B.N.M. Institute of Technology

An Autonomous Institution under VTU, Approved by AICTE

Department of Mathematics

Syllabus

Semester: III			
Course: Fourier Series, Transforms and Statistical Techniques **Course Code: 23MAE131 (Common to ECE, EEE & ME)**			
L:T:P:J	**2:2:0:0**	**CIA**	**: 50**
Credits:	**03**	**SEA**	**: 50**
Hours:	**40**	**SEA Duration**	**: 03 Hours**

Course Learning Objectives: The students will be able to develop the theoretical and practical knowledge of Statistical methods, Laplace transform, Fourier series, Fourier transforms and Z-transforms in a comprehensive manner in various fields of engineering.

Module-1: Curve fitting & Statistical methods	No. of hours	Blooms cognitive Levels
Examples from Engineering field that require curve fitting and statistical methods. **Curve Fitting:** Curve fitting by the method of least squares-fitting the curves of the form: $y = ax+b$, $y = ax^2 + bx + c$ and $y = ax^b$. **Statistical methods:** Introduction to Moments, Skewness, Kurtosis and problems. Karl Pearson's coefficient of correlation and lines of regression. *Experiential Learning component: Problems on curve fitting and statistical methods*	**L: 04** **T: 04**	**Apply**
Module-2: Laplace Transform		
Examples from Engineering field that require Laplace transforms. Transformation for time domain to frequency domain. Definition and Laplace transforms of elementary functions (statements only). Laplace transform of $e^{at} f(t)$, $t^n f(t)$, $\frac{f(t)}{t}$, $\int_0^t f(t)dt$ and $f^n(t)$ (without proof). Laplace transforms of Periodic functions, unit-step function and unit impulse function. *Experiential Learning component: Finding the Laplace transforms of a function .*	**L: 04** **T: 04**	**Apply**
Module-3: Inverse Laplace Transform		
Examples from Engineering field that require inverse Laplace transforms. Definition and problems. Inverse Laplace transform using convolution theorem (without proof). Solution of linear differential equations and simultaneous differential equations. Applications to engineering problems. *Experiential Learning component: Problems on convolution theorem.*	**L: 04** **T: 04**	**Apply**
Module-4: Fourier Series		
Examples from Engineering field that require Fourier series. Periodic functions, Introduction to Fourier Series, Dirichlet's condition. Fourier series of periodic functions with period 2π and arbitrary period. Half range Fourier sine and cosine series. Practical harmonic analysis over the interval *(0, 2l).* *Experiential Learning component: Finding the Fourier series.*	**L : 04** **T : 04**	**Apply**
Module-5: Fourier Transforms & Z -Transforms		
Examples from Engineering field that require Fourier Transforms & Z -Transforms. **Fourier Transforms:** Fourier transform and properties-problems, Fourier sine and cosine transforms. Inverse Fourier transforms. **Z-Transforms:** Introduction to Z-transform, Z-transform of standard functions and properties (without proof). Initial value and final value theorems, problems. *Experiential Learning component: Finding the Fourier transforms & Z –Transforms of a function.*	**L : 04** **T : 04**	**Apply**

Course Outcomes: After completing the course, the students will be able to

CO 1: Make use of correlation and regression analysis to fit a suitable mathematical model for the statistical data.

CO 2: Use Laplace transform to find the transformation for time domain to frequency domain.

CO 3: Use inverse Laplace transform in solving differential equations arising in network analysis, control system and other fields of engineering

CO 4: Demonstrate Fourier series to study the behavior of periodic functions and their applications in system communications, digital signal processing and field theory.

CO 5: Make use of Fourier transform and Z-transform to illustrate discrete / continuous function arising in wave and heat propagation, signals and systems.

Reference Books:

1. E. Kreyszig: "Advanced Engineering Mathematics", John Wiley & Sons, 10"Ed.(Reprint), 2016.
2. B. S. Grewal: "Higher Engineering Mathematics", Khanna Publishers, 44th Ed., 2017.
3. H. K. Dass, " Advanced Engineering Mathematics" S. Chand publication.
4. C. Ray Wylie, Louis C. Barrett : "Advanced Engineering Mathematics", 6" Edition, 2. McGraw-Hill Book Co., New York, 1995.
5. James Stewart : "Calculus —Early Transcendentals", Cengage Learning India Private Ltd., 2017.
6. B.V. Ramana: "Higher Engineering Mathematics" 11th Edition, Tata McGraw-Hill, 2010.
7. Srimanta Pal & Subodh C Bhunia: "Engineering Mathematics", Oxford University Press, 3 Reprint, 2016.
8. Gupta C. B., Singh S. R. and Mukesh Kumar: "Engineering Mathematics for Semester I & II", Mc-Graw Hill Education (India) Pvt. Ltd., 2015.

Web links and Video Lectures:

1. https://youtu.be/BsVtMnp3vks
2. https://youtu.be/Nz4WB8-gNBg
3. https://youtu.be/6MXMDrs6ZmA
4. https://youtu.be/r18Gi8lSkfM
5. https://youtu.be/cy_KI_FiS7I
6. https://youtu.be/sMYtHaSIXbU

Marks Distribution for Assessment:

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B.N.M. Institute of Technology

An Autonomous Institution under VTU

Dept. of Electronics and Communication Engineering
Choice Based Credit System (CBCS and Outcome Based Education (OBE))

Semester: III

Course Name: Network Analysis		**Course Code:23ECE132**
L: T: P: J	**2: 2: 0 :0**	**CIA Marks:** 50
Credits:	**3**	**SEA Marks:** 50
Hours	**40**	**SEA Duration:** 03 Hours

Pre-Requisites: Basic Electrical Concepts, Mathematical Preliminaries.

Course Learning Objectives: This course will enable students to:

1	Understand the basic network concepts, source transformation, mesh analysis, nodal analysis in analyzing the electrical circuits.
2	Gain the knowledge of various Network Theorems in analyzing the electrical circuits.
3	Introduce the behavior of networks subjected to transient conditions.
4	Use the applications of Laplace transforms to solve electrical circuits.
5	Study two port network parameters like Z, Y, h and T and their inter-relationships. Also, study the series and parallel resonance.

Module-1: Basic Concepts	**No. of Hours**	**Blooms Cognitive Levels/CO Mapping**
Basic Concepts, Classification of Electrical Networks, Source Transformation**,** Loop and Node analysis with linearly dependent and independent sources for DC and AC networks.	**8**	**Apply CO1**
Module–2: Network Theorems		
Superposition Theorem, Thevenin's and Norton's theorems, Maximum Power transfer theorem, Millman's Theorem. (Applicable only for independent sources only).	**8**	**Apply CO2**
Module–3: Transient Behavior and Initial Conditions		
Behavior of R, L, C components under switching conditions and their representations, evaluation of initial and final conditions in RL, RC and RLC circuits for DC excitations.	**8**	**Apply CO3**
Module–4: Laplace Transform and Its Applications		
Definition of Laplace transform, Laplace transform of Step, Ramp, Impulse functions, Initial and Final value theorem, solution of networks using Laplace transform, waveform Synthesis, solution of simple RL, RC, and RLC circuits for DC excitations using Laplace transforms.	**8**	**Apply CO4**
Module–5: Two Port Network Parameters		
Definition of Z, Y, h and Transmission parameters, modeling with these parameters, Network Analysis using of two port networks, Relationship between Parameters. **Resonance:** Series and parallel resonance, frequency response of series and parallel circuits, Q-factor, Bandwidth.	**8**	**Apply CO5**

Course Outcomes: After completing the course, the students will be able to	
23ECE132.1	Apply the concepts of source transformation, mesh analysis, and node analysis to solve and analyze the electrical circuits.
23ECE132.2	Apply network theorems such as Superposition, Thevenin's, Norton's, Maximum Power Transfer Theorem, and Millman's Theorem to solve and analyze the various electrical networks.
23ECE132.3	Evaluate the initial and final conditions in passive circuits and apply them for the RL, RC, and RLC electrical networks.
23ECE132.4	Apply and analyze the various electrical networks using Laplace transform.
23ECE132.5	Solve the given network using specified two port network parameters. Also, apply and analyze the concept of series and parallel resonance for RLC networks.
23ECE132.6	Apply and analyze the various applications of electrical networks.

Reference Books

1. Network Analysis, M.E. Van Valkenberg, Prentice Hall of India, 3rd Edition, 2010.
2. Networks and Systems, Roy Choudhury, 2nd Edition, New Age International Publications, 2013.
3. Engineering Circuit Analysis, Hayt, Kemmerly and Durbin, 7th Edition, Tata McGraw-Hill Education, 2010.
4. Network Analysis and Synthesis, Ravish R. Singh, 2nd Edition, Tata McGraw-Hill Education, 2013.
5. Circuit Theory (Analysis and Synthesis), A Chakrabarti, Dhanpat Rai and Co, 2013.
6. Circuits, A. Bruce Carlson, 2nd Edition, Thomson Publishers, 2009.

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B.N.M. Institute of Technology

An Autonomous Institution under VTU

B.E. (Electronics and Communication Engineering)

Choice Based Credit System (CBCS and Outcome Based Education (OBE)

Semester: III

COURSE: Data Structures using C		**Course Code: 23ECE133**
L: T:P: J	**2:0:2:0**	**CIA Marks:** 50
Credits:	**3**	**SEA Marks:** 50
Hours:	**40**	**SEA Duration: 03** Hours

Pre-Requisites: Basic C Programming knowledge

Course Learning Objectives: The students will be able to

1	Understand the role of data structures and time complexity analysis in algorithms.
2	Analyze the linear data structures arrays and linked lists with the operations performed.
3	Illustrate the concept of linear data structures stacks and queues with the operations performed.
4	Illustrate the working of non-linear tree data structure, operations performed and applications
5	Demonstrate the non-linear data structure – graphs and their applications along with sorting and searching algorithms. Also, apply the above data structures suitably to solve practical problems.

Module-1: INTRODUCTION TO DATA STRUCTURES & ALGORITHMS

Teaching component:	**No. of Hrs**	**Bloom's Taxonomy Levels**
Introduction and Overview: Introduction, Basic Terminology, Elementary Data Organization, Data Structures, Data Structure Operations, Abstract Data Types (ADT), ADT of Array, Stack, Queue. Algorithms: Complexity, Time-Space Trade off, Algorithms Notation, Complexity of Algorithms and other asymptotic notations for complexity of algorithms.	**8**	**Understand CO1**

Module–2: LINEAR DATA STRUCTURES

Teaching component:	**No. of Hrs**	**Bloom's Taxonomy Levels**
Arrays: Introduction, Linear Arrays, Representation of Linear Arrays in memory, Traversing Linear Arrays, Inserting and Deleting, Sorting; Bubble Sort, Two dimensional Arrays. **Linked Lists**: Introduction, linked lists, Representation of Linked lists in memory, traversing a linked list, searching linked list, memory allocation, garbage collection.	**8**	**Apply CO2**

Module–3: LINEAR DATA STRUCTURES -STACKS & QUEUES

Teaching component:	**No. of Hrs**	**Bloom's Taxonomy Levels**
Stacks: Introduction, Stacks, Array representation of Stacks, linked representation of Stacks, Arithmetic expressions; Postfix and prefix notations, Quick sort, application of stacks.	**8**	**Apply CO3**

Queues: Queues, linked representation of queues, dequeue		
Module–4: NON-LINEAR DATA STRUCTURES – TREES		
Teaching component: **Trees:** Introduction, Binary trees, representing binary trees in memory, traversing binary trees, binary search trees, searching and inserting in binary search trees, deleting in a binary search tree, AVL search trees.	**No. of Hrs**	**Bloom's Taxonomy Levels**
	8	**Apply CO4**
Module–5: GRAPHS, SORTING & SEARCHING		
Teaching component: **Graphs and their applications:** Introduction, Graph theory Terminology, linked representation of a graph, operation on graphs, traversing of graphs (Breadth-First Search, Depth first search) **Sorting & Searching:** Introduction, sorting, insertion sort, selection sort, merge sort, searching and data modification, hashing (hash functions only)	**No. of Hrs**	**Bloom's Taxonomy Levels**
	8	**Apply CO5**

Course Outcomes: After completing the course, the students will be able to	
23ECE133.1	Gain knowledge on the importance of data structures, algorithms and time complexity computations.
23ECE133.2	Apply linear data structures to analyse and obtain solutions
23ECE133.3	Apply non-linear tree data structure to analyse and obtain solutions
23ECE133.4	Apply non-linear graph data structure to analyse and obtain solutions
23ECE133.5	Apply the concepts of sorting and searching to problem solving
23ECE133.6	Analyse real time practical problems and apply appropriate data structures to obtain efficient solutions

Reference Books

1. Seymour Lipschutz, "Data Structures", Tata McGraw Hill Education, Revised 1st Edition, 2008.
2. Horowitz, Sahni & S.Anderson-Freed, "Fundamentals of Data structures in C", University Press, Second edition, 2008.
3. Thomas H. Cormen, C.E. Leiserson, R L.Rivest and C. Stein, Introduction to Algorithms , Third edition, MIT Press, 2009
4. R.L. Kruse, B.P. Leary, C.L. Tondo, "Data structure and program design in C", PHI, 2009(Fourth Impression)
5. Tannenbaum, "Data Structures", PHI, 2007(Fifth Impression)
6. Jean Paul Tremblay, Paul G. Sorenson," An introduction to Data Structures with Applications, Second Edition, Tata McGraw-Hill,1991.
7. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", Second Edition, Pearson Education, 1996.

List of Programs

Using C compiler, demonstrate the concepts using following programs:

1. Write a C program to Insert an element in an array and delete an element in the same array
2. Write a C program to sort the array elements using selection sort
3. Write a C program to sort the array elements using bubble sort
4. Write a C program to create of 'n' nodes in singly linked list and display them
5. Write a C program to insert a node at the middle of linked list
6. Write a C program to delete a node in linked list
7. Write a C program to implement the stack in array.
8. Write a C program to Reverse String using STACK
9. Write a C program to implement the queue in array
10. Write a C program to search the number/node in a tree
11. Write a C program to implement Graph

Marks Marks Distribution for Assessment:

CIA (50)	**Component**	**Description**	**Marks**
	Written Test	● Total Number of Test: 2 ● Each Theory test will be conducted for 30 marks ● Average of 2 tests = 30 Marks	30
	Lab Assignment	Lab records - 05 marks Performance day wise – 05 Marks	10
	Laboratory Internal Test	Conduction – 05 Marks Viva – 05 Marks	10
		Total Marks	**50**
SEA (50)	**Component**	**Description**	**Marks**
	Laboratory Exam	SEA to be conducted for 100 marks and scaled down to 50 Marks, • 5 theory questions from each module each 6M • Conduction - 60 Marks • Viva-Voce - 10 Marks (One program to be executed)	5x6 =30 70
		Total marks for the Course	**100**

Additional Assessment Tools (AAT) – Quiz, Presentations,Term Paper, Open ended experiments, Mini Projects, Two-minute video on latest topic, Short MOOC courses

B.N.M. Institute of Technology

An Autonomous Institution under VTU
Dept. of Electronics and Communication Engineering
Choice Based Credit System (CBCS and Outcome Based Education (OBE))

Semester: III

Course Name: Analog Electronics Circuits **Course Code: 23ECE134**

L: T: P: J	**3 : 0: 2 : 0**	**CIA Marks:** 50
Credits:	**4**	**SEA Marks:** 50
Hours	**40**	**SEA Duration:** 03 Hours

Pre-Requisites: Physics and Electronics fundamentals

Course Learning Objectives: The students will be able to

1	Explain various BJT parameters, connections and configurations.,
2	Design and demonstrate the transistor amplifiers.
3	Explain various types of FET biasing and demonstrate the use of FET amplifiers.
4	Analyze Power amplifier circuits in different modes of operation.
5	Design op-amp for linear and non-linear applications

Module-1: BJT Biasing, Small Signal Operation and Modelling	**No. of Hours**	**Blooms Cognitive Levels**
Teaching component: Biasing in BJT amplifier circuits: The Classical Discrete circuit bias (Voltage-divider bias), Biasing using a collector to base feedback resistor. Small signal operation and Models: Collector current and transconductance, Base current and input resistance, Emitter current and input resistance, voltage gain, The hybrid Π model, and The T model.	**8**	**Apply CO1**
Module-2: : MOSFETs Biasing, Small signal operation and Modelling		
MOSFETs: Biasing in MOS amplifier circuits: Fixing VGS, Fixing VG, Drain to Gate feedback resistor. Small signal operation and modeling: The DC bias point, signal current in drain, voltage gain, small signal equivalent circuit models, transconductance, The T equivalent circuit model	**8**	**Apply CO2**
Module-3: MOSFET Amplifier		
MOSFET Amplifier configuration: Basic configurations, characterizing amplifiers, CS amplifier with and without source resistance RS. MOSFET internal capacitances and High frequency model: The gate capacitive effect, Junction capacitances, High frequency model. Frequency response of the CS amplifier: The three frequency bands, high frequency response, Low frequency response.	**8**	**Apply CO3**
Module-4: Feedback Amplifier, Output Stages and Power Amplifiers		
Feedback Amplifier: General feedback structure, Properties of negative feedback, The Four Basic Feedback Topologies, The series-shunt, series-series, shunt-shunt, and shunt-series amplifiers (Qualitative Analysis). Output Stages and Power Amplifiers: Introduction, Classification of output stages, Class A output stage, Class B output stage: Transfer Characteristics, Power Dissipation, Power Conversion efficiency, Class AB output stage.	**8**	**Apply CO4**

Module-5: Op-Amp Circuits, 555 Timer and its applications		
Teaching component: Instrumentation Amplifier, DAC-weighted resistor and R-2R ladder, ADC- Successive approximation type, Small Signal half wave rectifier, Active Filters, First order low-pass and high-pass Butterworth filters, Band-pass filters, Band reject filters. 555 Timer and its Applications: Monostable and Astable Multivibrators.	**8**	**Apply CO5**

Lab Experiments (Lab sessions + 1 Lab Test)	
Sl. No	Experiments
1	Design and set up the BJT common emitter voltage amplifier without feedback and determine the gain-bandwidth product, input and output impedances.
2	Design and set up the FET common source voltage amplifier without feedback and determine the gain-bandwidth product, input, and output impedances.
3	Experiment to determine the Power efficiency of class C amplifier
4	Design Second Order Butterworth low pass filter using opamp
5	Design of Op- Amp as a comparator circuit
6	R-2R DAC
7	Simulation Experiment: Narrow Band-pass Filter
8	Simulation Experiment: Active second-order Butterworth high pass filters
9	Simulation Experiment: Monostable & Astable Multivibrator using 555 Timer
10	Simulation Experiment: Narrow band-reject filter

Course Outcomes: After completing the course, the students will be able to	
23ECE134.1	Design and analyze biasing circuits for BJTs amplifier circuits.
23ECE134.2	Design and analyze biasing circuits for FET amplifier circuits
23ECE134.3	Design and analyze FET common source amplifiers with different circuit configurations and biasing conditions.
23ECE134.4	Understand the feedback topologies and approximations in the design of amplifiers
23ECE134.5	Design of circuits using linear ICs for wide range applications such as ADC, DAC, filters and timers.
23ECE134.6	Design real-life application based on discrete Analog and linear IC circuits

Reference Books

1. Microelectronic Circuits, Theory and Applications, Adel S Sedra, Kenneth C Smith, 6th Edition, Oxford, 2015. ISBN:978-0-19-808913-1
2. Op-Amps and Linear Integrated Circuits, Ramakant A Gayakwad, 4th Edition, Pearson Education, 2018. ISBN: 978-93-325-4991-3.
3. Integrated Electronics: Analog and Digital Circuits and Systems, Jacob Millman, Christos C. Halkias, McGraw-Hill, 2015.
4. Electronic Devices and Circuit, Boylestad & Nashelsky, Eleventh Edition, Pearson, January 2015
5. Electronic Principles, Albert Malvino, David J Bates, 7th Edition, McGraw Hill Education (India) Private Limited, 2017, ISBN:978-0-07-063424-4.

Marks Distribution for Assessment:

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B.N.M. Institute of Technology

An Autonomous Institution under VTU, Approved by AICTE

Dept. of Electronics and Communication Engineering

Choice Based Credit System (CBCS and Outcome Based Education (OBE)

Semester: III

Course Name: Digital System Design Using Verilog		**Course Code: 23ECE135**
L: T: P: J	**3: 0: 2: 0**	**CIA Marks: 50**
Credits:	**4**	**SEA Marks: 50**
Hours	**40**	**SEA Duration: 03 Hours**

Pre-Requisites: Digital Circuits

Course Learning Objectives: The students will be able to

1	Simplifying Boolean expression using K-map techniques and Quine-McCluskey minimization techniques
2	Designing and analyzing combinational logic circuits.
3	Design methods and analysis of sequential logic circuits
4	Design of digital systems using Verilog HDL-data flow models.
5	Design of digital systems using Verilog HDL behavioral and structural models.

Module-1: Principles of Combinational Logic	**No. of Hours**	**Blooms Cognitive Levels/CO Mapping**
Definition of combinational logic, Canonical forms, Generation of switching equations from truth tables, Karnaugh maps- up to 4 variables, Incompletely Specified Functions, Simplifying Maxterm equations, Quine-McCluskey Minimization Technique. Quine-McCluskey using Don't Care Terms.	**8**	**Apply CO1**
Module-2: Logic Design with MSI Components		
Binary Adders and Subtracters, Binary Subtracters, Carry Lookahead Adder, Comparators, Decoders, Logic Design using Decoders, Decoders with a enable input, Encoders, Multiplexers, Logic Design with Multiplexers.	**8**	**Apply CO2**
Module-3: Flip-Flops and its Applications		
The Basic Bistable Element, Latches, SR Latch, An application of the SR Latch: A Switch Debouncer, S'R' Latch, Gated SR latch, Gated D Latch, The Master-Slave Flip-flops (Pulse Triggered flip-flops): MSSR flip-flops, MSJK flip flops, Edge triggered flip flops, The positive edge triggered D flip flop, Negative edge triggered D flip flops, Asynchronous inputs, Additional types of edge triggered flip flops, Characteristic equations, Registers, Binary Ripple Counters, Synchronous Binary Counters, Design of Synchronous mod-n Counter using clocked JK and D flip-flops.	**8**	**Apply CO3**
Module-4: Finite State Machine and Verilog Data flow description		
Mealy and Moore Model, Construction of State Diagrams, Up-down decade counter, Sequence detectors (non overlapped sequence only). **Note: Following topics are applicable to Verilog only.** Structure of Verilog module, Operators, Data Types, Styles of Description, Behavioral Descriptions, Structural Description, Data flow Description, Highlights of Data flow description, Structure of Data flow description, Half adder, Multiplexer, 2X2 Array Multiplier, D latch, 2-bit Magnitude Comparator	**8**	**Apply CO4**
Module-5: Verilog Behavioral and Structural description		
Half adder, Sequential statements, if statement, case statement, Edge triggered JKFF, 3 bit binary counter. Structural Descriptions, Organization of structural description, Half adder, 2x1 Multiplexer with active low enable, 2x4 decoder with tristate output, Full aA, SR Latch, 3 bit RCA	**8**	**Apply CO5**

Sl.No.	Lab Experiments
1	Simplify the given 3/4 variable Boolean expressions. and simulate the design using Verilog dataflow description.
2	Design a Full Adder using two half adders and simulate using verilog structural flow Description
3	Realize 32-bit ALU using Verilog Behavioral description.
4	Realize using Verilog Behavioral description: 8:1 mux, 8:3 Priority encoder
5	Realize using Verilog Behavioral description: 3:8 decoder, 2-bit Comparator
6	Realize using Verilog Behavioral description: Flip-flops: a) JK b) SR c) T d) D and verify the design using FPGA board.
7	Design 4 bit Binary and BCD counters with synchronous and asynchronous reset using Verilog Behavioral description and verify the design using FPGA board
8	Design 8-bit shift register for shift left and right operation using Verilog behavioral Description
9	Develop a Verilog Program to interface a Stepper motor to the FPGA and rotate the motor in the specified direction
10	Interface DAC to generate square and triangular waveform using Verilog program and implement into the FPGA board

Course Outcomes: After completing the course, the students will be able to	
23ECE135.1	Simplify Boolean functions using K-map and Quine-McCluskey minimization technique.
23ECE135.2	Analyze and design for combinational logic circuits.
23ECE135.3	Analyze the concepts of Flip Flops (SR, D, T and JK) and to design the synchronous sequential circuits
23ECE135.4	Design of combinational and sequential circuits using Verilog dataflow descriptions.
23ECE135.5	Design of combinational and sequential circuits using Verilog behavioral and structural descriptions.
23ECE135.6	Design the applications of combinational and sequential circuits

Reference Books

1. Digital Logic Applications and Design, John M Yarbrough, Thomson Learning, 2016
2. Digital Principles and Design, Donald D Givone, McGraw Hill, 2017
3. HDL Programming VHDL and Verilog, Nazeih M Botros, press, 2009
4. Quick Start Guide to Verilog, Brock J. LaMeres, 2024
5. Digital Systems, Ronald J Tocci, 12th edition, 2022
6. Digital Design, Morris Mano, 6th edition, Pearson Education, 2018

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B.N.M. Institute of Technology

An Autonomous Institution under VTU

B.E. (Electronics and Communication Engineering)
Choice Based Credit System (CBCS and Outcome Based Education (OBE))

Semester: III		
Course Name: Advanced Python Programming on Raspberry Pi		**Course Code: 23ECE136**
L: T: P: J	**0: 0 : 2 : 2**	**CIA Marks: 50**
Credits:	**2**	**SEA Marks: 50**
Hours	**25**	**SEA Duration: 03 Hours**

Pre-Requisites:
Basic understanding of IoT
Basic programming and Hardware knowledge
Basic knowledge of Python Programming

Course Learning Objectives: The students will be able to

1	Demonstrate proficiency in integrating Raspberry Pi for IoT applications, focusing on sensor and actuator connectivity and GPIO management.
2	Master the acquisition, processing, and analysis of IoT sensor data using Raspberry Pi platform.
3	Identify sensor technologies for sensing real-world entities and understand the role of IoT in various domains of Industry
4	Create cloud data visualization using Blynk, Firebase, ThingSpeak
5	Design and implement effective IoT communication protocols such as MQTT, WiFi, and Bluetooth for secure and reliable data transmission.

