoWmyynQ**

Skill development activities: Under Skill development activities in a concerning course, the students should

1. Interact with industry (small, medium, and large).
2. Involve in research/testing/projects to understand their problems and help creative and innovative methods to solve the problem.
3. Involve in case studies and field visits/ fieldwork.
4. Accustom to the use of standards/codes etc., to narrow the gap between academia and industry.
5. Handle advanced instruments to enhance technical talent.
6. Gain confidence in modelling of systems and algorithms for transient and steady-state operations, thermal study, etc.
7. Work on different software/s (tools) to simulate, analyze and authenticate the output to interpret and conclude.

All activities should enhance student's abilities to employment and/or self-employment opportunities, management skills, Statistical analysis, fiscal expertise, etc. Students and the course instructor/s to involve either individually or in groups to interact together to enhance the learning and application skills of the study they have undertaken. The students with the help of the course teacher can take up relevant technical – activities which will enhance their skill. The prepared report shall be evaluated for CIE marks.

Course outcomes:

COs	**Description**	Blooms Level
CO1	Able to understand the concepts of low pass and Bandpass signals representations at the Transmitter, the process of Detection and Estimation at the receiver in the presence of AWGN	Understand
CO2	Able to analyze the Receiver performance for various types of single	Analyse

	carrier symbol modulations through ideal and AWGN Non-bandlimited and bandlimited channels.	
CO3	Able to analyze and demonstrate the model of discrete time channel with ISI & the model of discrete time channel by equalizer.	Analyse
CO4	Able to understand single carrier equalizers for various symbol modulation schemes and detection methods for defined channel models, and compute parameters to meet desired rate and performance requirements.	Analyse
CO5	Able to analyze the Non band limited and Non power limited spread spectrum systems for communications in a Jamming environment, multiuser situation and low power intercept environment.	Analyse

Error Control Coding

Course Code	**MLEC203**	CIE Marks	50
Lecture Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Number of Lecture Hours	40 hours Theory	Exam Hours	**03**
Credits – 03			

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 levels: 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 levels: 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 levels: 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 levels: L2, L3

Module-5

Convolution codes: Encoding of convolutional codes: Systematic and Nonsystematic Convolutional Codes, Feedforward encoder inverse, A catastrophic 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 levels: L2, L3

Course outcomes:

COs	**Description**	Blooms Level
CO1	Able to understand the concept of the Entropy, information rate and capacity for the Discrete memoryless channel.	Understand
CO2	Able to Apply modern algebra and probability theory for the coding.	Apply
CO3	Able to understand and Compare Block codes such as Linear Block Codes, Cyclic codes, etc. and Convolutional codes.	Understand
CO4	Able to Understand error detection and correction for different data communication and storage systems.	Understand
CO5	Able to Analyze and implement different Block code encoders and decoders, and also convolutional encoders and decoders including soft and hard Viterbi algorithm.	Analyze

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

- Three Tests to be conducted with each of 20 Marks
- Two assignments each of 20 Marks or One Skill Development Activity of 40 marks to attain Cos and POs
- The sum three Tests and two assignments/one Skill Development Activity will be scaled down to 50 marks

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

Semester End Examination:

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

.

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

Skill development activities: Under Skill development activities in a concerning course, the students should

1. Interact with industry (small, medium, and large).
2. Involve in research/testing/projects to understand their problems and help creative and innovative methods to solve the problem.
3. Involve in case studies and field visits/ fieldwork.
4. Accustom to the use of standards/codes etc., to narrow the gap between academia and industry.
5. Handle advanced instruments to enhance technical talent.
6. Gain confidence in modelling of systems and algorithms for transient and steady-state operations, thermal study, etc.
7. Work on different software/s (tools) to simulate, analyze and authenticate the output to interpret and conclude.

All activities should enhance student's abilities to employment and/or self-employment opportunities, management skills, Statistical analysis, fiscal expertise, etc. Students and the course instructor/s to involve either individually or in groups to interact together to enhance the learning and application skills of the study they have undertaken. The students with the help of the course teacher can take up relevant technical –activities which will enhance their skill. The prepared report shall be evaluated for CIE marks.

Multimedia over Communication Links

Course Code	**MLEC204**	CIE Marks	50
Lecture Hours/Week (L:P:SDA)	**3:0:0**	SEE Marks	50
Total Number of Lecture Hours	**40 hours Theory**	Total Marks	**100**
Credits	**03**	Exam Hours	**03**

Module 1

Multimedia Communications: Introduction, Multimedia information representation, multimedia networks, multimedia applications, Application and networking terminology (Chap. 1 of Text1).
Information Representation: Introduction, Text, Images (Chap. 2- Sections 2.2 and 2.3 of Text 1).

RBT levels: L2, L3

Module 2

Information Representation: Audio and Video (Chap. 2 - Sections 2.4 and 2.5 of Text 1).
Distributed multimedia systems: Introduction, main Features of a DMS, Resource management of DMS, Networking, Multimedia operating systems (Chap. 4 - Sections 4.1 to 4.5 of Text 2).

