B.N.M. Institute of Technology

An Autonomous Institution under VTU, Approved by AICTE

Department of Mathematics

Syllabus

Semester: III			
Course: Fourier Series, Transforms, Numerical and Statistical Techniques **Course Code: 21MAC131 (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	Have an insight into Fourier series, Fourier transforms, Difference equations and Z-transforms.
2	Develop knowledge of solving ODE's arising in engineering applications, using numerical methods.
3	Develop knowledge of Statistical methods and curve fitting arising in engineering.

Module-1: Fourier Series	No. of hours	Blooms cognitive Levels
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).* **Self-study:** Applications of Fourier series in Engineering.	**L : 04** **T : 04**	**Apply**
Module-2: 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. **Self-study**: Applications of Fourier & Z-Transform in Engineering.	**L : 04** **T : 04**	**Apply**
Module-3: Numerical Solutions of Ordinary Differential Equations		
Numerical solution of ordinary differential equations of first order - Taylor series method, Euler's method, Modified Euler's method, Runge-Kutta method of fourth order, Milne's predictor and corrector methods (without proof) Numerical solution of second order ordinary differential equation using Runge-Kutta method of fourth order. **Self-study**: Solution of first order ordinary differential equation using Adam-Bashforth predictor and corrector methods.	**L : 04** **T : 04**	**Apply**
Module-4: Statistical Methods		
Introduction to Measures of Central tendency and Dispersion. Moments, Skewness, kurtosis and problems. Karl Pearson's coefficient of correlation and lines of regression. Rank correlation and problems **Self-study:** Problems on mean, median and mode.	**L : 04** **T : 04**	**Apply**
Module-5: Curve Fitting & Linear Programming		
Curve Fitting: Curve fitting by the method of least squares- fitting the curves of the form: $y = ax + b$, $y = ax^b$ *and* $y = ax^2 + bx + c$. **Linear Programming problems (LPP):** General Linear programming problem, canonical and standard forms of LPP, Basic solution, Basic feasible solution, Optimal solution, Simplex method-problems. **Self-study:** Linear programming problems using graphical method.	**L : 04** **T : 04**	**Apply**

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

CO 1: Demonstrate Fourier series to study the behavior of periodic functions and their applications in system communications, digital signal processing and field theory.

CO 2: Make use of Fourier transform and Z-transform to illustrate discrete / continuous function arising in wave and heat propagation, signals and systems.

CO 3: Solve first and second order ordinary differential equations arising in engineering problems using single step and multistep numerical methods.

CO 4: Make use of correlation and regression analysis to fit a suitable mathematical model for the statistical data.

CO 5: Fit a curve and solve linear programming problems by simplex method

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 & Subobh 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://archive.nptel.ac.in/courses/111/106/111106111/
2. https://www.youtube.com/watch?v=SO7wRj9vXM8
3. https://nptel.ac.in/courses/111107107
4. https://www.youtube.com/watch?v=ir1U8sIog78
5. https://nptel.ac.in/courses/111105090
6. http://academicearth.org/
7. https://archive.nptel.ac.in/courses/111/104/111104027/

Dept. of Electronics and Communication Engineering Choice Based Credit System (CBCS and Outcome Based Education (OBE))		
Semester: III		
Course Name: Network Analysis and Control System		**Course Code:21ECE132**
L: T: P: J	**3: 2: 0 :0**	**CIA Marks:** 50
Credits:	**4**	**SEA Marks:** 50
Hours/Week (Total)	**5**	**SEA Duration:** 03 Hours
Pre-Requisites: Basic Electrical, Mathematical Preliminaries		
Course Learning Objectives: The students will be able to		
1	Use the concepts of mesh analysis, nodal analysis and network theorems in analyzing the electrical circuits	
2	Study two port network parameters like Z, Y, h and T and their inter-relationships and applications	
3	Obtain mathematical model of Electrical and Mechanical systems	
4	Find time response from Transfer Functions	
5	Determine the stability of system in Time and Frequency Domain	