	No. of Hours	**Blooms Cognitive Levels/CO Mapping**
Module-1:		
Raspberry Pi Architecture. Basic knowledge of Python programming, understanding of GPIO pins on Raspberry Pi, familiarity with Raspberry Pi's RPi. GPIO library for GPIO control. Downloading And Installing Raspberry Pi Raspberry Pi4 Board features, pinout, OS installation, and configuration. Raspberry Pi4 GPIO programming, BCM Mode & Board pin numbering **Programs/Lab experiment:** 1. Write a Python program to interface LED and push button to Raspberry Pi. 2. Write a Python program to interface IR to Raspberry Pi.	**5**	**APPLY**
Module-2:		
7-segment Display, common anode, and common cathode. Measuring distance using an ultrasonic sensor **Programs/Lab experiment:** 1. Write a Python program to interface Seven Segment Display to Raspberry Pi. 2. Write a Python program to interface the ultrasonic sensor to Raspberry Pi.	**5**	**APPLY**
Module-3:		
Communication interfaces (SPI and I2C) communication. RFID data received from RC522 module. **Programs/Lab experiment:** 1. Interfacing 16 X 2 LCD to Raspberry Pi without using the library and using the library from Blynk 2. Interfacing RFID RC522 to Raspberry Pi into Blynk or Firebase	**5**	**APPLY**
Module-4:		

Raspberry Pi camera module. Image acquisition in Raspberry Pi. Cloud computing: data visualization using Blynk, Firebase, ThingSpeak **Programs/Lab experiment:** 1. Write Image to ThingSpeak from Raspberry Pi with Python 2. Interface LED/ bulb using Raspberry Pi which can be controlled by Android based smart phone through Bluetooth	**5**	**APPLY**
Module-5:		
Flask framework for web development, Python file handling for data logging, format and timestamp data for file storage. **Programs/Lab experiment:** 1. Raspberry Pi Web Server using Flask to Control LEDs and display humidity and temperature sensed by DH11 2. Raspberry Pi with DHT11 Data Logger to a file.	**5**	**APPLY**
List of Sample Projects		
1.Develop a Real time application like a smart home with following requirements. If anyone comes at door the camera module automatically captures his image send it to the e-mail account of user or send notification to the user. Door will open after users' approval. 2. Develop an application for time lapse images using your Raspberry Pi board and create a timelapse camera for capturing such images (ex: using the Blinkt add-on) and create a video. The students can use a Pi Camera for this project and combine it with your Pi board. 3. AI Assistant -You can create an AI assistant by using a Raspberry Pi as well. 4. Smart Home- Do Amazon Alexa and Google Home fascinate you? Then this project would be perfect for you. You can automate multiple home appliances by using Raspberry Pi. 5. Smart Parking system- to keep track of empty slots and show it at the entrance 6. Smart garbage bin- segregate and dump the waste in appropriate container using moisture sensor, 7. Smart Irrigation system: check for the soil moisture pH and other vital minerals and control the water and/or liquid fertilizers to plants. 8. Raspberry Pi Pico based Line Follower Robot 9. Tomato/other specific item Sorting Machine using Edge Impulse TinyML on Raspberry Pi 10. Automated Security System with Telegram Bot and Facial Recognition		

Course Outcomes: After completing the course, the students will be able to

23ECE136.1	Integrate Raspberry Pi effectively to develop IoT solutions, demonstrating proficiency in sensor and actuator connectivity and GPIO management.
23ECE136.2	Acquire, process, and analyze IoT sensor data using Raspberry Pi, demonstrating mastery in data handling techniques.
23ECE136.3	Design and implement robust IoT communication protocols (e.g., MQTT, WiFi, Bluetooth) for secure and reliable data transmission in various IoT applications.
23ECE136.4	Use Raspberry PI for webserver communication and cloud data visualization
23ECE136.5	Apply a problem-solving approach to design and prototype practical IoT systems that address real-world challenges, showcasing innovation and technical competence.
23ECE136.6	Collaborate in teams to plan, execute, and present comprehensive IoT projects, demonstrating effective communication, teamwork, and project management skills.

Reference Books

1. Derek Molloy "Exploring Raspberry PI Interfacing to the Real World with Embedded Linux", Wiley 2016
2. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", 1st Edition, Pearson Education (Cisco Press Indian Reprint).(ISBN:978- 9386873743)
3.Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT, 2014. (ISBN:978-8173719547)
4. https://www.raspberrypi.org/learn/
5. Srinivasa K G, "Internet of Things", CENGAGE Learning India, 2017.

Web links and Video Lectures:
1. https://www.raspberrypi.org/learn/ 2. https://pinout.xyz/pinout/blinkt# **3.** https://www.coursera.org/specializations/iot-systems-and-industrial-applications-with-design-thinking

Marks Distribution for Assessment:

<table>
<tr><td>PBL</td><td>CIA</td><td>SEA</td><td colspan="3">CIA (50)</td><td>SEA
Conduction: 100 M
Reduced to 50 M</td></tr>
<tr><td rowspan="4">Conduction</td><td rowspan="4">50</td><td rowspan="4">50</td><td rowspan="2">Theory</td><td>I IA</td><td>II IA</td><td rowspan="4">Write up- 10 Marks
Project Report- 25 Marks
Presentation & Demonstration- 50 Marks
Viva-Voce- 15 Marks
Project
Assessed for 100 marks reduced to 50 marks</td></tr>
<tr><td>20</td><td>20</td></tr>
<tr><td colspan="3">Average of 2 Tests-20 marks</td></tr>
<tr><td>Practical</td><td colspan="2">Weekly Assessment (Record/Project)-10 Marks
Lab IA test-20 Marks</td></tr>
<tr><td colspan="4">Total- 50 marks</td><td>Total- 50 marks</td></tr>
</table>

B.N.M. Institute of Technology

An Autonomous Institution under VTU

Semester: III		
COURSE: CONSTITUTION OF INDIA AND PROFESSIONAL ETHICS		
Course Code: 23CIP137	**L:T:P:J: 1:0:0:0**	**CIA Marks:** 50
Credits:	**1**	**SEA Marks: 5 0**
Hours:	**15 hrs**	**SEA Duration: 2Hrs**

Course Learning Objectives: The students will be able to

1	know the fundamental political codes, structure, procedures, powers, and duties of Indian government institutions, fundamental rights, directive principles, and the duties of citizens
2	know the Indian top civil service positions and the exams conducted by UPSC and SPSC for the same
3	Understand engineering ethics and their responsibilities; identify their individual roles and ethical responsibilities towards society.

MODULE 1: Introduction to Indian Constitution	**RBT**	**Hrs**
The Necessity of the Constitution, Introduction to Indian Constitution, The Making of the Constitution, Role of Constituent Assembly, Preamble and Salient features of the Constitution of India, Fundamental Rights and its Restriction and limitations in different complex situations, Directive Principles of State Policy, Fundamental Duties.	**1,2,3**	**3**
MODULE 2: System of Government, Central Government, State Government	**RBT**	**Hrs**
System of Government-Parliamentary System, Federal System. Central Government-Basic details, Powers and Functions of Union Executive. Parliament- LS and RS (Composition, Duration, Membership and Presiding officers of Parliament and their functions). Leaders in Parliament (Leader of the House and Leader of the Opposition). Sessions of Parliament (Summoning, Adjournment, Adjournment Sine Die, Prorogation, Dissolution). Quorum of House, Language in Parliament, Joint sitting of two Houses. State Government-Basic details, Powers and Functions of State Executive. State Legislature (Composition, Duration, Membership and Presiding officers of Parliament and their functions).	**1,2,3**	**3**
MODULE 3: Judiciary, Amendments and Emergency Provisions	**RBT**	**Hrs**
Supreme Court, High Court, Judicial Review, Judicial Activism. Methods in Constitutional Amendments (How and Why). Types of Emergencies and its Consequences, Recent Amendments to the Constitution.	**1,2,3**	**3**
MODULE 4: Elections, Constitutional and Non Constitutional Bodies	**RBT**	**Hrs**
Elections- Election Commission of India, Electoral Process. Constitutional Bodies- Election Commission, Union Public Service Commission, State Public Service Commission, Goods and Service Tax Council. Non Constitutional Bodies- Central Information Commission, State Information Commission.	**1,2,3**	**3**

MODULE 5: Professional Ethics	RBT	Hrs
Scope & Aims of Engineering & Professional Ethics, Positive and Negative Faces of Engineering Ethics, Responsibilities in Engineering, the impediments to Responsibility. Trust and Reliability in Engineering, Risks, Safety and liability in Engineering, Clash of Ethics, IPRs (Intellectual Property Rights)	**1,2,3**	**3**

Course outcome: On completion of this course, students will be able to,
CO1: Have constitutional knowledge and legal literacy.
CO2: Have knowledge on All India Services and State Civil Services.
CO3: Understand Engineering and Professional Ethics and responsibilities of Engineers.

Reference Books

Suggested Learning Resources:

1.**Title of the Book - Indian Polity**
Name of the Author - M Lakshmikanth
Name of the Publisher-Mc Graw Hill Education
Edition and Year- 2019

2.**Title of the Book - Engineering Ethics**
Name of the Authors - M. Govindarajan, S.Natarajan, V.S. Senthilkumar
Name of the Publisher- Prentice-Hall
Edition and Year-2004

3. Durga Das Basu (DD Basu): "Introduction to the Constitution on India", (Students Edition.) Prentice –Hall EEE, 19th / 20th Edn., (Latest Edition) or 2008.

4. Shubham Singles, Charles E. Haries, and Et al : "Constitution of India and Professional Ethics" byCengage Learning India Private Limited, Latest Edition – 2018.

5. M.Govindarajan, S.Natarajan, V.S.Senthilkumar, "Engineering Ethics", Prentice –Hall of IndiaPvt. Ltd. New Delhi, 2004

6. M.V.Pylee, "An Introduction to Constitution of India", Vikas Publishing, 2002.

7. Latest Publications of **NHRC - Indian Institute of Human Rights**, New Delhi.

Web Links and Video Lectures

www.unacademy.com/lesson/future-perfect-tense/YQ9NSNQZ https://successesacademy

Question paper pattern for SEA and CIA.

- The SEA question paper will be set for 50 marks and the pattern of the question paper will be objective type (MCQ).
- The CIA question paper will be set for 50 marks and the pattern of the question paper will be objective type (MCQ).

Final Marks = CIA + SEA = 50+50 = 100 Marks

Class Internal Assessment

IA1	Objective type questions 50Marks	Average of 2 IA will be taken 50Marks
IA2	Objective type questions 50Marks	
	Total CIA	**50 Marks**

Semester End Assessment

Semester end Exam	Objective type questions 50Marks	50 Marks
	Total SEA	**50 Marks**

Final Marks = CIA + SEA = 50+50 = 100 Marks

BNM Institute of Technology

Syllabus for Softskills-1
SEMESTER – III

Subject Name	Softskills-1 (Soft skills for Industry & Quantitative Aptitude and Logical Reasoning)	**Weekly Continuous Assessment Marks (6 tests)**	Max 10 Min 4
Subject Code	23SFT	**Practice Tests for Internal Assessment Marks (6 tests)**	Max 15 Min 6
Number of Contact Hours/Week	2	**Final Assessment Marks (during 3rd test on Tab MCQ)**	Max 25 Min 10
Total Number of Contact Hours	24	**Credits**	1

1.Understanding Corporate Communication: (2hrs)	Define corporate communication and its importance. Identify key stakeholders in corporate. Understand workplace etiquette: communication tone, addressing colleagues, and handling conflicts. Resume Writing.
2.Cross Culture Sensitivity: (2hrs)	Knowledge, awareness and acceptance of other cultures/caste/creed. Being of oneness and understanding the work environment.
3. Effective Communication and Interpersonal Skills (2hrs)	Skills we use daily when we communicate and interact with other people, both individually and in groups. Active listening, right response and clear message. Conduct mock presentations on technical topics relevant to engineering.
4. Collaboration and Team Communication: (2hrs)	Participate in team-based activities and projects to practice collaboration. Understanding types of Leadership and inculcating leadership skills
5. Written Communication (2hrs)	Passage / Email writing Identify your goal. Before you write an email, ask yourself what you want the recipient to do after they've read it. Writing technical documentation and reviews
6. Goal Setting & Mind Mapping (2hrs)	Development of an action plan designed to motivate and guide a person or group toward a goal. Gives one's life direction and boosts your motivation and self-confidence. Developing career Action plans
7. Quantitative Aptitude - 1(6hrs)	**Speed Math** : Number System, Multiple and factors, Divisibility Rules HCF & LCM, Squares and Cubes, BODMAS & Tables, Approximation, Decimals, Fractions, Surds & Indices
	Profit & Loss - Concepts of SP, CP, Profit, Loss, Gain or Loss %. Marked Price & Discount problems, Successive Selling Tye, Discount
	Percentages – Percent to Decimal or Fraction Conversion, Inverse Case – Value From Percentage, relative Percentage, Successive Selling type, Dishonest Dealings, partnerships **Averages** - Understanding Averages, relevance, meaning, properties of average, deviation method, weighted average, & solving problems.
8. Logical Reasoning - 1 (6hrs)	**Logical Aptitude** – Syllogism, Venn diagram method, three statement syllogism, deductive and inductive reasoning, introduction to puzzle and games organizing information, parts of an argument, common flaws, arguments and assumptions.

Coding & Decoding – Letter Coding, Number coding, symbol coding, **Crypt arithmetic** – basic concepts, addition, subtraction, multiplication of coded alphabets, types of cryptarithmetic Concept of EJOTY, Opposite Letter, Reversing thealphabets. Jumbling of Letter, Finding Codes of Derivatives.
Image Analysis - Paper cutting & Folding, Mirror & Water Image, Cubes andDice, Analogy, Find the odd one out, Rule Detection. Cubes and dice
Series Completion - Basics of Next no, Missing no and Wrong no and problemson that. Solving various types of Letter series and understanding different types.
Odd Man Out - Following certain patterns and groups. Identifying the errors/odd one in the group.
Visual sequence, visual analogy and classification, single & multiple comparisons, linear sequencing
Logical Puzzles - K-level thinking, Arithmetic Puzzles and stick puzzles

Department of Mathematics

Syllabus

Semester: IV		
Course: Complex Analysis, Probability and Random Process **Course Code: 23MAE141 (Common to ECE, EEE & ME)**		
L:T:P:J	**2:2:0:0**	**CIA: 50**
Credits:	**03**	**SEA: 50**
Hours:	**40**	**SEA Duration: 03 Hours**

Course Learning Objectives: The students will be able to

1 Provide an insight into applications of complex variables and conformal mapping arising in potential theory, quantum mechanics, heat conduction and field theory.

2 Develop the knowledge of probability, joint probability distribution and Random process occurring in digital signal processing, design engineering and microwave engineering.

Module-1: Complex Analysis	No. of hours	Blooms cognitive Levels
Examples from Engineering that require complex analysis. Review of function of a complex variable, limits, continuity and differentiability. Analytic functions. Cauchy-Riemann equations in Cartesian and polar forms. Consequences of Cauchy-Riemann equations (only statement), construction of analytic function using Milne-Thomson method. *Experiential Learning component: Problems on construction of analytic functions*	**L: 04** **T: 04**	**Apply**
Module-2: Conformal Mapping & Complex Integration		
Examples from Engineering that require Conformal Mapping & Complex Integration. **Conformal mapping:** Introduction, discussion of transformations: $w = e^z$, $w = z^2$, $w = z + \frac{1}{z} (z \neq 0)$. Bilinear transformations. **Complex integration:** Introduction to complex integration, Cauchy's theorem and Cauchy's integral formula. Poles and residues, Residue theorem (without proof) *Experiential Learning component: Problems on Cauchy's integral formula*	**L: 04** **T: 04**	**Apply**
Module-3: Probability Distributions & Joint probability distribution		
Examples from Engineering that require Probability and Joint probability distribution. **Probability Distributions:** Review of basic probability theory. Discrete and continuous Random variables, probability mass/density functions (definitions only). Binomial, Poisson, exponential and normal distributions (without proof). **Joint probability distribution:** Joint Probability distribution for two discrete random variables, expectation, covariance and correlation. *Experiential Learning component: Problems on Binomial, Poisson, Exponential and Normal distributions*	**L: 04** **T: 04**	**Apply**
Module-4: Random Process		
Examples from Engineering that require random process. Introduction, classification of random process, methods of description of a random process, stationary, auto-correlation function, Ergodicity, Spectral representation, Weiner-Kinchine theorem, Poisson process, pure birth process, birth and death process with a constant rate, death process with a linear rate. *Experiential Learning component: Problems on Poisson process, pure birth process, birth and death process*	**L: 04** **T: 04**	**Apply**
Module-5: Markov Chain & Sampling Theory		
Examples from Engineering that require Markov Chain and Sampling Theory. **Markov Chain**: Introduction to Stochastic process, Probability vectors, Stochastic matrices, Regular stochastic matrices, Markov Chains, Higher transition probabilities, Stationary distribution of Regular Markov chains and absorbing states, Markovian processes.	**L: 04** **T: 04**	**Apply**

Sampling Theory: Introduction to sampling theory, Testing of hypothesis, level of significance, confidence limits, test of significance of mean and difference of means for large samples-z-test, test of significance of small samples-Student's t- distribution, Goodness of fit-Chi-square test. *Experiential Learning component: Problems on Markovian processes and, Sampling Theory*		

Course Outcomes: After completing the course, the students will be able to

CO1: Use the concepts of analytic function and complex potentials to solve the problems arising in electromagnetic field theory.

CO2: Utilize conformal mapping and complex integral arising in aerofoil theory, fluid flow visualization and image processing.

CO3: Apply discrete and continuous probability and joint probability distributions in analyzing the probability models arising in engineering field.

CO4: Use Markov chain in prediction of future events and demonstrate the validity of testing the hypothesis.

CO5: Use the concepts of random process in dealing with signals in engineering problems.

Reference Books:

1. E. Kreyszig: "Advanced Engineering Mathematics", John Wiley & Sons, 10th Edition(Reprint), 2016.
2. B. S. Grewal: Higher Engineering Mathematics, Khanna Publishers, 44th Edition, 2017.
3. S. D. Sharma : "Operations Research", KedarNath Ram Nath & Co. Meerut, 2014.
4. T. Veerarajan : "Probability, Statistics and Random processes", McGraw Hill Education (India) Private Limited, Third edition, Nineteenth reprint 2017.
5. C. Ray Wylie, Louis C. Barrett : "Advanced Engineering Mathematics", 6th Edition, 2. McGraw-Hill Book Co., New York, 1995.
6. James Stewart : Calculus —Early Transcendental, Cengage Learning India Private Ltd., 2017.
7. B. V. Ramana: "Higher Engineering Mathematics" 11th Edition, Tata McGraw-Hill, 2010.
8. Srimanta Pal & Subodh C. Bhunia: "Engineering Mathematics", Oxford University Press, 3rd Reprint, 2016.

Web links and Video Lectures:

1. https://nptel.ac.in/courses/111106141
2. https://www.digimat.in/nptel/courses/video/111107119/L29.html
3. https://archive.nptel.ac.in/courses/122/107/122107036/
4. https://archive.nptel.ac.in/courses/105/105/105105045/
5. https://archive.nptel.ac.in/courses/111/102/111102014/
6. https://archive.nptel.ac.in/courses/111/103/111103159/

Marks Distribution for Assessment:

<table>
<tr><th rowspan="2">PCC</th><th rowspan="2">CIA</th><th rowspan="2">SEA</th><th colspan="4">CIA (50)</th><th rowspan="2">SEA
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<tr><td>Assignment</td><td colspan="3">Two assignments – Scaled to 10 Marks</td></tr>
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</table>

B.N.M. Institute of Technology

An Autonomous Institution under VTU, Approved by AICTE

Dept. of Electronics and Communication Engineering

Choice Based Credit System (CBCS and Outcome Based Education (OBE)

Semester: IV

Course Name: Digital Signal Processing		**Course Code:** 23ECE142
L: T: P: J	3 : 2 : 0 : 0	**CIA Marks:** 50
Credits:	4	**SEA Marks:** 50
Hours	50	**SEA Duration:** 03 Hours

Course Learning Objectives: The students will be able to

1	To discuss continuous and discrete-time signals and systems, their properties, representations, and methods that are necessary for the analysis of continuous and discrete-time signals and systems.
2	To develop the mathematical and computational skills needed in application areas like communication, signal processing, and control, which will be taught in other courses.
3	Understand the concept of Z-transforms, frequency domain sampling, and Discrete Fourier Transform (DFT).
4	Design digital FIR filters and IIR filters.

Module-1:	**No. of Hours**	**Blooms Cognitive Levels**
Introduction and Classification of Signals: Definition of signal and Classification of signals **Basic Operations on signals**: Amplitude scaling, addition, multiplication, Differentiation, and Integration of signals. Time scaling, time shift, and time reversal. **Elementary signals/functions:** Exponential, sinusoidal, step, impulse, ramp functions, triangular, and rectangular pulse.	**10**	**Apply CO1**
Module-2:		
System and its properties: Definition of system, Linear-nonlinear, Time variant-invariant, causal-noncausal, static-dynamic, Stable and Unstable Systems. **Impulse response representation of LTI Systems:** Convolution Sum & Convolution Integral (combination of Unit Step and Exponential). **Properties of Impulse response representation for LTI systems.**	**10**	**Apply CO2**
Module-3:		
Z-Transforms: Definition, Basic problems, Region of Convergence, Inverse Z Transform (Partial Fraction Method only). **Fourier Representation of aperiodic Signals:** Introduction to DTFT, Definition, and basic problems, Properties (Linearity, Time Shift, Frequency Shift, Differentiation in the Frequency Domain).	**10**	**Apply CO3**

Module-4:		
IIR Filters: Introduction to IIR filters, Bilinear Transformations, Design of Analog and Digital Butterworth filters (low-pass and high-pass). Realization of IIR filter structure (Direct form I & form II, Cascade, Parallel).	**10**	**Apply CO4**
Module-5:		
FIR Filters: Introduction to FIR filters, Frequency response of ideal digital low pass filter, high pass filter, Windowing design of FIR filters using Rectangular, Hanning, Hamming, Blackmann & Bartlett windows. FIR filter realization using Direct form and linear phase structure.	**10**	**Apply CO5**

Course Outcomes: After completing the course, the students will be able to	
23ECE142.1	Classify the signals as continuous/discrete, periodic/aperiodic, even/odd, energy/power, and deterministic/random signals.
23ECE142.2	Determine the linearity, causality, time-invariance, and stability properties of continuous & discrete-time systems and compute convolution.
23ECE142.3	Represent signals in the frequency domain using Z-Transforms, DTFT, and compute the DFT of signals.
23ECE142.4	Develop and realize the transfer function of IIR filters
23ECE142.5	Develop and realize the transfer function of FIR filters.
23ECE142.6	Interpret the signals and systems used in the different areas of application.

