VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI.

Scheme of Teaching and Examinations and Syllabus
M.Tech.in Digital Electronics (LDE)
(Effective from the Academic year 2023-24)

SEMESTER –II

ANTENNA THEORY AND DESIGN			
Course Code	**MLDE201**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	(3:2:0)	SEE Marks	50
Total Hours of Pedagogy	40 Hours Theory + 10-12 Lab slots	Total Marks	100
Credits	04	Exam Hours	03

Course Learning objectives: Thiscoursewillenablestudents:

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

MODULE-1

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

MODULE-2

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

MODULE-3

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

MODULE-4

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

MODULE 5

Antenna in systems & Measurements: Receiving properties of antennas, Antenna temperature & radiometry.
CEM for antennas: The method of moments: Introduction of the methods moments, Pocklington's integral equation, Integral equation and Kirchhoff's networking equations, Source modeling weighted residual formulations and computational consideration, Calculation of antenna and scatter characteristics. .
RBT Level: L1, L2, L3

PRACTICAL COMPONENT OF IPCC

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	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
11	**Can be Demo experiments for CIE**
12	**Can be Demo experiments for CIE**

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

1. 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.

2. 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**.
3. The laboratory test at the end /after completion of all the experimentsshall be conducted for **50 marks** and scaled down to **05 marks.**

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

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SEE for IPCC

Theory SEE will be conducted by 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).

4. 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.
5. SEE will be conducted for 100 marks and students shall secure 40% of the maximum marks to qualify in the SEE. Marks secured will be scaled down to 50. (Student has to secure an aggregate of 50% of maximum marks of the course (CIE+SEE)

Suggested Learning Resources:

Textbook:

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

Reference Books:

1. 'Antenna Theory Analysis and Design', C. A. Balanis, John Wiley, 2nd Edition, 2007

2. 'Antennas and Wave Propagation', J. D. Krauss, McGraw Hill TMH, 4th Edition, 2010

3. 'Antennas and propagation', A.R.Harish, M.Sachidanada, Pearson Education, 2015

Web links and Video Lectures (e-Resources):

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

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

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

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	To classify different types of antennas	Understand
CO2	To define and illustrate various types of array antennas	Understand
CO3	To design antennas like Yagi-Uda, Helical antennas and other broad band antennas	Understand
CO4	To describe different antenna synthesis methods	Understand
CO5	To apply methods like Method of Moments, Pocklington's integral equation, Source modelling	Analyze

REAL TIME OPERATING SYSTEM			
Course Code	**MLDE202**	CIE Marks	50
Teaching Hours/Week (L:P: SDA)	3:0:2	SEE Marks	50
Total Hours of Pedagogy	40 Hours Theory	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives: This course will enable students:

1. Analyse issues of On-chip interconnect Modelling and Interconnect delay calculation.
2. Analyse the Switching Characteristics in Digital Integrated Circuits.
3. Use the Dynamic Logic circuits in state-of-the-art VLSI chips.
4. Study critical issues such as ESD protection, Clock distribution, Clock buffering, and Latch phenomenon
5. Use Bipolar and Bi-CMOS circuits in very high speed design.

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 Reentrant Functions.

RBT Level: L1, L2

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.

RBT Level: L1, L2

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

RBT Level: L1, L2

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.**RBT Level: L2, L3**

MODULE 5

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

RBT Level: L1,L2,L3

Assessment Details (both CIE and SEE)

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

Continuous Internal Evaluation:

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

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

Semester End Examination:

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

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

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.

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=yShUSwskUNA
- https://www.youtube.com/watch?v=dHsHP9RrXBw&list=PLz0jrgeMBDX9_GvD5K-6cC_jd9uNTK3R4

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

Activity-based learning for Real-Time Operating Systems (RTOS) involves hands-on, practical activities to understand and apply RTOS concepts, such as task scheduling, resource management, and real-time programming, through coding exercises, simulations, and projects

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	Analyze
CO2	Analyse the Switching Characteristics in Digital Integrated Circuits.	Analyze
CO3	Use the Dynamic Logic circuits in state-of-the-art VLSI chips.	Analyze
CO4	Study critical issues such as ESD protection, Clock distribution, Clock buffering, and Latch phenomenon	Understand
CO5	Use Bipolar and Bi-CMOS circuits in very high speed design.	Understand

Program Outcome of this course

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

Mapping of COS and POs

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

ERROR CONTROL CODING			
Course Code	**MLDE203**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	50
Total Hours of Pedagogy	40 Hours Theory	Total Marks	100
Credits	03	Exam Hours	3