Module-1: Basic Concepts and Network Theorems	**No. of Hours**	**Blooms Cognitive Levels**
Basic Concepts: Loop and node analysis with linearly dependent and independent sources for DC and AC networks. **Network Theorems:** Network Analysis using Superposition, Thevenin's and Norton's theorems, Maximum Power transfer theorem, Millman's Theorem Reciprocity Theorem. (All theorems for independent sources only)	**10**	**Apply CO1**
Module–2: Two port Network parameters		
Two port network parameters: Definition of Z, Y, h and Transmission parameters, modelling with these parameters, Network Analysis using of two port networks, Relationship between Parameters. **Laplace transform and its applications:** Step, Ramp, Impulse functions, initial and final value theorem, solution of networks using Laplace transform, Interconnection of two ports, Laplace Transform.	**10**	**Apply CO2**
Module–3: Introduction to Control Systems and Transfer function		
Introduction to Control Systems: Types of Control Systems, Differential equation of Physical Systems, Mechanical Systems, Electrical Systems, Analogous Systems. Differential equation of electro-mechanical Systems. **Transfer function:** Block diagram algebra, Signal Flow graph.	**10**	**Apply CO3**
Module–4: Time Response and Stability Analysis		
Time response analysis: Standard test signals, Step response of first order, second order systems, Time response specification, steady state error and error constants. **Stability Analysis:** Concept of stability, R H criterion, applications of R H criterion with limitations. Concepts for P, PD, PI and PID Controllers.	**10**	**Apply CO4**
Module–5: Root Locus Technique and Frequency Domain Analysis		
Root locus technique: Introduction to root locus concepts, Construction rules, Analysis of stability by root locus plot **Frequency domain analysis:** Correlation between frequency response and transient response. Bode and inverse bode plots. **Self-study component/Case study**: Effect of addition of open loop poles and zeros on root locus and stability.	**10**	**Apply CO5**

Course Outcomes: After completing the course, the students will be able to	
21ECE132.1	Apply the concepts of mesh analysis, node analysis, and network theorems to solve and analyse the electrical circuits.
21ECE132.2	Solve the given network using specified two port network parameters.
21ECE132.3	Develop the mathematical model of mechanical, electrical systems and transfer function for a given control system (block diagram and signal flow graph method).
21ECE132.4	Determine the time domain specifications for first and second order systems and stability of a system in time domain using Routh-Hurwitz criterion.
21ECE132.5	Determine the stability of a system using Root locus and bode plots.
21ECE132.6	Explain the method of conserving energy using closed loop control system.

Text Books
1. Network analysis, M.E. Van Valkenberg, Prentice Hall of India, 3rdedition, 2000, ISBN: 9780136110958. 2. Control Engineering, J. Nagrath & M. Gopal, New Age International Publishers/ 5th edition/ 2005.
Reference Books
1. Engineering Circuit Analysis, Hayt, Kemmerly and Durbin, TMH 7th Edition, 2010. 2. Networks and systems, Roy Choudhury, 2nd edition, New Age International Publications, 2006, ISBN: 9788122427677. 3. Automatic Control Systems, Benjamin C. Kuo, John Wiley India Pvt. Ltd./ 8 th Edition/ 2008.

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	Quiz will be conducted on all the modules	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.

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: 21ECE133**
L: T: P: J	**2: 0: 2: 0**	**CIE Marks:** 50
Credits:	**3**	**SEE Marks:** 50
Hours/Week (Total)	**40 hours**	**SEE 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	**No. of Hrs**	**Bloom's Cognitive Levels**
Introduction and Overview: Introduction, Basic Terminology, Elementary Data Organization, Data Structures, Data Structure Operations, Abstract Data Types (ADT). 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		
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		
Stacks: Introduction, Stacks, Array representation of Stacks, linked representation of Stacks, Arithmetic expressions; Polish notations, Quick sort, an application of stacks. **Queues**: Queues, linked representation of queues, dequeue	**8**	**Apply CO3**
Module–4: Non-Linear Data Structures – Trees		
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	**8**	**Apply CO4**
Module–5: Graphs, Sorting & Searching		
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)	**8**	**Apply CO5**

Sorting & Searching: Introduction, sorting, insertion sort, selection sort, merge sort, searching and data modification, hashing (hash functions only)		

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 beginning of linked list
6. Write a C program to insert a node at the middle of linked list
7. Write a C program to insert a node at the end of linked list
8. Write a C program to delete a node in linked list
9. Write a C program to create and display Doubly linked list in both direction
10. Write a C program to implement the stack in array.
11. Write a C program to implement stack using Linked list.
12. Write a C program to Reverse String using STACK
13. Write a C program to implement the queue in array
14. Write a C program to search the number/node in a tree
15. Write a C program to find the largest item in binary tree
16. Write a C program to implement Graph
17. Write a C program for Heap Sort

Course Outcomes: After completing the course, the students will be able to	
21ECE133.1	Gain knowledge on the importance of data structures, algorithms and time complexity computations.
21ECE133.2	Apply linear data structures to analyse and obtain solutions
21ECE133.3	Apply non-linear tree data structure to analyse and obtain solutions
21ECE133.4	Apply non-linear graph data structure to analyse and obtain solutions
21ECE133.5	Apply the concepts of sorting and searching to problem solving
21ECE133.6	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.