RBT levels: L2, L3

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 levels: L2, L3

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 levels: 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 levels: L2, L3

Course Outcomes:

COs	**Description**	Blooms Level
CO1	Able to understand basics of different multimedia networks and applications	Understand
CO2	Able to Analyze media types like audio and video to represent in digital form.	Analyze
CO3	Able to understand different compression techniques to compress audio.	Understand
CO4	Able to Understand different compression techniques to compress audio video.	Understand
CO5	Able to understand the basics of Multimedia Communication Across Networks	Understand

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. Three Tests to be conducted with each of 20 Marks
2. Two assignments each of 20 Marks or One Skill Development Activity of 40 marks to attain Cos and POs

The sum three Tests and two assignments/one Skill Development Activity will be scaled down to 50 marks

CIE question paper is designed to attain the different levels of Bloom's taxonomy as per the COs 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.
4. There will be two full questions (with a maximum of four sub questions) from each module.
5. Each full question will have sub questions covering all the topics under a module.
6. The students will have to answer five full questions, selecting one full question from each module.

Text Books:

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

Reference Book:

Ralf Steinmetz, Klara Nahrstedt, 'Multimedia: Computing, Communications and Applications', Pearson education, 2002, ISBN - 9788177584417.

Skill development activities: Under Skill development activities in a concerning course, the students should

1. Interact with industry (small, medium, and large).
2. Involve in research/testing/projects to understand their problems and help creative and innovative methods to solve the problem.
3. Involve in case studies and field visits/ fieldwork.
4. Accustom to the use of standards/codes etc., to narrow the gap between academia and industry.
5. Handle advanced instruments to enhance technical talent.
6. Gain confidence in modelling of systems and algorithms for transient and steady-state operations, thermal study, etc.
7. Work on different software/s (tools) to simulate, analyze and authenticate the output to interpret and conclude.

All activities should enhance student's abilities to employment and/or self-employment opportunities, management skills, Statistical analysis, fiscal expertise, etc. Students and the course instructor/s to involve either individually or in groups to interact together to enhance the learning and application skills of the study they have undertaken. The students with the help of the course teacher can take up relevant technical –activities which will enhance their skill. The prepared report shall be evaluated for CIE marks.

Professional Elective III

Wireless Sensor Networks

Course Code	**MLEC215A**	CIE Marks	50
Lecture Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Number of Lecture Hours	**40 hours**	Total Marks	**100**
Credits	**03**	Exam Hours	**03**

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 levels: L2, L3

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 levels: 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 levels: L2, L3

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 levels: L2, L3

Module-5

Time Synchronization: Challenges for Time Synchronization, Network Time Protocol, Timing-Sync Protocol for Sensor Networks (TPSN), Reference- Broadcast Synchronization (RBS), Adaptive Clock Synchronization (ACS) (Chap. 11 of Text1).
Localization; Challenges in Localization, Ranging Techniques, Range-Based Localization Protocols, Range-Free Localization Protocols. (Chap. 12 Text 1).

RBT levels: 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.

CIE for the theory component of IPCC

1. Three Tests to be conducted with each of 20 Marks
2. Two assignments each of 20 Marks or One Skill Development Activity of 40 marks to attain Cos and POs

The sum three Tests and two assignments/one Skill Development Activity will be scaled down to 50 marks

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

Semester End Examination:

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

Textbooks:

1. 'Wireless Sensor Networks', Ian F. Akyildiz and Mehmet Can Vuran, John Wiley & Sons Ltd. ISBN 978-0-470-03601-3 (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://www.youtube.com/watch?v=IR4jIFiHwgc
https://www.youtube.com/watch?v=TNXS05Efumo
https://www.youtube.com/watch?v=7h5Wwk_mheg
https://www.youtube.com/watch?v=sx0UPzztC5o
https://www.youtube.com/watch?v=SHO9eeWxPxY
https://www.youtube.com/watch?v=ZYIdYIt7W_g&t=24s

Skill development activities: Under Skill development activities in a concerning course, the students should

1. Interact with industry (small, medium, and large).
2. Involve in research/testing/projects to understand their problems and help creative and innovative methods to solve the problem.
3. Involve in case studies and field visits/ fieldwork.
4. Accustom to the use of standards/codes etc., to narrow the gap between academia and industry.
5. Handle advanced instruments to enhance technical talent.
6. Gain confidence in modelling of systems and algorithms for transient and steady-state operations, thermal study, etc.
7. Work on different software/s (tools) to simulate, analyze and authenticate the output to interpret and conclude.

All activities should enhance student's abilities to employment and/or self-employment opportunities, management skills, Statistical analysis, fiscal expertise, etc. Students and the course instructor/s to involve either individually or in groups to interact together to enhance the learning and application skills of the study they have undertaken. The students with the help of the course teacher can take up relevant technical –activities which will enhance their skill. The prepared report shall be evaluated for CIE marks.