Course Learning objectives: This course will enable students to:

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

Module-1

Information theory: Introduction, Entropy, Source coding theorem, discrete memoryless channel, Mutual Information, Channel Capacity Channel coding theorem (Chap. 5 of Text 1).
Introduction to algebra: Groups, Fields, binary field arithmetic, Construction of Galois Fields GF (2m) and its properties, (Only statements of theorems without proof) Computation using Galois field GF (2m) arithmetic, Vector spaces and Matrices. **RBT Level: L1, L2, L3**

Module-2

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

Module-3

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

Module-4

BCH codes: Binary primitive BCH codes, Decoding procedures, Implementation of Galois field arithmetic. (6.1,6.2,6.7 of Text 2) Primitive BCH codes over GF (q),
Reed -Solomon codes
Majority Logic decodable codes: One -step majority logic decoding, Multiplestep majority logic (8.1,8.4 of Text 2).**RBT Level: L1, L2, L3**

Module-5

Convolution codes: Encoding of convolutional codes: Systematic and Non-systematic Convolutional Codes, Feedforward encoder inverse, Acatastrophic encoder, Structural properties of convolutional codes: state diagram, state table, state transition table, tree diagram, trellis diagram. Viterbi algorithm, Sequential decoding: Log Likelihood Metric for Sequential Decoding.**RBT Level: L1, L2, L3**

Assessment Details (both CIE and SEE)

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

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks**or**oneSkill Development Activity of 40 marks**

to attain the COs and POs

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

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

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.

Suggested Learning Resources:

Textbooks:

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

Reference Books:

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

Web links and Video Lectures (e-Resources):

- NPTEL Course on Information Theory and Coding

Skill Development Activities Suggested

- Mini Projectscanbesuggestedtoimprovethe coding skills.
- Onlinecertificationcoursescan besuggestedin therelatedarea.

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Understand the concept of the Entropy, information rate and capacity for the Discrete memoryless channel.	Understand
CO2	Apply modern algebra and probability theory for the coding.	Apply
CO3	Compare Block codes such as Linear Block Codes, Cyclic codes, etc. and Convolutional codes.	Apply
CO4	Detect and correct errors for different data communication and storage systems.	Apply
CO5	Analyze and implement different Block code encoders and decoders, and also convolutional encoders and decoders including soft and hard Viterbi algorithm.	Apply

Program Outcome of this course

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

Mapping of COS and POs

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

MULTIMEDIA OVER COMMUNICATION SYSTEM			
Course Code	**MLDE204**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	(2:0:2)	SEE Marks	50
Total Hours of Pedagogy	40 Hours Theory	Total Marks	100
Credits	03	Exam Hours	3

Course Learning objectives: This course will enable students to:

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

Module-1

Multimedia Communications: Introduction, Multimedia information representation, multimedia networks, multimedia applications, Application and networking terminology.

RBT Level: L1, L2

Module-2

Information Representation: Introduction, Text, Images, Audio and Video.

Distributed multimedia systems: Introduction, main Features of a DMS, Resource management of DMS, Networking, and Multimedia Operating Systems. **RBT Level: L1, L2, L3, L4**

Module-3

Multimedia Processing in Communication: Introduction, Perceptual coding of digital Audio signals, Transform Audio Coders, Audio Sub band Coders.

RBT Level: L1, L2

Module-4

Multimedia Communication Standards: Introduction, MPEG approach to multimedia standardization, MPEG-1, MPEG-2, Overview of MPEG-4.

RBT Level: L1, L2, L3

Module-5

Multimedia Communication Across Networks: Packet audio/video in the network environment, Video transport across generic networks, Multimedia Transport across ATM Networks.**RBT Level: L1, L2, L3**

Assessment Details (both CIE and SEE)

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

Continuous Internal Evaluation:

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

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

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

Semester End Examination:

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

Suggested Learning Resources:

Textbooks:

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

Reference Books:

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

Web links and Video Lectures (e-Resources):

https://onlinecourses.nptel.ac.in/noc20_ph07/preview

https://www.classcentral.com/course/swayam-optical-communications-6699

Skill Development Activities Suggested

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

Suggested Simulation Packages: Promodel

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

Course outcome (Course Skill Set)

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

Program Outcome of this course

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

Mapping of COS and POs

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

DIGITAL CIRCUITS SIMULATION LABORATORY			
CourseCode	**MLDEL207**	CIEMarks	50
TeachingHours/Week(L:T:P: S)	0:4:0:0	SEE Marks	50
Credits	**2**	Total	100
		Exam Hours	3

Courseobjectives: This course will enable students:

- To understand the digital circuits using graphical programming tool LabVIEW.
- To understand the interfaces and observe the results with digital circuits.
- To learn and develop Verilog Programs for Digital Circuit design.
- To analyze digital systems on FPGA/CPLD.
- To analyze and validate digital systems using Logic analyzer/Chipscope.