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
	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, 2 theory questions write-up - 20 Marks Conduction - 50 Marks Viva-Voce - 10 Marks (One program to be executed)	**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

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: 21ECE134**
L: T: P: J	**3: 0: 2: 0**	**CIA Marks:** 50
Credits:	**4**	**SEA Marks:** 50
Hours/Week (Total)	**5 (50 hours)**	**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**
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. BJT current mirrors.	**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 modelling:** The DC bias point, signal current in drain, voltage gain, small signal equivalent circuit models, transconductance, The T equivalent circuit model, MOSFET differential amplifier.	**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. Fast Switching MOSFETs.	**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, Audio Power Amplifier Systems.	**8**	**Apply CO4**
Module-5: Op-Amp Circuits, 555 Timer and its applications		
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. Comparator & Schmitt Trigger, Wien Bridge Oscillators using Opamp.	**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 and set up the circuits using Opamp: i) Integrator, ii) Differentiator
5	Design of Op- Amp as comparator circuit
6	R-2R DAC
7	Simulation Experiment: Narrow Band-pass Filter
8	Simulation Experiment: Active second order Butterworth low pass and 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	
21ECE134.1	Understand the characteristics of BJTs for switching and amplifier circuits.
21ECE134.2	Understand the characteristics of FETs for switching and amplifier circuits.
21ECE134.3	Design and analyze FET amplifiers with different circuit configurations and biasing conditions.
21ECE134.4	Understand the feedback topologies and approximations in the design of amplifiers
21ECE134.5	Design of circuits using linear ICs for wide range applications such as ADC, DAC, filters and timers.
21ECE134.6	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:

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
	Lab Component	Observation + Record=10 Marks Lab Internal Assessment=10 Marks	20
		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.

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: 21ECE135**
L: T: P: J	**3: 0: 2: 0**	**CIA Marks: 50**
Credits:	**4**	**SEA Marks: 50**
Hours/Week (Total)	**5 / (50 Hours)**	**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**
Definition of combinational logic, Canonical forms, Generation of switching equations from truth tables, Karnaugh maps- up to 4 variables, Karnaugh maps using Don't care, Simplifying Maxterm equation up to 4 variables. Quine-McCluskey Minimization Technique. Quine-McCluskey using Don't Care Terms.	**8**	**Apply CO1**
Module-2: Logic Design with MSI Components and Programmable Logic Devices		
Binary Adders and Subtractors, Comparators, Decoders, Encoders, Multiplexers.	**8**	**Apply CO2**
Module-3: Flip-Flops and its Applications		
Latches, SR Latch, S'R'Latch, Gated SR latch, Gated D Latch, Timing Considerations (Propagation delay, Minimum pulse width, Setup and Hold Times), The Master-Slave Flip-flops (PulseTriggered flip-flops): SR flip-flops, JK flip flops, 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: Introduction to Verilog and Verilog Data flow description		
Structure of Verilog module, Operators, Data Types, Styles of Description. Highlights of Data flow description, Structure of Data flow description.	**8**	**Apply CO4**
Module-5: Verilog Behavioral and Structural description		
Structure, Variable Assignment Statement, Sequential Statements, Loop Statements, Verilog Behavioral Description of Multiplexers Highlights of Structural description, Organization of structural description, Structural description of ripple carry adder	**8**	**Apply CO5**

Laboratory Experiments

Using suitable simulation software, demonstrate the operation of the following circuits:

SL. No.	Programs
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.

SL. No.	Programs
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	
21ECE135.1	Simplify Boolean functions using K-map and Quine-McCluskey minimization technique.
21ECE135.2	Analyze and design for combinational logic circuits.
21ECE135.3	Analyze the concepts of Flip Flops (SR, D, T and JK) and to design the synchronous sequential circuits
21ECE135.4	Design of combinational and sequential circuits using Verilog dataflow descriptions.
21ECE135.5	Design of combinational and sequential circuits using Verilog behavioral and structural descriptions.
21ECE135.6	Design the applications of combinational and sequential circuits

Reference Books

1. Digital Logic Applications and Design, John M Yarbrough, Thomson Learning, 2001.
2. Digital Principles and Design, Donald D Givone, McGraw Hill, 2002.
3. HDL Programming VHDL and Verilog, Nazeih M Botros, press, 2009.
4. Fundamentals of logic design, Charles H Roth Jr., Cengage Learning.
5. Verilog HDL-a guide to digital design and synthesis, Sameer Palnitkar2nd edition, Pearson Edition 2003.

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
	Lab Exam	Observation + Record=10 Marks Lab Internal Assessment=10 Marks	20
		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.