Course outcomes:

COs	**Description**	Blooms Level
CO1	Able to understand the basic concepts of Wireless sensor networks architecture and protocols. .	Understand
CO2	Able to understand the challenges in designing a Wireless sensor networks.	Understand
CO3	Able to the function of Data link and Network layer Protocols.	Understand
CO4	Able to understand the function of Transport layer Protocols.	Analyse
CO5	Able to analyse the wireless sensor network system for different applications under consideration	Understand

Cryptography and Network Security

Course Code	**MLEC215B**	CIE Marks	50
Lecture Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Number of Lecture Hours	**40 hours**	Total Marks	**100**
Credits	**03**	Exam Hours	**03**

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 Cipher. (Text 1: Chapter 2: Section2.1, 2.2, Chapter 4).

RBT levels: L2, L3

Module-2

Introduction to modular arithmetic, Prime Numbers, Fermat's and Euler's theorem, primality testing, Chinese Remainder theorem, discrete logarithm. (Text 1: Chapter 7: Section 1, 2, 3, 4, 5). Principles of Public-Key Cryptosystems, The RSA algorithm, Diffie – Hellman Key Exchange, Elliptic Curve Arithmetic, Elliptic Curve Cryptography (Text 1:Chapter 8, Chapter 9: Section 9.1, 9.3, 9.4).

RBT levels: 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 levels: 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 levels: 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), Combining security Associations. (Text 1: Chapter 18: Section18.1 to 18.4).
Web Security: Web Security Considerations, SSL (Text 1: Chapter 15: Section 15.1, 15.2).

RBT levels: 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.

CIE for the theory component of IPCC

3. Three Tests to be conducted with each of 20 Marks
1. Two assignments each of 20 Marks or One Skill Development Activity of 40 marks to attain Cos and POs

The sum three Tests and two assignments/one Skill Development Activity will be scaled down to 50 marks

CIE question paper is designed to attain the different levels of Bloom's taxonomy as per the COs 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.
4. There will be two full questions (with a maximum of four sub questions) from each module.
5. Each full question will have sub questions covering all the topics under a module.
6. The students will have to answer five full questions, selecting one full question from each module.

Textbooks:

1. 'Cryptography and Network Security Principles and Practice', William Stallings, Pearson Education Inc., ISBN: 978-93325-1877-3, 6th Edition, 2014
2. 'Applied Cryptography Protocols, Algorithms, and Source code in C', Bruce Schneier, Wiley Publications ISBN: 9971-51348-X, 2nd Edition

Reference Books:

1. 'Cryptography and Network Security', Behrouz A. Forouzan, TMH, 2007
2. 'Cryptography and Network Security', Atul Kahate, TMH, 2003

Web links and Video Lectures (e-Resources):

https://www.youtube.com/watch?v=iTVyKbDCJrA&list=PLgMDNELGJ1CbdGLyn7OrVAP-IKg-0q2U2
https://www.youtube.com/watch?v=eIJzIUhks6E&list=PLgMDNELGJ1CbdGLyn7OrVAP-IKg-0q2U2&index=3
https://www.youtube.com/watch?v=NrRJInkFsyQ&list=PLgMDNELGJ1CbdGLyn7OrVAP-IKg-0q2U2&index=4

Skill development activities: Under Skill development activities in a concerning course, the students should

1. Interact with industry (small, medium, and large).
2. Involve in research/testing/projects to understand their problems and help creative and innovative methods to solve the problem.
3. Involve in case studies and field visits/ fieldwork.
4. Accustom to the use of standards/codes etc., to narrow the gap between academia and industry.
5. Handle advanced instruments to enhance technical talent.
6. Gain confidence in modelling of systems and algorithms for transient and steady-state operations, thermal study, etc.
7. Work on different software/s (tools) to simulate, analyze and authenticate the output to interpret and conclude.

All activities should enhance student's abilities to employment and/or self-employment opportunities, management skills, Statistical analysis, fiscal expertise, etc. Students and the course instructor/s to involve either individually or in groups to interact together to enhance the learning and application skills of the study they have undertaken. The students with the help of the course teacher can take up relevant technical –activities which will enhance their skill. The prepared report shall be evaluated for CIE marks.

Course outcomes:

COs	**Description**	Blooms Level
CO1	Able to understand the basics of symmetric key and public key cryptography.	Understand
CO2	Able to understand cryptographic algorithms to encrypt the data.	Understand
CO3	Able to understand the Generation some pseudorandom numbers required for cryptographic applications.	Understand
CO4	Able to understand for providing the authentication and protection for encrypted data.	Understand
CO5	Able to understand techniques and features of Email, IP and Web security.	Understand

Biomedical Signal Processing

Course Code	**MLEC215C**	CIE Marks	50
Lecture Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Number of Lecture Hours	**40 hours**	Total Marks	**100**
Credits	**03**	Exam Hours	**03**

Module-1

Introduction-Genesis and significance of bio electric potentials, ECG, EEG, EMG and their monitoring and measurement, Spectral analysis.

RBT levels: L2, L3

Module-2

Filtering- Digital and Analog filtering, Correlation and Estimation techniques, AR / ARMA models.

RBT levels: L2, L3

Module-3

ECG-Pre-processing, Measurements of amplitude and time intervals, Classification, QRS detection, ST segment analysis, Base line wander removal, waveform recognition, morphological studies and rhythm analysis, automated diagnosis based on decision theory ECT compression, Evoked potential estimation.