Part A:

Graphical Programming using LabVIEW.

Sl.No.	Experiments
1	Design of 4 bit Adders (CLA, CSA, CMA, Parallel adders)
2	Design of Binary Subtractors
3	Design of Encoder (8 x 3), Decoder(3 x 8)
4	Design of Multiplexer (8 x 1) and De-multiplexer (1 x 8)
5	Design of code converters & Comparator
6	Design of FF (SR, D, T, JK, and Master Slave with delays)
7	Design of registers using latches and flip-flops
8	Design of 8-bit Shift registers
9	Design of Asynchronous & Synchronous Counters

PART-B:

Develop Verilog Program for design and testing the followingdigital circuits (for 4/8 bits) using FPGA/CPLD. Use logicanalyzer/Chipscope for the verification of results.

(Note: Programming can be done using any complier. Download theprograms on FPGA/CPLD boards and performance testing may bedone using pattern generator (32 channels and logic analyzer)/Chipscope pro. Implementing the above designs onXilinx/Altera/Cypress/equivalent based FPGA/CPLD kits.)

Sl.No.	Experiments
1	Carry skip and carry look ahead adder
2	BCD adder and subtractor
3	Array Multiplication (signed and unsigned)
4	Booth multiplication (radix-4)
5	Magnitude comparator
6	LFSR
7	Parity generator
8	Universal Shift Register
9	Sequence generation (11101 say) using Mealy/Moore FSM

Note: Conduct the experiments using C/NS2/Qualnet/OPNET/OMNETsimulation

toolsCourseoutcomes(CourseSkillSet):

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

1. Simulate the digital circuits using graphical programming tool LabVIEW.
2. Build user friendly interfaces to interact with the digital circuits and to observe the outputs.
3. Develop Verilog Programs for Digital Circuit design simulation.
4. Implementdigital systems on FPGA/CPLD.
5. Test and validate digital systems using Logic analyzer/Chipscope.

AssessmentDetails(bothCIEandSEE)

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 havesatisfied the academic requirements and earned the credits allotted to each course. The student has to securenot less than 40%of maximum marksinthe semester-endexamination (SEE). Intotal of CIEandSEEstudenthasto secure 50%maximummarks ofthe course.

ContinuousInternalEvaluation(CIE):

CIE marksforthepracticalcourse is**50Marks**.

Thesplit-upofCIE marksforrecord/journal andtest areintheratio**60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics forthe evaluation of the journal/write-up for hardware/software experiments designed by the faculty who ishandlingthelaboratorysessionandis madeknown tostudentsatthebeginningofthepracticalsession.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will beevaluatedfor 10 marks.
- Total marksscoredbythestudentsarescaleddownedto 30marks (60%of maximummarks).
- Weightagetobegivenforneatnessandsubmissionofrecord/write-upontime.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of thesemesterandthe second testshallbeconductedafter the 14thweekofthe semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge willcarrya weightage of60%and therest40%for viva-voce.
- Thesuitablerubricscanbedesignedto evaluateeachstudent'sperformanceandlearningability.
- Theaverageof02testsis scaleddownto **20marks**(40%of themaximummarks).

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

SemesterEndEvaluation(SEE):

SEEmarksforthepracticalcourseis 50Marks.

SEEshallbeconductedjointlybythetwoexaminersofthesameinstitute;examinersareappointedbytheUniversity.

- All laboratoryexperimentsaretobeincludedforpracticalexamination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to bestrictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall bedecidedjointlybyexaminers.
- Students can pick one question (experiment) from the questions lot prepared by the internal /externalexaminersjointly.
- Evaluationoftest write-up/ conductionprocedureandresult/vivawillbeconductedjointlybyexaminers.
- GeneralrubricssuggestedforSEEarementionedhere,writeup-20%,Conductionprocedureandresultin -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scoredmarks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by theexaminers)
- Change of experiment is allowed only once and 10% Marks allotted to the procedure part to be madezero.

Theduration of SEE is 03Hours.