Dept. of Electronics and Communication Engineering Choice Based Credit System (CBCS and Outcome Based Education (OBE)		
Semester: III		
Course Name: Python Programming on Raspberry PI		**Course Code: 21ECE136**
L: T: P: J	**0 : 0 : 2 : 2**	**CIA Marks:** 50
Credits:	**2**	**SEA Marks:** 50
Hours/Week (Total)	**4 / 25**	**SEA Duration:** 03 Hours
Pre-Requisites: Basics of C and C++ language, Students should be familiarized about Python installation and setting Python environment		
Course Learning Objectives: The students will be able to		
1	Learn syntax and semantics in Python	
2	Handle Strings, Files, Functions in Python	
3	Understand Lists and Dictionaries in Python	
4	Understand interface of Sensors with Raspberry Pi	
5	Learn interface of display devices with Raspberry Pi	

Part A- Python Programs	
Sl. No.	**List of Programs (To be Covered in 5 lab sessions)**
1.	**Aim:** Introduce the Python fundamentals, data types, operators, flow control and exception handling in Python. a) Write a python program to find the best of two test average marks out of three test's marks accepted from the user b) Develop a Python program to check whether a given number is palindrome or not and also count the number of occurrences of each digit in the input number
2.	**Aim:** Demonstrating creation of functions, passing parameters and return values. Develop a python program to perform the following code conversions using functions. a) Binary to Decimal b) Octal to Hexadecimal
3.	**Aim:** Demonstration of manipulation of strings using string methods. Write a Python program that accepts a sentence and find the following. a) Number of words and digits b) Number of uppercase letters and lowercase letters
4.	**Aim:** Discuss different collections like list and dictionary. a) Write a python program to implement insertion sort and merge sort using lists b) Write a program to convert roman numbers in to integer values using dictionaries
5.	**Aim:** Demonstration of reading, writing and organizing files. Write a python program to accept a file name from the user and perform the following operations. a) Display the first N line of the file b) Find the frequency of occurrence of the word accepted from the user in the file

Part B- Python Programs on Raspberry PI	
Sl. No.	**List of Programs (To be Covered in 5 lab sessions)**
6.	**Aim:** Demonstrate the interfacing of IR/PIR sensors to Raspberry Pi. Write a Python program to interface IR/PIR motion sensor to Raspberry Pi.
7.	**Aim:** Demonstrate the interfacing of output device to Raspberry Pi. Write a Python program to interface LED to Raspberry Pi.
8.	**Aim:** Demonstrate the interfacing of Seven Segment Display device to Raspberry Pi. Write a Python program to interface Seven Segment Display to Raspberry Pi.
9.	**Aim:** Demonstrate the interfacing of ultrasonic sensor to Raspberry Pi. Write a Python program to interface ultrasonic to Raspberry Pi.
10.	**Aim:** Demonstrate the interfacing of Temperature Humidity sensor to Raspberry Pi. Write a Python program to interface DHT11 sensor to Raspberry Pi.

Course Outcomes: After completing the course, the students will be able to	
21ECE136.1	Examine syntax and semantics using flow control in Python
21ECE136.2	Demonstrate proficiency in handling strings and file systems
21ECE136.3	Write, Execute and Manipulate the data structures like lists and dictionaries
21ECE136.4	Implement Python program to interface sensors with Raspberry Pi
21ECE136.5	Apply Python programming techniques to interface display devices with Raspberry Pi
21ECE136.6	Develop a Project using Python concepts

Text Books

1. Al Sweigart, "Automate the Boring Stuff with Python",1st Edition, No Starch Press, 2015. (Available under CC-BY-NC-SA license at https://automatetheboringstuff.com/)
2. Reema Thareja "Python Programming Using Problem Solving Approach" Oxford University Press.
3. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2nd Edition, Green Tea Press, 2015. (Available under CC-BY-NC license at http://greenteapress.com/thinkpython2/thinkpython2.pdf)

AAT: ONLINE COURSES/VIDEO LECTURES

https://www.coursera.org/learn/raspberry-pi-platform

https://nptel.ac.in/courses/106106145

Mark Distribution for Assessment:

CIA (50)	Component	Description	Marks
	Practical	● Lab records ● Performance day wise	5 5
	Internal Laboratory Test	● Conduction ● Viva	5 5
	Project	● Demonstration ● Presentation ● Report	10 10 10
		Total Marks	**50**
SEA (50)	**Component**	**Description**	**Marks**
	External Laboratory Exam	External Lab exam will be conducted for 100 marks and scaled down to 50 Marks. The marks allocated is as follows: Write up – 20 Conduction – 70 Viva-voce – 10	**50**
		Total marks for the Course	**100**

B.N.M. Institute of Technology

An Autonomous Institution under VTU

Semester: III/IV		
COURSE: ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ (ಕನ್ನಡ ಬಲ್ಲ ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ)		
Course Code: 21KAN1371	**L: T: P: J: 1:0:0:0**	**CIA Marks:** 50
Credits:	**1**	**SEA Marks: 5 0**
Hours:	**15 hrs**	**SEE Duration: 1.5hrs**