RBT levels: L2, L3

Module-4

EEG: Evoked responses, Epilepsy detection, Spike detection, Hjorth parameters, averaging techniques, removal of Artifacts by averaging and adaptive algorithms, pattern recognition of alpha, beta, theta and delta waves in EEG waves, sleep stages.

RBT levels: L2, L3

Module-5

EMG-Wave pattern studies, bio feedback, Zero crossings, Integrated EMG. Time frequency methods and Wavelets in Biomedical Signal Processing.

RBT levels: L2, L3

Skill development activities: Under Skill development activities in a concerning course, the students should

1. Interact with industry (small, medium, and large).
2. Involve in research/testing/projects to understand their problems and help creative and innovative methods to solve the problem.
3. Involve in case studies and field visits/ fieldwork.
4. Accustom to the use of standards/codes etc., to narrow the gap between academia and industry.
5. Handle advanced instruments to enhance technical talent.
6. Gain confidence in modelling of systems and algorithms for transient and steady-state operations, thermal study, etc.
7. Work on different software/s (tools) to simulate, analyze and authenticate the output to interpret and conclude.

All activities should enhance student's abilities to employment and/or self-employment opportunities, management skills, Statistical analysis, fiscal expertise, etc. Students and the course instructor/s to involve either individually or in groups to interact together to enhance the learning and application skills of the study they have undertaken. The students with the help of the course teacher can take up relevant technical –activities which will enhance their skill. The prepared report shall be evaluated for CIE marks.

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. Three Tests to be conducted with each of 20 Marks
2. Two assignments each of 20 Marks or One Skill Development Activity of 40 marks to attain Cos and POs

The sum three Tests and two assignments/one Skill Development Activity will be scaled down to 50 marks

CIE question paper is designed to attain the different levels of Bloom's taxonomy as per the COs 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.
4. There will be two full questions (with a maximum of four sub questions) from each module.
5. Each full question will have sub questions covering all the topics under a module.
6. The students will have to answer five full questions, selecting one full question from each module.

Textbook:

1. 'Biomedical Digital Signal Processing', Willis J Tompkins, Prentice Hall of India, 1996.

Reference Books:

- 'Biomedical Signal Processing (in IV parts)', R E Challis and RI Kitney, Medical and Biological Engg. and current computing, 1990-91.
- Special issue on 'Biological Signal Processing', Proc. IEEE 1972.
- 'Biomedical Signal Processing', Arnon Cohen, Volumes I & II, CRC Press.
- 'Time frequency and Wavelets in Biomedical Signal Processing', Metin Akay, IEEE Press, 1999. Current Published literature.

Web links and Video Lectures (e-Resources):

https://www.youtube.com/watch?v=OqNDFF1RsMU
https://www.youtube.com/watch?v=7Kf0kWqqFAk
https://www.youtube.com/watch?v=YTH-CXphdXw
https://www.youtube.com/watch?v=aoLktSYOfwg

Skill development activities: Under Skill development activities in a concerning course, the students should

1. Interact with industry (small, medium, and large).
2. Involve in research/testing/projects to understand their problems and help creative and innovative methods to solve the problem.
3. Involve in case studies and field visits/ fieldwork.
4. Accustom to the use of standards/codes etc., to narrow the gap between academia and industry.
5. Handle advanced instruments to enhance technical talent.
6. Gain confidence in modelling of systems and algorithms for transient and steady-state operations, thermal study, etc.
7. Work on different software/s (tools) to simulate, analyze and authenticate the output to interpret and conclude.

All activities should enhance student's abilities to employment and/or self-employment opportunities, management skills, Statistical analysis, fiscal expertise, etc. Students and the course instructor/s to involve either individually or in groups to interact together to enhance the learning and application skills of the study they have undertaken. The students with the help of the course teacher can take up relevant technical –activities which will enhance their skill. The prepared report shall be evaluated for CIE marks.

Course outcomes:

COs	**Description**	Blooms Level
CO1	Able to understand a biomedical system.	Understand
CO2	Able to understand various methods of acquiring bio signals.	Understand
CO3	Able to understand various sources of bio signal distortions and its remedial techniques.	Understand
CO4	Able to Analyze ECG and EEG signal with characteristic feature points.	Analyze
CO5	Able to understand the use of bio signals in diagnosis, patient monitoring and physiological investigation.	Understand

Advances in Image Processing

Course Code	**MLEC215D**	CIE Marks	50
Lecture Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Number of Lecture Hours	**40 hours**	Exam Hours	**03**
Credits – 03			
Module-1			
The image, its representations and properties: Image representations a few concepts, Image digitization, Digital image properties, Color images. **RBT levels: L2, L3**			
Module-2			
Image Pre-processing: Pixel brightness transformations, geometric transformations, local pre-processing. **RBT levels: L2, L3**			
Module-3			
Segmentation: Thresholding; Edge-based segmentation – Edge image thresholding, Edge relaxation, Border tracing, Hough transforms; Region – based segmentation – Region merging, Region splitting, Splitting and merging, Watershed segmentation, Region growing post-processing. **RBT levels: L2, L3**			
Module-4			
Shape representation and description: Region identification; Contour-based shape representation and description – Chain codes, Simple geometric border representation, Fourier transforms of boundaries, Boundary description using segment sequences, B-spline representation; Region-based shape representation and description – Simple scalar region descriptors, Moments, Convex hull. **RBT levels: L2, L3**			
Module-5			
Mathematical Morphology: Basic morphological concepts, Four morphological principles, Binary dilation and erosion, Skeletons and object marking, Morphological segmentations and watersheds. **RBT levels: L2, L3**			