Professional Elective 1

WIRELESS SENSOR NETWORKS			
Course Code	**MLDE215A**	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: Thiscoursewillenablestudentsto:

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

Module-1

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

Module-2

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

Module-3

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

Module-4

Transport Layer: Challenges for Transport Layer, Reliable Multi Segment Transport (RMST) Protocol, Pump Slowly, Fetch Quickly (PSFQ) Protocol, Congestion Detection and Avoidance (CODA) Protocol, Event-to-Sink Reliable Transport (ESRT) Protocol, GARUDA

Application Layer: Source Coding (Data Compression), Query Processing, Network Management (Chap. 9 Text 1). **RBT Level: L1, L2, L3, L4**

Module-5

SPREAD SPECTRUM SIGNALS FOR DIGITAL COMMUNICATION: Model of spread spectrum digital communication system, Direct sequence spread spectrum signals, some applications of DS spread spectrum signals, generation of PN sequences, Frequency hopped spreadspectrum signals, Time hopping SS, Synchronization of SS systems. **RBT Level: L1, L2**

Assessment Details (both CIE and SEE)

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

Continuous Internal Evaluation:

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

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

Semester End Examination:

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

Suggested Learning Resources:

Books:

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

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

Web links and Video Lectures (e-Resources):

Massive Open Online Courses:

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

Skill Development Activities Suggested

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

Course outcome (Course Skill Set)

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

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

Program Outcome of this course

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

Mapping of COS and POs

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

CRYPTOGRAPHY AND NETWORK SECURITY			
Course Code	**MLDE215B**	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 outcomes: This course will enable students to:

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

Module-1

Foundations: Terminology, Steganography, substitution ciphers and transpositions ciphers, Simple XOR, One-Time Pads, Computer Algorithms

SYMMETRIC CIPHERS: Traditional Block Cipher structure, Data Encryption Standard (DES), The AES Structure, AES Key Expansion. **RBT Level: L1, L2**

Module-2

More Number Theory: Prime Numbers, Fermat's and Euler's theorem, Testing for Primality, The Chinese Remainder theorem, Discrete Logarithms.

Principles of Public-Key Cryptosystems, The RSA algorithm, Diffie - Hellman Key Exchange, Elliptic Curve Arithmetic, Elliptic Curve Cryptography.

RBT Level: L1, L2, L3

Module-3

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

RBT Level: L1, L2, L3

Module-4

One-Way Hash Functions: Background, Snefru, N-Hash, MD4, MD5, Secure Hash Algorithm [SHA], One way hash functions using symmetric block algorithms, Using public key algorithms, Choosing a one-way hash functions, Message Authentication Codes.

Digital Signature Algorithm, Discrete Logarithm Signature Scheme

RBT Level: L1, L2, L3

Module-5

E-mail Security: Pretty Good Privacy-S/MIME.

IP Security: IP Security Overview, IP Security Policy, Encapsulation Security Payload (ESP)

.

Web Security: Web Security Considerations, SSL.

RBT Level: L1, L2

Assessment Details (both CIE and SEE)

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

Continuous Internal Evaluation:

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

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

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

Semester End Examination:

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

Suggested Learning Resources:

Textbooks:

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

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

Reference Books:

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

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

Web links and Video Lectures (e-Resources):

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

Skill Development Activities Suggested

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

Course outcome (Course Skill Set)

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

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

Program Outcome of this course

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

Mapping of COS and POs

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

DIGITAL COMPRESSION			
Course Code	**MLDE215C**	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: This course will enable students:

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.

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.

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 Level: L1, L2

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 Level: L1, L2**

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 Level: 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 Level: L1,L2,L3

Assessment Details (both CIE and SEE)

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

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks.**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs.
3. The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

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

Semester End Examination:

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

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

Textbook:

'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

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Explain the evolution and fundamental concepts of Data Compression and Coding techniques.	Understand
CO2	Acquire contemporary knowledge in Data Compression and Coding.	Understand
CO3	Analyze the operation of a range of commonly used Coding and Compression techniques	Analyze
CO4	Identify the basic software and hardware tools used for data compression.	Apply
CO5	Analyze and evaluate the performance of different Data Compression and Coding methods	Analyze

Program Outcome of this course

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

Mapping of COS and POs

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

NANOELECTRONICS			
Course Code	**MLDE215D**	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: This course will enable students to:

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

Module-1

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

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

Module-2

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

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

Module-3

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

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

Module-4

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

ballistic carrier transport, Inter band absorption, intra band absorption, Light emission processes, phonon bottleneck, quantum confined stark effect, nonlinear effects, coherence and dephasing, characterization of semiconductor nanostructures: optical electrical and structural (Text1). **RBT Level: L1, L2, L3**

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

Module-5

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

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

Assessment Details (both CIE and SEE)

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

Continuous Internal Evaluation:

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

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

Semester End Examination:

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

Suggested Learning Resources:

Textbooks:

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

Reference Book:

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

Web links and Video Lectures (e-Resources):

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

Skill Development Activities Suggested

- Seminar on recent applications of Carbon nano tubes

Course outcome (Course Skill Set)

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

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

Program Outcome of this course

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

Mapping of COS and POs

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

Professional Elective 2

AUTOMOTIVE ELECTRONICS			
Course Code	**MLDE216A**	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: This course will enable students:

1.Implement various control requirements in the automotive system.