Course Learning Objectives: The students will be able to

1	ಪದವಿ ವಿದ್ಯಾರ್ಥಿಗಳಾಗಿರುವುದರಿಂದ ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡದ ಜೊತೆಗೆ ಕ್ರಿಯಾತ್ಮಕ ಕನ್ನಡವನ್ನು, ಕನ್ನಡ ಸಾಹಿತ್ಯ, ಸಂಸ್ಕೃತಿ ಮತ್ತು ನಾಡು ನುಡಿಯ ಪರಿಚಯ ಮಾಡಿಕೊಡುವುದು.
2	ಆಧುನಿಕ ಪೂರ್ವ ನಡುಗನ್ನಡ ಸಾಹಿತ್ಯದ ಪ್ರಮುಖ ಸಾಹಿತ್ಯ ಪ್ರಕಾರಗಳಾದ ವಚನ ಸಾಹಿತ್ಯ ಮತ್ತು ಕೀರ್ತನ ಸಾಹಿತ್ಯ ಇವೆರಡರ ಮಹತ್ವವನ್ನು ಪರಿಚಯ ಮಾಡಿಕೊಡುವುದು.
3	ಆಧುನಿಕ ಕಾವ್ಯಭಾಗದಲ್ಲಿ ಅನೇಕ ಪ್ರಮುಖ ಕವಿಗಳು ಇದ್ದರಾದರೂ ಇಲ್ಲಿ ಸಾಂಕೇತಿವಾಗಿ ಈ ನಾಲ್ಕು ಕವಿಗಳ ಸಮಕಾಲೀನ ಪ್ರಜ್ಞೆಯಿಂದ ಕೂಡಿದ ಕವನಗಳನ್ನು ಪರಿಚಯ ಮಾಡಿಕೊಡುವುದು.
4	ಕನ್ನಡದ ತಾಂತ್ರಿಕ ವಿಜ್ಞಾನ ಕ್ಷೇತ್ರದ ಅಸ್ತಿಭಾರ ಹಾಕಿದ ಸರ್ ಎಂ ವಿಶ್ವೇಶ್ವರಯ್ಯನವರ ಬಗ್ಗೆ ಜನಮಾನಸದಲ್ಲಿರುವ ನೆನಪಿನ ಪ್ರಸಂಗಗಳನ್ನು ಇಟ್ಟುಕೊಂಡು ಕರ್ನಾಟಕಕ್ಕೆ ಅವರು ಮಾಡಿದ ಸೇವೆಯನ್ನು ಪರಿಚಯ ಮಾಡಿಕೊಡುವುದು.
5	ಕನ್ನಡ ಭಾಷಾಭ್ಯಾಸ,ಸಾಮಾನ್ಯ ಕನ್ನಡ ಹಾಗೂ ಆಡಳಿತ ಕನ್ನಡದ ಪದಗಳ ಪರಿಚಯ ಮಾಡಿಕೊಡುವುದು

Module 1 – ಕನ್ನಡ ನಾಡು ನುಡಿ ಮತ್ತು ಸಂಸ್ಕೃತಿಗೆ ಸಂಬಂಧಿಸಿದ ಲೇಖನಗಳು	**RBT**	**Hrs**
ಕರ್ನಾಟಕ ಸಂಸ್ಕೃತಿ - ಹಂಪನಾಗರಾಜಯ್ಯ ಕರ್ನಾಟಕದ ಏಕೀಕರಣ, ಒಂದು ಅಪೂರ್ವ ಚರಿತ್ರೆ - ಪ್ರೊ ಜಿ ವೆಂಕಟಸುಬ್ಬಯ್ಯ ಆಡಳಿತ ಭಾಷೆಯಾಗಿ ಕನ್ನಡ – ಡಾ||ಎಲ್ ತಿಮ್ಮೇಶ ಮತ್ತು ಪ್ರೊ.ವಿ ಕೇಶವಮೂರ್ತಿ	**1,2,3**	**3**
Module 2 – ಕಾವ್ಯಭಾಗ (ಆಧುನಿಕ ಪೂರ್ವ)	**RBT**	**Hrs**
ವಚನಗಳು: ಜೇಡರ ದಾಸಿಮಯ್ಯ, ಅಲ್ಲಮಪ್ರಭು, ಬಸವಣ್ಣ, ಅಕ್ಕಮಹಾದೇವಿ, ಆಯ್ದಕ್ಕಿ ಲಕ್ಕಮ್ಮ, ಆಯ್ದಕ್ಕಿ ಮಾರಯ್ಯ ಕೀರ್ತನೆಗಳು : ಪುರಂದರದಾಸ, ಕನಕದಾಸ	**1,2,3**	3
Module 3 – ಕಾವ್ಯಭಾಗ (ಆಧುನಿಕ)	**RBT**	**Hrs**
ಮಂಕುತಿಮ್ಮನ ಕಗ್ಗ : ಡಿ.ವಿ.ಜಿ. ಕುರುಡು ಕಾಂಚಣಾ : ದ.ರಾ. ಬೇಂದ್ರೆ ಹೊಸ ಬಾಳಿನ ಗೀತೆ : ಕುವೆಂಪು ಚೋಮನ ಮಕ್ಕಳ ಹಾಡು : ಸಿದ್ದಲಿಂಗಯ್ಯ	**1,2,3**	**3**
Module 4 – ತಾಂತ್ರಿಕ ವ್ಯಕ್ತಿ ಪರಿಚಯ	**RBT**	**Hrs**
ಕಥೆ ಮತ್ತು ಪ್ರವಾಸ ಕಥನ - ಸರ್ ಎಂ ವಿಶ್ವೇಶ್ವರಯ್ಯ - ವ್ಯಕ್ತಿ ಮತ್ತು ಐತಿಹ್ಯ - ಎ ಎನ್ ಮೂರ್ತಿರಾವ್	**1,2,3**	**3**
Module 5 – ತತ್ವಜ್ಞಾನ ಮತ್ತು ತಂತ್ರಜ್ಞಾನ	**RBT**	**Hrs**
ಭಗವದ್ಗೀತೆಯ ಸಾರ, ಭಗವದ್ಗೀತೆಯಲ್ಲಿ ಬರುವ ಗುರು ಶಿಷ್ಯ ಸಂಬಂಧ. ತಾಂತ್ರಿಕ ಪದಕೋಶ - ತಾಂತ್ರಿಕ ಹಾಗೂ ಪಾರಿಭಾಷಿಕ ಕನ್ನಡ ಪದಗಳು	**1,2,3**	**3**