Reference Books

1. Simon Haykins and Barry Van Veen, “Signals and Systems”, 2nd Edition, 2018, Wiley India. ISBN 9971-51-239-4.
2. Proakis & Monalakis, “Digital signal processing – Principles Algorithms & Applications”, 4th Edition, Pearson Education, New Delhi, 2007. ISBN: 81-317-1000-9.
3. Michael Roberts, “Fundamentals of Signals & Systems”, 2nd edition, Tata McGraw-Hill, 2010, ISBN 978-0-07-070221-9.
4. Li Tan, Jean Jiang, “Digital Signal processing - Fundamentals and Applications”, Academic Press, 2013, ISBN: 978-0-12-415893.
5. Sanjit K Mitra, “Digital Signal Processing, A Computer Based Approach”, 4th Edition, McGraw Hill Education, 2013.
6. Dr. D. Ganesh Rao and Satish Tunga, “Signals and Systems”, Cengage India Private Limited, 2017, ISBN: 978-81-315-3362-8
7. Dr. D. Ganesh Rao and Vineeth P Gejji, “Digital Signal Processing” Cengage India Private Limited, 2017, ISBN: 9386858231

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B.N.M. Institute of Technology

An Autonomous Institution under VTU, Approved by AICTE

Dept. of Electronics and Communication Engineering

Choice Based Credit System (CBCS and Outcome Based Education (OBE))

Semester: IV

Course Name: Control Systems		**Course Code:23ECE143**
L: T: P: J	**1: 2: 2 :0**	**CIA Marks:** 50
Credits:	**3**	**SEA Marks:** 50
Hours	**40**	**SEA Duration:** 03 Hours

Pre-Requisites: Basic Electrical, Mathematical Preliminaries

Course Learning Ob0jectives: The students will be able to

1	Understand the terminologies of control systems and mathematical modelling of electrical and mechanical system.
2	Determine the transfer function from block diagram and signal flow graph
3	Find time response from Transfer Functions
4	Analyze the stability of a system in time and frequency domain

Module-1: Introduction to Control Systems	**No. of Hours**	**Blooms Cognitive Levels**
Introduction to Control Systems: Definitions, Classification of control systems open loop and closed loop, linear and nonlinear, time variant and time invariant, continuous and discrete time systems. Block diagram of a typical open loop and closed loop control system. The transfer function concept, transfer function of simple electrical networks. Mathematical Modeling and Representation mechanical translational, rotational systems and electrical system. Analogous Systems.	**8**	**Apply CO1**
Module–2: Block diagram algebra and Signal Flow graph		
Block diagram algebra, Signal Flow graph: Block Diagram Reduction, Signal Flow Graphs, Mason's Gain Formula (No Proof), Conversion from electrical circuit to SFG and Block diagram to SFG.	**8**	**Apply CO2**
Module–3: Time Response of Feedback Control Systems		
Time Response of Feedback Control Systems: Standard test signals, step response of first and second order systems, time domain specifications. Type and order of the system, Steady state error and static error constants. Concepts for P, PD, PI and PID Controllers.	**8**	**Apply CO3**
Module–4: Time Domain Analysis		
Stability Analysis: Concept of stability, R H criterion, applications of R H criterion with limitations. **Root locus technique:** Introduction to root locus concepts, Construction rules, Analysis of stability by root locus plot	**8**	**Apply CO4**
Module–5: Frequency Domain Analysis		
Frequency domain analysis: Correlation between frequency response and transient response. Frequency domain specifications, concept of phase margin and gain margin, Introduction to frequency domain plots. Polar plots, Bode and inverse bode plots.	**8**	**Apply CO5**

Sl. No	Practical Experiments
1	Determination of transfer function of electric/ mechanical System.
2	Determine the transfer function for given closed loop system in block diagram representation.
3	Time Response of First order system.
4	Time response of Second order system.
5	Stability Analysis Based on Pole Position.
6	Effect of Loop Gain of negative feedback system on stability.
7	To reduce steady state error of a system.
8	Create root locus for a given transfer function.
9	To observe effect of the PID parameters on the closed loop dynamics.
10	Stability Analysis of system using Bode Plot.

Course Outcomes: After completing the course, the students will be able to

23ECE143.1	Develop the mathematical model of mechanical, electrical systems and transfer function for a given control system
23ECE143.2	Develop transfer function using block diagram reduction and signal flow graph techniques.
23ECE143.3	Determine the time domain specifications for first and second order system
23ECE143.4	Determine the stability of a system in time domain using Routh-Hurwitz criterion and Root locus technique.
23ECE143.5	Determine the stability of a system in the frequency domain using Polar and bode plots.
23ECE143.6	Explain the method of conserving energy using closed loop control system.

Reference Books

1. Control Engineering, J. Nagrath & M. Gopal, New Age International Publishers/ 5th edition/ 2005.
2. Automatic Control Systems, Benjamin C. Kuo, John Wiley India Pvt. Ltd./ 8 th Edition/ 2008.
3. Control systems, A Anand Kumar, PHI learning private limited, New Delhi
4. Control Engineering, D.Ganesh Rao and K.Channavenkatesh Publisher-Sanguine Technical Publishers,2008.

Marks Distribution for Assessment:

<table>
<tr><th rowspan="2"></th><th rowspan="2">CIA</th><th rowspan="2">SEA</th><th colspan="4">CIA (50)</th><th rowspan="2">SEA
Conduction: 100 M
Reduced to: 50 M</th></tr>
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<tr><td colspan="3">Average of 3 tests - 15 marks</td></tr>
<tr><td colspan="3">AAT - 10 Marks</td></tr>
<tr><td>Practical</td><td colspan="3">eekly Assessment – 10 Marks
IA test – 15 Marks</td></tr>
<tr><td colspan="5">Total – 50 Marks</td><td>Total – 50 Marks</td></tr>
</table>

B.N.M. Institute of Technology

An Autonomous Institution under VTU, Approved by AICTE

Dept. of Electronics and Communication Engineering

Choice Based Credit System (CBCS and Outcome Based Education (OBE)

Semester: IV

Course Name: ARM Microcontroller & Its Application **Course Code: 23ECE144**

L: T: P: J	**3: 0: 2: 0**	**CIA Marks: 50**
Credits:	**4**	**SEA Marks: 50**
Hours	**40**	**SEA Duration: 03 Hours**

Pre-Requisites: Basic knowledge of Microcontroller/Microprocessor

Course Learning Objectives: The students will be able to

1	Understand the architectural features of 32-bit microcontroller ARM Cortex M3.
2	Program ARM Cortex M3 using the instructions set and C language for different applications.
3	Describe the memory systems, bus interface unit, exceptions of ARM Cortex M3.

Module-1: ARM-32-bit Microcontroller	**No. of Hours**	**Blooms Cognitive Levels**
Overview of the Cortex-M3, Architecture of ARM Cortex M3, Various Units in the architecture, Debugging support, General Purpose Registers, Special Registers, Exceptions/ Interrupts, The Built-In Nested Vectored Interrupt Controller, Stack operation, Operation Modes.	**8**	**Understand CO1**
Module-2: ARM Cortex M3 Instruction Sets and Programming-Part 1		
ARM Cortex M3 Instruction, Assembly basics, General Data-Processing Instructions, Bit Field instructions, IF THEN instructions, Saturation Operations.	**8**	**Apply CO2**
Module-3: ARM Cortex M3 Instruction Sets and Programming-Part 2		
Memory Access instructions, Branch control instructions, Combined Compare and Conditional Branch, Typical Development Flow, CMSIS, Programming in C, Programming in assembly	**8**	**Apply CO3**
Module-4: Memory Systems of Cortex-M3		
Memory System Features Overview, Memory Maps, Memory Access Attributes, Bit-Band Operations, The Pipeline, A Detailed Block Diagram, Bus Interfaces on the Cortex-M3: The I-Code Bus, The D-Code Bus, The System Bus, The External PPB, The DAP Bus	**8**	**Understand CO4**
Module-5: Exceptions in Cortex M3		
Exception Types, Definitions of Priority, Vector Tables, Interrupt Inputs and Pending Behaviour, Fault Exceptions, Bus Faults, Memory Management Faults, Usage Faults, Hard Faults, Dealing with Faults, Supervisor Call and Pendable Service Call	**8**	**Understand CO5**

List of Lab Experiments
1. ALP to find the sum of first 10 integer numbers
2. ALP to multiply two 16-bit binary numbers
3. ALP to find the number of 0's and 1's in a 32-bit number
4. ALP to find determine whether the given 16 bit is even or odd
5. ALP to store data in the RAM.
6. Interface a simple switch and display its status through Relay, Buzzer and LED.
7. Interface a Stepper motor and rotate it in clockwise and anti-clockwise direction.
8. Interface a DAC and generate Triangular and Square waveforms.
9. Display the Hex digits 0 to F on a 7-segment LED interface, with an appropriate delay in between.
10. Toggle the LED when an external interrupt occurs

Course Outcomes: After completing the course, the students will be able to	
23ECE144.1	Describe the architectural features of 32-bit microcontroller ARM Cortex M3.
23ECE144.2	Apply the knowledge of instruction set of ARM Cortex M3 for programming.
23ECE144.3	Apply the knowledge of embedded C Programming for ARM Cortex M3 for different applications.
23ECE144.4	Understand the memory map & Bus interface unit of ARM Cortex M3.
23ECE144.5	Describe the exceptions of ARM Cortex M3.
23ECE144.6	Design Embedded system using ARM CortexM3 for Societal needs, Health care, Home application.

Reference Books

1. The Definitive Guide to the ARM® Cortex-M3, Second Edition, Joseph You.
2. Discovering the STM32 Microcontroller by Geoffrey Brown, Publisher: Indiana University,Published: 2016.

Marks Distribution for Assessment

<table>
<tr><th rowspan="2">PCI</th><th rowspan="2">CIA</th><th rowspan="2">SEA</th><th colspan="4">CIA (50)</th><th rowspan="2">SEA
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B.N.M. Institute of Technology

An Autonomous Institution under VTU
Dept. of Electronics and Communication Engineering
Choice Based Credit System (CBCS and Outcome Based Education (OBE))

Semester: IV

Course Name: Analog and Digital Communication
Course Code: 23ECE145

L: T: P: J	**3:0:2:0**	**CIA Marks:** 50
Credits:	**4**	**SEA Marks:** 50
Hours	**40**	**SEA Duration:** 03 Hours

Pre-Requisites: Fourier Transform, Basics of Signals and systems

Course Learning Objectives: The students will be able to

1	Understand and analyze concepts of Analog Modulation schemes viz; AM, FM techniques.
2	Understand and analyze concepts digitization of signals viz; sampling, quantizing, and encoding.
3	Understand the concept of signal processing of digital data and signal conversion to symbols at the transmitter and receiver.
4	Understand the concepts of waveform coding for Base-band Transmission of digital signals.
5	Understand and analyze the concepts of Digital Modulation schemes and compute performance metrics of bandlimited channel.

Module-1: AMPLITUDE MODULATION		
AMPLITUDE MODULATION: Introduction, Communication Block diagram, Need for Modulation, Amplitude Modulation: Time & Frequency Domain description, switching modulator, Envelop detector. **DOUBLE SIDE BAND-SUPPRESSED CARRIER MODULATION:** Time and Frequency Domain description, Ring modulator Coherent detection, Costas Receiver, Frequency Translation.	**No. of Hours** **8**	**Blooms Cognitive Levels** **Apply CO1**
Module-2: ANGLE MODULATION		
ANGLE MODULATION: Basic definitions, Frequency Modulation: Narrow Band FM, Wide Band FM, the Transmission bandwidth of FM Signals, Generation of FM Signals, Demodulation of FM Signals, FM Stereo Multiplexing, Phase–Locked Loop: Linear model of PLL. Figure of Merit of FM receiver	**8**	**Apply CO2**
Module-3: SAMPLING AND QUANTIZATION		
Introduction, Why Digitize Analog Sources? The Low pass Sampling process, Pulse Amplitude Modulation, Time Division Multiplexing, Pulse-Position Modulation, Generation of PPM Waves, Detection of PPM Waves, Quantization Random Process, Quantization Noise.	**8**	**Apply CO3**
Module-4: BASE-BAND TRANSMISSION OF DIGITAL SIGNALS		
Pulse–Code Modulation: Sampling, Quantization, Encoding, Regeneration, Decoding, Filtering, Multiplexing; Delta Modulation. Base-band transmission of Digital Signals: Baseband pulse, Pulse Shaping and Matched Filter Detection, Intersymbol interference (qualitative analysis), Eye pattern.	**8**	**Apply CO4**
Module-5: DIGITAL MODULATION TECHNIQUES		

Amplitude shift keying, Frequency shift keying, Binary Phase shift keying; Generation and detection with constellation diagram; Performance analysis; Power and Bandwidth; Bit error rate. (qualitative analysis)	**8**	**Apply CO5**

Course Outcomes: After completing the course, the students will be able to	
23ECE145.1	Derive the time-domain and frequency domain representation of Amplitude modulation.
23ECE145.2	Derive the time-domain and frequency domain representation of Frequency modulation.
23ECE145.3	Compute the performance of pulse modulation schemes with quantization noise.
23ECE145.4	Apply the concepts of waveform coding for Base-band Transmission of digital signals.
23ECE145.5	Compute the performance of digital modulation schemes over the noisy channel.
23ECE145.6	Apply and develop the functional blocks of signal processing and communication applications.

Reference Books

1. "Communication Systems", Simon Haykins & Moher, 5th Edition, John Willey, India Pvt. Ltd, 2010, ISBN 978 – 81 – 265 – 2151 – 7.
2. "Digital communications", Simon Haykin, John Wiley India Pvt. Ltd, 2008.
3. "Digital Communication Systems", Simon Haykin, John Wiley & Sons, First Edition, 2014, ISBN 978-0-471-64735-5.
4. "Fundamentals of Communication Systems", John G Proakis and Masoud Salehi, 2014 Edition, Pearson Education, ISBN 978-8-131-70573-5.
5. "Modern Digital and Analog Communication Systems", B. P. Lathi, Oxford University Press., 4th edition.
6. "An Introduction to Analog and Digital Communication", Simon Haykins, John Wiley India Pvt. Ltd., 2008, ISBN 978–81–265–3653–5.
7. "Digital Communications - Fundamentals and Applications", Bernard Sklar and Ray, Pearson Education, Third Edition, 2014, ISBN: 978-81-317-2092-9.

List of Lab Experiments	
Sl. No.	**Experiment**
1	Pulse sampling, Verification of sampling theorem.
2	Time Division Multiplexing and Demultiplexing of two bandlimited signals.
3	BASK generation and detection.
4	BFSK generation and detection.

5	Simulate Amplitude Modulation and Demodulation: Standard AM using MATLAB. (One hour session to be engaged for concept discussion).
6	Simulate Amplitude Modulation and Demodulation: DSBSC using MATLAB. (One hour session to be engaged for concept discussion).
7	Simulate Frequency modulation and demodulation using MATLAB.
8	Simulate Pulse Width modulation and demodulation using MATLAB. (One hour session to be engaged for concept discussion).
9	Simulate Pulse Position modulation and demodulation using MATLAB. (One hour session to be engaged for concept discussion).
10	Simulate Pulse code modulation and demodulation using MATLAB. (One hour session to be engaged for concept discussion).

Marks Distribution for Assessment:

<table>
<tr><th rowspan="2">PCL</th><th rowspan="2">CIA</th><th rowspan="2">SEA</th><th colspan="4">CIA (50)</th><th rowspan="2">SEA
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<tr><td>Assignment</td><td colspan="3">AAT - 10 Marks</td></tr>
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B.N.M. Institute of Technology

An Autonomous Institution under VTU, Approved by AICTE

Dept. of Electronics and Communication Engineering

Choice Based Credit System (CBCS and Outcome Based Education (OBE)

Semester: 4

Course Name: Signal Processing Applications using MATLAB
Course Code: 23ECE146

L: T: P: J	**0: 0 : 2 : 2**	**CIA Marks:** 50
Credits:	**2**	**SEA Marks:** 50
Hours	**25**	**SEA Duration:** 03 Hours

Pre-Requisites: Signals and Systems and DSP Fundamentals

Course Learning Objectives: The students will be able to

1	Simulate continuous time, discrete time signals and verify sampling theorem using MATLAB.
2	Perform computation of DFT and convolution along with the verification of their properties.
3	Perform operations and transformations on Images.
4	Compute and display the filtering operations and compare with the theoretical values.
5	Able to use Simulink platform to verify the properties of a system.

Description	No. of Hours	Blooms Cognitive Levels
1. Plot discrete and continuous time waveforms like rectangular pulse, square wave, triangular pulse, triangular wave, impulse, step, and ramp signal.	**2**	**Apply CO1**
2. Computation of Linear convolution of two given sequences.	**2**	**Apply CO1, CO2**
3. Prove commutative, distributive, and associative property of Linear convolution.	**5**	**Apply CO2**
4. **Theory: Discrete Fourier Transform (DFT)**: Frequency domain sampling, The Discrete Fourier Transform, DFT as a linear transformation, Properties of the DFT: Periodicity, Linearity, Multiplication of two DFTs and Circular Convolution. Necessity for efficient computation of DFT, Radix-2 Fast Fourier Transform (FFT) algorithm for DFT computation. Radix-2 FFT algorithm for computation of Inverse Discrete Fourier Transform (IDFT)	**2**	**Apply CO2**
5. Computation of N point DFT of a given sequence and to plot magnitude and phase spectrum.	**2**	**Apply CO3**
6. Introduction to Image processing toolbox. Perform basic image processing operations like add, subtract, complement, and crop.	**2**	**Apply CO3**

7. Design and implementation of Low pass IIR filter to meet the desired specifications.	**2**	**Apply CO4**
8. Design and implementation of Low pass FIR filter to meet the desired specifications.	**2**	**Apply CO4**
9. Checking Linearity/Non-Linearity of a system using SIMULINK	**2**	**Apply CO5**
10. Checking Time variance/invariance of a system using SIMULINK	**2**	**Apply CO5**

Mini Project

One mini project to be completed in 12 lab sessions including its evaluation.

Sample Mini Projects

1. Light Animation using Arduino and MATLAB.
2. Fruit identification.
3. Vehicle number plate detection.
4. Simulation of power plant.
5. Hybrid electric vehicle modeling.
6. Image processing using MATLAB.
7. Improve speech communication in the car.
8. Remove noise from the voice signal.

Course Outcomes: After completing the course, the students will be able to

23ECE146.1	Demonstrate sampling theorem and plot elementary waveforms in continuous and discrete time domains.
23ECE146.2	Analyze and plot the signals using DFT and convolution.
23ECE146.3	Perform basic operations on images.
23ECE146.4	Apply filtering techniques on audio/speech signals.
23ECE146.5	Build a system to verify the properties of a given system using SIMULINK.
23ECE146.6	Develop a real time application in speech/audio/image processing.

Reference Books

1. Vinay K Ingle, John G Proakis, Digital Signal Processing using MATLAB, Fourth Edition, Cengage India Private Limited, 2017.
2. John W. Leis, Digital Signal Processing Using MATLAB for Students and Researchers, Wiley, August 2011

Marks Distribution for Assessment:

<table>
<tr><th>PBL</th><th>CIA</th><th>SEA</th><th colspan="3">CIA (50)</th><th>SEA
Conduction: 100 M
Reduced to: 50 M</th></tr>
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Project Report – 25 Marks
Presentation and Demonstration – 50 Marks
Viva-Voce – 15 Marks

Project Assessed for 100 Marks
Reduced to 50 Marks</td></tr>
<tr><td>20</td><td>20</td></tr>
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<tr><td>Lab</td><td colspan="2">Weekly Assessment (Record/Project) – 10 Marks
Lab IA test – 20 Marks</td></tr>
<tr><td colspan="4">Total – 50 Marks</td><td>Total – 50 Marks</td></tr>
</table>

BNM Institute of Technology

Syllabus for Softskills-2
SEMESTER – IV

Subject Name	Softskills-2 (Quantitative Aptitude & Logical Reasoning)	**Weekly Assessment Marks (6 tests)**	Max 10 Min 4
Subject Code	23SFT147 /148	**Practice Tests for Internal Assessment Marks (6 tests)**	Max 15 Min 6
Number of Contact Hours/Week	2	**Final Assessment Marks (during 3rd test on Tab MCQ)**	Max 25 Min 10
Total Number of Contact Hours	24	**Credits**	1

Module 1 (Quantitative Aptitude - 2) (6hrs)	**Ratio and Proportion** · Simple Ratios, Compound Ratios · Comprehend and Dividend · Direct & Indirect Proportions · Problems on ages,
	Mixtures & Alligation– technique, general representation, the straight-line approach, application of weighted allegation methods in problems involving mixtures, application of allegation on situations other than mixtures problems & Coin problems.
	Data Interpretation – Simple arithmetic, rules for comparing fractions, calculating(approximation)fractions, shortcut ways to find the percentages, Classification of data tables, Bar Graph, Tabular Form, Line Chart, case let Form. Pie Chart, Radar/Web, combination of graphs, combination of graphs and tables. and Missing Data Interpretation.
	Simple interest and Compound Interest - Simple Interest, Basic Difference b/w both the Interests. Mixed interest, CI with a Fractional Rate, to find Installments of both SI and CI.
Module 2 (Logical Reasoning -	**Ages & Blood Relation** - Generation Tree, Family Tree Problems, Statement Based Questions, Coded Blood Relation Question, Blood Relation Based Puzzles.
	Seating Arrangement - Single or Double rows facing each other or away from each other in the same direction Circular Seating Arrangement · Uni- & Bi-directional problems on · Circular, Square, Rectangular, Hexagonal tables

2) (6hrs)	**Distance & Direction** - Distance and Displacement between any two points as well as puzzles based on that, Concept of Shadows.
Module 3 (Quantitative aptitude - 3) (6hrs)	**Speed, Time & Distance** - Relative speed, Average speed, Problems on Races when somebody gives a start to other Person. Persons moving opposite & same direction in circular track, problems on train, Boat & Stream,
	Permutation & Combination - Arrangement, law of addition & multiplication, factorial function, concept of step arrangement, permutation of similar things, circular things, find the rank of word in dictionary. Concepts of selections using combination.
	Time & Work - Partial work done problems Work done on Alternate days. Problems related to efficiency. Division of Wages According to Work. Work & wages, pipes & cisterns
Module 4 (Logical Reasoning - 3) (6hrs)	**Clocks & Calendars** - Understanding concepts and basic formula along with solving different types of problems. **Probability** - Single event probability, multi event probability, independent events and dependent events, mutually exclusive events, non-mutually exclusive events, combination method for finding the outcomes.
	Analogies - Drawing similarity between different but sufficiently similar events, situations, or circumstances using tips and tricks, find the odd one out, rule detection,

Dept. of Electronics and Communication Engineering
Choice Based Credit System (CBCS and Outcome Based Education (OBE)

Semester: V

Course Name: Digital Image Processing		**Course Code: 23ECE151**
L: T: P: J	**3 : 0 : 0 : 0**	**CIA Marks:** 50
Credits:	**3**	**SEA Marks:** 50
Hours/Week (Total)	**3**	**SEA Duration:** 03 Hours

Course Learning Objectives: The students will be able to

1	Understand the fundamentals of Digital Image Processing.
2	Explain the image enhancement techniques both in the Spatial and Frequency Domain.
3	Explain the Restoration techniques used in Digital image processing.
4	Understand the Color and Morphological Image Processing methods.
5	Understand the techniques for Segmentation and Representation of gray scale Images.

Module-1: Digital Image Fundamentals	**No. of Hours**	**Blooms Cognitive Levels**
Digital Image Fundamentals: What is Digital Image Processing?, Origins of Digital Image Processing, Examples of fields that use DIP, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Elements of Visual Perception, Image Sensing and Acquisition, Image Sampling and Quantization, Some Basic Relationships Between Pixels, Linear and Nonlinear Operations.	**8**	**Apply CO1**
Module-2: Filtering in the Spatial and Frequency Domain		
Spatial Domain: Some Basic Intensity Transformation Functions, Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters **Frequency Domain:** Preliminary Concepts, The Discrete Fourier Transform (DFT) of Two Variables, Properties of the 2-D DFT, Filtering in the Frequency Domain, Image Smoothing and Image Sharpening Using Frequency Domain Filters, Selective Filtering	**8**	**Apply CO2**
Module-3: Restoration		
Restoration: Noise models, Restoration in the Presence of Noise Only using Spatial Filtering and Frequency Domain Filtering, Linear, Position-Invariant Degradations, Estimating the Degradation Function, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering.	**8**	**Apply CO3**
Module-4: Color and Morphological Image Processing		
Color Image Processing: Color Fundamentals, Color Models, Pseudocolor Image Processing. **Morphological Image Processing:** Preliminaries, Erosion and Dilation, Opening and Closing, The Hit-or-Miss Transforms.	**8**	**Apply CO4**
Module-5: Segmentation, Representation and Description		
Segmentation: Point, Line, and Edge Detection, Thresholding, Region-Based Segmentation **Representation and Description**: Representation, Boundary descriptors, Regional Descriptors	**8**	**Apply CO5**

Course Outcomes: After completing the course, the students will be able to	
23ECE151.1	Understand image formation and the role human visual system plays in perception of gray and color image data.
23ECE151.2	Apply image processing techniques in both the spatial and frequency (Fourier) domains.
23ECE151.3	Apply image Restoration techniques in the spatial domain.
23ECE151.4	Apply image processing techniques for Color and Morphological Image Processing.
23ECE151.5	Design image analysis techniques in the form of image segmentation evaluate the methodologies for Representation and Description.
23ECE151.6	Conduct independent study and analysis of Image Enhancement and Restoration techniques for real time applications.