2. Comprehend dashboard electronics and engine system electronics.

3. Identify various physical parameters that are to be sensed and monitored for maintaining the stability of the vehicle under dynamicconditions.

4. Understand and implement the controls and actuator system pertainingto the comfort and safety of commuters.

5. Design sensor network for mechanical fault diagnostics in an automotive vehicle.

MODULE-1

Automotive Fundamentals, the Systems Approach to Control and Instrumentation:Use of Electronics in the Automobile, Antilock Brake Systems(ABS), Electronic steering control, Power steering, Tractioncontrol, Electronically controlled suspension. .

RBT Level: L1, L2

MODULE-2

Automotive instrumentation Control: Operational amplifiers, Digital circuits, Logic circuits, Microcomputer fundamentals, Microcomputer operations, Microprocessor architecture, digital to analog converter, analog to digital converter, Microcomputer applications in automotive systems, Instrumentation applications of microcomputers, Microcomputer in control systems.

RBT Level: L1, L2

MODULE-3

The basics of Electronic Engine control: Integrated body: Climate controls, Motivation for Electronic Engine Control, Concept of An Electronic Engine Control System,Definition of General Terms, Definition of Engine Performance Terms, Electronic fuel control system, Engine control sequence, Electronic Ignition, Sensors and Actuators, Applications of sensors and actuators, air flow rate sensor, Indirect measurement of mass air flow, Engine crankshaft angular position sensor,Automotive engine control actuators, Digital engine control,Engine speed sensor, Timing sensor for ignition and fuel delivery,Electronic ignition control systems, Safety systems, Interior safety, Lighting, Entertainment systems. **RBT Level: L1, L2**

MODULE 4

Vehicle Motion Control and Automotive diagnostics: Cruisecontrol system, Digital cruise control, Timing light, Engineanalyzer, On-board and off-board diagnostics, Expert systems.Stepper motor-based actuator, Cruise control electronics,Vacuum - antilock braking system, Electronic suspension system Electronic steering control, Computer-based instrumentation system, Sampling and Input\output signal conversion, Fuelquantity measurement, Coolant temperature measurement, Oilpressure measurement, Vehicle speed measurement, Display devices, Trip-Information-Computer, Occupant protection systems.**RBT Level: L2, L3**

MODULE 5

Future automotive electronic systems: Alternative Fuel Engines, Collision Wide Range Air/Fuel Sensor,Alternative Engine, Low Tire Pressure Warning System, Collisionavoidance Radar Warning Systems, Low Tire Pressure Warning System, Radio Navigation, Advance Driver information System.Alternative-Fuel Engines, Transmission Control, Collision Avoidance Radar Warning System, Low Tire Pressure WarningSystem, Speech Synthesis Multiplexing in Automobiles, Control Signal Multiplexing, Navigation Sensors, Radio Navigation, Signpost Navigation, Dead Reckoning Navigation Future Technology, Voice Recognition Cell Phone Dialling Advanced Driver information System, Automatic Driving Control. .**RBT Level: L1,L2,L3**

Text Book:

'Understanding Automotive Electronics', William B. Ribbens,SAMS/Elsevier publishing, 6thEdition, 1997.

Reference Book:

'Automotive Electrics and Automotive Electronics-Systems and Components, Networking and Hybrid Drive', Robert Bosch Gmbh,Springer Verlag,5thEdition, 2007.

