Semester - II

ANTENNA THEORY AND DESIGN			
Course Code	MLEL201	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	(3:2:0)	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 10-12 Lab slots	Total Marks	100
Credits	04	Exam Hours	03

Course objectives: Thiscoursewillenablestudents:

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

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. **RBTLevel: 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

L2,L3,L4

MODULE-3

Resonant Antennas: Wires and Patches, Dipole antenna, Yagi-Uda antennas, Microstrip antenna. **Broadband Antennas:** Traveling wave antennas, Helical antennas, Biconical antennas, Sleeve antennas, and Principles of frequency independent antennas, Spiral antennas, and Log-periodic antennas. **L2, L3**

MODULE-4

Aperture antennas: Techniques for evaluating gain, Reflector antennas, Parabolic reflector antenna principles,Axisymmetricparabolicreflectorantenna,offsetparabolicreflectors,Dualreflectorantennas,Gaincalculations for reflector antennas, Feed antennas for reflectors, Field representations, Matching the feed to the reflector, General feed model,Feed antennas used in practice.

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'sintegral equation, Integral equation and Kirchh off'snet working equations, Source modeling weighted residual formulations and computational consideration ,Calculation of antenna and scatter characteristics.

L3,L4

PRACTICAL COMPONENT OF IPCC

Sl.NO	Experiments
1	MATLAB/C Implementation to Obtain the Radiation Pattern of an Antenna
2	Study of Radiation Pattern of Different Antennas
3	Determine the Directivity and Gains of Horn / Yagi / Dipole / Parabolic Antennas
4	Impedance Measurements of Horn Antennas
5	Study of Radiation Pattern of E-Plane Horns
6	Significance of Pocklington's Integral Equation
7	Determine the Directivity and Gains of Dipole Antennas
8	Impedance Measurements of Yagi Antennas
9	Determine the Directivity and Gains of Parabolic Antennas
10	Study of Radiation Pattern of E-Plane Horns

Assessment Details (both CIE and SEE)

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

CIE for the theory component of IPCC

1. Two Tests each of **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:

Books

Textbook:

1.'AntennaTheoryand Design',Stutzmanand Thiele,JohnWiley, 2ndEdition,2010

ReferenceBooks:

1. 'AntennaTheoryAnalysisandDesign',C.A.Balanis,JohnWiley,2ndEdition,2007

2. 'AntennasandWavePropagation',J.D.Krauss, McGrawHillTMH,4thEdition,2010

'Antennasandpropagation',A.R.Harish,M.Sachidanada,PearsonEducation,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	L2,L3
CO2	Define and illustrate various types of array antennas	L2,L3,L4
CO3	Design antennas like Yagi-Uda,Helical antennas and other broad band antennas	L2,L3
CO4	Describe different antenna synthesis methods	L2,L3
CO5	ApplymethodslikeMethodofMoments,Pocklington'sintegralequation,Source modeling.	L3,L4

DIGITAL VLSI DESIGN			
Course Code	MLEL202	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	03	Exam Hours	03

Course Learning objectives:

- To understand the operation of MOS transistor, Scaling and Small Geometry Effects.
- To study Static Characteristics, Switching Characteristics and Interconnect Effect of MOS Inverter.
- To provide the insight of Semiconductor Memories, Dynamic Logic Circuits and BiCMOS Logic Circuits.

Module-1

MOS Transistor: The Metal Oxide Semiconductor (MOS) Structure, The MOS System under External Bias, Structure and Operation of MOS Transistor, MOSFET Current-Voltage Characteristics, MOSFET Scaling and SmallGeometry Effects. MOS Inverters-Static Characteristics: Introduction, Resistive-Load Inverter, Inverters with n_Type MOSFET Load.

Module-2

MOS Inverters-Static Characteristics: CMOS Inverter. MOS Inverters: Switching Characteristics and Interconnect Effects: Introduction, Delay-Time Definition, Calculation of Delay Times, Inverter Design with Delay Constraints, Estimation of Interconnect Parasitics, Calculation of Interconnect Delay, Switching Power Dissipation of CMOS Inverters

Module-3

Semiconductor Memories: Introduction, Dynamic Random Access Memory (DRAM), Static Random Access Memory (SRAM).