Reference Books
1. Digital Image Processing- Rafel C Gonzalez and Richard E. Woods, PHI 3rd Edition 2010
2. Image Processing- S.Jayaraman, S.Esakkirajan, T.Veerakumar, Tata McGraw Hill 2014.
3. Fundamentals Digital of Digital Image Processing-A. K. Jain, Pearson 2004

Marks Marks Distribution for Assessment:

CIA (50)	**Component**	**Description**	**Marks**
	Written Test	● Total Number of Test: 3 ● Each Theory test will be conducted for 30 marks ● Average of 3 tests = 30 Marks	30
	Assignment	Average of 2 Assignments for 10 marks each	10
	AAT	Open ended experiments	10
		Total Marks	**50**
SEA (50)	**Component**	**Description**	**Marks**
	Written Exam	Theory exam will be conducted for 100 marks and scaled down to 50 Marks The question paper will have 10 full questions each of 20 marks. Students have to answer 5 full questions	**50**
		Total marks for the Course	**100**

Additional Assessment Tools (AAT) –Open ended experiments.

Dept. of Electronics and Communication Engineering
Choice Based Credit System (CBCS and Outcome Based Education (OBE)

Semester: 5th

Course Name: Electromagnetic waves and transmission lines **Course Code:** 23ECE152

L:T:P:J	**2:2:0:0**	**CIA Marks:**50
Credits:	**3**	**SEA Marks:**50
Hours/Week (Total)	**4**	**SEA Duration:**03Hours

Pre-Requisites: Vector Calculus

Course Learning Objectives: The students will be able to

1	Understand the applications of Coulomb's law and Gauss law to different charge distributions and the applications of Laplace's and Poisson's Equations to solve real time problems on capacitance of different charge distributions.
2	Understand the physical significance of Biot-Savart's and Ampere's Law for different current distributions
3	Know the physical interpretation of Maxwell' equations and applications for Plane waves for their behavior in different media
4	Acquire knowledge of Poynting Theorem and its application of Power flow.
5	Understand the parameters of microwave transmission line and waveguides.

Module-1: Laws of static electric field	**No. of Hours**	**Blooms Cognitive Levels**
Vector Basics: Vector Algebra, Rectangular coordinate system, vector components and unit vectors, the dot product, the cross product, circular cylindrical coordinates, the spherical coordinate system. **Coulomb's Law, Electric Field Intensity and Flux density** Experimental law of Coulomb, Electric field intensity, Field due to continuous point charge distribution, Field of a line charge, Electric flux density **Gauss's law and Divergence** Gauss's law, Divergence. Maxwell's First equation (Electrostatics), Vector Operator ▼ and divergence theorem[Qualitative Analysis Only]	**8**	**Apply CO1**
Module-2: Energy, Potential, Current and Current density , Poisson's, Laplace's Equations		
Energy, Potential and Conductors: Energy expended in moving a point charge in an electric field, The line integral, Definition of potential difference and potential, The potential field of point charge, Potential gradient. **Current, Current density, Continuity of current.** **Poisson's and Laplace's Equations:** Derivation of Poisson's and Laplace's Equations, Uniqueness theorem, Examples of the solution of Laplace's equation.	**8**	**Apply CO2**
Module-3: Laws of Magneto-static fields and Time varying field		
Steady Magnetic Field: Biot-Savart Law, Ampere's circuital law, Curl, Stokes' theorem[Qualitative Analysis Only], Magnetic flux and magnetic flux density, Scalar and Vector Magnetic Potentials **Faraday' law of Electromagnetic Induction –**Integral form and Point form **Maxwell's equations:**Inconsistency of Ampere's law with continuity equation, displacement current, Maxwell's equations in point form and integral form.	**8**	**Apply CO3**
Module-4: Uniform Plane Wave		

Uniform Plane Wave: Wave Propagation in free space, Derivation of General wave equations from Maxwell's equations, Relation between E and H, Solution of wave equation for free space and good conductor, wave propagation in free space and good conductor (γ, α, β, η) Skin effect or Depth of penetration, Poynting theorem.	**8**	**Apply CO4**
Module-5: Transmission lines		
Transmission Line equations and solutions, Reflection Coefficient and Transmission Coefficient, Standing Waves and Standing Wave Ratio, Smith chart- Properties and its applications.	**8**	**Apply CO5**

Course Outcomes: After completing the course, the students will be able to	
23ECE152.1	Evaluate problems on electrostatic force, electric field due to point, linear, volume charges by applying conventional methods. Understanding Gauss law to evaluate Electric fields due to different charge distributions and Volume Charge distribution by using Divergence Theorem
23ECE152.2	Determine potential and energy with respect to point charge. Apply Laplace's equation to determine voltage function, capacitance.
23ECE152.3	Apply Biot-Savart's and Ampere's laws for evaluating Magnetic field for different current configurations, Apply Maxwell's equations for time varying fields.
23ECE152.4	Apply Maxwell's equations for deriving the propagation of EM waves in free space and conductors and Evaluate power associated with EM waves using Poynting theorem.
23ECE152.5	Explain propagation of RF signals through transmission line and transmission line basics.
23ECE152.6	Self-learning through listening and comprehension of audio / video lectures related to electro-magnetic fields and waves domain and understand the effects of E.M. waves with respect to Electromagnetic interference (EMI) and Electromagnetic Compatibility (EMC).

Reference Books

1. Engineering Electromagnetics by W.H. Hayt and J.A. Buck, Tata McGraw Hill, 2014, ISBN-978-93-392-0327-6, 8th Edition.
2. Microwave Devices and Circuits by Samuel Y.Liao, PHI, 3rd Edition
3. Electromagnetic Waves and Radiating systems, E. C. Jordan and K.G. Balman,PHI 2nd Edition
4. Elements of Electromagnetics, Matthew N.O., Sadiku, Oxford university press 4th Edition.
5. Electromagnetics, Joseph Edminister, Schaum Outline Series, McGraw Hill,2nd Edition

Marks Distribution for Assessment:

PCC	CIA	SEA	CIA (50)				SEA Conduction: 100 M Reduced to: 50 M
				I	II	III	
Conduction	50	50	Written Test	30	30	30	Five questions with each of 20 marks (with internal choice). Student should answer one full question from each module
				Average of three tests – 30 Marks			
			Assignment	10 Marks			
			AAT	10 Marks			
				Total – 50 marks			**Total – 50 marks**

i) CIA: 50%

IA Test: 3 IA tests - Each of 30 Marks - Average of 3 tests	30 Marks
Assignment – Two assignments	10 Marks
Additional Assessment Tools (AAT) – Oral /Online Quizzes, Presentations, Group discussions, Case studies, Term Paper, Open ended experiments, Mini industrial/social/rural Projects, Two-minute video on latest topic, Short MOOC courses, Practical Orientation on Design thinking, creativity & Innovation, Participatory & Industry integrated learning, Practical activities, Problem solving exercises, Participation in seminars/academic events/symposia and any other activity	10 Marks
Total	**50 Marks**

ii) SEA : 50%

Theory Exam	5 questions to answer each of 20 Marks 2 questions from each module with internal choice Student should answer one full question from each module	20 M x 5 = **100 M** **reduced to 50 M**
	Total	**50 Marks**

Dept. of Electronics and Communication Engineering
Choice Based Credit System (CBCS and Outcome Based Education (OBE)

Semester: V

Course Name: Computer Networks and Security Course Code: 23ECE153

L: T: P: J	**3 : 0 : 2 : 0**	**CIA Marks:** 50
Credits:	**4**	**SEA Marks:** 50
Hours/Week (Total)	**5**	**SEA Duration:** 03 Hours

Pre-Requisites: Basics of data transmission, modulation techniques, and signal propagation, Familiarity with Linux/Unix Commands, Discrete Mathematics, Proficiency in a programming language such as C**,** Python.

Course Learning Objectives: The students will be able to

1	Understand and apply fundamental principles of data communication, layered network architectures, and transmission media.
2	Apply data link layer protocols and MAC techniques to design reliable and efficient local area networks.
3	Analyze IP addressing schemes, routing algorithms, and network-layer protocols to manage and optimize data flow in complex networks.
4	Apply transport and application layer services for end-to-end communication in modern networked systems.
5	Apply core security principles and analyze threats to network infrastructure to recommend and implement appropriate security solutions.

Module-1: Data communication and Physical Layer	**No. of Hours**	**Blooms Cognitive Levels**
Data communication: Components, Data representation, Data flow. Networks: Network criteria, Physical Structures, Network types: LAN, WAN, Network Topologies, Switching techniques, the Internet. TCP/IP Protocol Suite, Layered Architecture, Layers in the TCP/IP Protocol Suite, Description of each Layer, Encapsulation and De-capsulation, Addressing, Multiplexing and De-multiplexing, OSI versus TCP/IP. Transmission media (guided and unguided), digital signals, bandwidth and throughput	**10**	**Apply CO1**
Module-2: Data-Link Layer		
Data-Link Layer: Nodes and Links, Services, Two Categories of links, Sublayers, Link Layer addressing: Types of addresses, ARP. Data Link Control (DLC) services: Framing, Flow and Error Control, Data Link Layer Protocols: Simple Protocol, Stop and Wait protocol **Wired and Wireless LANs:** Ethernet Protocol, Standard Ethernet, Introduction to wireless LANs, Characteristics MAC Protocols: ALOHA, CSMA/CD, CSMA/CA	**10**	**Apply CO2**
Module-3: Network Layer		
Network Layer: Introduction, Network Layer services: Packetizing, Routing and Forwarding, Packet Switching: Datagram Approach, Virtual Circuit Approach. IPV4 Addresses: Address Space, Classful Addressing, Classless Addressing, DHCP, Network Address Resolution **Network Layer Protocols:** Internet Protocol(IP) Routers, Gateways, Distance Vector Routing, Dijkstra's algorithm	**10**	**Apply CO3**
Module-4: Transport Layer and Application Layer		
Transport Layer: Introduction, Transport Layer Services, Connectionless and Connection-oriented Protocols		

Transport-Layer Protocols in the Internet: User Datagram Protocol: User Datagram, UDP Services Transmission Control Protocol: TCP Services, TCP Features, Segment, Connection, State Transition0 diagram, Flow control, Error control, TCP congestion control **Application Layer:** Introduction, Services, Application - layer paradigms.	**10**	**Apply CO4**
Module-5: Network Security		
Network Security: Need for Security, Security Approaches, Principles of Security, Types of Attacks, Viruses and Related Threats, Need for Firewalls, Firewall Characteristics, Types of Firewalls, overview of IP security. Network Attacks: DoS, DDoS, Man-in-the-Middle, Phishing, Spoofing	**10**	**Apply CO5**

Lab Experiments
1. Program to implement three nodes point – to – point network with duplex links between them.
2. Program to implement transmission of ping messages/trace route over a network topology consisting of 6 nodes and find the number of packets dropped due to congestion.
3. Program to implement an Ethernet LAN using n nodes and set multiple traffic nodes and plot congestion window for different source / destination.
4. Program to construct simple LAN and understand the concept and operation of Address Resolution Protocol (ARP) using CISCO Packet Tracer.
5. Program for simulation of distance vector routing algorithm.
6. Program for simulation of link state routing algorithm.
7. Program to analyze the performance of various configurations and protocols in LAN using CISCO Packet Tracer.
8. Program to construct a Wireless LAN and make the PCs communicate wirelessly using CISCO Packet Tracer.
9. Program to install and configure network interface card. Identify IP address of a work station, class of the address and configure the IP address on a work station. To share the hardware resources on a network.
10. To configure a basic firewall in Cisco Packet Tracer using **Standard Access Control Lists** to **restrict access** from one network to another (e.g., block a specific host from accessing the server).
Revision
Lab assessment & evaluation

Course Outcomes: After completing the course, the students will be able to	
23ECE153.1	Apply concepts of data communication and physical layer technologies to build and analyze small-scale network infrastructure.
23ECE153.2	Apply error and flow control mechanisms and analyze MAC protocols for both wired and wireless LANs.
23ECE153.3	Apply addressing and routing strategies to IP networks and analyze routing algorithms for optimal data transfer.
23ECE153.4	Apply transport and application layer functionalities to manage reliable data transmission and analyze connection-oriented communication using TCP.
23ECE153.5	Apply security principles to protect network systems and analyze various network attacks and corresponding defense mechanisms.
23ECE153.6	Discuss and analyze the various applications that can be implemented on networks.

References

1. Forouzan, "Data Communications and Networking", 5th Edition, McGraw Hill, 2016, ISBN: 1-25-906475-3.
2. William Stallings, "Cryptography and Network Security Principles and Practice", Pearson Education Inc., 5th Edition, 2014, ISBN: 978-81-317- 6166-32.
3. Atul Kahate, "Cryptography and Network Security", TMH, 4th Edition, 2019, ISBN-13: 978-9353163303, ISBN-10: 9353163307.
4. Andrew S. Tanenbaum and David J. Wetherall, "*Computer Networks"*, 5th Edition, 2022, Pearson Education.

Marks Distribution for Assessment:

<table>
<tr><th rowspan="2">PCL</th><th rowspan="2">CIA</th><th rowspan="2">SEA</th><th colspan="4">CIA (50)</th><th rowspan="2">SEA
Conduction: 100 M
Reduced to: 50 M</th></tr>
<tr><th></th><th>I</th><th>II</th><th>III</th></tr>
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<tr><td colspan="3">Average of three tests – 30 marks scaled down to 20 marks</td></tr>
<tr><td>Assignment</td><td colspan="3">Average of 2 Assignments – 10M</td></tr>
<tr><td>Practical</td><td colspan="3">Weekly Assessment – 10 Marks
IA test – 10 Marks</td></tr>
<tr><td colspan="4">Total – 50 Marks</td><td>Total – 50 Marks</td></tr>
</table>

i) CIA: 50%

Theory	**IA Test** (Theory): 3 IA tests - each of 30 Marks **Assignment**: 2 Assignments – each of 10 Marks	Average of 3 tests 30 Marks
Lab	**Weekly Assessment** – 10 Marks **Practical test (1)** - 10 Marks	20 Marks
	Total	**50 Marks**

ii) SEA: 50%

Question Paper:

Theory Exam	5 questions to answer, each of 20 Marks 2 questions from each module with internal choice Student should answer one full question from each module	20 M x 5 = **100 M** **Reduced to 50 M**
	Total	**50 Marks**

B.N.M. Institute of Technology

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Department of Electronics and Communication Engineering

SEMESTER – V

REAL TIME OPERATING SYSTEM
Credit: 4

Course Code	23ECE154	CIA Marks	50
Teaching Hours/Week (L: T: P: J)	2:0:4:0	SEA Marks	50
Total Number of Lecture Hours	50	Exam Hours	03

Course Learning Objectives:

This course will enable students to

- Understand the Architecture of QNX Neutrino RTOS and Develop Real-Time Applications
- Understand the working of QNX Development Tools (Momentics IDE)
- Able to Implement Process and Thread Management
- Understand the Master Inter-Process Communication (IPC)
- Debug and Optimize Embedded Systems

Pre-Requisites: Operating Systems basics and Embedded systems.

QNX Momentics Development Basics: Eclipse Basics, Targets, Projects and Source, Compiling, Exercise, Running and Debugging, Exercise and Versions.

QNX Neutrino RTOS Environment Setup

Objective: Install and configure QNX SDP, Momentics IDE, and target system (real or virtual).
Outcome: Understand development workflow in QNX.

	Number of Hours	**Bloom's Level**
Module-1		
Introduction to QNX Real Time Operating System: Architecture – Executive, Microkernel, Inter process Communication, Processes and Threads, Interrupt Handling, Scheduling.	**4**	**Apply (CO1)**
Laboratory Component: Process Creation and Management Objective: Create and run hello world example on VM Ware virtual machine or Rasp-pi board. Outcome: Print hello world on panel of QNX Momentics IDE Objective: Write a program to create and manage multiple processes. Outcome: Demonstrate use of fork(), exec(), and wait() in QNX. **Self-Study Component:** Demonstrate how to Detecting the termination of a child processes.	**6**	**Apply (CO1, CO2)**
Module-2		
Process Managers: Introduction, System Library, Shared Objects, OS Services, Boot Sequence and Security. **Processes, Threads & Synchronization:** Introduction, Processes: Creation and Detecting termination, Threads, Process Termination and Cleanup,	**4**	**Apply (CO2)**

Synchronization.		
Laboratory Component: Thread Creation and Synchronization Objective: Implement multi-threaded programs with POSIX threads. Outcome: Use pthread_create(), mutexes, and semaphores for synchronization. **Self-Study Component:** Implement a multi-threaded application using POSIX threads (pthread_create). Each thread should process a different part of an array and the main thread should wait for all threads to complete using pthread_join.	**6**	**Apply (CO2)**
Module-3		
Introduction to QNX Inter-Process Communication: Message Passing, Designing a Message Passing System (1): Pulses, Client Information Structure, How a Client Finds a Server, Multi-Part Messages Designing a Message Passing System (2).	**4**	**Understand (CO3)**
Laboratory Component: **Signal and Pulse Handling** Objective: Use signals and pulses for lightweight communication and event notification. Outcome: Differentiate between signals and pulses in real-time applications. **Self-Study Component:** Implementing a thread-safe bounded buffer (also known as a circular queue) that is shared between multiple producer threads and multiple consumer threads. The buffer has a fixed size (N slots). Producers add items to the buffer, and consumers remove items from the buffer.	**6**	**Apply (CO3, CO4)**
Module-4		
QNX Inter-Process Communication: Issues Related to Priorities, Designing a Message Passing System (3): Event Delivery Shared Memory **Introduction to Hardware Programming:** Hardware I/O, Programming PCI bus devices, Handling Interrupts.	**4**	**Apply (CO4)**
Laboratory Component: **Inter-Process Communication using Message Passing** Objective: Implement server-client IPC using MsgSend(), MsgReceive(), and MsgReply(). Outcome: Understand QNX's microkernel IPC model. **Self-Study Component:** How to create two processes that communicate using shared memory by using shm_open(), mmap(), and memory protection in QNX.	**6**	**Apply (CO4)**
Module-5		
Resource Managers: Introduction, A Simple Resource Manager: Initialization and Handling read() and write(). **Timing Architecture:** Introduction, Getting and Setting the System Clock, Timers, High-Resolution Timers, Design Considerations, Kernel Timeouts	**4**	**Apply (CO5)**

Laboratory Component: **Timer and Clock Management** Objective: Implement periodic timer-based tasks. Outcome: Learn to use timer_create(), timer_settime(), and high-resolution timers. ***Self-Study Component:*** **Resource Manager to handle file** Objective: Design a basic resource manager to handle file or device-like operations. Outcome: Gain experience with QNX's modular driver model.	**6**	**Apply (CO5)**

Course outcomes:

The students will be able to

- Understand the Architecture of QNX Neutrino RTOS and Develop Real-Time Applications
- Apply the working of QNX Development Tools (Momentics IDE)
- Implement Process and Thread Management
- Apply the Master QNX Inter-Process Communication
- Understand the timing architecture, High-Resolution Timers, Design Considerations, Kernel Timeouts

Reference Books:

1. Operating Systems: Design and Implementation - Andreq S Tanenbaum
2. The Linux Programming Interface- Michael Kerrisk

Marks Distribution for Assessment

CIA (50)	Components	Description	Marks
	Written test	• Total Number of Test:03 • Each Theory test will be conducted for 30 marks • Average of 3 tests= 30 Marks	**30**
	Practical	• Total number of Test : 02 [Part-A(Modue-1 and 2) and Part-B(Module 3,4 and 5)] Each Lab test will be conducted for 50 marks and reduce to 10 Average of 2 tests= 10 Marks • Laboratory conduction is to be evaluated every week. conducted & Viva = 5 Marks Lab Record = 5 Marks	**10** **10**
		Total CIA	**50**
SEA (50)	Practical Exam	• Students are allowed to pick one experiment from Part-A and one experiment from PART-B. Mark Distribution : Total 100 marks Part – A : 40 Marks (Procedure:6, Execution:28, Viva: 6) Part – B : 60 Marks(Procedure:9, Execution:42, Viva: 9) Scale down to 50 marks	**50**
		Total Marks for the Course	**100**

B.N.M. Institute of Technology

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Dept. of Electronics and Communication Engineering
Choice Based Credit System (CBCS and Outcome Based Education (OBE))

Semester:V

Course Name: Artificial Intelligence and Machine Learning Applications **CourseCode:23ECE155**

L:T:P:J	**0:0:2:2**	**CIA Marks:50**
Credits:	**2**	**SEA Marks:50**
Hours/Week(Total)	**12 Lab sessions+12 sessions for project**	**SEA Duration:03Hours**

Pre-Requisites: Linear Algebra Fundamentals and basics of MATLAB

Course Learning Objectives: The students will be able to

1	Introduce some concepts and techniques that are core to Artificial Intelligence and Machine Learning.
2	Understand Intelligent Systems, and problem solving.
3	Understand K-means clustering algorithms.
4	Acquire knowledge of Classification and Regression Techniques.
5	Identify and apply Machine Learning algorithms to solve real world problems.

Module1: Introduction to AI and ML	**No. of Hours**	**Blooms Cognitive Levels/CO Mapping**
Artificial Intelligence: History, Intelligent systems, foundation and sub Area of AI, applications, current trend and development of AI, Introducing to ML with MATLAB **Program:** 1. Write a MATLAB script to import an excel file by a.) Manual Method b.) Programmatic Method using in-built command as a table variable and display the summary of table 2. Perform Data Preprocessing and apply Classification- Navie Bayes on FeaturesPart1 dataset for Human Activity Recognition Using Sensor Data. (Use Classification learner app in MATLAB)	**5**	**Apply CO1**
Module2: Machine Learning Tool box		
Machine Learning: Data Scrubbing, Different types of Learning: Supervised, Unsupervised and Reinforcement learning, Feature Selection. **Program:** 1. Write a MATLAB script to load the titanic dataset (Ref1) and use suitable functions to select the best features for predicting the survival status of a given passenger. 2. Preprocess and Explore Time-Stamped Data Using timetable and plot the results for Compare the data for July 4 to data for the rest of the month of July.	**5**	**Apply CO2**
Module3: Clustering Algorithms		
Introduction to Clustering algorithms, K-Means clustering algorithm **Program:** 1. Write a MATLAB script to perform data clustering. a.) Hard Clustering Algorithm b.) Soft Clustering Algorithm 2. Using "Bat Algorithm" perform the clustering operation using a suitable dataset.	**5**	**Apply CO3**

Module4: Classification		
Introduction to Classification, Evaluation Metrics, MATLAB Implementation. **Program:** 1. Write a MATLAB script to develop a classifier model to predict the survival status of a passenger using titanic dataset 2. Write a MATLAB script to perform "Eigenvalue Classification" using "Wine" dataset.	**5**	**Apply CO4**
Module5: Regression		
Introduction to Regression, Evaluation Metrics, MATLAB Implementation. **Program:** 1. Write a MATLAB script to implement a Regression Model on a given Dataset 2. Perform Multivariate polynomial regression using a dataset, represent the results suitably.	**5**	**Apply CO5**
Mini-Project: One mini project to be completed in 12 lab sessions including its evaluation.		
Sample Mini-Projects 1. Image Segmentation. 2. Sign Language Recognition System. 3. Game Playing Project. 4. Handwritten Character Recognition. 5. Bit coin Price Predictor. 6. Music Genre Classification. 7. Wine Quality Test. 8. Titanic Survival Prediction Project.		

CourseOutcomes:Aftercompleting thecourse,thestudentswillbeableto	
23ECE155.1	Implement data importing and reading using MATLAB
23ECE155.2	Implement Feature Selection and Prediction using MATLAB
23ECE155.3	Design Clustering Algorithms for a given Problem Statement and a Dataset
23ECE155.4	Design a suitable Classification Algorithm for a given Problem Statement and a Dataset
23ECE155.5	Design a suitable Regression Algorithm for a given Problem Statement and a Dataset
23ECE155.6	Apply Machine Learning algorithms to solve real-world problems.