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Implement various control requirements in the automotive system.	Understand
CO2	Comprehend dashboard electronics and engine system electronics.	Analyze
CO3	Identify various physical parameters that are to be sensed and monitored for maintaining the stability of the vehicle under dynamicconditions.	Analyze
CO4	Understand and implement the controls and actuator system pertainingto the comfort and safety of commuters.	Understand
CO5	Design sensor network for mechanical fault diagnostics in an automotive vehicle.	Understand

Program Outcome of this course

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

Mapping of COS and POs

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

SOC DESIGN			
Course Code	**MLDE216B**	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: This course will enable students:

1. Apply the 3- and 5-stage pipeline ARM processor cores and analyse the implementation issues.
2. Use the concepts and methodologies employed in designing a System- on chip (SoC) based around a microprocessor core and in designing the microprocessor core itself.
3. Understand how SoCs and microprocessors are designed and used, and why a modern processor is designed the way that it is.
4. Use integrated ARM CPU cores (including StrongARM) that incorporate full support for memory management.
5. Analyze the requirements of a modern operating system and use the ARM architecture to address the same.

MODULE-1

ARM Organization and Implementation: 3-stage pipeline ARM organization, 5-stage pipeline ARM organization, ARM instruction execution, ARM implementation, The ARM coprocessor interface. The ARM Instruction Set: Introduction, Exceptions, Conditional execution, Branch and Branch with Link (B, BL), Branch, Branch with Link and exchange (BX, BLX), Software Interrupt (SWI), Data processing instructions, Multiply instructions, Count leading zeros (CLZ - architecture v5T only), Single word and unsigned byte data transfer instruction, Half-word and signed byte data transfer instructions, Multiple register transfer instructions, Swap memory and register instructions (SWP), Status register to general register transfer instructions, General register to status register transfer instructions, Coprocessor instructions, Coprocessor data operations, Coprocessor data transfers, Coprocessor register transfers, Breakpoint instruction (BRK - architecture v5T only), Unused instruction space, Memory faults, ARM architecture

MODULE-2

Architectural Support for High-Level Languages: Abstraction in software design, Data types, Floating-point data types, The ARM floating-point architecture, Expressions, Conditional statements, Loops, Functions and procedures, Use of memory, Run-time environment. Architectural Support for System Development: The ARM memory interface, The Advanced Microcontroller Bus Architecture (AMBA), The ARM reference peripheral specification, Hardware system prototyping tools, The ARMulator, The JTAG boundary scan test architecture, The ARM debug architecture, Embedded Trace, Signal processing support. **RBT Level: L1, L2**

MODULE-3
ARM Processor Cores: ARM7TDMI, ARM8, ARM9TDMI, ARM10TDMI, Discussion, Example and exercises. Memory Hierarchy: Memory size and speed, On-chip memory, Caches, Cache design - an example, Memory management, Examples and exercises.**RBT Level: L1, L2**
MODULE 4
Architectural Support for Operating Systems: An introduction to operating systems, The ARM system control coprocessor, CP15 protection unit registers, ARM protection unit, CP15 MMU registers, ARM MMU architecture, Synchronization, Context switching, Input/ Output, Example and exercises. ARM CPU Cores: The ARM710T, ARM720T and ARM740T, The ARM810, The Strong ARM SA-110, The ARM920T and ARM940T, The ARM946E-S and ARM966E-S, The ARM1020E, Discussion, Example and exercises. **RBT Level: L2, L3**
MODULE 5
Embedded ARM Applications: The VLSI Ruby II Advanced Communication Processor, The VLSI ISDN Subscriber Processor, The One C™VWS22100 GSM chip, The Ericsson-VLSI Bluetooth Baseband Controller, The ARM7500 and ARM7500FE, The ARM7100 364, The SA-1100 368, Examples and exercises. The AMULET Asynchronous ARM Processors: Self-timed design 375, AMULET1 377, AMULET2 381, AMULET2e 384, AMULET3 387, The DRACO telecommunications controller 390, A self-timed future? 396, Example and exercises. **RBT Level: L1,L2,L3**
Assessment Details (both CIE and SEE) The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together. **Continuous Internal Evaluation:** 1. Three Unit Tests each of **20 Marks** 2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks. CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.** **Semester End Examination:** 1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50. 2. The question paper will have ten full questions carrying equal marks. 3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.

4. Each full question will have a sub-question covering all the topics under a module.

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

Text Book:

'ARM System-On-Chip Architecture', Steve Furber, Addison Wesley, 2nd edition.