Module-4

Dynamic Logic Circuits: Introduction, Basic Principles of Pass Transistor Circuits, Voltage Bootstrapping, Synchronous Dynamic Circuit Techniques, Dynamic CMOS Circuit Techniques, High Performance Dynamic CMOS circuits

Module-5

BiCMOS Logic Circuits: Introduction, Bipolar Junction Transistor (BJT): Structure and Operation, Dynamic Behavior of BJTs, Basic BiCMOS Circuits: Static Behavior, Switching Delay in BiCMOS Logic Circuits,BiCMOS Applications

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. "Sung Mo Kang & Yusuf Leblebici", CMOS Digital Integrated Circuits: Analysis and Design, Tata McGraw-Hill, Third Edition
2. "Neil Weste and K. Eshraghian", Principles of CMOS VLSI Design: A System Perspective Pearson Education (Asia) Pvt. Ltd. Second Edition, 2000.
3. "Wayne, Wolf", Modern VLSI Design: System on Silicon, Prentice Hall PTR/ Pearson Education Second Edition, 1998.
4. "Douglas A Pucknell& Kamran Eshraghian", Basic VLSI Design PHI 3 rd Edition

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=57uTCtSQV50·&list=PLHO2NKv71TvsSqYwVvUCZwNkY-jUyUHdS .
- https://www.youtube.com/watch?v=oL8SKNxEaHs·&list=PLLy_2iUCG87Bdulp9brz9AcvW_TnFCUmM

Skill Development Activities Suggested

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 outcome (Course Skill Set)

At

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

Sl. No.	Description	Blooms Level
CO1	Analyse issues of On-chip interconnect Modelling and Interconnect delay calculation	L3
CO2	Analyse the Switching Characteristics in Digital Integrated Circuits.	L3
CO3	Use the Dynamic Logic circuits in state-of-the-art VLSI chips.	L4
CO4	Study critical issues such as ESD protection, Clock distribution, Clock buffering, and Latch phenomenon	L4
CO5	Use Bipolar and Bi-CMOS circuits in very high speed design.	L4

Course Code	MLEL203	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	03	Exam Hours	03

Course Objectives:

This course will expose the students to the digital communication coding,

- It includes the understanding of signal space design,
- It gives broader view on modulation methods, demodulation methods,
- It gives an insight into M-ary modulation techniques.
- Students will learn concepts of Digital Communications through fading Multipath channels

MODULE-1

Source Coding Coding Techniques for Analog sources: Temporal Waveform Coding, Spectral Waveform coding, Model based Source Coding.CodingforDiscrete sources: Coding for discrete memory less sources, discrete stationary sources, Lempel-Ziv Algorithm.

MODULE-2

Characterization of Communication Signals and Systems Representation of Band pass signals and systems, Signal space representation, Representation of digitally modulated signals, spectral characteristics of digitally Modulated signals.

MODULE-3

Baseband Modulation and demodulation Spectral Attributes of PCM Waveform Bits per PCM Word and Bits per Symbol, M-ary Pulse Modulation Waveforms Correlative Coding, Detection of Binary Signals in Gaussian Noise, Intersymbol Interference, Linear Equalization.

MODULE-4

Bandpass modulation and Demodulation Digital Band Pass Modulation Techniques, Detection of Signals in Gaussian Noise, Coherent and non Coherent Detection, Error Performance for Binary Systems, M-arySignalingand Performance, Symbol Error Performance for M-ary Systems (M> 2)

MODULE-5

Digital Communications through Fading Multipath Channels Characterization of fading multipath channels, effect of signal characteristics, Diversity techniques, Digital Signalling over a frequency selective slowly fading channel.

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.

The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books

Text Books:

1. "Digital Communications: Fundamentals & Applications", Bernard Sklar and Dorling Kindersley, Prentice Hall, 2009.

Reference Books:

1. "Digital Communications" , John G Proakis , , 4th Edition ,McGraw Hill, 2001
2. "Digital Communication Systems Using Matlab& Simulink", David Silage, Bookstand Publishing, 2009.
3. "Digital Communication Systems", Simon Haykin, Wiley Student Edition, 2013.

Web links and Video Lectures (e-Resources):

Skill Development Activities Suggested

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 outcome (Course Skill Set)

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

SL NO	Description	Blooms level
CO1	Understand the concepts of advanced digital communication systems. Visualization of signal in Signal Space.	L2
CO2	Apply different modulation schemes to baseband signals.	L3
CO3	Analyze the characteristics of M-ary Bandpass Modulated signals	L4
CO4	Analyze the digital modulated wave in various fading Channels	L4

REAL TIME OPERATING SYSTEM			
Course Code	MLEL 204	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	03	Exam Hours	03

Course Learning objectives:

- To understand a typical embedded system and its constituents
- To learn the selection process of processor and memory for the embedded systems
- To learn communication buses and protocols used in the embedded and real-time systems
- To understand real-time operating system and the types of RTOS
- To learn various approaches to real-time scheduling
- To learn software development process and tools for RTOS applications

Module-1

Real-Time Systems and Resources: Brief history of Real Time Systems, A brief history of Embedded Systems. System Resources, Resource Analysis, Real-Time Service Utility, Scheduler concepts, Real-Time OS, State transition diagram and tables, Thread Safe Re-entrant Functions.