Course outcomes:

COs	**Description**	Blooms Level
CO1	Able to understand the representation of the digital image and its properties.	Understand
CO2	Able to Apply pre-processing techniques required to enhance the image for its further analysis.	Apply
CO3	Able to understand segmentation techniques to select the region of interest in the image for analysis.	Understand
CO4	Able to Understand the representation of the image based on its shape and edge information	Understand
CO5	Able to Understand the morphological operations to simplify images, and quantify and preserve the main shape characteristics of the objects.	Analyze

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

- Three Tests to be conducted with each of 20 Marks
- Two assignments each of 20 Marks or One Skill Development Activity of 40 marks to attain Cos and POs

- The sum three Tests and two assignments/one Skill Development Activity will be scaled down to 50 marks

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

Semester End Examination:

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

Text Book:

1. 'Image Processing, Analysis, and Machine Vision', Milan Sonka, Vaclav Hlavac, Roger Boyle, Cengage Learning, ISBN: 978-81-315-1883-0, 2013

Reference Books:

1. 'Digital Image Processing for Medical Applications', Geoff Doughertry, Cambridge university Press, 2010.
2. 'Digital Image Processing', S Jayaraman, S Esakkirajan, T Veerakumar, Tata McGraw Hill, 2011.

Professional Elective IV

Statistical Signal Processing

Course Code	**MLEC216A**	CIE Marks	50
Lecture Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Number of Lecture Hours	**40 hours**	Total Marks	**100**
Credits	**03**	Exam Hours	**03**

Module-1
Random Processes: Random variables, random processes, white noise, filtering random processes, spectral factorization, ARMA, AR and MA processes (Text 1). **RBT levels: L2, L3**
Module 2
Signal Modeling: Least squares method, Padé approximation, Prony's method, finite data records, stochastic models, Levinson-Durbin recursion; Schur recursion; Levinson recursion (Text 1). **RBT levels: L2, L3**
Module 3
Spectrum Estimation: Nonparametric methods, minimum-variance spectrum estimation, maximum entropy method, parametric methods, frequency estimation, principal components spectrum estimation (Text 1). **RBT levels: L2, L3**
Module 4
Optimal and Adaptive Filtering: FIR and IIR Wiener filters, Discrete Kalman filter, FIR Adaptive filters: Steepest descent, LMS, LMS-based algorithms (Text 1). **RBT levels: L2, L3**
Module 5
Array Processing: Array fundamentals, beam-forming, optimum array processing, performance considerations, adaptive beamforming, linearly constrained minimum-variance beam-formers, side-lobe cancellers (Text 2). **RBT levels: L2, L3**

Course Outcomes:

COs	**Description**	Blooms Level
CO1	Able to Analyze statistical DSP algorithms to meet desired needs	Analyze
CO2	Able to Analyze vector space methods to statistical signal processing problems	Analyze
CO3	Able to understand Wiener filter theory and design discrete and continuous Wiener filters	Understand
CO4	Able to Understand Kalman Filter theory and design discrete Kalman filters	Understand
CO5	Able to apply computer tools (such as MATLAB) in developing and testing stochastic DSP algorithms	Analyze

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

- Three Tests to be conducted with each of 20 Marks
- Two assignments each of 20 Marks or One Skill Development Activity of 40 marks to attain Cos and POs
- The sum three Tests and two assignments/one Skill Development Activity will be scaled down to 50 marks

CIE question paper is designed to attain the different levels of Bloom's taxonomy as per the COs 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.
4. There will be two full questions (with a maximum of four sub questions) from each module.
5. Each full question will have sub questions covering all the topics under a module.
6. The students will have to answer five full questions, selecting one full question from each module.

Text Books:

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

Skill development activities: Under Skill development activities in a concerning course, the students should

1. Interact with industry (small, medium, and large).
2. Involve in research/testing/projects to understand their problems and help creative and innovative methods to solve the problem.
3. Involve in case studies and field visits/ fieldwork.
4. Accustom to the use of standards/codes etc., to narrow the gap between academia and industry.
5. Handle advanced instruments to enhance technical talent.
6. Gain confidence in modelling of systems and algorithms for transient and steady-state operations, thermal study, etc.
7. Work on different software/s (tools) to simulate, analyze and authenticate the output to interpret and conclude.

All activities should enhance student's abilities to employment and/or self-employment opportunities, management skills, Statistical analysis, fiscal expertise, etc. Students and the course instructor/s to involve either individually or in groups to interact together to enhance the learning and application skills of the study they have undertaken. The students with the help of the course teacher can take up relevant technical –activities which will enhance their skill. The prepared report shall be evaluated for CIE marks.