Reference Books

1. **"ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ"** ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ವಿಶ್ವವಿದ್ಯಾಲಯದ ಕನ್ನಡ ಮಾತೃಭಾಷೆಯ ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ ನಿಗದಿಪಡಿಸಿದ ಪಠ್ಯಪುಸ್ತಕ
   ಪ್ರಧಾನ ಸಂಪಾದಕರು - ಕುಲಪತಿಗಳು ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ವಿಶ್ವವಿದ್ಯಾಲಯ ಬೆಳಗಾವಿ
   ಸಂಪಾದಕರು –
   ಡಾ\|\| ಹಿ. ಚಿ. ಬೋರಲಿಂಗಯ್ಯ, ಕುಲಪತಿಗಳು ಕನ್ನಡ ವಿಶ್ವವಿದ್ಯಾಲಯ ಹಂಪಿ
   ಡಾ\|\| ಎಲ್ ತಿಮ್ಮೇಶ , ಪ್ರಾಧ್ಯಾಪಕರು ಸರ್ಕಾರಿ ಇಂಜಿನಿಯರಿಂಗ್ ಕಾಲೇಜ್, ಹಾಸನ

B.N.M. Institute of Technology

An Autonomous Institution under VTU

Semester: III/IV		
COURSE: Balake Kannada (For Non-Karnataka students)		
Course Code: 21KAN1372	**L:T:P:J: 1:0:0:0**	**CIE Marks:** 50
Credits:	**1**	**SEE Marks:** 50
Hours:	**15 hrs**	**SEE Duration: 1.5Hrs**

Course Learning Objectives: The students will be able to	
1	The course will enable the Non-Karnataka students to understand speak read and write Kannada language and communicate or Converse in Kannada language in their daily life with Kannada speakers

Module 1 – SPOKEN KANNADA	**RBT**	**Hrs**
i. Interaction in Hostel / College. ii. Conversation in a Bus. iii. Conversation between friends. iv. Conversation with Teachers. v. Telephonic Conversation. vi. Conversation with shopkeeper. vii. Conversation with Auto and Cab Driver.	**1,2,3**	**5**
Module 2 – READ AND WRITE	**RBT**	**Hrs**
Vowels, Initial forms & Secondary forms Yogavahas Classified consonants, Un-classified consonants.	**1,2,3**	**4**
Module 3 – HISTORY OF KARNATAKA	**RBT**	**Hrs**
Royal Dynasties of Karnataka	**1,2,3**	**2**
Module 4 – LITERATURE AND TOURIST PLACES OF KARNATAKA	**RBT**	**Hrs**
The Birds view of Kannada Literature Karnataka's Tourist Paradise	**1,2,3**	**2**
Module 5 – KANNADA LANGUAGE	**RBT**	**Hrs**
History of Kannada Language	**1,2,3**	**2**