Module-2

Processing with Real Time Scheduling: Scheduler Concepts, Pre-emptive Fixed Priority Scheduling Policies with timing diagrams and problems and issues, Feasibility, Rate Monotonic least upper bound, Necessary and Sufficient feasibility, Deadline –Monotonic Policy, Dynamic priority policies, Alternative to RM policy.

Module-3

Memory and I/O: Worst case execution time, Intermediate I/O, Shared Memory, ECC Memory, Flash file systems. Multi-resource Services, Blocking, Deadlock and live lock, Critical sections to protect shared resources, Missed deadline, QoS, Reliability and Availability, Similarities and differences, Reliable software, Available software.

Module-4

Firmware Components: The 3 firmware components, RTOS system software mechanisms, Software application components. Debugging Components, Exceptions, assert, checking return codes, Single-step debugging, Test access ports, Trace Ports.

Module-5

Process and Threads: Process and thread creations, Programs related to semaphores, message queue, shared buffer applications involving intertask /thread communication.

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

Textbooks:

1. 'Real-Time Embedded Systems and Components', Sam Siewert, Cengage Learning, India Edition, 2007.
2. 'Embedded/Real Time Systems, Concepts, Design and Programming, Black Book', Dr. K.V.K.K Prasad, Dream Tech Press, New edition, 2010.

Reference Books:

1. 'Real Time System', James W S Liu, Pearson Education, 2008.
2. 'Programming for Embedded Systems', Dream Tech Software Team, John Wiley, India Pvt. Ltd., 2008.

Skill Development Activities Suggested:

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 outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Recognize and classify real-time systems	L2
CO2	Apply software development process to a given RTOS application	L2
CO3	Design a given RTOS based application	L3
CO4	Ability to use commercial tools to develop RTOS based applications	L3

CMOS RF CIRCUIT DESIGN			
Course Code	MLEL215A	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	03	Exam Hours	3

Course Learning objectives:

- To provide understanding of designing RF integrated circuits in state-of-the-art CMOS technology.
- To study transceiver, Low Noise Amplifiers, PLLs and other related concepts and circuits.

Module-1

Introduction to RF Design, Wireless Technology and Basic Concepts: A wireless world, RF design is challenging, The big picture. General considerations, Effects of Nonlinearity, Noise, Sensitivity and dynamic range, Passive impedance transformation. Scattering parameters, Analysis of nonlinear dynamic systems, conversion of gains and distortion.

Module-2

Communication Concepts: General concepts, analog modulation, digital modulation, spectral re-growth, coherent and non-coherent detection, Mobile RF communications, Multiple access techniques, Wireless standards, Appendix 1: Differential phase shift keying

Module-3

Transceiver Architecture: General considerations, Receiver architecture, Transmitter architectures, Direct conversion and two-step transmitters, RF testing for heterodyne, Homodyne, Image reject, Direct IF and sub sampled receivers.

Module-4

Low Noise Amplifiers and Mixers: General considerations, Problem of input matching, LNA topologies: common-source stage with inductive load, common-source stage with resistive feedback. Mixers- General considerations, passive down conversion mixers, Various mixers- working and implementation.

Module-5

VCO and PLLs- Oscillators- Basic topologies VCO and definition of phase noise, Noise power and trade off. Resonator VCO designs, Quadrature and single sideband generators. Radio frequency Synthesizers- PLLS, Various RF synthesizer architectures and frequency dividers, Power Amplifier design.

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. B. Razavi, "RF Microelectronics" second edition, PHI
2. R. Jacob Baker, H.W. Li, D.E. Boyce, "CMOS Circuit Design, layout and Simulation" PHI 1998
3. Thomas H. Lee, "Design of CMOS RF Integrated Circuits" Cambridge University press 1998

Y.P. Tsividis, "Mixed Analog and Digital Devices and Technology" , TMH 1996

Web links and Video Lectures (e-Resources):

1. .https://nptel.ac.in/courses/108106105
2. https://www.youtube.com/watch?v=T0Kbt7CcqUA&list=PLQorUaRee4AEeyuqnpysZcGT4FFgRd kuM

Skill Development Activities Suggested

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 outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Analyze the effect of nonlinearity and noise in RF and microwave design.	L4
CO2	Exemplify the approaches taken in actual RF products	L2
CO3	Minimize the number of off-chip components required to design mixers, Low-Noise Amplifiers, VCO and PLLs.	L3
CO4	Explain various receivers and transmitter topologies with their merits and drawbacks.	L3
CO5	Demonstrate how the system requirements define the parameters of the circuits and the impact on the performance.	L2

STATISTICAL SIGNAL PROCESSING			
Course Code	MLEL215B	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	(3:0:0)	SEE Marks	50
Total Hours of Pedagogy	40HoursTheory	Total Marks	100
Credits	3	Exam Hours	03

Course Learning objectives: This course will enable students:

- Understand random processes and its properties
- Understand the basic theory of signal detectionan destimation
- 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).