ReferenceBooks

1. Oliver Theobald , Machine Learning for Absolute Beginners,3rd Edition2021 edition Sanage publication house , ISBN 13:978-9-3620568-6-3
2. SarojKaushik,ArtificialIntelligence,CengageLearning,2022,2ndEdition,CengageLearning India, ISBN: 9789355730428
3. GiuseppeCiaburro,MATLABforMachineLearning,PacktPublishing,2017,ISBN:978-1-78839-843-5,2017
4. ElaineRich, KevinKnight,ArtificialIntelligence,TataMcGrawHillEducation,3rdedition, 2017
5. OliverTheobald,MachineLearningforAbsoluteBeginners,3rd Edition, 2021.

MarksDistributionforAssessment:

<table>
<tr><th>PBL</th><th>CIA</th><th>SEA</th><th colspan="3">CIA(50)</th><th>SEA
Conduction:100M
Reduced to50 M</th></tr>
<tr><td rowspan="4">Conduction</td><td rowspan="4">50</td><td rowspan="4">50</td><td rowspan="3">IA TEST</td><td>IIA (40M)</td><td>IIIA (40M)</td><td rowspan="4">Project
Assessedfor100
marks.
reducedto50Marks</td></tr>
<tr><td>20(T) + 20 (E)</td><td>20(T) + 20 (E)</td></tr>
<tr><td colspan="2">averageof2tests–40marks</td></tr>
<tr><td>Continuous
Assessment</td><td colspan="2">WeeklyAssessment(Record/Projec
t) 5+5= 10 M</td></tr>
<tr><td colspan="4">Total40+10=50Marks</td><td>Total–50Marks</td></tr>
</table>

i) CIA:50%

Theory& Execution-2IAtests-Eachof40 Marks	40Marks
Practical **WeeklyAssessment** -Labrecord/Project–10Marks	10Marks
Total	**50M**

ii) SEA:50%

Project	Writeup–10Marks. Projectreport–25Marks Presentation&Demonstration-50Marks Viva-Voce – 15 Marks	**100 Marks reducedto 50 Marks**
	Total	**50Marks**

Dept. of Electronics and Communication Engineering
Choice Based Credit System (CBCS and Outcome Based Education (OBE)

Semester: V

Course Name: Smart Sensor Technologies **Course Code: 23ECE1561**

L: T: P: J	**3 : 0 : 0 : 0**	**CIA Marks:** 50
Credits:	**3**	**SEA Marks:** 50
Hours/Week	**3**	**SEA Duration:** 03 Hours

Pre-Requisites: Basic Engineering Science

Course Learning Objectives: The students will be able to

1	To develop a foundational understanding of sensing principles and system integration for effective measurement and instrumentation in engineering applications.
2	To equip students with the ability to apply the principles of tactile sensing in selecting and utilizing appropriate sensors for force, pressure, and touch-based applications.
3	To enable students to apply the concepts of wireless sensor networks in designing and analyzing sensor node architecture, communication methods, and energy-efficient systems for real-world applications.
4	To develop students to apply knowledge of smart sensor standards and emerging technologies in designing interoperable and future-ready sensing systems.
5	To equip students with the ability to apply sensor technologies in diverse domains such as automotive, aerospace, healthcare, industry, and environmental monitoring.

Module-1: Sensor Fundamentals	**No. of Hours**	**Blooms cognitive Levels**
Introduction, Sensor Requirement in Smart Systems, Sensor Technologies for Smart Systems, Sensor Systems, System Characteristics, Instrument Selection, Sensors, Signals, and Systems, Sensor Classification, Units of Measurements, Types of Sensors: Position, Acceleration, Strain, Load, Sound, Light, Voltage, Current, Flow, Temperature	**8**	**Understand CO1**
Module-2: Advanced Tactile and Touch Sensor Systems		
Tactile Sensors: Switch Sensors, Piezoelectric Sensors, Piezoresistive Sensors, MEMS Sensors, Capacitive Touch Sensors, Acoustic Touch Sensors, Optical Sensors, Piezoelectric Force Sensors	**8**	**Apply CO2**
Module-3: Wireless Sensor Networks: Principles and Applications		
Introduction to Wireless Sensor Network, Individual Wireless Sensor Node Architecture, Wireless Sensor Networks Architecture, Radio Options for the Physical Layer in Wireless Sensor Networks, Power Consideration in Wireless Sensor Networks, Applications of Wireless Sensor Networks: Structural Health Monitoring – Smart Structures, Industrial Automation Civil Structure Monitoring	**8**	**Apply CO3**
Module-4: Standards for Smart Sensing and The Next Phase of Sensing Systems		
Setting the Standards for Smart Sensors and Systems, IEEE 1451.1, IEEE 1451.2, IEEE P1451.3, IEEE P1451.4, Extending the System to the Network The Next Phase of Sensing Systems: Future Semiconductor Capabilities, Future System Requirements, Software, Sensing, and the System, Alternative Views of Smart Sensing	**8**	**Apply CO4**
Module-5: Bio-Medical and Automotive Sensors		
Electrical Potentials and Propagation of Nerve Signals, Electrodes, EMG, ECG, EEG, Blood pressure, Engine temperature, Airflow, Combustion, Torque, Accelerometers, Gas composition sensors – Liquid level sensors	**8**	**Understand CO5**

Course Outcomes: After completing the course, the students will be able to	
23ECE1561.1	Students will be able to explain sensor operations, analyze system behavior, and select suitable instruments based on application requirements.
23ECE1561.2	Students will be able to apply the working concepts of tactile sensors to identify suitable sensor types and implement them in practical engineering scenarios.
23ECE1561.3	Students will be able to apply wireless sensor network principles to configure sensor nodes, choose suitable communication options, and implement solutions for monitoring and automation tasks.
23ECE1561.4	Students will be able to apply smart sensor interface standards and evaluate emerging trends to develop scalable and adaptable sensor network solutions.
23ECE1561.5	Students will be able to apply suitable sensors for specific application areas by analyzing functional requirements and operational environments.
23ECE1561.6	Students will be able to apply sensor-related concepts to select, configure, and implement appropriate sensors and systems for domain-specific applications, ensuring performance, interoperability, and efficiency.

Reference Books

1. D. Patranabis, "Sensors and Transducers", PHI learning pvt. Ltd.,2nd edition, 2024
2. Jacob Fraden, "Handbook of Modern Sensors: Physics, Designs, and Applications", 5th Edition, Springer, 2016.
3. Frank, Randy, "Understanding smart sensors", Artech House integrated microsystems series, 3rd Edition, 2013.
4. J. G. Webster, Medical Instrumentation; Application and Design, 2010, 4th Edition, John Wiley, USA.
5. John G Webster, Measurement, Instrumentation and Sensors Handbook, 2014, CRC Press, USA.

Marks Distribution for Assessment:

CIA (50)	Component	Description	Marks
	Written Test	● Total Number of Tests: 3 ● Each Theory test will be conducted for 30 marks. ● Average of 3 tests = 30 Marks	30
	Assignment	1 Assignment for 10 marks	10
	AAT	Two-minute video on latest topic related to sensor technologies with presentation	10
		Total Marks	**50**
SEA (50)	**Component**	**Description**	**Marks**
	Written Exam	Theory exam will be conducted for 100 marks and scaled down to 50 Marks The question paper will have 10 full questions each of 20 marks. Students have to answer 5 full questions	**50**
		Total marks for the Course	**100**

Additional Assessment Tools (AAT) – Quiz, Presentations, Term Paper, Open ended experiments, Mini Projects, Two-minute video on latest topic, Short MOOC courses

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Dept. of Electronics and Communication Engineering

Choice Based Credit System (CBCS and Outcome Based Education (OBE)

Semester: V

Course Name: Mobile Communication and Processor		**Course Code: 23ECE1562**
L: T: P: J	**3 : 0 :0 :0**	**CIA Marks:** 50
Credits:	**3**	**SEA Marks:** 50
Hours	**40**	**SEA Duration:** 03 Hours

Pre-Requisites:
Basics of Communication
Basics of Electronics and Processors

Course Learning Objectives: The students will be able to

1	Understand the Concepts of Wireless Communication Systems
2	Understand basic blocks of Mobile Phone
3	Understand Software Architecture of Mobile Phone

Module-1: Evolution of Wireless Communications Technology	**No. of Hours**	**Blooms Ccognitive Levels**
Introduction to wireless communications: Evolution of mobile radio communications, paging system, cordless telephone system, cellular telephone system, Modern wireless communication systems: 2G networks, 3G networks, Bluetooth and personal area networks.	**8**	**Understand CO1**
Module-2: GSM System (2G) Overview		
Introduction, History of GSM, Overview of GSM Network Architecture, PLMN and Network operators, GSM Mobility and Roaming, GSM PLMN Services, GSM Interfaces, GSM Subscriber and Equipment Identity	**8**	**Understand CO2**
Module-3: Anatomy of GSM Mobile Handset		
Introduction of GSM Handset, Functional Blocks Inside a GSM Mobile Phone, Hardware Block diagram of Mobile Phone, Antenna, Analog to Digital Conversion Module, Automatic Frequency Correction module, Loudspeaker, Microphone, Subscriber Identification Module, Application Processing Unit, Camera, LCD Display, Keypad, Connectivity Modules, Battery, Clocking Scheme, Memory.	**8**	**Understand CO3**
Module-4: GSM Mobile Phone Software Design		
Introduction to GSM Mobile Handset Software, Operating System Software, Device Driver Software, GSM System Protocol Software, Speech and Multimedia Application Software	**8**	**Understand CO4**
Module-5: Next Generation Mobile Phones		
Introduction, 3GPP LTE, LTE System Design, IEEE802.16 System, 4G Mobile System, Key Challenges in Designing 4G Mobile System and Research Areas, Cognitive Radio.	**8**	**Understand CO5**

Course Outcomes: After completing the course, the students will be able to	
23ECE1562.1	Understand the different generation wireless communication technology
23ECE1562.2	Understand the basic GSM System operation
23ECE1562.3	Understand the Hardware architecture of mobile phone
23ECE1562.4	Understand the software architecture of mobile phone
23ECE1562.5	Understand the requirements of Next Generation Wireless Communication Technologies
23ECE1562.6	Troubleshoot the hardware and software issue in a basic mobile phone

Reference Books

1. Rappaport T. S., "Wireless Communication: Principles and Practice", Second Edition, Pearson Education, 2009
2. Sajal K. Das, "Mobile Handset Design", Wiley, 2010
3. Luke Wroblewski, "Mobile First-A Book Apart"; First Edition (2011)
4. Tommi Mikkonen, "Programming Mobile Devices: An Introduction for Practitioners", John Wiley & Sons Ltd, 2007.
5. J Scheible and Ville Tulos John, "Mobile Python Rapid Prototyping of Applications on the Mobile Platform" Wiley India Pvt. Ltd, 2008.
6. S. Poslad, "Ubiquitous Computing: Smart Devices, Environments and Interactions," Wiley,2009.
7. Nick Lecrenski, Karli Watson, "Windows Phone 7 Application Development" version 2011
8. Jermaine G. Anderson "Flash Lite Mobile Development" version 2010

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B.N.M. Institute of Technology

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Department of Electronics and Communication Engineering

SEMESTER – V

REAL TIME OPERATING SYSTEM
Credit: 4

Course Code	23ECE1563	CIA Marks	50
Teaching Hours/Week (L: T: P: J)	2:0:4:0	SEA Marks	50
Total Number of Lecture Hours	50	Exam Hours	03

Course Learning Objectives:

This course will enable students to

- Understand the Architecture of QNX Neutrino RTOS and Develop Real-Time Applications
- Understand the working of QNX Development Tools (Momentics IDE)
- Able to Implement Process and Thread Management
- Understand the Master Inter-Process Communication (IPC)
- Debug and Optimize Embedded Systems

Pre-Requisites: Operating Systems basics and Embedded systems.

QNX Momentics Development Basics: Eclipse Basics, Targets, Projects and Source, Compiling, Exercise, Running and Debugging, Exercise and Versions.

QNX Neutrino RTOS Environment Setup

Objective: Install and configure QNX SDP, Momentics IDE, and target system (real or virtual).
Outcome: Understand development workflow in QNX.

	Number of Hours	**Bloom's Level**
Module-1		
Introduction to QNX Real Time Operating System: Architecture – Executive, Microkernel, Inter process Communication, Processes and Threads, Interrupt Handling, Scheduling.	**4**	**Apply (CO1)**
Laboratory Component: Process Creation and Management Objective: Create and run hello world example on VM Ware virtual machine or Rasp-pi board. Outcome: Print hello world on panel of QNX Momentics IDE Objective: Write a program to create and manage multiple processes. Outcome: Demonstrate use of fork(), exec(), and wait() in QNX. **Self-Study Component:** Demonstrate how to Detecting the termination of a child processes.	**6**	**Apply (CO1, CO2)**
Module-2		
Process Managers: Introduction, System Library, Shared Objects, OS Services, Boot Sequence and Security. **Processes, Threads & Synchronization:** Introduction, Processes: Creation and Detecting termination, Threads, Process Termination and Cleanup,	**4**	**Apply (CO2)**

Synchronization.		
Laboratory Component: Thread Creation and Synchronization Objective: Implement multi-threaded programs with POSIX threads. Outcome: Use pthread_create(), mutexes, and semaphores for synchronization. **Self-Study Component:** Implement a multi-threaded application using POSIX threads (pthread_create). Each thread should process a different part of an array and the main thread should wait for all threads to complete using pthread_join.	**6**	**Apply (CO2)**
Module-3		
Introduction to QNX Inter-Process Communication: Message Passing, Designing a Message Passing System (1): Pulses, Client Information Structure, How a Client Finds a Server, Multi-Part Messages Designing a Message Passing System (2).	**4**	**Understand (CO3)**
Laboratory Component: **Signal and Pulse Handling** Objective: Use signals and pulses for lightweight communication and event notification. Outcome: Differentiate between signals and pulses in real-time applications. **Self-Study Component:** Implementing a thread-safe bounded buffer (also known as a circular queue) that is shared between multiple producer threads and multiple consumer threads. The buffer has a fixed size (N slots). Producers add items to the buffer, and consumers remove items from the buffer.	**6**	**Apply (CO3, CO4)**
Module-4		
QNX Inter-Process Communication: Issues Related to Priorities, Designing a Message Passing System (3): Event Delivery Shared Memory **Introduction to Hardware Programming:** Hardware I/O, Programming PCI bus devices, Handling Interrupts.	**4**	**Apply (CO4)**
Laboratory Component: **Inter-Process Communication using Message Passing** Objective: Implement server-client IPC using MsgSend(), MsgReceive(), and MsgReply(). Outcome: Understand QNX's microkernel IPC model. **Self-Study Component:** How to create two processes that communicate using shared memory by using shm_open(), mmap(), and memory protection in QNX.	**6**	**Apply (CO4)**
Module-5		
Resource Managers: Introduction, A Simple Resource Manager: Initialization and Handling read() and write(). **Timing Architecture:** Introduction, Getting and Setting the System Clock, Timers, High-Resolution Timers, Design Considerations, Kernel Timeouts	**4**	**Apply (CO5)**

Laboratory Component: **Timer and Clock Management** Objective: Implement periodic timer-based tasks. Outcome: Learn to use timer_create(), timer_settime(), and high-resolution timers. ***Self-Study Component:*** **Resource Manager to handle file** Objective: Design a basic resource manager to handle file or device-like operations. Outcome: Gain experience with QNX's modular driver model.	**6**	**Apply (CO5)**

Course outcomes:

The students will be able to

- Understand the Architecture of QNX Neutrino RTOS and Develop Real-Time Applications
- Apply the working of QNX Development Tools (Momentics IDE)
- Implement Process and Thread Management
- Apply the Master QNX Inter-Process Communication
- Understand the timing architecture, High-Resolution Timers, Design Considerations, Kernel Timeouts

Reference Books:

1. Operating Systems: Design and Implementation - Andreq S Tanenbaum
2. The Linux Programming Interface- Michael Kerrisk

Marks Distribution for Assessment

CIA (50)	Components	Description	Marks
	Written test	• Total Number of Test:03 • Each Theory test will be conducted for 30 marks • Average of 3 tests= 30 Marks	**30**
	Practical	• Total number of Test : 02 [Part-A(Modue-1 and 2) and Part-B(Module 3,4 and 5)] Each Lab test will be conducted for 50 marks and reduce to 10 Average of 2 tests= 10 Marks • Laboratory conduction is to be evaluated every week. conducted & Viva = 5 Marks Lab Record = 5 Marks	**10** **10**
		Total CIA	**50**
SEA (50)	Practical Exam	• Students are allowed to pick one experiment from Part-A and one experiment from PART-B. Mark Distribution : Total 100 marks Part – A : 40 Marks (Procedure:6, Execution:28, Viva: 6) Part – B : 60 Marks(Procedure:9, Execution:42, Viva: 9) Scale down to 50 marks	**50**
		Total Marks for the Course	**100**

B.N.M. Institute of Technology

An Autonomous Institution under VTU, Approved by AICTE

Dept. of Electronics and Communication Engineering

Choice Based Credit System (CBCS and Outcome Based Education (OBE)

Semester: V

Course Name: Embedded System Design Using Raspberry Pi **Course Code:** 23ECE1564

L: T: P: J	**3 : 0 : 0 : 0**	**CIA Marks:** 50
Credits:	**3**	**SEA Marks:** 50
Hours	**40**	**SEA Duration:** 03 Hours

Pre-Requisites: Microprocessor/Microcontroller, Python Basics.

Course Learning Objectives: The students will be able to

1	Gain the knowledge of knowledge of hardware software co-design
2	Understand the firmware approaches design and development and its applications
3	Understand the embedded product development life cycle and its trends in embedded industry.
4	Understand the working principle of Raspberry Pi board and interfacing peripherals.
5	Identify sensor technologies for sensing real world entities and to control Arduino using Raspberry pi

Module-1: Hardware Software Co-Design & Embedded Firmware Design, Development & Its Applications	**No. of Hours**	**Blooms cognitive Levels**
Fundamental Issues in Hardware Software Co-Design, Computational Model in Embedded Design, Introduction to Unified Modelling Language, Hardware Software Trade Offs, Embedded Firmware Design Approaches, Embedded Firmware Development Languages, High Level Language Based Development, Applications: Washing Machine-Application Specific, Automotive: Domain Specific.	**8**	**Understand CO1**
Module-2: Embedded Product Development Life Cycle & Trends in Embedded Industry		
Different Phases of EDLC, EDLC Approaches (Modeling the EDLC), Processor Trends in Embedded Systems, Embedded OS Trends, Development Language Trends, Open Standard, Frameworks and Alliances, Bottlenecks, Development Platform Trends, Cloud, Internet of Things and Embedded Systems- The next big thing.	**8**	**Apply CO2**
Module-3: Introduction to Raspberry Pi and its Applications		
Introduction to Raspberry Pi, Features of Raspberry Pi, Introduction to Raspberry Pi architecture, Pin Details, Memory, Basic Setup for Raspberry Pi, Operating Systems, Raspberry Pi Applications, Controlling Hardware: Connecting an LED, Controlling the Brightness of an LED, Make a Buzzing Sound, Changing the Colour of an RGB LED, Using Lots of LEDs, Controlling GPIO Outputs Using a Web Interface	**8**	**Understand CO3**
Module-4: Implementation of IoT with Raspberry Pi		
Raspberry Pi based Motor Speed Control: Controlling the Speed of DC Motor, Controlling the Direction of DC Motor, Using a Unipolar Stepper Motor, Using a Bipolar Stepper Motor, Raspberry Pi based Using Sensor: Resistive Sensors, Measuring Light, Measuring Temperature Using Digital Sensor, Measuring Distance. Displays: Using a Four Digit LED Display, Displaying Messages on an Alphanumeric LCD	**8**	**Understand CO4**

Module-5: Interfacing Arduino and Peripherals with Raspberry Pi		
Programming an Arduino from Raspberry Pi, Communicating with the Arduino by Using the Serial Monitor, Setting Up PyFirmata to Control an Arduino from a Raspberry Pi Writing Digital Outputs on an Arduino from a Raspberry Pi, Using PyFirmata with TTL Serial, Reading Arduino Digital Inputs Using PyFirmata, Reading Arduino Analog Inputs Using PyFirmata, Analog Outputs (PWM) with PyFirmata, Custom Communication with an Arduino over TTL Serial, I2C, Temperature Dependent Auto Cooling System,	**8**	**Understand CO5**

Course Outcomes: After completing the course, the students will be able to	
23ECE1564.1	Develop the hardware software co-design for an Embedded Systems
23ECE1564.2	Develop the embedded firmware design and its applications
23ECE1564.3	Demonstrate the embedded product development life cycle and its trends in embedded industry.
23ECE1564.4	Design and Development of Raspberry Pi based Embedded applications.
23ECE1564.5	Illustrate different sensor technologies for sensing real world entities and to control the Arduino using Raspberry Pi
23ECE1564.6	Apply and analyze the various applications of Embedded systems.

Reference Books

1. Shibu K V, "Introduction to Embedded Systems", Tata McGraw Hill Education, 2nd Edition, 2000.
2. Simon Monk, "Raspberry Pi Cookbook", O'Reilly Media, Inc,2014.
3. https://archive.nptel.ac.in/courses/106/105/106105166/
4. Raj Kamal, "Internet of Things: Architecture and Design Principles", 1 st Edition, McGraw Hill Education, 2017. (ISBN: 978-9352605224)

Marks Distribution for Assessment:

CIA (50)	**Component**	**Description**	**Marks**
	Written Test	● Total Number of Test: 3 ● Each Theory test will be conducted for 30 marks. ● Average of 3 tests = 30 Marks	30
	Assignment	1 Assignment for 10 marks	10
	AAT	Open ended experiments, Presentations on interfacing peripherals with Raspberry Pi	10
		Total Marks	**50**
SEA (50)	**Component**	**Description**	**Marks**
	Written Exam	Theory exam will be conducted for 100 marks and scaled down to 50 Marks. The question paper will have 10 full questions each of 20 marks. Students have to answer 5 full questions	**50**
		Total marks for the Course	**100**

Dept. of Electronics and Communication Engineering
Choice Based Credit System (CBCS and Outcome Based Education (OBE)

Semester: VI

Course Name: Engineering Project Management and Finance
Course Code: 23ECE161

L: T: P: J	**2:0:0:0**	**CIA Marks:** 50
Credits:	**2**	**SEA Marks:** 50
Hours	**25**	**SEA Duration:** 03 Hours

Pre-Requisites: -

Course Learning Objectives: The students will be able to

1	Indicate the importance of project management for engineering projects
2	Define project processes and project success measures
3	Understand what constitutes project scheduling and plan for the execution of the project by breaking into manageable work units
4	Gain knowledge and develop curiosity on latest technology trends in Project management
5	Appreciate the various financial estimates and projections in projects

Module-1: Project Management	**No. of Hours**	**Blooms Cognitive Levels**
Overview of Project Management: Project Definition, Project related concepts, Need for Project Managers, Essential Elements of Project, Speaking the language of Project Management, Project, People skill in Project Management, Success criteria **Roles and Responsibilities of Project Managers**: The Project Manager's Functions, Process Functions of Project Managers, Characteristics of an Effective Project Manager	**5**	**Apply CO1**
Module-2: Project Planning: The Schedule		
Benefits of Planning and Scheduling, The Planning and Scheduling Process Developing the Work Breakdown Structure, Key Facts About Developing a WBS, The WBS Dictionary, Enterprise Environmental Factors, Estimating Activity Duration and Sequencing Activities, Displaying the Project Schedule, The CPM Network Diagram, Scheduling Software and Combined Schedule Formats	**5**	**Apply CO2**
Module-3: Project Planning: The Risk Management Plan		
Risk Management: Definition, classification of Risk factors, Risk as it relates to project success criteria, Risk identification process, qualitative and quantitative risk analysis, quantitative risk analysis tools.	**5**	**Apply CO3**

Module-4: Financial Estimates and Projections		
Cost of Project, Means of Finance, Estimates of Sales and Production, Cost of Production, Working Capital Requirement and Its Financing	**5**	**Apply CO4**
Module-5: Financing Of Projects		
Capital Structure, Menu of Financing, Internal Accruals, Equity Capital, Preference Capital, Debentures (Or Bonds), Term Loans	**5**	**Apply CO5**

Course Outcomes: After completing the course, the students will be able to	
23ECE161.1	Develop the ability to manage teams, resolve conflicts, and drive projects toward successful completion.
23ECE161.2	Use Project Management Tools and processes to track and control Projects
23ECE161.3	Assess how various risk factors impact project success criteria such as cost, schedule, quality, and performance
23ECE161.4	Identify various sources of financing available for projects and evaluate their suitability.
23ECE161.5	Differentiate between equity and preference capital and evaluate its role in financial structuring.
23ECE161.6	Demonstrate the concepts of project processes based on success criteria and tools through interactive problem-solving exercises.