Reference Books

1. **"ಬಳಕೆ ಕನ್ನಡ"** ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ವಿಶ್ವವಿದ್ಯಾಲಯದ ಕನ್ನಡ ಮಾತೃಭಾಷೆ ಅಲ್ಲದ ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ ನಿಗದಿಪಡಿಸಿದ ಪಠ್ಯಪುಸ್ತಕ.
   ಪ್ರಧಾನ ಸಂಪಾದಕರು - ಕುಲಪತಿಗಳು ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ವಿಶ್ವವಿದ್ಯಾಲಯ ಬೆಳಗಾವಿ
   ಸಂಪಾದಕರು –
   ಡಾ|| ಎಲ್ ತಿಮ್ಮೇಶ , ಪ್ರಾಧ್ಯಾಪಕರು ಸರ್ಕಾರಿ ಇಂಜಿನಿಯರಿಂಗ್ ಕಾಲೇಜ್, ಹಾಸನ

Class Internal Assessment

IA1	30 Marks	Average of 2 IA will be taken 30 Marks
IA2	30 Marks	
Assignment 1	10 Marks	10 Marks
Assignment 2	10 Marks	10 Marks
	Total CIA	**50 Marks**

Semester End Assessment

Semester end Exam	Objective Type Questions	50 Marks
	Total SEA	**50 Marks**

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

Faculties:

1. Sri. Chandrashekar
2. Dr. Chandravathi

B.N.M. Institute of Technology

An Autonomous Institution under VTU

Semester: III		
COURSE: Soft Skill-1		
Course Code: 21SFT138	**L:T:P:J: 0:0:2:0**	**CIA Marks:** 50
Credits:	**1**	**SEA Marks: 5 0**
Hours:	**15 hrs**	**SEE Duration: 1.5Hrs**

Course Learning Objectives: The students will be able	
1	To help students understand their strengths and weakness.
2	To develop analytical and creative ability to solve problems individually or as a team.
3	To make students industry ready through practice of corporate etiquettes.
4	To enhance public speaking and presentation skills.

Module No.	Contents of the Module	Hours	Cos
1	**Module-1 Understanding and Managing Self** Self-Awareness, Self-Management, Anger Management, Time management, Change management. Vision and goal setting - Diff between vision and goal, smart, stretched goal concept, case studies Knowledge, Skill, Attitude Personality analysis using Big 5 personality test Critical Thinking, Problem solving, Creativity and innovation Integrity, ethics, values	8	**1 &2**
2	**Module -2 Corporate etiquettes and Mannerism** Introduction to Etiquette and Mannerism, Personal Etiquette, Grooming etiquettes- professional styling, Body & personality styling, Video Interview Etiquettes, Personal Interview EtiquettesEffective meeting skills. Workplace behavior, Personal interview	6	**3**
3	**Module -3 Public Speaking and presentation skills** Introduction to public speaking, making ideas, illustrating and delivering ideas, overcoming fear of public speaking and developing great delivery. Advanced Business presentation skills, PowerPoint presentation, Group discussion	**6**	**4**
4	**Module -4 Team Work** Interpersonal skills, group work vs team work	**4**	**5**

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

CO1	Understand their strength and weaknesses.
CO2	Develop analytical and creative ability to solve problems.
CO3	Identify themselves as industry ready through the practice of corporate etiquettes.
CO4	Enhance public speaking and presentation skills.
CO5	Build team collaboration by working towards shared goals.

Mapping of Course Outcomes with Programme Outcomes:

COs	PO8	PO9	PO10	PO11
CO1	3	3		
CO2		3		3
CO3	3	3		3
CO4		3	3	
CO5			3	3

MOOC Course:

Communicate with impact - https://www.coursera.org/learn/communicate-with-impact

Leading Diverse Teams - https://www.coursera.org/learn/leading-diverse-teams

Practical component:

1. Mock GD and interview may be conducted at the end of the course to check their confidence. Students can prepare their SWOT analysis and present the same.
2. The students are to be involved in various activities and games such as Just a Minute or Pick and speak to demonstrate each topic.

Class Internal Assessment – 50 Marks

1. **Video Assignment -30Marks**
2. **Weekly Assessment -20Marks**

Rubrics for evaluation: (TOTAL - 30 Marks)

Sl. No.	Assessment	COs	Marks
1	Creativity	CO 2	5M
2	Approach and flow	CO 2	5M
3	Time Management (duration of video and deadline)	CO 1	5M
4	Individual presentation in the video	CO 4	5M
5	Report- Brief about the topic and Contribution of team members	CO 5	5M
6	Report- Reflections (learnings from the activity)	CO 2 & CO 5	5M

Semester End Assessment – 50 Marks

PPT	**- 10 Marks**
Communication (Clarity and English)	**- 10 Marks**
Body Language	**- 10 Marks**
Viva (Q and A)	**- 10 Marks**
Project Report	**- 10 Marks**

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

Faculties:

1. Ms. Jasmine Basumatary, Assistant Professor, Dept. of Humanities
2. Mrs. Rohini T., Assistant Professor, Dept. of ECE

B.N.M. Institute of Technology

An Autonomous Institution under VTU, Approved by AICTE

Department of Mathematics

Syllabus

Semester: III

Course: BRIDGE MATHEMATICS – I

Course Code: 21MATDIP131

(Mandatory Learning Course : Common to all Programmes)