Reference Books:

1. 'The Definitive Guide to the ARM Cortex-M3', Joseph Yiu, Newnes, (Elsevier), 2nd edition,2010.
2. 'On-Chip Communication Architectures: System on Chip Interconnect', Sudeep Pasricha and NikilDutt, Morgan Kaufmann Publishers, 2008.
3. 'Reuse Methodology Manual for System on Chip designs', Michael Keating, Pierre Bricaud, Kluwer Academic Publishers, 2nd edition, 2008

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Apply the 3- and 5-stage pipeline ARM processor cores and analyse the implementation issues	Understand
CO2	Use the concepts and methodologies employed in designing a System- onchip (SoC) based around a microprocessor core and in designing the microprocessor core itself.	Analyze
CO3	Understand how SoCs and microprocessors are designed and used, and why a modern processor is designed the way that it is.	Analyze
CO4	Use integrated ARM CPU cores (including StrongARM) that incorporate full support for memory management.	Understand
CO5	Analyze the requirements of a modern operating system and use the ARM architecture to address the same.	Understand

Program Outcome of this course

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

Mapping of COS and POs

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

Micro Electro Mechanical Systems			
Course Code	**MLDE216C**	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: This course will enable students:

1. Understand the technologies related to Micro Electro Mechanical Systems.
2. Relate to the scaling laws in miniaturization.
3. Analyse the MEMS devices and develop suitable mathematical models
4. Understand the various application areas for MEMS devices
5. Describe the design and fabrication processes involved with MEMS devices.

MODULE-1

Overview of MEMS and Microsystems: MEMS and Microsystem, Typical MEMS and Microsystems Products, Evolution of Microfabrication, Microsystems and Microelectronics, Multidisciplinary Nature of Microsystems, Miniaturization. Applications and Markets.

RBT Level: L1, L2

MODULE-2

Working Principles of Microsystems: Introduction, Microsensors, Microactuation, MEMS with Microactuators, Microaccelerometers, Microfluidics.

Engineering Science for Microsystems Design and Fabrication:

Introduction, Atomic Structure of Matters, Ions and Ionization, Molecular Theory of Matter and Inter-molecular Forces, Doping of Semiconductors, The Diffusion Process, Plasma Physics, Electrochemistry.**RBT Level: L1, L2**

MODULE-3

Engineering Mechanics for Microsystems Design: Introduction, Static Bending of Thin Plates, Mechanical Vibration, Thermomechanics, Fracture Mechanics, Thin Film Mechanics, Overview on Finite Element Stress Analysis.**RBT Level: L1, L2**

MODULE 4

Introduction, Scaling in Geometry, Scaling in Rigid-Body Dynamics, Scaling in Electrostatic Forces, Scaling of Electromagnetic Forces, Scaling in Electricity, Scaling in Fluid Mechanics, Scaling in Heat Transfer.**RBT Level: L2, L3**

MODULE 5

Overview of Micro-manufacturing: Introduction, Bulk Micro-manufacturing, Surface Micromachining, The LIGA Process, Summary on Micro manufacturing.

Microsystem Design: Introduction, Design Considerations, Process Design, Mechanical Design, Using Finite Element Method.**RBT Level: L1,L2,L3**

Text Book:

'MEMS and Micro systems: Design, Manufacture and Nanoscale Engineering', Tai-Ran Hsu, John Wiley & Sons, ISBN: 978-0470-08301-7,2nd Edition, 2008

Reference Books:

1. 'Micro and Nano Fabrication: Tools and Processes', Hans H. Gatzen, Volker Saile, Jurg Leuthold, Springer, 2015
2. 'Micro Electro Mechanical Systems (MEMS)', Dilip Kumar Bhattacharya, Brajesh Kumar Kaushik, Cengage Learning.

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 technologies related to Micro Electro Mechanical Systems.	Understand
CO2	Relate to the scaling laws in miniaturization.	Analyze
CO3	Analyse the MEMS devices and develop suitable mathematical models	Analyze
CO4	Understand the various application areas for MEMS devices	Understand
CO5	Describe the design and fabrication processes involved with MEMS	Understand

Program Outcome of this course

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

Mapping of COS and POs

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

Advanced Control System			
Course Code	**MLDE216D**	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: This course will enable students:

1. Derive the pulse transfer function for various closed loop configurationsand understand the stability analysis of sampled data control systems.
2. Apply state space techniques to model linear continuous and discrete time systems, convert state space (SS) representations to transfer function (TF)representation and vice versa.
3. Apply controllability and observability tests.
4. Solve the optimal control problems using state variable approach andknowledge of adaptive control systems.
5. Understand the types of nonlinearities, characteristics of Non-linear systems and the stability analysis of Non-linear control systems.