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).

Module-3

pectrum Estimation: Non-parametric methods, minimum-variance spectrum estimation, maximum entropy method, parametric methods, frequency estimation, principal components spectrum estimation (Text1).

Module-4

Optimal and Adaptive Filtering: FIR and IIR Wiener filters, Discrete Kalman filter, FIR Adaptive filters: Steepest descent, LMS, LMS-based algorithms, adaptive recursive filters, RLS algorithms (Text1).

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)

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

Textbooks:

1. Monson H. Hayes, "Statistical Digital Signal Processing and Modeling",John Wiley & Sons (Asia) Pvt. Ltd.,2002.
2. 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.

Skill Development Activities Suggested

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 outcome (Course Skill Set)

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

SL NO	Description	Blooms level
C01	Design statistical DSP algorithms to meet desired needs	L4
CO2	Apply vector space methods to statistical signal processing problems	L3
CO3	Identify the engineering problems that can be put into the frame of statistical signal processing	L2
CO4	Understand Wiener filter theory and design for discrete and continuous Wiener filters	L2
CO5	Analyze Kalman Filter theory and design discrete Kalman filters	L3

PROBABILITY AND RANDOM PROCESS			
Course Code	MLEL215C	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	(3:0:0)	SEE Marks	50
Total Hours of Pedagogy	40HoursTheory	Total Marks	100
Credits	3	Exam Hours	03

Course Learning 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 Process Techniques
- Analyze about the correlation Functions.

Module-1

Probability and Random Variable Probability:
Set theory, Experiments and Sample Spaces, Discrete and Continuous Sample Spaces, Events, Probability Definitions and Axioms, Mathematical Model of Experiments, Joint Probability, Conditional Probability, Total Probability, Bayes' Theorem, and Independent Events, Bernoulli's trials.

The Random Variable:
Definition of a Random Variable, Conditions for a Function to be a Random Variable, Discrete and Continuous, Mixed Random Variable.

Module-2

Distribution and Density Functions and Operations on One Random Variable

Distribution and Density Functions:
Distribution and Density functions, Properties, Binomial, Poisson, Uniform, Exponential, Gaussian, Rayleigh and Conditional Distribution, Methods of defining Conditioning Event, Conditional Density function and its properties, problems.

Operation `on One Random Variable:
Expected value of a random variable, function of a random variable, moments about the origin, central moments, variance and skew, characteristic function, moment generating function, transformations of a random variable, monotonic transformations for a continuous random variable, non-monotonic transformations of continuous random variable, transformations of Discrete random variable.

Module-3

MultipleRandomVariablesandOperationsonMultipleRandomVariablesMultipleRandom Variables: Vector Random Variables, Joint Distribution Function and Properties, Joint density Function andProperties, Marginal Distribution and density Functions, conditional Distribution and density Functions,Statistical Independence, Distribution and density functions of Sum of Two Random Variables and Sum ofSeveral Random Variables, Central Limit Theorem- Unequal Distribution, **Equal Distributions Operationson Multiple Random Variables:** Expected Value of a Function of Random Variables, Joint Moments aboutthe Origin, Joint Central Moments, Joint Characteristic Functions, and **Jointly Gaussian Random Variables:**TwoRandomVariablescaseandNRandomVariablecase,Properties,Transformationso fMultipleRandom Variables.

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 1Ergodicity, 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

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.

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

Textbooks:

1. Probability,RandomVariables &RandomSignal Principles -Peyton Z.Peebles,TMH, 4thEdition, 2001.
2.ProbabilityandRandomProcesses-Scott Miller,DonaldChilders,2nd Edn,Elsevier,2012

Skill Development Activities Suggested

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 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	L2
CO2	To apply concepts of Probability to solve problems in Communication Engineering.	L3
CO3	To find functional relationship between random inputs and outputs with the use of Random Process Techniques	L3
CO4	Analyse about the correlation Functions	L4

SIMULATION,MODELLINGANDANALYSIS			
Course Code	MLEL215D	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	(3:0:0)	SEE Marks	50
Total Hours of Pedagogy	40HoursTheory	Total Marks	100
Credits	3	Exam Hours	03

Course Learning 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)

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 model's 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)

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)

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)

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.