Array Signal Processing

Course Code	**MLEC216B**	CIE Marks	50
Lecture Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Number of Lecture Hours	**40 hours**	Total Marks	**100**
Credits	**03**	Exam Hours	**03**

Module 1

Spatial Signals: Signals in space and time, Spatial Frequency vs Temporal Frequency, Review of Co-ordinate Systems, Maxwell's Equation, Wave Equation. Solution to Wave equation in Cartesian Co-ordinate system –Wave number vector, Slowness vector.

RBT levels: L2, L3

Module 2

Wave number-Frequency Space Spatial Sampling: Spatial Sampling Theorem-Nyquist Criteria, Aliasing in Spatial frequency domain, Spatial sampling of multidimensional signals.

RBT levels: L2, L3

Module 3

Sensor Arrays: Linear Arrays, Planar Arrays, Frequency – Wave number Response and Beam pattern, Array manifold vector, Conventional Beam former, Narrowband beam former.

RBT levels: L2, L3

Module 4

Uniform Linear Arrays: Beam pattern in θ, u and ψ -space, Uniformly Weighted Linear Arrays.
Beam Pattern Parameters: Half Power Beam Width, Distance to First Null, Location of side lobes and Rate of Decrease, Grating Lobes, Array Steering.

RBT levels: L2, L3

Module 5

Array Design Methods: Visible region, Duality between Time -Domain and Space -Domain Signal Processing, Schelkunoff's Zero Placement Method, Fourier Series Method with windowing, Woodward - Lawson Frequency-Sampling Design. Non parametric method -Beam forming, Delay and sum Method, Capons Method.

RBT levels: L2, L3

Course outcomes:

COs	**Description**	Blooms Level
CO1	Able to Understand the basics of signals in space and time.	Understand
CO2	Able to Understand the important concepts of array signal processing.	Understand
CO3	Able to Understand the basic principle of direction of arrival estimation techniques.	Understand
CO4	Able to Understand the basic principle of direction of arrival estimation techniques.	Understand
CO5	Able to Understand the Concepts of Spatial Frequency along with the Spatial Samplings.	Understand

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. Three Tests to be conducted with each of 20 Marks
2. Two assignments each of 20 Marks or One Skill Development Activity of 40 marks to attain Cos and POs

The sum three Tests and two assignments/one Skill Development Activity will be scaled down to 50 marks

CIE question paper is designed to attain the different levels of Bloom's taxonomy as per the COs 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.
4. There will be two full questions (with a maximum of four sub questions) from each module.
5. Each full question will have sub questions covering all the topics under a module.
6. The students will have to answer five full questions, selecting one full question from each module.

Text Book:

1. 'Optimum Array Processing Part IV of Detection, Estimation, and Modulation Theory', Harry L. Van Trees, John Wiley & Sons, ISBN: 9780471093909, 2002.

Reference Books:

- 'Array Signal Processing: Concepts and Techniques', Don H. Johnson, Dan E. Dugeon, Prentice Hall Signal Processing Series, 1st Edition, ISBN-13: 978-0130485137.
- 'Spectral Analysis of Signals', PetreStoica and Randolph L. Moses, Prentice Hall, ISBN: 0-13-113956-8, 2005.
- 'Electromagnetic Waves and Antennas', Sophocles J. Orfanidis, ECE Department, Rutgers University, 94 Brett Road Piscataway, NJ 88548058. http://www.ece.rutgers.edu/~orfanidi/ewa/ISBN: 0-07-114243-64, 2003.
- "Real-Time Concepts for Embedded Systems", Qing Li and Carolyn Yao, CMP Books, ISBN:1578201241, 2003.
- "Real Time Systems", Jane W. S. Liu, Prentice Hall, ISBN: 0130996513, 2000.
- "Real-Time Systems Design and Analysis", Phillip A. Laplante, John Wiley & Sons, 2004.

Skill development activities: Under Skill development activities in a concerning course, the students should

1. Interact with industry (small, medium, and large).
2. Involve in research/testing/projects to understand their problems and help creative and innovative methods to solve the problem.
3. Involve in case studies and field visits/ fieldwork.
4. Accustom to the use of standards/codes etc., to narrow the gap between academia and industry.
5. Handle advanced instruments to enhance technical talent.
6. Gain confidence in modelling of systems and algorithms for transient and steady-state operations, thermal study, etc.
7. Work on different software/s (tools) to simulate, analyze and authenticate the output to interpret and conclude.

All activities should enhance student's abilities to employment and/or self-employment opportunities, management skills, Statistical analysis, fiscal expertise, etc. Students and the course instructor/s to involve either individually or in groups to interact together to enhance the learning and application skills of the study they have undertaken. The students with the help of the course teacher can take up relevant technical –activities which will enhance their skill. The prepared report shall be evaluated for CIE marks.

Digital Compression

Course Code	**MLEC216C**	CIE Marks	50
Lecture Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Number of Lecture Hours	**40 hours**	Exam Hours	**03**
Credits – 03			

Module-1

Introduction: Compression techniques, Modelling & coding, Distortion criteria, Differential Entropy, Rate Distortion Theory, Vector Spaces, Information theory, Models for sources, Coding uniquely decodable codes, Prefix codes, Kraft McMillan Inequality.