Reference Books

1. Project Management for Engineering and Technology, David L. Goetsch, Pearson, 2015.
2. Project Planning: Analysis, Selection, Implementation and Review, Prasanna Chandra, 7/e TMH, 2011.
3. Project Management and Control, Narendra Singh, HPH, 2003
4. Project Management: The Managerial Process, Gray & Larson, 4/e, TMH, 2011
5. Projects: Planning, Analysis, Selection, Financing, Implementation, and Review - Prasanna Chandra, 9/e, 2019, McGraw-Hill Education.
6. Financial Management: Problems and Cases, Khan M. Y.& Jain P. K, TMH, 8/e, 2019.
7. Financial Management, Prasanna Chandra, TMH, 9/e, 2017.

Marks Distribution for Assessment:

<table>
<tr><th rowspan="2">PCC</th><th rowspan="2">CIA</th><th rowspan="2">SEA</th><th colspan="4">CIA (50)</th><th rowspan="2">SEA
Conduction: 100 M
Reduced to: 50 M</th></tr>
<tr><th></th><th>I</th><th>II</th><th>III</th></tr>
<tr><td rowspan="5">Conduction</td><td rowspan="5">50</td><td rowspan="5">50</td><td rowspan="2">Written Test</td><td>30</td><td>30</td><td>30</td><td rowspan="4">Five questions with each of 20 marks (with internal choice). Student should answer one full question from each module</td></tr>
<tr><td colspan="3">Average of three tests
30 Marks</td></tr>
<tr><td>Assignment</td><td colspan="3">Two assignments
Scaled to 10 Marks</td></tr>
<tr><td>AAT</td><td colspan="3">10 Marks</td></tr>
<tr><td colspan="4">Total – 50 marks</td><td>Total – 50 marks</td></tr>
</table>

B.N.M. Institute of Technology

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B.E.(Electronics and Communication Engineering)
Choice Based Credit System(CBCS and Outcome Based Education(OBE)

Semester: VI		
Course Name : Microwave & Antennas		**Course Code: 23ECE162**
L: T:P: J	**3:0:2:0**	**CIAMarks:**50
Credits:	**4**	**SEAMarks:**50
Hours/week(Total)	**3(40)**	**SEA Duration: 0**3 Hours
Pre-Requisites: Electromagnetic waves and transmission lines fundamentals		
Course Learning Objectives: The students will be able to		
1	Apply the knowledge of fields and waves to develop concepts of transmission line theory.	
2	Describe the basic operation of microwave devices.	
3	Describe the radiation from isolated, linear wire antennas and from linear elements near or on a conducting surface.	
4	Calculate the fundamental parameters for antennas and the radiation field from an antenna.	

Module-1: Microwave Waveguides & S- Parameters

	No. of Hrs	**Bloom'sCognitive Levels**
Microwave Waveguides : Introduction, TE, TM waves Rectangular waveguides (qualitative analysis TE, TM modes), group velocity phase velocity, and wave impedance, Microwave cavities (qualitative analysis), resonant frequency. **S-parameters:** Introduction, properties of S matrix (qualitative analysis)	**8+2**	Apply CO1

Module–2: Microwave Devices

Microwave Sources: Klystron Oscillator, Magnetron, TWT amplifiers. **Microwave Passive Devices:** Waveguide Tee's, Directional couplers, circulators, power divider, Faraday Isolator, Phase shifters (Rotatory type), Attenuators (Rotatory type).	**8+2**	Apply CO2

Module–3: Antenna Basics and Electric Dipoles

Antenna Basics :Introduction, antenna radiation mechanism, basic Antenna parameters, patterns, beam area, radiation intensity, beam efficiency, Directivity and gain, antenna apertures, effective height, bandwidth, radiation, efficiency, antenna temperature and antenna field zones. **Electric dipoles:** Introduction, short electric dipole (Directivity, radiation resistance).	**8+2**	Apply CO3

Module–4: Point Sources & Thin linearAntenna

Point Sources: Introduction, Point Sources, Power Theorem, Arrays of two isotropic point sources, Linear Arrays of n Isotropic Point Sources of equal Amplitude and Spacing. **Thin Linear Antenna**: Directivity and Radiation Resistance	**8+2**	Apply CO4
Module–5: Antenna Types		
Printed Antennas: Introduction to Printed Antennas, Omnidirectional Microstrip Antenna, Stripline Fed Tapered Slot Antenna, Rectangular Microstrip Fed Slot Antenna. **Milimeter Wave Antennas**:Parabolic Dish Antenna, Log Periodic Antenna, Monopole Antennas, Lens Antennas	**8+2**	Apply CO5

Practical Experiments	
Sl.No	**Experiments**
1	Measurement of frequency, guide wavelength, power, VSWR and attenuation in microwave test bench.
2	Obtain the Radiation Pattern and Measurement of directivity and gain of microstrip dipole and Yagi antennas.
3	Determination of Coupling and isolation characteristics of microstrip directional coupler.
4	Determination of Resonance characteristics of microstrip ring resonator and computation of dielectric constant of the substrate.
5	Determination of Power division and isolation of microstrip power divider.
6	Simulate Broadside array, End-Fired array of Dipole Antenna and to plot the Radiation pattern.
7	Simulate Linear array(Uniform) Antenna and plot the Radiation pattern
8	Simulate Dipole Antenna and plot the Radiation pattern
9	Simulate and calculate Phase and group velocity(X- band) waveguide at 9GHz
10	Simulate Rectangular Waveguide propagation modes.
Course Outcomes: After completing the course, the students will be able to	
23ECE162.1	Develop generation and propagation of RF signals using Microwave oscillators through transmission line.
23ECE162.2	Compute the performance parameters and S-Matrix of microwave passive devices by applying the network/field concepts.
23ECE162.3	Determine various antenna parameters for building an RF system.
23ECE162.4	Develop expressions for field intensity of a given antenna / an array of antennas. (Point sources, dipole, thin linear antenna)
23ECE162.5	Select suitable antenna configuration according to specific applications.
23ECE162.6	Illustrate the benefits and hazards of microwave radiation to human health, environment, and society.

Reference Books
1. Microwave Engineering, David M Pozar,4thEdition, 2011, John Wiley, ISBN: 978-0-470-63155-3
2. Antenna Theory and Design, C A Balanis, 3rd Edition,2005, John Wiley & sons, Inc.

publication,ISBN-13: 978-0471667827
3. Foundations of Microwave Engineering, R E Collin, 2009, 2nd Edition, IEEE Press on Electromagnetic and Wave Theory, ISBN-13: 978-0-7803-6031-0
4. Computational Electromagnetics with MATLAB, Matthew N.O. Sadiku, 2019, Taylor & FrancisGroup, ISBN: 13: 978-1-138-55815-1
5. Joseph C. Liberti, Theodore S. Rappaport – "Smart Antennas for WirelessCommunications: IS95 and third generation CDMA Applications", Prentice Hall, Communications Engineering and Emerging Technologies Series.
6. "Microstrip and Printed Antenna Design", 2nd Edition, Randy Bancroft. ISBN No. 978974652107-9

Marks Distribution for Assessment:

PCI	CIA	SEA	CIA (50)				SEA Conduction: 100 M Reduced to: 50 M
				I	II	III	
Conduction	50	50	Theory	30	30	30	Five questions with each of 20 marks (with internal choice). Student should answer one full question from each module
				Average of 3 tests - 15 marks			
				AAT - 10 Marks			
			Practical	Weekly Assessment – 10 Marks IA test – 15 Marks			
				Total – 50 Marks			**Total – 50 Marks**

i) CIA: 50%

Theory	**IA Test** (Theory): 3 IA tests - each of 30 Marks- Average of 3 tests	15 Marks
	AAT – 10 Marks Assignment, Oral /Online Quizzes, Presentations, Group discussions, Case studies, Term Paper, Open ended experiments, Two-minute video on latest topic, Practical Orientation on Design thinking, creativity & Innovation, Practical activities, Problem solving exercises, Participation in seminars/academic events/ symposia and any other activity	10 Marks
Practical	**Weekly Assessment** – 10 Marks	25 Marks
	IA test - 15 marks	
	Total	**50 Marks**

ii) SEA : 50%
Question Paper:

Theory Exam	5 questions to answer, each of 20 Marks 2 questions from each module with internal choice Student should answer one full question from each module	20 M x 5 = **100 M** **Reduced to 50 M**
	Total	**50 Marks**

B.N.M. Institute of Technology

An Autonomous Institution under VTU

Semester: B. E		
Course Name : VLSI Design		**Code: 23ECE163**
L: T:P: J	**3:0:2:0**	**CIA Marks:** 50
Credits:	**3**	**SEA Marks:** 50
Hours	**5(50)**	**SEA Duration: 0**3 Hours

Pre-Requisites: KVL & KCL, MOSFET fundamentals, Digital electronics

Course Learning Objectives: The students will be able to

1	Learn MOS transistor theory and CMOS technologies
2	Learn the operation principles and analysis of inverter and logic circuits
3	Design combinational, sequential and dynamic logic circuits as per the requirements
4	Design memory SRAM, DRAM, ROM
5	Demonstrate the concepts of Static Timing Analysis and CMOS testing

Module -1: CMOS Logic Fundamentals		
Brief History, VLSI Design Flow, MOS Transistors V-I Characteristics, Non-Ideal characteristics, CMOS Logic Inverter DC Characteristics. Different Logic gates by truth table. Laboratory Experiment 1: I- V Characteristics of n- MOSFET and p MOSFET Using Cadence Tool. Laboratory Experiment 2: Inverter Characteristics Pre-layout Using Cadence Tool.	**No. of Hrs** **10**	**Bloom's Cognitive Levels** Apply CO2
Module -2: CMOS Fabrication and CMOS Delays		
CMOS Fabrication and lay out, Layout design rules, Scaling – Constant voltage, Constant field, MOSFET Capacitances without derivations, Transient Characteristics of Inverter, RC Delay, Linear Delay model. Laboratory Experiment 3: Inverter Post layout simulation Using Cadence Tool. Laboratory Experiment 4: CMOS NAND gate Design, Pre and Post layout simulation Using Cadence Tool.	**10**	Apply CO2
Module–3: Combinational Logic Circuits		
Logical effort of paths and transistor sizing Combinational logic design Circuit families, - Static, Ratioed, CVSL, Dynamic logic, - Comparison of Performance parameters. Laboratory Experiment 5: 4 Bit adder Timing analysis, Slack calculation Using Cadence Tool. Laboratory Experiment 6: 4 Bit ALU - Timing analysis, Slack calculation.	**10**	Apply CO3
Module–4: Sequential logic circuits and Semiconductor memories		
Sequential logic circuits, Sequencing methods and timing, Latches and flipflops	**10**	Apply CO4

Semiconductor Memories Memory architecture, SRAM 6T and 8T DRAM 1T and 3T Laboratory Experiment 7: 4 Bit Up- down counter - Timing analysis, Slack calculation Using Cadence Tool. Laboratory Experiment 8: 6T SRAM Characterization – demonstration Using Cadence Tool.		
Module–5: STA and Verification		
STA Concepts Timing arcs, Maximum and minimum timing path, Critical path, Clock domain crossing. **Verification** Logic Verification principles, Testing Manufacturing Test Principles, Design for Testability, Built in Self-test, MBIST Laboratory Experiment 9: Estimation of Path delay and Setup and Hold time analysis for any RTL with predefined clock frequency Using Cadence Tool. Laboratory Experiment 10: Insert Scan chain for a given RTL and analyze Using Cadence Tool.	**10**	Analyze CO5

Lab Experiments

Sl. No.	**NOTE: EDA tools with Custom circuit design flow and RTL Design flow to be used**
1	I- V Characteristics of n- MOSFET and p MOSFET
2	Inverter Characteristics Pre-layout
3	Inverter Post layout simulation
4	CMOS NAND gate Design, Pre and Post layout simulation
5	4 Bit adder Timing analysis, Slack calculation
6	4 Bit ALU - Timing analysis, Slack calculation
7	4 Bit Up- down counter - Timing analysis, Slack calculation
8	6T SRAM Characterization – Demonstration
9	Estimation of Path delay and Setup and Hold time analysis for any RTL with predefined clock frequency.
10	Insert Scan chain for a given RTL and analyze.

Course Outcomes: After completing the course, the students will be able to	
23ECE163.1	Demonstrate understanding of MOS transistor theory, CMOS fabrication flow and technology scaling
23ECE163.2	Design the basic gates using the stick and layout diagrams for physical design and estimate sheet resistance and delays.
23ECE163.3	Compute the logic delay and path delay based on logical effort and path effort single stage and Multistage network.
23ECE163.4	Apply simulation techniques and design practices to observe, identify, and troubleshoot timing-related issues in latches, flip-flops, and memory circuits under real-time constraints.
23ECE163.5	Analyze timing consideration in Memory elements, Verification methodologies and Testing issues in VLSI Design.
23ECE163.6	Analyze an RTL design with timing and power constraints and bring up the physical design for the chosen RTL with EDA tools.

Reference Books
1. CMOS VLSI Design- A Circuits and Systems Perspective, Neil H.E.& Weste, David Harris, Ayan Banerjee, Pearson Education, 4th Edition, 2011 2. CMOS Digital Integrate d Circuits: Analysis and De sign - Sung Mo Kang & Yosuf Leblebici, Third Edition, Tata McGraw-Hill. 2003 3. Static Timing Analysis for Nanometer Designs: A Practical Approach, J. Bhasker, R Chadha, Springer, 2009 4. Microelectronics Circuits The ory and Applications, Adel Sedra and K. C. Smith, 6th or 7th Edition, Oxford University Press, International Version, 2009. 5. Basic VLSI Design, Douglas A Pucknell & Kamran Eshragian,, PHI 3rd Edition, (original Edition 1994).

Marks Distribution for Assessment:

<table>
<tr><th rowspan="2">PCL</th><th rowspan="2">CIA</th><th rowspan="2">SEA</th><th colspan="4">CIA (50)</th><th rowspan="2">SEA
Conduction: 100 M
Reduced to: 50 M</th></tr>
<tr><th></th><th>I</th><th>II</th><th>III</th></tr>
<tr><td rowspan="4">Conduction</td><td rowspan="4">50</td><td rowspan="4">50</td><td rowspan="2">Written Test</td><td>30</td><td>30</td><td>30</td><td rowspan="4">Five questions with each of 20 marks (with internal choice). Student should answer one full question from each module</td></tr>
<tr><td colspan="3">Average of three tests – 30 marks scaled down to 20 marks</td></tr>
<tr><td>Assignment</td><td colspan="3">Average of 2 Assignments – 10M</td></tr>
<tr><td>Practical</td><td colspan="3">Weekly Assessment – 10 Marks
IA test – 10 Marks</td></tr>
<tr><td colspan="4">Total – 50 Marks</td><td>Total – 50 Marks</td></tr>
</table>

i) CIA: 50%

Theory	**IA Test** (Theory): 3 IA tests - each of 30 Marks **Assignment** : 2 Assignments – each of 10 marks	Average of 3 tests 30 Marks
Lab	**Weekly Assessment** – 10 Marks **Practical test (1)** - 10 marks	20 Marks
	Total	**50 Marks**

ii) SEA : 50%

Question Paper:

Theory Exam	5 questions to answer, each of 20 Marks 2 questions from each module with internal choice Student should answer one full question from each module	20 M x 5 = **100 M** **reduced to 50 M**
	Total	**50 Marks**

Additional Assessment Tools (AAT) – Quiz, Presentations, Term Paper, Open ended experiments, Mini Projects, Two-minute video on latest topic, Short MOOC courses

B.N.M. Institute of Technology

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Dept. of Electronics and Communication Engineering

Choice Based Credit System (CBCS and Outcome Based Education (OBE)

Semester: VI

Course Name: Java Programming and its Applications **Course Code: 23ECE164**

L: T: P: J	**0: 0 : 2 : 2**	**CIA Marks:** 50
Credits:	**2**	**SEA Marks:** 50
Hours	**25**	**SEA Duration:** 03 Hours

Pre-Requisites: Basics of C and C++ language, Students should be familiarized about java installation and setting the java environment, Usage of IDEs like Eclipse/Netbeans should be introduced.

Course Learning Objectives: The students will be able to

1	To introduce the use of Eclipse/Netbeans IDE to create Java Applications.
2	Reinforce the understanding of basic object-oriented programming concepts.
3	Create multi-threaded programs and event handling mechanism.
4	To make the students to understand the concept of exception handling
5	Using java programming to develop programs for solving real-world problems.

	No. of Hours	**Blooms Cognitive Levels**
Module-1: Introduction to Java		
Introduction to Java: Features of OOP, Characteristics/Buzz words of Java, Java Environment: JDK, JVM, JRE, Fundamental Programming Structure in Java, Variables, Data Types, Operators & Expressions, Control Statements, Iteration Statements, Command Line Arguments. **Programs:** **1.** Write a java program that prints all real solutions to the quadratic equation $ax^2+bx+c=0$. Read in a, b, c and use the quadratic formula. **2.** Write a program to check prime number **3.** Write a program for Arithmetic calculator using switch case menu	**5**	**Apply CO1**
Module-2: Classes & Objects		
Classes & Objects: Defining Classes & Objects, Access Specifies, Constructors, Overloading Constructor, Method Overloading, Passing and Returning object form Method, new operator, finalize() method, this keyword, Static Keyword, Encapsulation, Polymorphism. Array and String: Single and Multidimensional Array, Definition of String, String Literals, String Class, String Inbuilt Methods, StringBuffer & StringBuilder Class, Use of Wrapper class. **Programs:** **4.** Create a Java class called Student with the following details as variables within it: USN, Name, Branch, Phone. Write a Java program to create n Student objects and print the USN, Name, Branch, and Phone of these objects with suitable headings. **5.** Design a super class called **Staff** with details as StaffId, Name, Phone, Salary. Extend this class by writing three subclasses namely Teaching (domain, publications), Technical (skills), and Contract (period). Write a Java program to read and display at least 3 staff objects of all three categories. **6.** Write a java program demonstrating Method overloading and Constructor overloading.	**5**	**Apply CO2**

Module-3: Inheritance, Interfaces & Packages.		
Inheritance: Defining an Inheritance, Types of Inheritance, Constructor in subclass, Method Overriding, super keyword, abstract keyword, final keyword. Interfaces & Packages: Defining an Interface, Implementing an Interface, Difference between Interface & Classes, Extending a Interface, Usage of Package, Classpath, Importing a Package. **Programs:** **7.** Write a program to generate the resume. Create 2 Java classes Teacher (data: personal information, qualification, experience, achievements) and Student (data: personal information, result, discipline) which implements the java interface Resume with the method biodata (). **8.** Develop a java application to implement currency converter (Dollar to INR, EURO to INR, Yen to INR and vice versa), distance converter (meter to KM, miles to KM and vice versa), time converter (hours to minutes, seconds and viceversa) using packages	**5**	**Apply CO3**
Module-4: Multithreading & IO Programming		
Multithreading: Multi Threaded Programming: What are threads? How to make the classes threadable ; Extending threads; Implementing runnable; Synchronization. IO Programming: Introduction to Stream, Byte Stream, Character stream, Readers and Writers, File Class, File InputStream, File Output Stream, InputStreamReader. **Programs:** **9.** Write a Java program that implements a multi-thread application that has three threads. First thread generates a random integer for every 1 second; second thread computes the square of the number and prints; third thread will print the value of cube of the number.	**5**	**Apply CO4**
Module-5: Exceptions		
Exceptions: Definition of Exception, Classification of Exception, Structure of Try & catch block, Error Vs Exception, Throw Keyword, Throws Keyword, Finally Keyword, Custom Exception. **Programs:** **10.** Write a Java program to read two integers a and b. Compute a/b and print, when b is not zero. Raise an exception when b is equal to zero. **11.** Write a Java program to demonstrate the String functions for the following a. Append - add at end b. Insert – add at particular index c. Search d. List all string starts with given letter	**5**	**Apply CO5**
List of Sample Projects		
1. Airline Reservation System **2.** Electricity Billing System **3.** Library Management System **4.** Online Bank Management System **5. e**-Healthcare Management System **6.** Online Quiz Management System **7.** Stock Management System **8**. Weather Report Application **9.** Telephone Billing System **10.** Currency Converter		

Course Outcomes: After completing the course, the students will be able to	
23ECE164.1	Use Eclipse/NetBeans IDE to design, develop, debug Java Projects
23ECE164.2	Analyze the necessity for Object Oriented Programming paradigm over structured programming and become familiar with the fundamental concepts in OOP.
23CE164.3	Demonstrate the ability to design and develop java programs, analyze, and interpret object oriented data and document results
23ECE164.4	Apply the concept of Multithreading and IO programming for Java Program applications
23ECE164.5	Apply the concepts of exception/event handling, abstraction to develop robust programs.
23ECE164.6	Develop a Project using JAVA using the concepts

Reference Books

1. E Balagurusamy, Programming with Java, McGraw Hill, 7th Edition, 2020.
2. Herbert Schildt, C: Java the Complete Reference, McGraw Hill, 11th Edition, 2020
3. Core Java Volume-I Fundamentals Horstmann & Cornell, - Pearson Education. - Eight Edition
4. Head First Java: A Brain-Friendly Guide, 2nd Edition- Kathy Sierra, Bert Bates

Marks Distribution for Assessment:

<table>
<tr><th>PBL</th><th>CIA</th><th>SEA</th><th colspan="3">CIA(50)</th><th>SEA
Conduction: 100 M
Reduced to 50 M</th></tr>
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Project Report- 25 Marks
Presentation & Demonstration- 50 Marks
Viva-Voce- 15 Marks

Project
Assessed for 100 marks
reduced to 50 marks</td></tr>
<tr><td>30</td><td>30</td></tr>
<tr><td colspan="2">Average of 2 Tests-30 marks</td></tr>
<tr><td>Practical</td><td colspan="2">Weekly Assessment (Record/Project)-10 Marks
Lab IA test-10 Marks</td></tr>
<tr><td colspan="4">Total- 50 marks</td><td>Total- 50 marks</td></tr>
</table>

Dept. of Electronics and Communication Engineering Choice Based Credit System (CBCS and Outcome Based Education (OBE)		
Semester: VI		
Course Name: Information Theory & Coding		**Course Code: 23ECE1651**
L: T: P: J	**3: 0: 0: 0**	**CIA Marks:** 50
Credits:	**3**	**SEA Marks:** 50
Hours	**40**	**SEA Duration:** 03 Hours
Pre-Requisites: Set theory, Discrete mathematics, Probability theory and Statistics		
Course Learning Objectives: The students will be able to		
1	Understand the concept of Entropy, Rate of information and order of the source with reference to dependent and independent source.	
2	Study various source encoding algorithms.	
3	Model discrete & continuous communication channels.	
4	Study Various Error Control Coding Algorithms	

Module-1: INFORMATION THEORY	**No. of Hours**	**Blooms Cognitive Levels**
Introduction: Block Diagram for Digital Communication, Measure of information, Information content of message, Average Information content of symbols in Long Independent sequences, Markov Statistical Model of Information Sources, Average Information content of symbols in Long dependent sequences, Entropy of Markoff Sources, Information rate of Markoff Sources	**08**	**Analyse CO1**
Module-2: SOURCE CODING		
Encoding of the Source Output, Shannon's Encoding Algorithm, Shannon Fano Encoding Algorithm, Source coding theorem, Prefix codes, Kraft McMillan Inequality property – KMI, Huffman Codes & Extended Huffman coding	**08**	**Apply CO2**
Module-3: : DISCRETE INFORMATION CHANNELS		
Introduction to Discrete Communication Channels, Channel Matrix, Joint probability Matrix, Binary Symmetric Channel, System Entropies, Mutual Information, Channel Capacity, Channel Capacity of Binary Symmetric Channel and Binary Erasure Channel	**08**	**Apply CO3**
Module-4: ERROR CONTROL CODING		
Introduction to Error Control Coding, Examples, Methods of Controlling Errors, Types of Errors, Types of Codes, Linear Block Codes: matrix description of Linear Block Codes, Error Detection and Error Correction Capabilities of Linear Block Codes, Single Error Correcting Hamming Codes. Binary Cyclic Codes: Algebraic Structure of Cyclic Codes, Systematic and Non Systematic form, Encoding using an (n-k) Bit Shift register, Syndrome Calculation, Error Detection and Correction	**08**	**Analyse CO4**
Module-5: CONVOLUTIONAL CODES		
Convolution Encoder, Time domain approach, Transform domain approach, State Diagram, Code Tree, Trellis Diagram, The Viterbi Algorithm.	**08**	**Apply CO5**

Course Outcomes: After completing the course, the students will be able to	
23ECE1651.1	Calculate Symbol rate, Self-Information, Entropy and Information Rate as a measure of Information for memory less and dependent sources.
23ECE1651.2	Develop efficient representation of data generated by discrete information source.
23ECE1651.3	Analyze discrete channels using joint, conditional, and mutual entropies of variables in terms of their coupled probabilities.
23ECE1651.4	Develop reliable codes for data on imperfect communication channels.
23ECE1651.5	Apply concept of convolutional codes to carry out encoding and decoding operations.
23ECE1651.6	Relate the basics of Information Theory & coding to find solutions for practical problems in terms of storage and secured communication

Text Books

1. Digital and Analog communication systems, K. Sam Shanmugam, John Wiley India Pvt. Ltd, 1996.
2. Digital communication, Simon Haykin, John Wiley India Pvt. Ltd, 2008.