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

Textbooks:

1. AverillLaw,"Simulationmodelingandanalysis",McGrawHill4thedition,2007.

ReferenceBooks:

1. TayfurAltiok and Benjamin Melamed, "Simulation modeling and analysis with ARENA", Elsevier,Academicpress, 2007.
2. JerryBanks,"Discreteevent systemSimulation",Pearson,2009
3. SeilaCericandTadikamalla,"Appliedsimulationmodeling",Cengage,2009.
4. George.S.Fishman,"Discreteevent simulation",Springer,2001. FrankL. Severance, "System modeling and simulation", Wiley, 2009..

Skill Development Activities Suggested

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 outcome (Course Skill Set)

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

SL NO	Description	Blooms level
CO1	Describe the role of important elements of discrete event simulation and modeling paradigm	L2
CO2	Conceptualize real world situations related to systems development decisions originating from source requirements and goals.	L3
CO3	Develop skills to apply simulation software to construct and execute goal-driven system models.	L4
CO4	Interpret the model and apply the results to resolve critical issues in a real world environment	L4

MECHATRONICS			
Course Code	MLEL216A	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	(3:0:0)	SEE Marks	50
Total Hours of Pedagogy	40HoursTheory	Total Marks	100
Credits	3	Exam Hours	03

- **Course Learning objectives:**
- To understand the basics of Mechatronics and its design approach.
- To understand the operation and applications of various sensors.
- To understand the operation of various actuators and their applications in systems.
- To understand the concepts of logic design, computer communication networks and Fault diagnosis and Analysis in Mechatronic Systems.
- To understand the concepts of data acquisition, software design and development.

Module-1

Overview of mechatronics: What is Mechatronics? Integrated Mechatronic Design Approach, System Interfacing, Embedded Systems, Instrumentation and Control Systems, Open and closed loop systems, importance of feedback systems, Transfer function, Microprocessor Based Controllers and Microelectronics. An Introduction to Micro-technology and Nanotechnology, Mechatronics: Miniaturized, Examples and applications

Module-2

Sensors and application: Introduction to Sensors, Classification of sensors, Sensor – Static and Dynamic Characteristics, Sensors, Linear and Rotational Sensors, Acceleration Sensors, Force Measurement, Torque and Power Measurement, Flow Measurement, Temperature Measurements, Distance Measuring and Proximity Sensors, Light Detection, Use of RF, Infra-Red sensors in automobiles, Micro-sensors.

Module-3

Actuators: Introduction to Actuators – Mechanical, Electrical and combinational actuators, Electro-mechanical Actuators, Electrical Machines, Piezoelectric Actuators, Hydraulic and Pneumatic Actuation Systems, Applications of few types of actuators in automobiles.

Electrical Actuation Systems: Importance of actuators, classification of Actuators, Mechanical Switches, Bouncing and De-bouncing in Mechanical Switches, Solid State Switches: transistors, Darlington pair, Thyristors, Triacs.

Module-4

Computers and Logic Systems: Logic System Design, Synchronous and Asynchronous Systems, Sequential Systems, Control System Architecture, Control with Embedded Computers and Programmable Logic Control, Digital Signal Processing for Mechatronic Applications, Neural Networks and Fuzzy Systems, Artificial Intelligence and Expert System Approach to control System design, Design Optimization of Mechatronic Systems.

Module-5

Data Acquisition and Software Development: Introduction to Data Acquisition, Measurement, Techniques, Data Acquisition systems, Importance of data acquisition in automobiles. Computer-Based Instrumentation Systems, Software Design and Development, Data Recording and Data Logging, DAQ for automotive engine system and other Measurements, Electronic Control Unit (ECU), Features of design and system logic in multiple signal measurements.

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

Text Books

1. Mechatronics – W.Bolton, Longman, 2Ed, Pearson Publications, 2007
2. Microprocessor Architecture, Programming & Applications With 8085/8085A – R.S. Ganokar, Wiley Eastern, 2008

Reference Books

1. Mechatronics – Principles, Concepts and Applications – Nitiagour and PremchandMohalik – Tata McGraw Hill – 2003.
2. Measurement, Instrumentation, and Sensors Handbook - John G. Webster. Editor-inchief, CRC Press. 1999. 0-8493-2145-X. PDF files online available at www.engnetbase.com
3. Mechatronics Principles & Applications by Godfrey C. Onwubolu,

Elsevier. Introduction Mechatronics & Measurement Systems, David.G. Aliciatore

Skill Development Activities Suggested

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 outcome (Course Skill Set)

Sl. No.	Description	POs
CO1	Explain the basics of Mechatronics and its design approach.	L3
CO2	Explain the operation and applications of various sensors.	L3
CO3	Explain and discuss the operation of various actuators and their applications in systems.	L4
CO4	Explain and discuss the concepts of logic design, computer communication networks and Fault diagnosis and Analysis in Mechatronic Systems.	L4
CO5	Explain and discuss the concepts of data acquisition, software design and development.	L4