Quantization: Quantization problem, Uniform Quantizer, Adaptive Quantization, Non-uniform Quantization; Entropy coded Quantization, Vector Quantization, LBG algorithm, Tree structured VQ, Structured VQ.

RBT levels: L2, L3

Module-2

Differential Encoding: Basic algorithm, Prediction in DPCM, Adaptive DPCM, Delta Modulation, Speech coding–G.726, Image coding.

Transform Coding: Transforms – KLT, DCT, DST, DWHT; Quantization and coding of transform coefficients, Application to Image compression – JPEG, Application to audio compression.

RBT levels: L2, L3

Module-3

Sub-band Coding: Filters, Sub-band coding algorithm, Design of filter banks, Perfect reconstruction using two channel filter banks, M-band QMF filter banks, Poly-phase decomposition, Bit allocation, Speech coding– G.722, Audio coding–MPEG audio, Image compression.

RBT levels: L2, L3

Module-4

Wavelet Based Compression: Wavelets, Multi resolution analysis & scaling function, Implementation using filters, Image compression–EZW, SPIHT, JPEG 2000.

Analysis/Synthesis Schemes: Speech compression–LPC10, CELP, MELP. **Video Compression:** Motion compensation, Video signal representation, Algorithms for video conferencing & video phones–H.261, H.263, Asymmetric applications–MPEG 4, MPEG 7, Packet video.

RBT levels: L2, L3

Module-5

Loss less Coding: Huffman coding, Adaptive Huffman coding, Golomb codes, Rice codes, Tunstall codes, Applications of Huffman coding, Arithmetic coding, Algorithm implementation, Applications of Arithmetic coding, Dictionary techniques–LZ77, LZ78, Applications of LZ78– JBIG, JBIG2, Predictive coding– Prediction with partial match, Burrows Wheeler Transform, Applications– CALIC, JPEG-LS.

RBT levels: L2, L3

Course outcomes:

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

1. Explain the evolution and fundamental concepts of Data Compression and Coding techniques.
2. Acquire contemporary knowledge in Data Compression and Coding.
3. Analyze the operation of a range of commonly used Coding and Compression techniques
4. Identify the basic software and hardware tools used for data compression.
5. Analyze and evaluate the performance of different Data Compression and Coding 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. 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. Three Tests to be conducted with each of 20 Marks
2. Two assignments each of 20 Marks or One Skill Development Activity of 40 marks to attain Cos and POs

The sum three Tests and two assignments/one Skill Development Activity will be scaled down to 50 marks **CIE question paper is designed to attain the different levels of Bloom's taxonomy as per the COs 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.
4. There will be two full questions (with a maximum of four sub questions) from each module.
5. Each full question will have sub questions covering all the topics under a module.
6. The students will have to answer five full questions, selecting one full question from each module.
7. The students will have to answer five full questions, selecting one full question from each module.

Textbook:

1. Introduction to Data Compression', K Sayood, Harcourt India Pvt. Ltd. & Morgan Kaufmann Publishers, 1996.

Reference Books:

1. 'Digital Coding of Waveforms: Principles and Applications to Speech and Video', N Jayant and P Noll, Prentice Hall, USA, 1984.
2. 'Data Compression: The Complete Reference', D Salomon, Springer, 2000.
3. 'Fundamentals of Multimedia', Z Li and M S Drew, Pearson Education (Asia) Pvt. Ltd., 2004.

Wavelet Transforms and Applications

Course Code	**MLEC216D**	CIE Marks	50
Lecture Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Number of Lecture Hours	**40 hours**	Exam Hours	**03**
Credits – 03			

Module-1

Continuous Wavelet Transform: Continuous time frequency representation of signals, The Windowed Fourier Transform, Uncertainty Principle and time frequency tiling, Wavelets, specifications, admissibility conditions, Continuous wavelet transform, CWT as a correlation, CWT as an operator, Inverse CWT.

RBT levels: L2, L3

Module-2

Discrete wavelet Transform: Approximations of vectors in nested linear vector spaces, Example of an MRA, Formal definition of MRA, Construction of genera orthonormal MRA, a Wavelet basis for MRA, Digital filtering interpretations- Decomposition and Reconstruction filters, examples of orthogonal basis generating wavelets, interpreting orthonormal MRA for Discrete time signals, Mallat algorithm Filter bank implementation of DWT.

RBT levels: L2, L3

Module-3

Alternative wavelet representations- Biorthogonal Wavelets: biorthogonality in vector space, biorthogonal wavelet bases, signal representation using biorthogonal wavelet system, advantages of biorthogonal wavelets, biorthogonal analysis and synthesis, Filter bank implementation, Two dimensional Wavelets, filter bank implementation of two-dimensional wavelet transform.

RBT levels: L2, L3

Module-4

Lifting scheme: Wavelet Transform using polyphase matrix factorization, Geometrical foundations of the lifting scheme, lifting scheme in the z- domain, mathematical preliminaries for polyphase factorization, Dealing with Signal Boundary.