Reference Books

1. ITC and Cryptography, Ranjan Bose, TMH, II Edition, 2007.
2. Principles of digital communication, J. Das, S. K. Mullick, P. K. Chatterjee Wiley Technology & Engineering, 1986.
3. Digital Communications – Fundamentals and Applications, Bernard Sklar, Pearson Education, Second Edition, 2016, ISBN:9780134724058.
4. Information Theory and Coding, Hari Bhat, Ganesh Rao, Cengage, 2017.
5. Error Correction Coding Todd K Moon Wiley Std., Edition, 2006.

Marks Distribution for Assessment:

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Dept. of Electronics and Communication Engineering
Choice Based Credit System (CBCS and Outcome Based Education (OBE)

Semester: 6

Course Name: Nanoelectronics **Course Code: 23ECE1652**

L: T: P: J	**3: 0:0:0**	**CIA Marks:** 50
Credits:	**3**	**SEA Marks:** 50
Hours/Week (Total)	**3**	**SEA Duration:** 03 Hours

Pre-Requisites:

Course Learning Objectives: The students will be able to

1	Describe nanotechnology with basic fabrication methods for nanostructures.
2	Describe the classification of characterization methods.
3	Describe the various fabrication techniques and physical processes.
4	Discuss the applications of semiconductor nanostructures

Module-1: Introduction	**No. of Hours**	**Blooms Cognitive Levels**
Introduction: Overview of nanoscience and engineering. Development milestones in microfabrication and electronic industry. Moore's 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.	**8**	**Understand CO1**
Module-2: Fabrication methods and techniques		
Fabrication methods: Top-down processes, Bottom up processes methods for templating the growth of nanomaterials, ordering of nanosystems. **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, collidal quantum dots, self-assembly techniques. (Text 1).	**8**	**Understand CO2**
Module-3: Characterization		
Characterization: General considerations for imaging, Image magnification and resolution, other considerations for imaging, Light microscopy, Classification, Microscopic techniques, Field ion microscopy, scanning probe techniques, diffraction techniques: bulk and surface diffraction techniques. The characterization of semiconductor nanostructures-Optical and electrical characterization, Structural characterization.	**8**	**Understand CO3**
Module-4: Inorganic semiconductor nanostructures		
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, Modulation doping, The quantum Hall effect, Resonant tunnelling, Charging effects.	**8**	**Understand CO4**
Module-5: Applications of semiconductor nanostructures		
Applications of semiconductor nanostructures: Injection lasers, quantum cascade lasers, single-photon sources, biological tagging, optical memories, coulomb blockade devices, photonic structures.	**8**	**Understand CO5**

Course Outcomes: After completing the course, the students will be able to	
23ECE1652.1	Explain the overview and classification of nanostructures.
23ECE1652.2	Explain the top-down and bottom-up fabrication methods and fabrication techniques involved.
23ECE1652.3	Explain Image magnification and microscopic techniques used in characterization.
23ECE1652.4	Explain the Inorganic semiconductor nanostructures with doping and charge effects.
23ECE1652.5	Explain the applications of nano sensors, injection lasers and analyze the effects of nanotechnology applications

Reference Books

i. Ed Robert Kelsall, Ian Hamley, Mark Geoghegan, "Nanoscale Science and Technology", John Wiley, 2007.

ii. Charles P Poole, Jr, Frank J Owens, "Introduction to Nanotechnology", John Wiley, Copyright 2006, Reprint 2011.

iii. T Pradeep, "Nano: The essentials-Understanding Nanoscience and Nanotechnology", TMH.

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

Marks Distribution for Assessment:

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B.N.M. Institute of Technology

An Autonomous Institution under VTU

B.E. (Electronics and Communication Engineering)
Choice Based Credit System (CBCS and Outcome Based Education (OBE)

Semester: VI		
Course Name: Wearable Technology		**Course Code: 23ECE1653**
L: T: P: J	**3 :0 :0 :0**	**CIA Marks: 50**
Credits:	**3**	**SEA Marks: 50**
Hours	**40**	**SEA Duration: 03 Hours**

Prerequisites:

Course Learning Objectives: The students will be able to

1	Identify and understand the need for development of wearable devices and its influence on various sectors.
2	Explore the smart fabrics and their applications in wearable devices.
3	Familiarize the characteristics, working principle and application of special purpose transducers
4	Introduce the adoption of wearable and non-invasive assistive technologies for wearable devices.
5	Provide a basic understanding of evolution of IoT and its functional modules.

Module-1: Wearables: Fundamentals, advancements and roadmap for the future	**No. of Hours**	**Blooms Cognitive Levels/CO Mapping**
World of Wearables, Role of Wearables, Attributes of Wearables, Textiles and clothing: The meta-wearable, Challenges and opportunities. Soft Mechanical and Biochemical Sensors: Mechanical sensors, Biochemical sensors, Tears, Saliva, Wound and interstitial fluids.	**8**	**Understand CO1**
Module-2: Smart Fabrics		
Introduction. Sensor design, physiological basis and sensor placement, electrical contacts and interconnections for smart garments. Textile integration and design of functional garments, functional evaluation. Woven Electronic textiles: Introduction, Textiles, Applications: Touchpad, Textile switch, Textile electrodes, Device-embedded textiles.	**8**	**Understand CO2**
Module-3: Pressure and Flow Sensors		
Concepts of Pressure, Units of Pressure, Mercury Pressure sensors, Bellows, membranes and thin plates, Piezoresistive sensors, capacitance sensors, VRP sensors, optoelectronic pressure sensors, indirect pressure sensor, vacuum sensors. Basics of flow dynamics, thermal transport sensors, ultrasonic sensors, electromagnetic sensors, breeze sensor, Dust and smoke detectors.	**8**	**Understand CO3**
Module-4: Wearable and Non-invasive assistive technologies		
Assistive devices for individuals with severe paralysis: Sip-n-puff, Head controllers, Eye tracking systems, Electromyography (EMG)-based controllers, Voice controllers, Brain-Computer interfaces (BCI), Tongue-operated devices, Wireless tracking of tongue motion, Wearable Tongue Drive System, Sensor Signal processing algorithm, Multimodal Tongue Drive System, Clinal assessment.	**8**	**Understand CO4**
Module-5: Wearables to THINKables: Data Analytics and Machine Learning		
Remote health monitoring using wearable sensors, AI enabled sensors, challenges of AI-enabled sensors in health, future directions. Data analytics for wearable IoT based telemedicine: introduction, need and	**8**	**Understand CO5**

demand of wearables technologies in the society, smart glove design, signal processing pipeline: from sensor signals to classifications		

Course Outcomes: After completing the course, the students will be able to

23ECE1653.1	Identify and understand the need for development of wearable devices and its influence on various sectors.
23ECE1653.2	Identify the integration of smart fabrics and wearable devices.
23ECE1653.3	Understand the working principle of special purpose sensors and the need for developing smart sensors.
23ECE1653.4	Explore the role of wearable and non-invasive assistive technologies for wearable devices
23ECE1653.5	Explain and identify AI based wearable applications.
23ECE1653.6	Describe and perform the experiments on the sensors and wearable devices.

Reference Books

1. Jacob Fraden, "Hand Book of Modern Sensors: physics, Designs and Applications", 3rd ed., Springer, 2010.
2. Edward Sazonov, Michael R Neuman, "Wearable Sensors: Fundamentals, Implementation and Applications" Elsevier, 2014
3. Toshiyo Tamura, Wenxi Chen, "Seamless Healthcare Monitoring Advancements in Wearable, Attachable, and Invisible Devices". Springer International Publishing, 2017.Daniel J. Inman, Shashank Priya "Energy Harvesting Technologies", Springer US, 2008
4. Simone Cirani, Gianluigi Ferrari, Marco Picone, Luca Veltri "Internet of Things: Architectures, Protocols and Standards" , Wiley, 2018
5. "Environmental, Chemical and Medical Sensors", by Shantanu Bhattacharya, A K Agarwal, Nripen Chanda, Ashok Pandey and Ashis Kumar Sen, Springer Nature Singapore Pte Ltd. 2018
6. M. Mardonova and Y. Choi, "Review of Wearable Device Technology and Its Applications to the Mining Industry," Energies, vol. 11, p. 547, 2018.

Marks Distribution for Assessment:

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<tr><th rowspan="2">PE-1</th><th rowspan="2">CIA</th><th rowspan="2">SEA</th><th colspan="4">CIA (50)</th><th>SEA
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</table>

Additional Assessment Tools (AAT) – Quiz, Presentations,Term Paper, Open ended experiments, Mini Projects, Two-minute video on latest topic, Short MOOC courses.

B.N.M. Institute of Technology

An Autonomous Institution under VTU, Approved by AICTE

Dept. of Electronics and Communication Engineering

Choice Based Credit System (CBCS and Outcome Based Education (OBE)

Semester: VI

Course Name: Artificial Neural Networks		**Course Code: 23ECE1654**
L: T: P: J	**3 : 0 : 0 : 0**	**CIA Marks:** 50
Credits:	**3**	**SEA Marks:** 50
Hours	**40**	**SEA Duration:** 03 Hours

Pre-Requisites: Basic knowledge of calculus, linear algebra, probability theory and programming

Course Learning Objectives: The students will be able to

1	Understand the basics of ANN and comparison with Human brain
2	Demonstrate knowledge on Generalization and function approximation and various architectures of building an ANN
3	Get knowledge of supervised, unsupervised and reinforcement learning using neural networks

Module-1	**No. of Hours**	**Blooms Cognitive Levels**
Introduction: Biological Neuron – Artificial Neural Model - Types of activation functions – Architecture: Feedforward and Feedback, Convex Sets, Convex Hull and Linear Separability, Non-Linear Separable Problem. Xor Problem, Multilayer Networks. **Learning:** Learning Algorithms, Error correction and Gradient Descent Rules, Learning objective of TLNs, Perceptron Learning Algorithm, Perceptron Convergence Theorem.	**8**	**Apply CO1**
Module-2		
Supervised Learning: Perceptron learning and Non Separable sets,α-Least Mean Square Learning, MSE Error surface, Steepest Descent Search, μ-LMS approximate to gradient descent, Application of LMS to Noise Cancelling, Multi-layered Network Architecture, Backpropagation Learning Algorithm, Practical consideration of BP algorithm.	**8**	**Apply CO2**
Module-3		
Support Vector Machines and Radial Basis Function: Learning from Examples, Statistical Learning Theory,Support Vector Machines, SVM application to Image Classification, Radial Basis Function Regularization theory, Generalized RBF Networks, Learning in RBFNs, RBF application to face recognition.	**8**	**Apply CO3**
Module-4		
Attractor Neural Networks: Associative Learning Attractor Associative Memory, Linear Associative memory, Hopfield Network, application of Hopfield Network, Brain State in a Box neural Network, Simulated Annealing, Boltzmann Machine, Bidirectional Associative Memory.	**8**	**Apply CO4**
Module-5		
Self-organization Feature Map: Maximal Eigenvector Filtering, Extracting Principal Components, Generalized Learning Laws, Vector Quantization, Self-organization Feature Maps, Application of SOM, Growing Neural Gas.	**8**	**Apply CO5**

Course Outcomes: After completing the course, the students will be able to	
23ECE1654.1	Understand artificial neural model and its architectures.
23ECE1654.2	Apply steepest descent, LMS algorithm and Backpropagation algorithm
23ECE1654.3	Apply support vector machines to classify images.
23ECE1654.4	Understand attractor neural networks and its applications.
23ECE1654.5	Apply self-organization feature maps.
23ECE1654.6	Understand the role of neural networks in engineering, artificial intelligence, and cognitive modelling and be able to apply the concepts of ANN to real world applications.

Text Books

1. Neural Networks A Classroom Approach– Satish Kumar, McGraw Hill Education (India) Pvt. Ltd, Second Edition.

Reference Books

1. Introduction to Artificial Neural Systems-J.M. Zurada, Jaico Publications, 1994.
2. Artificial Neural Networks-B. Yegnanarayana, PHI, New Delhi 1998

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An Autonomous Institution under VTU, Approved by AICTE

Dept. of Electronics and Communication Engineering

Choice Based Credit System (CBCS and Outcome Based Education (OBE)

Semester: VI

Course Name: Computer Architecture and Organisation		**Course Code:23ECE1655**
L: T: P: J	**3 : 0 : 0 : 0**	**CIA Marks:** 50
Credits:	**3**	**SEA Marks:** 50
Hours	**40**	**SEA Duration:** 03 Hours

Pre-Requisites: Digital Logic solving, Number System

Course Learning Objectives: The students will be able to

1	Explain the basic sub systems of a computer, their organization, structure and operation
2	Illustrate the concept of programs as sequences of machine instructions
3	Demonstrate different ways of communicating with I/O devices
4	Describe memory hierarchy and concept of virtual memory
5	Illustrate organization of simple pipelined processor and other computing systems

Module-1:	**No. of Hours**	**Blooms Cognitive Levels**
Basic Structure of Computers: Computer Types, Functional Units, Basic, Operational Concepts, Bus Structures, Software, Performance – Processor Clock, Basic Performance Equation **Machine Instructions and Programs:** Numbers, Arithmetic Operations and Characters, IEEE standard for Floating point Numbers, Memory Location and Addresses, Memory Operations, Instructions and Instruction Sequencing	**8**	**Understand CO1**
Module-2:		
Addressing Modes, Assembly Language, Basic Input and Output Operations, Stacks and Queues, Subroutines, Additional Instructions.	**8**	**Apply CO2**
Module-3:		
Input/Output Organization: Accessing I/O Devices, Interrupts – Interrupt Hardware, Enabling and Disabling Interrupts, Handling Multiple Devices, Controlling Device Requests, Direct Memory Access	**8**	**Apply CO3**
Module-4:		
Memory System: Basic Concepts, Semiconductor RAM Memories-Internal organization of memory chips, Static memories, Asynchronous DRAMS, Read Only Memories, Cash Memories, Virtual Memories, Secondary Storage-Magnetic Hard Disks	**8**	**Apply CO4**
Module-5:		
Basic Processing Unit: Some Fundamental Concepts, Execution of a Complete Instruction, Multiple Bus Organization, Hardwired Control, Microprogrammed Control	**8**	**Understand CO5**

Course Outcomes: After completing the course, the students will be able to	
23ECE1655.1	Explain the basic organization of a computer system.
23ECE1655.2	Explain the different addressing modes and assembly language instructions.
23ECE1655.3	Explain different ways of accessing an input / output device including interrupts.
23ECE1655.4	Illustrate the organization of different types of semiconductor and other secondary storage memories.
23ECE1655.5	Illustrate simple processor organization based on hardwired control and micro programmed control.
23ECE1655.6	Analyze the architecture and performance issues in different processor families.

Reference Books

1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky: Computer Organization, 5th Edition, Tata McGraw Hill, 2002.
2. David A. Patterson, John L. Hennessy: Computer Organization and Design – The Hardware / Software Interface ARM Edition, 4th Edition, Elsevier, 2009.
3. William Stallings: Computer Organization & Architecture, 7th Edition, PHI, 2006.
4. Vincent P. Heuring & Harry F. Jordan: Computer Systems Design and Architecture, 2nd Edition, Pearson Education, 2004.

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</table>

B.N.M. Institute of Technology

An Autonomous Institution under VTU

6th Semester: B.E		
Course Name: VLSI Physical Design Course Code: 23ECE1662		
L:T:P: J	3:0:0:0	CIAMarks:50
Credits:	3	SEAMarks:50
Hours	40	SEADuration:03Hours

Pre-Requisites: Basic concepts in digital circuit design

Course Learning Objectives: The students will be able to

1	To introduce the foundational concepts of physical design automation and explore the processes of partitioning, floor planning, and placement in VLSI design.
2	To provide an understanding of routing techniques in physical design, including grid, global, and detailed routing, along with the principles of clock design and clock routing.
3	To equip students with the knowledge of static timing analysis, timing closure techniques, physical synthesis, and performance-driven design flows in VLSI design.
4	To introduce interconnect modeling, layout compaction, and testing techniques, including fault modeling, simulation, test pattern generation, and design-for-testability (DFT) and built-in self-test (BIST) methods.
5	To explore low power design techniques and methodologies aimed at reducing power consumption in VLSI systems while maintaining performance.

Module-1: Introduction to physical design automation, Partitioning, Floor planning and Placement		
Introduction, Design Representation, VLSI Design Styles (Part 1), VLSI Design Styles (Part 2), VLSI Physical Design Automation (Part 1), VLSI Physical Design Automation (Part 2)	**No. of Hrs**	**Bloom's Cognitive Levels**
Partitioning, Floor planning, Floor planning Algorithms, Pin Assignment, Placement (Part 1), Placement (Part 2), Placement (Part 3), Placement (Part 4)	**8**	Apply CO1
Module–2: Grid Routing, Global Routing and Detailed Routing, Clock Design, Clock Routing		
Grid Routing (Part 1), Grid Routing (Part 2), Grid Routing (Part 3) Global Routing (Part 1), Global Routing (Part 2), Detailed Routing (Part 1), Detailed Routing, Detailed Routing (Part 3), Detailed Routing (Part 4), Clock Design (Part 1), Clock Design (Part 2), Clock Design (Part 3), Clock Network Synthesis, Clock Network Synthesis Clock Network Synthesis (Part 3), Clock Network Synthesis (Part 4), Power And Ground Routing	**8**	Apply CO2
Module–3: Static Timing Analysis and Timing Closure, Physical Synthesis, Performance Driven Design Flow		
Time Closure (Part 1), Time Closure (Part 2), Time Closure (Part 3), Time Closure (Part 4), Time Closure (Part 5), Timing Driven Placement, Timing Driven Routing, Physical Synthesis (Part 1) Physical Synthesis (Part 2), Performance-Driven Design Flow Miscellaneous Approaches to Timing Optimization	**8**	Apply CO3
Module 4: Interconnect Modeling and Layout Compaction, Introduction to Testing, Fault Modeling and Simulation, Test Pattern Generation, DFT and BIST		
Interconnect Modeling (Part 1), Interconnect Modeling (Part 2) Design Rule Check, Layout Compaction (Part 1), Layout Compaction (Part 2), Testing of VLSI Circuit, Fault Modelling (Part 1), Fault Modeling (Part 2), Fault Simulation (Part 1), Fault	**8**	Apply CO4

Simulation (Part 2), Test Pattern Generation, Design for Testability, Boundary Scan Standard, Built-in Self-Test, Built-in Self-Test (Part 2).		
Module–5: Low Power Design Techniques		
Low Power VLSI Design, Techniques to Reduce Power, Gate Level Design for Low Power (Part 1), Gate Level Design for Low Power (Part 2), Other Low Power Design Techniques, Algorithmic Level Techniques for Low Power Design, Summarization of the Course	**8**	Apply CO5

Course Outcomes: After completing the course, the students will be able to	
23ECE1663.1	Comprehend the principles of physical design and apply partitioning, floor planning, and placement techniques to optimize chip layouts
23ECE1663.2	Gain the ability to analyze and implement routing algorithms and design efficient clock networks to ensure optimal signal distribution in VLSI circuits.
23ECE1663.3	Perform static timing analysis, achieve timing closure, and implement performance-driven design flows to optimize circuit functionality and speed.
23ECE1663.4	Develop the skills to model interconnects, perform layout compaction, and implement testing strategies to detect faults and enhance circuit reliability using DFT and BIST techniques.
23ECE1663.5	Apply low power design principles and strategies to optimize power efficiency in modern VLSI circuits and systems.

Professional Core Course(PCC)

PCC		**CIA**	**SEA**	**CIA (50)**				**SEA Conduction: 100 M Reduced to:50M**
					I	**II**	**III**	
Conduction		**50**	**50**	**Written Test**	**30**	**30**	**30**	**Five questions with each of 20marks(with internal choice). Student should answer one full question from each module**
					Average of three tests – 30 Marks			
				Assignment	**10**			
				AAT	**10**			
				Total–50 marks				**Total–50 marks**

SEA: 50%QuestionPaper:

Theory Exam	5questionstoanswer,eachof20Marks 2questionsfromeachmodulewithinternalchoiceStudentsho uldansweronefullquestionfromeach module	20 Mx5=**100M** **Reduced to 50M**
	Total	**50 Marks**

Text/Reference Books

1. VLSI Physical Design, by Indranil Sengupta.
2. https://drive.google.com/file/d/1eXCHlpK2QYPa_9oOzGLDhbiC0DAb99EQ/view
3. VLSI Physical Design: From Graph Partitioning to Timing Closure, by Andrew B. Kahng, Jens Lienig , Igor L. Markov , Jin Hu. 2nd edition, Springer

B.N.M. Institute of Technology

An Autonomous Institution under VTU

Semester: B. E		
Course Name : Embedded System Design		**Code: 23ECE1663**
L: T:P: J	**3:0:0:0**	**CIA Marks:** 50
Credits:	**3**	**SEA Marks:** 50
Hours		**SEA Duration:** 03 Hours

Pre-Requisites: Computer Organization, Basic of Microprocessors

Course Learning Objectives: The students will be able to

1	Understand what is Embedded System, ASICs and ASIPs , Single Purpose Processors its design and Optimization and students will be Introduced to FPGAs and their Synthesis
2	Understand Sensors, converters, Arduino Uno, Serial Communication, Timer and Controller Design using Arduino
3	Understand Power Aware Embedded System Design, Real Time Operating System
4	Understand RTS Algorithms, FSM and Statechart, Program State Machines
5	Understand SDL, Data Flow Model Digital Camera Design and Hardware Software Partitioning, Design Optimization.

Module-1: Introduction to Embedded System, ASICs and ASIPs , Introduction to FPGAs and Synthesis		
Introduction to Embedded System, Processors, General Purpose and ASIPs Processor, Designing a Single Purpose Processor Optimization Issues , Introduction to FPFA, FPGA Contd., Behaviour Synthesis on FPGA using VHDL	**No. of Hrs**	**Bloom's Cognitive Levels**
	8	Understand CO1
Module–2: Introduction to Sensors, converters, Arduino Uno, Serial Communication, Timer and Controller Design using Arduino		
Sensors and Signals, Discretization of Signals and A/D Converter,Quantization Noise, SNR and D/A Converter , Arduino Uno, Arduino Uno (Contd.), Serial Communication and Timer , Controller Design using Arduino	**8**	Understand CO2
Module–3: Power Aware Embedded System Design, Real Time Operating System		
Power Aware Embedded System - I, Power Aware Embedded System - II ,SD and DD Algorithm , Parallel Operations and VLIW ,Code Efficiency, DSP Application and Address Generation Unit, Real Time O.S - I ,Real Time O.S - II ,	**8**	Understand CO3
Module–4: RTS Algorithms, FSM and Statechart, Program State Machines		
RMS Algorithm , EDF Algorithm and Resource Constraint Issue , Priority Inversion and Priority Inheritance Protocol, Modeling and Specification - I , Modeling and Specification - II FSM and Statechart , Statechart and Statemate Semantics, Statecharts (Contd.) ,Program State Machines	**8**	Apply CO4
Module–5: SDL, Data Flow Model, Scheduling Digital Camera Design and Hardware Software Partitioning, Design Optimization.		

SDL ,Data Flow Model - I,Data Flow Model - II, Hardware Synthesis – I, Hardware Synthesis - II ,Scheduling, Digital Camera Design , Digital Camera - Iterative Design, Hardware Software Partitioning, Optimization - I, Optimization - II, Simulation, Formal Verification	8	Apply CO5

Course Outcomes: After completing the course, the students will be able to	
23ECE1663.1	Understand what is Embedded System, ASICs and ASIPs , Single Purpose Processors its design and Optimization and students will be Introduced to FPGAs and their Synthesis
23ECE1663.2	Understand Sensors, converters, Arduino Uno, Serial Communication, Timer and Controller Design using Arduino
23ECE1663.3	Understand Power Aware Embedded System Design, Real Time Operating System
23ECE1663.4	Understand RTS Algorithms, FSM and Statechart, Program State Machines
23ECE1663.5	Understand SDL, Data Flow Model Digital Camera Design and Hardware Software Partitioning, Design Optimization.