INTERNET OF THINGS AND APPLICATIONS			
Course Code	MLEL216B	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	(3:0:0)	SEE Marks	50
Total Hours of Pedagogy	40HoursTheory	Total Marks	100
Credits	3	Exam Hours	03

Course Learning objectives: This Course will enable students to

- Understand IoT concepts and network architecture for practical application.
- Understand roles in IoT, simplified architecture, and computing hierarchy.
- Understand smart objects, sensor networks, and IoT access technologies.
- Gain knowledge about IoT application protocols, data analytics, and big data technologies.

Understand IoT security strategies and best practices.

-

Module-1

What is IoT: Introduction to IoT, Genesis of IoT, IoT and Digitization , IoT Impact, Convergence of IT and OT ,IoT Challenges

IoT Network Architecture and Design: Drivers Behind New Network Architectures, Comparing IoT Architectures

Module-2

Simplified IoT Architecture: The Core IoT Functional Stack, Layer1, Layer 2, Layer3.
IoT Data Management and Compute Stack: Fog Computing, Edge Computing, The Hierarchy of Edge, Fog and Cloud.

Module-3

Smart Objects: The "Things" in IoT: Sensors, Actuators and Smart Objects, Micro-Electro-Mechanical Systems (MEMS),Smart Objects, Sensor Networks.
Connecting Smart Objects: Communications Criteria, Range, Frequency Bands, Power Consumption, Topology, Constrained Devices, Constrained-Node Networks, Data Rate and Throughput, Latency and Determinism, Overhead and Payload.
IoT Access Technologies: IEEE 802.15.4, Standardization and Alliances, Physical Layer, MAC Layer, Topology, Security, Competitive Technologies, IEEE 802.15.4g and 802.15.4e, Standardization and Alliances, Physical Layer, MAC Layer, Topology, Security, Competitive Technologies.

Module-4

Application Protocols for IoT: The Transport Layer, IoT Application Transport Methods, Application Layer Protocol Not Present, SCADA, A Little Background on SCADA, Adapting SCADA for IP, Tunneling Legacy SCADA over IP Networks, SCADA Protocol Translation, SCADA Transport over LLNs with MAP-T, Generic Web-Based Protocols.
Data and Analytics for IoT: An introduction to Data Analytics for IoT, Big Data Analytics Tools and Technology, Edge Streaming Analytics

Module-5

Securing IoT: A Brief History of OT Security, Common Challenges in OT Security, How IT and OT Security Practices and Systems Vary, Formal Risk Analysis Structures, The Phased Application of Security in an Operational Environment.

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

Text Books:

1. David Hanes , Gonzalo Salgueiro, Patrick Grossetete , Robert Barton , Jerome Henry "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things".

Reference books:

1. Arshdeep Bhaga, Vijay Madishetti, "Internet of things: A hands on Approach", Universities Press, ISBN:978172719547, 2015.

Web links and Video Lectures (e-Resources):

- .https://youtu.be/c6lqXb14c0I

Skill Development Activities Suggested

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 outcome (Course Skill Set)

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

SL NO	Description	Blooms leve
CO1	Explain IoT concepts and network architecture for practical application.	L3
CO2	Analyse roles in IoT, apply simplified architecture and computing hierarchy	L4
CO3	Analyse smart objects, sensor networks, and IoT access technologies.	L4
CO4	Analyze and apply IoT application protocols, data analytics, and big data technologies.	L4
CO5	Explain IoT security strategies and apply best practices effectively.	L3

CYBER SECURITY			
Course Code	MLEL216C	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	(3:0:0)	SEE Marks	50
Total Hours of Pedagogy	40HoursTheory	Total Marks	100
Credits	3	Exam Hours	03

Course Learning objectives:

- To understand the cybercrime and laws and computer forensics
- To explain the phishing and identity theft

Module-1

Introduction to Cybercrime and Laws

Introduction, Cybercrime: Definition and Origins of the word, Cybercrime and Information Security, Who are Cybercriminals?
Classifications of Cybercrimes.
How Criminals Plan Them – Introduction, How Criminals Plan the Attacks, Cybercafé and Cybercrimes, Botnets, Attack Vector, The Indian IT ACT 2000 and amendments.

Module-2

Tools and Methods used in Cybercrime

Introduction, Proxy Server and Anonymizers, Password Cracking, Keyloggers and Spyware, Virus and Warms, Trojan and backdoors, Steganography, DOS and DDOS attack, SQL injection, Buffer Overflow.