RBT levels: L2, L3

Module-5

Applications: Image Compression: EZW Coding, SPIHT, Wavelet Difference Reduction Compression Algorithm, Denoising, speckle removal, edge detection and object isolation, audio compression, communication applications – scaling functions as signalling pulses, Discrete Wavelet Multitone Modulation. **Beyond Wavelet:** Ridge lets and curve lets: Ridge let transform and Digital Curve let transform, Curve let construction, Properties and applications.

RBT levels: L2, L3

.

Course Outcome: After successful completion of this course, students should able to;

1. Classify various wavelet transform and explain importance of it.
2. Describe Continuous Wavelet Transform (CWT) and Discrete Wavelet Transform (DWT).
3. Explain the properties and application of wavelet transform.
4. Develop and realize computationally efficient wavelet-based algorithms for signal and image processing.
5. Explain brief features and strength of transform beyond wavelet.

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. Three Tests to be conducted with each of 20 Marks
2. Two assignments each of 20 Marks or One Skill Development Activity of 40 marks to attain Cos and POs

The sum three Tests and two assignments/one Skill Development Activity will be scaled down to 50 marks **CIE question paper is designed to attain the different levels of Bloom's taxonomy as per the COs 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.
4. There will be two full questions (with a maximum of four sub questions) from each module.
5. Each full question will have sub questions covering all the topics under a module.
6. The students will have to answer five full questions, selecting one full question from each module.

Textbooks:

1. Wavelet Transforms –Introduction and applications - Raghuveer M. Rao and Ajit S. Bopardikar- - Pearson Education, 2008
2. Insight into Wavelets from Theory to practice - K.P Soman, K. I. Ramachandran, PHI, 2006
3. Fundamentals of Wavelets: Thory, Algorithms and Applications- J C Goswamy and A K Chan, Wiley- Inderscience Publications, John Wiley and Sons, 1999.

Advanced Communication Laboratory			
Course Code	**MLECL207**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	**0:4:0:0**	SEE Marks	50
Credits -02	Exam Hours:3	Total Hours	100

Sl.NO	Experiments
1	Simulation of ASK modulation and demodulation
2	Simulation of FSK modulation and demodulation
3	Simulation of BPSK modulation and demodulation
4	Simulation of QPSK modulation and demodulation
5	Simulation of signal constellation QPSK with Rayleigh fading and AWGN
6	Simulation of signal constellation M-ary QAM with AWGN fading
7	To simulate the communication link
8	To simulate Zero Forcing algorithm
9	To simulate LMS algorithm
10	Generation of m-Sequence and verify its properties
	Generation Gold Sequence and verify its properties
	Note: Conduct the experiments using MATLAB/PYTHON/OCTAVE

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

1. Understand the modulation and demodulation of modulation techniques
2. Understand the different modulation techniques under Rayleigh fading and AWGN environment and probability of error analysis
3. Understand the behaviour of the different filtering techniques
4. Understand the generation of PN sequence and understand its properties.

Conduct of Practical Examination:

1. All laboratory experiments are to be included for practical examination.
2. Students are allowed to pick one experiment from the lot.
3. Strictly follow the instructions as printed on the cover page of answer script for breakup of marks.
4. Change of experiment is allowed only once and Marks allotted to the procedure part to be made zero.

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 marks is scaled down to 20 marks** (40% of the maximum marks).

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

ABILITY/SKILL ENHANCEMENT COURSE (OFFLINE/ONLINE)

Modelling and Simulation of Antenna Using Simulation Tool			
Course Code	**MLECL258A**	CIE Marks	50
Teaching Hours/Week (L:T:P)	**0:2:0**	SEE Marks	50
Credits -01	Exam Hours:3	Total Marks	100

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 • Return loss characteristics • gain • 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	**MLECL258B**	CIE Marks	50
Teaching Hours/Week (L:T:P)	**0:2:0**	SEE Marks	50
Credits -01	Exam Hours:3	Total Marks	100

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

Python Programming			
Course Code	**MLECL258C**	CIE Marks	50
Teaching Hours/Week (L:T:P)	**0:0:2**	SEE Marks	50
Credits -01	Exam Hours:3	Total Marks	100

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.
To enable the students to implement and validate the algorithms studied in Communication.

Sl.NO	**Experiments**
1.	Write a Python program that calculates the sum of the first n terms of the following mathematical series: $1-\frac{x^2}{2!}+\frac{x^4}{4!}-\frac{x^6}{6!}....\frac{x^n}{n!}$
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: • Bar plots • Histograms • Line plots • 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: a) Contain at least 1 letter between a and z b) Contain at least 1 number between 0 and 9 c) Contain at least 1 letter between A and Z

	d) Contain at least 1 character from $, #, @ e) Minimum length of password: 6 f) 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:

- Students will be able to design and implement Python programs that solve complex problems, including mathematical series, file handling, matrix operations, and more.
- 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.
- Students will demonstrate the ability to connect Python programs to MySQL databases, perform CRUD (Create, Read, Update, Delete) operations, and manage database interactions proficiently.
- 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.
- 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:

- 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