Professional Core Course (PCC)

PCC	CIA	SEA	CIA (50)				SEA
				I	II	III	Conduction: 100 M Reduced to: 50 M
Conduction	50	50	Written Test	30	30	30	Five questions with each of 20 marks (with internal choice). Student should answer one full question from each module
				Average of three tests – 30 Marks			
			Assignment	10			
			AAT	10			
			Total – 50 marks				Total – 50 marks

i) CIA: 50%

IA Test: 3 IA tests - Each of 30 Marks - Average of 3 tests	25 Marks
Assignment – Two assignments – one for 10 marks and another for 5 marks	15 Marks
Additional Assessment Tools (AAT) – Oral /Online Quizzes, Presentations, Group discussions, Case studies, Term Paper, Open ended experiments, Mini industrial/social/rural Projects, Two-minute video on latest topic, Short MOOC courses, Practical Orientation on Design thinking, creativity & Innovation, Participatory & Industry integrated learning, Practical activities, Problem solving exercises, Participation in seminars/academic events/symposia and any other activity	10 Marks
Total	**50 Marks**

ii) SEA: 50%

Question Paper:

Theory Exam	5 questions to answer, each of 20 Marks 2 questions from each module with internal choice Student should answer one full question from each module	20 M x 5 =**100 M** **Reduced to 50M**
	Total	**50 Marks**

Reference Books
Embedded Systems Design by Prof. Anupam Basu, https://drive.google.com/file/d/1VOACjI9oyGsgUDC7BryI7sXv5MfBhpOd/view
Introduction to Embedded Systems - shibu k v, Mcgraw Hill Education,2nd edition, Reprint 2023.
Embedded Systems Design by Frank Vahid,3rd Edition, Reprint 2009.

B.N.M. Institute of Technology

An Autonomous Institution under VTU

Semester: VI		
Course Name: Database Management System Part -1		
Course Code: 23ECE1665	**L: T:P: J: 3:0:0:0**	**CIA Marks: 50**
Credits:	**3**	**SEA Marks: 50**
Hours/week:	**3**	**SEA Duration: 03** Hours
Pre-Requisites: Data Structures using C		

Course Learning Objectives: The students will be able to	
1	Introduce the fundamental concepts and architecture of database management systems and their applications.
2	Provide knowledge of the relational model, data integrity, constraints, and entity–relationship modeling.
3	Explain database normalization techniques and functional dependencies for effective database design.
4	Develop the ability to use SQL DDL and DML commands for creating, modifying, and manipulating database tables.

Modules	**No. of Hrs.**	**Blooms cognitive Levels**
Module 1: Introduction DBMS		
Database Systems Overview, Types of Database Systems, Relational Model, Data Integrity and Constraints, Entity and Relationships.	**8**	Understand CO1
Module 2: Normalization & SQL Basics		
Introduction to normalization, Functional Dependency, Normal Forms, SQL Commands and Data Types, SQL Data Types, Operators and Expressions.	**8**	Understand CO2
Module 3: DDL and DML statements Part 1		
Create and Drop Table Syntax, Create Table Syntax Errors, Constraints, Create Table Syntax Errors, Alter Table Syntax, Alter Table, alter table Syntax, Insert Statement Syntax, select statement syntax, order of query execution	**8**	Apply CO3
Module 4: DML statements Part 2		
Update Statement syntax, delete statement Syntax, Error codes, Functions, Case statement syntax, Sorting data – Order by, practice Problems.	**8**	Appy CO4
Module 5: Group by Having		
Group by, having, order of query execution, group by animation, Do's and Dont's for group by Having, Combining Data, Join Introduction, Cartesian product and inner join, inner join with condition syntax.	**8**	Apply CO5

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Course Outcomes: After completing the course, the students will be able to	
23ECE1665.1	Understand the fundamentals of database systems, relational models, data integrity, and entity–relationship concepts.
23ECE1665.2	Understand normalization concepts, functional dependencies, and basic SQL commands, data types, and expressions.
23ECE1665.3	Apply DDL and basic DML commands to create, alter, and retrieve data from database tables.
23ECE1665.4	Apply DML statements, SQL functions, and sorting techniques to manipulate and analyze database records.
23ECE1665.5	Apply GROUP BY, HAVING clauses, and inner joins to combine and analyze data from multiple tables.

Reference Books

1. A Silberschatz, H Korth, S Sudarshan, "Database System and Concepts", fifth Edition McGraw-Hill, Rob, Coronel, "Database Systems", Seventh Edition, Cengage Learning.
2. A First Course in Database Systems, by Jeffrey D. Ullman and Jennifer Widom, Prentice Hall, Third Edition, 2008.

Professional Core Course (PCC)

PCC	CIA	SEA	CIA (50)				SEA Conduction: 100 M Reduced to: 50 M
				I	II	III	
Conduction	50	50	Written Test	30	30	30	Five questions with each of 20 marks (with internal choice). Student should answer one full question from each module
				Average of three tests – 30 Marks			
			Assignment	10			
			AAT	10			
			Total – 50 marks				**Total – 50 marks**

Dept. of Electronics and Communication Engineering
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)

Semester: 6

Course Name: NANOTECHNOLOGY **Course Code: 23ECE1671**

L: T: P: J	**3:0:0:0**	**CIA Marks:** 50
Credits:	**3**	**SEA Marks:** 50
Hours	**40**	**SEA Duration:** 03 Hours

Pre-Requisites:

Course Learning Objectives: The students will be able to

1	Understand basics of nanomaterials and their properties.
2	Describe synthesis of nanomaterials by chemical techniques.
3	Learn to analyze and assess parameters involved in synthesis and characterization.
4	Compare models involved in synthesis of nanostructures.

Module-1: Introduction	**No. of Hours**	**Blooms Cognitive Levels**
Introduction: introduction to nanoscience and nanotechnologies, importance and scope of nanotechnology, Development milestones in microfabrication and electronic industry. Moore's law and continued miniaturization, natural nanomaterials, properties at nanoscale (physical, chemical, surface, electrical. magnetic, optical, mechanical), Classification of Nanostructures, Kinetics in Nanostructured Materials.	**8**	**Understand CO1**
Module-2: Types of Nanomaterials and synthesis		
Types of Nanomaterials (Quantum dots, Nanoparticles, Nanocrystals, Dendrimers, Buckyballs, Nanotubes); Synthesis of Nanomaterials- top down and bottom up approach, Ball Milling , Gas, liquid, and solid –phase synthesis of nanomaterials; Lithography techniques (Photolithography, Dip-pen and Electron beam lithography); Thin film deposition; Electrospinning. Bio-synthesis of nanomaterials.	**8**	**Apply CO2**
Module-3: Characterization of Nano materials		
Microscopy-Scanning tunnelling microscope, Atomic force microscope, scanning electron microscopy, Field Emission Scanning Electron Microscopy, transmission electron microscopy, Environmental Scanning Electron Microscopy (ESEM) High Resolution Transmission Electron Microscope (HRTEM), Surface enhanced Raman Spectroscopy, X-ray diffraction technique, X ray Photoelectron Spectroscopy Surface area analysis, particle size analysis, gravimetric analysis.	**8**	**Apply CO3**
Module-4: Nano Structures		
Carbon Nanotubes, Fullerenes, Nanowires, Quantum Dots. Applications of nanostructures. Reinforcement in Ceramics, Drug delivery, Giant magnetoresistance, etc. Cells response to Nanostructures.	**8**	**Apply CO4**
Module-5: Application of Nanotechnology		
Nano electronics, Nano sensors, Nanotechnology in Diagnostics applications, Environmental and Agricultural Applications of nanotechnology, Nano technology for energy systems.	**8**	**Understand CO5**

Course Outcomes: After completing the course, the students will be able to	
23ECE1671.1	Identify various nano materials and describe the basic science behind the properties of materials.
23ECE1671.2	Explain the types and methods of nanomaterial synthesis.
23ECE1671.3	Interpret the creation and characterization of nanoscale materials.
23ECE1671.4	Apply principles of nano materials in describing nanostructures.
23ECE1671.5	Comprehend the applications of nanotechnology at the leading edge of scientific research Apply their knowledge of nanotechnology to identify how they can be exploited for new applications.

Reference Books

1. Textbook of Nanoscience and Nanotechnology, Pradeep T, 2012, Tata McGraw Hill Education Pvt. Ltd. ISBN: 9781259007323.
2. Nano-structured Materials and Nanotechnology, Hari Singh Nalwa, 2002, Gulf Professional Publishing, Academic Press, ISBN:0-12-513920-9
3. Nanomaterials, Nanotechnologies and Design: An Introduction to Engineers and Architects, D. Michael Ashby, Paulo Ferreira, Daniel L. Schodek, Butterworth-Heinemann, 2009. Springer
4. Handbook of Nanotechnology by Bharat Bhushan 2004.

Marks Distribution for Assessment:

<table>
<tr><th rowspan="2">PCC</th><th rowspan="2">CIA</th><th rowspan="2">SEA</th><th colspan="4">CIA (50)</th><th rowspan="2">SEA
Conduction: 100 M
Reduced to: 50 M</th></tr>
<tr><th></th><th>I</th><th>II</th><th>III</th></tr>
<tr><td rowspan="5">Conduction</td><td rowspan="5">50</td><td rowspan="5">50</td><td rowspan="2">Written Test</td><td>30</td><td>30</td><td>30</td><td rowspan="4">Five questions with each of 20 marks (with internal choice). Student should answer one full question from each module</td></tr>
<tr><td colspan="3">Average of three tests – 30 Marks</td></tr>
<tr><td>Assignment</td><td colspan="3">Two assignments – Scaled to 10 Marks</td></tr>
<tr><td>AAT</td><td colspan="3">10 Marks</td></tr>
<tr><td colspan="4">Total – 50 marks</td><td>Total – 50 marks</td></tr>
</table>

B.N.M. Institute of Technology

An Autonomous Institution under VTU

Dept. of Electronics and Communication Engineering
Choice Based Credit System (CBCS and Outcome Based Education (OBE)

Semester: VI

Course Name: Wearable Devices **Course Code: 23ECE1672**

L: T: P: J	**3 :0 :0 :0**	**CIA Marks:** 50
Credits:	**3**	**SEA Marks:** 50
Hours	**40**	**SEA Duration:** 03 Hours

Pre-Requisites:

Course Learning Objectives: The students will be able to

1	Understand and Identify the need for development of wearable devices and its influence on various sectors.
2	To provide the basic understanding of measurement and instrumentation systems and the insight of the resistive sensors and its applications in real life.
3	To familiarize the characteristics, working principle and application of special purpose transducers
4	Acquaint the usage of wearable devices as assistive devices, diagnostic devices and other modern applications.
5	To impart the importance of smart sensors, sensor interface standards for wearable device applications and to provide a brief overview of the wearable technology and its impact on social life

Module-1: Wearables: Fundamentals, advancements and roadmap for the future	**No. of Hours**	**Blooms Cognitive Levels**
World of Wearables, Role of Wearables, Attributes of Wearables, Textiles and clothing: The meta-wearable, Challenges and opportunities. Wearing sensors for disease detection: introduction, cardiovascular diseases, neurological diseases, gastrointestinal diseases	**8**	**Understand CO1**
Module-2: Sensors, Actuators and low-power electronics		
Mechanical sensors, Biochemical sensors, tears, saliva, wound and interstitial fluids. Biopotential signals and their characteristics, electrode-body interface and electrode noise, Low-power ADCs for biomedical applications, architectural design for low power biopotential acquisition.	**8**	**Understand CO2**
Module-3: Pressure and Flow Sensors		
Concepts of Pressure, Units of Pressure, Mercury Pressure sensors, Bellows, membranes and thin plates, Piezoresistive sensors, capacitance sensors, VRP sensors, optoelectronic pressure sensors, indirect pressure sensor, vacuum sensors. Basics of flow dynamics, thermal transport sensors, ultrasonic sensors, electromagnetic sensors, breeze sensor, Dust and smoke detectors	**8**	**Apply CO3**
Module-4: Smart Fabrics		
Introduction. Sensor design, physiological basis and sensor placement, electrical contacts and interconnections for smart garments. Textile integration and design of functional garments, functional evaluation, Woven electronic textile applications	**8**	**Understand CO4**
Module-5: Wearables to THINKables: Data Analytics and Machine Learning		
Remote health monitoring using wearable sensors, AI enabled sensors, challenges of AI-enabled sensors in health, future directions Data analytics for wearable IoT based telemedicine: introduction, need and demand of wearables technologies in the society, smart glove design, signal processing pipeline: from sensor signals to classifications	**08**	**Understand CO5**

Course Outcomes: After completing the course, the students will be able to	
23ECE1672.1	Identify and understand the need for development of wearable devices and its influence on various sectors.
23ECE1672.2	Understand the wearable devices for detection of biochemical and physiological body signals
23ECE1672.3	Apply the knowledge of sensors to develop suitable special purpose sensors for wearables and the need for developing smart sensors
23ECE1672.4	Acquaint the usage of wearable devices as assistive devices, diagnostic devices and other modern applications.
23ECE1672.5	Understand the usage of Machine Learning and Data analytics in wearables
23ECE1672.6	Analyze the different low cost smart wearables from different companies- case study

Text Books

1. Jacob Fraden, "Hand Book of Modern Sensors: physics, Designs and Applications", 3rd ed., Springer, 2010.
2. Edward Sazonov, Michael R Neuman, "Wearable Sensors: Fundamentals, Implementation and Applications" Elsevier, 2014
3. Toshiyo Tamura, Wenxi Chen, "Seamless Healthcare Monitoring Advancements in Wearable, Attachable, and Invisible Devices". Springer International Publishing, 2017.

Reference Books

1. "Wearable Electronics Sensors - For Safe and Healthy Living", Subhas Chandra Mukhopadhyay, Springer 2015 ECE(BSW) Page 37
2. "Environmental, Chemical and Medical Sensors", by Shantanu Bhattacharya, A K Agarwal, Nripen Chanda, Ashok Pandey and Ashis Kumar Sen, Springer Nature Singapore Pte Ltd. 2018
3. M. Mardonova and Y. Choi, "Review of Wearable Device Technology and Its Applications to the Mining Industry," Energies, vol. 11, p. 547, 2018.
4. N. Luo, W. Dai, C. Li, Z. Zhou, L. Lu, C. C. Y. Poon, et al., "Flexible Piezoresistive Sensor Patch Enabling Ultralow Power Cuffless Blood Pressure Measurement," Advanced Functional Materials, vol. 26, pp. 1178-1187, 2016.

Marks Distribution for Assessment:

<table>
<tr><th rowspan="2">PCL</th><th rowspan="2">CIA</th><th rowspan="2">SEA</th><th colspan="4">CIA (50)</th><th rowspan="2">SEA
Conduction: 100 M
Reduced to: 50 M</th></tr>
<tr><th></th><th>I</th><th>II</th><th>III</th></tr>
<tr><td rowspan="5">Conduction</td><td rowspan="5">50</td><td rowspan="5">50</td><td rowspan="2">Written Test</td><td>30</td><td>30</td><td>30</td><td rowspan="4">Five questions with each of 20 marks (with internal choice). Student should answer one full question from each module</td></tr>
<tr><td colspan="3">Average of three tests – 30 marks scaled down to 20 marks</td></tr>
<tr><td>Assignment</td><td colspan="3">Average of 2 Assignments – 10M</td></tr>
<tr><td>Practical</td><td colspan="3">Weekly Assessment – 10 Marks
IA test – 10 Marks</td></tr>
<tr><td colspan="4">Total – 50 Marks</td><td>Total – 50 Marks</td></tr>
</table>

B.N.M. Institute of Technology

An Autonomous Institution under VTU, Approved by AICTE

B.E. (Electronics and Communication Engineering)

Choice Based Credit System (CBCS and Outcome Based Education (OBE)

Semester: VI

Course Name: Robotics and Automation **Course Code: 23ECE1673**

L: T: P: J	**3 : 0 : 0 : 0**	**CIA Marks: 50**
Credits:	**3**	**SEA Marks: 50**
Hours	**40**	**SEA Duration: 03 Hours**

Pre-Requisites:

Course Learning Objectives: The students will be able to

1	To study the various parts of robots and fields of robotics
2	To study the electronics circuits used in robotic applications
3	To study sensors used in robotics
4	To study the programming aspects of robots for specific applications
5	To study the control of robots for some specific applications

Module-1: Introduction	**No. of Hours**	**Blooms Cognitive Levels/CO Mapping**
History, Robots, Robot Usage, Robot Subsystems, Classification of Robots, Industrial Applications	**8**	**Understand CO1**
Module-2: Actuators and Grippers		
Electric Actuators, Hydraulic Actuators, Pneumatic Actuators, Selection of Motors, Grippers	**8**	**Understand CO2**
Module-3: Sensors, Vision and Signal Conditioning		
Sensor Classification, Internal Sensors, External Sensors, Vision, Signal Conditioning.	**8**	**Understand CO3**
Module-4: Programming of Robots		
Robot Programming: Methods of Robot Programming, Lead through Programming Methods, A Robot Program as a Path in Space, Motion Interpolation, Wait, Signal, and Delay Commands, Branching, Robot Language Structure.	**8**	**Understand CO4**
Module-5: Robot Applications in Manufacturing		
General Considerations in Robot Material Handling, Material Transfer Applications, Machine Loading and Unloading, Processing Applications: Spot Welding, Continuous Arc Welding, Spray Coating	**8**	**Understand CO5**

Course Outcomes: After completing the course, the students will be able to	
23ECE1673.1	Understand the evolution and basics of robotic systems.
23ECE1673.2	Understand various actuators used in robotic applications.
23ECE1673.3	Understand the working of various sensors used in robotic applications
23ECE1673.4	Understand the Robot programming and its languages
23ECE1673.5	Interface hardware and software for building robots
23ECE1673.6	Develop robots for societal applications

Reference Books

1. Introduction to Robotics', 2e, S K Saha, Tata McGraw Hill Education Private Limited, 2008
2. 'Industrial Robotics Technology, Programming and Applications', Mikell P. Groover, Mitchell Weiss, Roger N. Nagel and Nicholas G. Odrey, Mc Graw Hill Book company, 1986
3. 'Industrial Robotics', Bernard Hodges, Jaico Publishing House, 1993

Marks Distribution for Assessment:

<table>
<tr><th rowspan="2">PCC</th><th rowspan="2">CIA</th><th rowspan="2">SEA</th><th colspan="4">CIA (50)</th><th>SEA
Conduction: 100 M
Reduced to: 50 M</th></tr>
<tr><td></td><td>I</td><td>II</td><td>III</td><td></td></tr>
<tr><td rowspan="5">Conduction</td><td rowspan="5">50</td><td rowspan="5">50</td><td rowspan="2">Written Test</td><td>30</td><td>30</td><td>30</td><td rowspan="4">Five questions with each of 20 marks (with internal choice). Student should answer one full question from each module</td></tr>
<tr><td colspan="3">Average of three tests – 30Marks</td></tr>
<tr><td>Assignment</td><td colspan="3">10 Marks</td></tr>
<tr><td>AAT</td><td colspan="3">10 Marks</td></tr>
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</table>

B.N.M. Institute of Technology

An Autonomous Institution under VTU

B.E. (Electronics and Communication Engineering)
Choice Based Credit System (CBCS and Outcome Based Education (OBE)

Semester: VI		
Course Name: Automotive Electronics		**Course Code: 23ECE1674**
L: T: P: J	**3 : 0 :0 :0**	**CIA Marks: 50**
Credits:	**3**	**SEA Marks: 50**
Hours	**40**	**SEA Duration: 03 Hours**
Pre-Requisites: Control Systems, Internet of Things, Electronic Circuits, Digital System Design		
Course Learning Objectives: The students will be able to		
1	Understand the basics of automobile dynamics and design electronics to complement those features. ·	
2	Understand principle of working of sensors and actuators used in automobiles for control	
3	Design and implement the electronics that attribute the reliability, safety, and smartness to the automobiles, providing add-on comforts.	

Module-1: Automotive Fundamentals Overview	**No. of Hours**	**Blooms Cognitive Levels/CO Mapping**
Automotive Fundamentals Overview Evolution of Automotive Electronics, Automobile Physical Configuration, Survey of Major Automotive Systems, The Engine - Engine Block, Cylinder Head, Four Stroke Cycle, Engine Control, Ignition System- Spark plug, High voltage circuit and distribution, Spark pulse generation, Ignition Timing, Diesel Engine, Drive Train - Transmission, Drive Shaft, Differential, Suspension, Brakes, Steering System, Starter Battery- Operating principle. **The Basics of Electronic Engine Control-** Motivation for Electronic Engine Control- Exhaust Emissions, Fuel Economy, Concept of an Electronic Engine control system, Definition of General terms, Definition of Engine performance terms, Engine mapping, Effect of Air/Fuel ratio, spark timing and EGR on performance, Control Strategy, Electronic Fuel control system, Analysis of intake manifold pressure, Electronic Ignition.	**8**	**Understand CO1**
Module-2: Automotive Sensors		
Automotive Sensors Automotive Control System applications of Sensors and Actuators - Variables to be measured, Airflow rate sensor, Strain Gauge MAP sensor, Engine Crankshaft Angular Position Sensor, Magnetic Reluctance Position Sensor, Hall effect Position Sensor, Shielded Field Sensor, Optical	**8**	**Understand CO2**

Crankshaft Position Sensor, Throttle Angle Sensor (TAS), Engine Coolant Temperature (ECT) Sensor, Exhaust Gas Oxygen (02/EGO) Lambda Sensors, Piezoelectric Knock Sensor.		
Module-3: Digital Engine Control Systems		
Digital Engine Control Systems Digital Engine control features, Control modes for fuel Control (Seven Modes), EGR Control, Electronic Ignition Control -Closed loop Ignition timing, Spark Advance Correction Scheme, Integrated Engine Control System- Secondary Air Management, Evaporative Emissions Canister Purge, Automatic System Adjustment, System Diagnostics.	**8**	**Understand CO3**
Module-4: Automotive Networking		
Automotive Networking - Bus Systems- Classification, Applications in the vehicle, Coupling of networks, Examples of networked vehicles Buses - CAN Bus, UN Bus, MOST Bus, Bluetooth, Flex Ray, Diagnostic Interfaces.	**8**	**Understand CO4**
Module-5: Automotive Diagnostics		
Automotive Diagnostics- Timing Light, Engine Analyser, On-board diagnostics, Off-board diagnostics, Expert Systems, Occupant Protection Systems - Accelerometer based Air Bag systems. **Future Automotive Electronic Systems-** Alternative Fuel Engines, Electric and Hybrid vehicles, Fuel cell powered cars, Collision Avoidance Radar warning Systems, Low tire pressure warning system, Heads Up display, Speech Synthesis, Navigation - Navigation Sensors - Radio Navigation, Signpost navigation, dead reckoning navigation, Voice Recognition Cell Phone dialling, Advanced Cruise Control, Stability Augmentation, Automatic driving Control	**8**	**Understand CO5**

Course Outcomes: After completing the course, the students will be able to	
23ECE1674.1	Acquire an overview of automotive components, subsystems, and basics of Electronic Engine Control in today's automotive industry
23ECE1674.2	Understand the automotive sensors and actuators for interfacing with microcontrollers / microprocessors during automotive system design.
23ECE1674.3	Understand the fundamentals of digital engine control systems in today's automotive industry.
23ECE1674.4	Understand the networking of various modules in automotive systems, communication protocols and diagnostics of the sub systems.
23ECE1674.5	Understand the importance of automotive diagnostics and get fair idea on future Automotive Electronic Systems
23ECE1674.6	Understanding the design of the electronics that attribute the reliability, safety, and smartness to the automobiles, providing add-on comforts.

Reference Books

1. Understanding Automotive Electronics_ William B. Ribbens_ Elsevier Publishing_6th Edition_2003
2. Bosch Automotive Electrics and Automotive Electronics Systems and Components, Networking and Hybrid Drive_ Robert Bosch Gmbh (Ed.)_ John Wiley& Sons Inc_5th edition_2007

Marks Distribution for Assessment:

<table>
<tr><th rowspan="2">PCC</th><th rowspan="2">CIA</th><th rowspan="2">SEA</th><th colspan="4">CIA (50)</th><th>SEA
Conduction: 100 M
Reduced to: 50 M</th></tr>
<tr><td></td><td>I</td><td>II</td><td>III</td><td></td></tr>
<tr><td rowspan="5">Conduction</td><td rowspan="5">50</td><td rowspan="5">50</td><td rowspan="2">Written Test</td><td>30</td><td>30</td><td>30</td><td rowspan="4">Five questions with each of 20 marks (with internal choice). Student should answer one full question from each module</td></tr>
<tr><td colspan="3">Average of three tests – 30 Marks</td></tr>
<tr><td>Assignment</td><td colspan="3">10</td></tr>
<tr><td>AAT</td><td colspan="3">10</td></tr>
<tr><td colspan="4">Total – 50 marks</td><td>Total – 50 marks</td></tr>
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