Module-3

Phishing and Identity Theft

Introduction, Phishing – Methods of Phishing, Phishing Techniques, Phishing Toolkits and Spy Phishing.
Identity Theft – PII, Types of Identity Theft, Techniques of ID Theft.
Digital Forensics Science, Need for Computer Cyber forensics and Digital Evidence, Digital Forensics Life Cycle.

Module-4

Understanding Computer Forensics:

Introduction, Historical Background of Cyber forensics, Digital Forensics Science, The Need for Computer Forensics, Cyber forensics and Digital Evidence, Forensics Analysis of E-Mail, Digital Forensics Life Cycle, Chain of Custody Concept, Network Forensics, Approaching a Computer Forensics Investigation, Setting up a Computer Forensics Laboratory : Understanding the Requirements, Computer Forensics and Steganography, Relevance of the OSI 7 Layer Model to Computer Forensics, Forensics and Social Networking Sites: The Security/Privacy Threats, Computer Forensics from Compliance Perspective, Challenges in Computer Forensics, Special Tools and Techniques, Forensics Auditing, Antiforensics.

Module-5

Introduction to Security Policies and Cyber Laws: Need for An Information Security Policy, Information Security Standards Iso, Introducing Various Security Policies and Their Review Process, Introduction to Indian Cyber Law, Objective and Scope of the IT Act, 2000, Intellectual Property Issues, Overview of Intellectual -Property -RelatedLegislationinIndia,Patent,Copyright,LawRelatedtoSemiconductorLayoutandDesign,Software License.

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. Anti-Hacker ToolKit (Indian Edition) by Mike Shema, Publication: McGraw Hill.
2. Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Nina Godbole and Sunit Belpure, Publication: Wiley.
3. Introduction to Information Security and Cyber Laws by Surya Prakash Tripathi, Ritendra Goyal, Praveen Kumar Shukla, Dreamtech Press, 2015.
4. Computer Forensics and Cyber Crime: An Introduction by Marjie T. Britz, Pearson.
5. Introduction to Computer Networks and Cybersecurity by Chwan-Hwa (John) Wu, J. David Irwin, CRC Press.
6. Guide to Computer Forensics and Investigations by Bill Nelson, Amelia Phillips, Christopher Steuart, Cengage Learning.

Web links and Video Lectures (e-Resources):

1. .https://www.mooc.org/
2. https://onlinecourses.nptel.ac.in/

Skill Development Activities Suggested

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 outcome (Course Skill Set)

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

SLNO	Description	Blooms level
CO1	Understand the origins, classifications, and legal aspects of cybercrime, including the Indian IT Act 2000.	L2
CO2	Identify and explain the tools and techniques used by cybercriminals, such as malware, anonymizers, and attack vectors.	L3
CO3	Analyze phishing techniques, identity theft methods, and the role of digital forensics in cyber investigations.	L4
CO4	Apply the concepts and procedures of computer forensics to investigate and analyze digital evidence.	L3
CO5	Evaluate cybersecurity policies, standards, and the legal framework surrounding intellectual property and IT law in India.	L5

AUTOMOTIVE ELECTRONICS			
Course Code	MLEL216D	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	(3:0:0)	SEE Marks	50
Total Hours of Pedagogy	40HoursTheory	Total Marks	100
Credits	3	Exam Hours	03

Course Learning objectives:

- To introduce the fundamentals of automotive electronics.
- To create complete understanding of Sensors and actuators related to engine.
- To study the Digital Control systems of engine.
- To impart the knowledge of Bus architectures in automotive field.
- To know the Vehicle Electronics Architecture.

Module-1

Automotive Fundamentals Overview – Evolution of Automotive Electronics, Automobile Physical Configuration, Survey of Major Automotive Systems, The Engine – Engine Block, Cylinder Head, Four Stroke Cycle, Engine Control, Ignition System – Spark plug, High voltage circuit and distribution, Spark pulse generation, Ignition Timing, Diesel Engine, Drive Train -Transmission, Drive Shaft, Differential, Suspension, Brakes, Steering System Starter Battery -Operating principle: The Basics of Electronic Engine Control – Motivation for Electronic Engine Control – Exhaust Emissions, Fuel Economy, Concept of an Electronic Engine control system, Definition of General terms, Definition of Engine performance terms, Engine mapping, Effect of Air/Fuel ratio, spark timing and EGR on performance, Control Strategy, Electronic Fuel control system, Analysis of intake manifold pressure, Electronic Ignition.