MODULE-1

Digital Control Systems: Review of Difference equations, Z – transformsand Inverse Z transforms, The Z- transfer function(Pulse transfer function), The Z - Transform Analysis of Sampleddata Control Systems, The Z and S - domain relationship, Stabilityanalysis (Jury's Stability Test and Bilinear Transformation**RBT Level: L1, L2**

MODULE-2

State Models & Solution of State equations: State models for Linear Continuous Time and Linear Discrete Time systems,Diagonalization, Solution of State Equations (for both Continuousand Discrete Time systems), Relevant problems.**RBT Level: L1, L2**

MODULE-3

State Feedback Systems: Concepts of Controllability and Observability (for both Continuous and Discrete Time systems),Pole Placement by State Feedback (for both continuous anddiscrete Time systems), Observer System (Full order and Reducedorder observers for both Continuous and Discrete Time systems),Relevant problems**RBT Level: L1, L2**

MODULE 4

Regulators: Dead beat Control by State Feedback, Optimal control problems using State Variable approach, State regulator andOutput regulator, Concepts of Model Reference Adaptive Control(MRAC). **RBT Level: L2, L3**

MODULE 5

Nonlinear Control Systems: Behaviour of Nonlinear Systems, Common Physical Nonlinearities, Describing Function Method,Stability Analysis by Describing Function Method, Phase

PlaneMethod, Stability Analysis by Phase Plane Method.

RBT Level: L1,L2,L3

Assessment Details (both CIE and SEE)

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

Continuous Internal Evaluation:

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

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

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

Semester End Examination:

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

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

Text Book:

1. 'Control Systems Engineering', IJ Nagrath&MGopal, New Age International Publishers, Fifth edition, 2007.

2. 'Discrete Time Control Systems', K Ogata, 2ndedition, PHI, 2009.

Reference Books:

1. 'Modern Control Engineering', K Ogata, PHI, 5thEdition, 2010.

2. 'Modern Control System Theory', M Gopal,New Age International, 2012.

3. 'Digital Control and State Variable methods', M Gopal, TataMcGrawHill, 4 thedition, 2012.

4. 'Advanced Control Theory', A Nagoorkani, RBA publications, 2006.

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Derive the pulse transfer function for various closed loop configurations and understand the stability analysis of sampled data control systems	Design
CO2	Apply state space techniques to model linear continuous and discrete time systems, convert state space (SS) representations to transfer function (TF)representation and vice versa.	Apply
CO3	Apply controllability and observability tests.	Apply
CO4	Solve the optimal control problems using state variable approach and knowledge of adaptive control systems.	Analyse
CO5	Understand the types of nonlinearities, characteristics of Nonlinear systems and the stability analysis of Nonlinear control systems	Understand

Program Outcome of this course

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

Mapping of COS and POs

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

ABILITY/SKILL ENHANCEMENT COURSE (OFFLINE/ONLINE)

Modeling and Simulation of Antenna Using Simulation Tool			
Course Code	MLDE258A	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:0:2:0 / 1:0:0:0	SEE Marks	50
Credits	**1**	Total	100
		Exam Hours	02 / 01

Course objectives:

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

Sl.NO	**Experiments**
1	Design and simulate 1 GHz dipole antenna using suitable high frequency simulation tool, for return loss and gain characteristics.
2	Create and simulate a 5 element Yagi-Uda antenna using a copper wire with given data (a) Resonance frequency of 3 GHz (b) wire diameter of 1 mm. Study return Loss (RL) and gain characteristics
3	Design, model and simulate microstrip patch antenna at 2.45 GHZ for blue-tooth applications. Study its radiation pattern in terms of E and H plane.
4	Design, model and simulate 2 element MIMO antennas for 5G applications in Frequency Range-1. Perform isolation analysis and return loss characterization.
5	Design, model and simulate 4 element array antennas for a suitable frequency and study (a) Return loss characteristics (b) gain (c) radiation pattern.
6	Design, model and simulate normal mode helical antenna (NMHA) at 1.8 GHz. Study its return loss characteristics and effect of wire radius (between λ/180 to λ/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	MLDE258B	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:0:2:0 / 1:0:0:0	SEE Marks	50
Credits	1	Total	100
		Exam Hours	02 / 01

Course objectives:

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

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

Course outcomes (Course Skill Set):

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

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

Assessment Details (both CIE and SEE)

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

Continuous Internal Evaluation (CIE):

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

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

- Each experiment to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- **Total marks scored by the students are scaled down to 30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 01 tests for 100 marks, test shall be conducted after the 14th week of the semester.
- In test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- **The test marksis scaled down to 20 marks** (40% of the maximum marks).

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

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

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

All laboratory experiments are to be included for practical examination.
(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.
Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.
General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and

result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 10% Marks allotted to the procedure part to be made zero.

The duration of SEE is 03 hours

Suggested Learning Resources:

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

Python Programming			
Course Code	MLDE258C	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