Module-2

Automotive Sensors – Automotive Control System applications of Sensors and Actuators -Variables to be measured, Airflow rate sensor, Strain Gauge MAP sensor, Engine Crankshaft Angular Position Sensor, Magnetic Reluctance Position Sensor, Hall effect Position Sensor, Shielded Field Sensor, Optical Crankshaft Position Sensor, Throttle Angle Sensor (TAS), Engine Coolant Temperature (ECT) Sensor, Exhaust Gas Oxygen (O2/EGO) Lambda Sensors, Piezoelectric Knock Sensor. Automotive Engine Control Actuators – Solenoid, Fuel Injector, EGR Actuator, Ignition System.

Module-3

Digital Engine Control Systems -Digital Engine control features, Control modes for fuel Control (Seven Modes), EGR Control, Electronic Ignition Control -Closed loop Ignition timing, Spark Advance Correction Scheme, Integrated Engine Control System- Secondary Air Management, Evaporative Emissions Canister Purge, Automatic System Adjustment, System Diagnostics.

Module-4

Automotive Networking -Bus Systems – Classification, Applications in the vehicle, Coupling of networks, Examples of networked vehicles Buses – CAN Bus, LIN Bus, MOST Bus, Bluetooth, Flex Ray, Diagnostic Interfaces. Vehicle Motion Control – Typical Cruise Control System, Digital Cruise Control System, Digital Speed Sensor, Throttle Actuator, Digital Cruise Control configuration, Cruise Control Electronics (Digital only), Antilock Brake System (ABS).

Module-5

Vehicle Electronics Architecture Introduction ,Instrument Cluster ,Heating and Cooling, Airbag Safety Traction and Stability , Power Assist Steering ,Avionics Fly-By-Wire (FBW) ,Automotive X- By-Wire, Tire Pressure Monitoring ,Modules Count , Straight-Wire-Switch Topology , Embedded Function, A Conventional Radio, An Embedded Radio ,Distributed Vehicle Architecture ,Custom Built Modules ,Modules

Cross Compatibility , Integrating Dissimilar Functions ,Integrating Identical Functions: A Universal Module, Key-Off Load Current ,12V/42V Electrical Supply System , Vehicle Input Sensors and Switches 1.23 Vehicle
Output Devices ,Vehicle Interior Lights Dimming ,H-Bridge Motor Driver ,Microcontrollers Programming Options, Vehicle Operating Softwares.

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. William B. Ribbens, Understanding Automotive Electronics, Seventh edition 2012, Elsevier Publishing.
2. Robert Bosch Gmbh (Ed) Bosch Automotive Electrics and Automotive Electronics Systems and Components, Networking and Hybrid Drive, 5th edition, John Wiley& Sons Inc., 2007.
3. Najamuz Zaman" Automotive Electronics Design Fundamentals, Springer International Publishing Switzerland 2015.

Web links and Video Lectures (e-Resources):

1. .https://www.etf.ues.rs.ba/~slubura/Mehatronicki%20sistemi%20kod%20motora%20i%20vozila/Liter atura/understanding%20automative%20electronics.pdf
- https://link.springer.com/book/10.1007/978-3-319-17584-3.

Skill Development Activities Suggested

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 outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Understand fundamentals of automotive electronics.	L2
CO2	Apply the Sensors and actuators on engine.	L3
CO3	Analyse the Digital Control systems of engine.	L4
CO4	Identify the Bus architectures in automotive field.	L1,L2
CO5	Gain the knowledge of Vehicle Electronics Architecture	L1,L2

ADVANCED COMMUNICATION LAB			
Course Code	MLELL207	CIE Marks	50
Practical Hours/Week (L:T:P: S)	0:4:0	SEE Marks	50
Credits	02	Exam Hours	03

Course Objectives

- To introduce students to the principles of digital modulation techniques including ASK, FSK, BPSK, and QPSK.
-
- To provide hands-on experience in simulating modulation schemes under noise and fading conditions.
- To explore advanced communication techniques such as M-ary QAM, Rayleigh fading, and channel impairments.
- To enable students to simulate and evaluate adaptive filtering algorithms like LMS and Zero Forcing.
- To study the generation and validation of spreading sequences like m-sequences and Gold sequences.

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
11	Generation Gold Sequence and verify its properties

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.

The duration of SEE is 03 hours

Course outcome (Course Skill Set)

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

SLNO	Description	Blooms level
CO1	Simulate and analyze digital modulation schemes (ASK, FSK, BPSK, QPSK) and interpret their output waveforms.	L3
CO2	Evaluate signal constellation performance under Rayleigh fading and AWGN using QPSK and M-ary QAM.	L5
CO3	Design and simulate a basic digital communication link including channel impairments.	L6
CO4	Implement adaptive algorithms like LMS and Zero Forcing and compare their effectiveness in noise cancellation.	L4
CO5	Generate and verify properties of m-sequences and Gold sequences used in spread spectrum systems.	L3