(A bridge course for Lateral Entry students under Diploma quota to BE programmes)

L:T:P:J	**3:0:0:0**	**CIA**	**: 100**
Credits:	**0**	**SEA**	**: --**
Hours:	**30**	**SEA Duration**	**: --**

Course Learning Objectives: The students will be able to

1 Provide basic concepts of Laplace transform differential and integral calculus.

2 Provide an insight in to vector differentiation and first order OD E's.

Module-1: Laplace Transform	**No. of hours**	**Blooms cognitive Levels**
Introduction to the Laplace transform, Laplace transforms of elementary functions (statements only). Laplace transforms of $e^{at}f(t)$, $t^n f(t)$ and $\frac{f(t)}{t}$ (without proofs) and unit-step function– problems.	**06**	**Apply**
Module-2: Inverse Laplace Transform		
Definition and problems, Inverse Laplace transform by partial fractions. Solution of second order linear differential equations using Laplace transforms.	**06**	**Apply**
Module-3: Differential Calculus & Partial differentiation		
Differential Calculus: Review of successive differentiation-illustrative examples. Taylor's and Maclaurin's series expansions, problems on Maclaurin's series expansion. **Partial differentiation:** Introduction to partial differentiation: Euler's theorem-problems on first order derivatives only. Total derivatives-differentiation of composite functions. Jacobians of order two-problems.	**06**	**Apply**
Module-4:Integral Calculus and Vector Differentiation		
Integral Calculus: Introduction to double and triple integrals and problems. **Vector Differentiation:** Review of vector algebra-illustrative examples. Scalar and vector point functions. Gradient, Divergence, Curl-simple, Solenoidal and irrotational vector fields.	**06**	**Apply**
Module-5: Ordinary differential equations		
Introduction-solutions of first order and first-degree differential equations: exact and reducible to exact differential equations-Integrating factors on $\frac{1}{\mathrm{N}}\left(\frac{\partial \mathrm{M}}{\partial y}-\frac{\partial \mathrm{N}}{\partial \mathrm{x}}\right)$ and $\frac{1}{\mathrm{M}}\left(\frac{\partial \mathrm{M}}{\partial y}-\frac{\partial \mathrm{N}}{\partial \mathrm{x}}\right)$, linear and reducible to linear differential equations.	**06**	**Apply**

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. B.V. Ramana: "Higher Engineering Mathematics" 11th Edition, Tata McGraw-Hill, 2010.
4. Srimanta Pal & Subobh C. Bhunia: "Engineering Mathematics", Oxford University Press, 3rd Reprint, 2016.

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

CO 1: Apply the knowledge of Laplace transformin solving integral equations.
CO 2: Use Laplace transform and inverse Laplace transform in solving differential equations.
CO 3: Use derivatives and partial derivatives to calculate rate of change of multivariate functions.
CO 4: Solve double and triple integrals and illustrate the applications of multivariate calculus to understand the solenoidal and irrotational vectors.
CO 5: Identify and solve first order ordinary differential equations.

B.N.M. Institute of Technology

An Autonomous Institution under VTU, Approved by AICTE

Department of Mathematics

Syllabus

Semester: IV		
Course: Complex Analysis, Probability and Random Process **Course Code: 21MAC141 (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
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. **Self study:** Applications of Complex function in Engineering.	**L: 04** **T: 04**	**Apply**
Module-2: Conformal Mapping & Complex Integration		
Conformal mapping: Introduction, discussion of transformations: $w = e^z$, $w = z^2$, $w = z + \frac{1}{z}(z \neq 0)$ and bilinear transformations. **Complex integration:** Introduction to complex integration, Cauchy's theorem and Cauchy's integral formula. **Self study:** Problems on Complex line integration.	**L: 04** **T: 04**	**Apply**
Module-3: Probability Distributions & Jointprobabilitydistribution		
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. **Self study:** Applications of probability distribution in Engineering.	**L: 04** **T: 04**	**Apply**
Module-4:Markov Chain & 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. **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. **Self study:** Applications of Markov Chain in Engineering.	**L: 04** **T: 04**	**Apply**
Module-5: 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. **Self study:** Applications of Random process in Engineering.	**L: 04** **T: 04**	**Apply**

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 & Subobh 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/

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:** 21ECE142

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

Pre-Requisites: Math fundamentals

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, time scaling, time shift, and time reversal. **Elementary signals/functions:** Exponential, sinusoidal, step, impulse, ramp functions, triangular, and rectangular pulse. Differentiation, Integration of signals	**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 (combination of Unit Step and Exponential). Convolution Integral	**10**	**Apply CO2**
Module-3:		
Z-Transforms: Definition, Basic problems, Region of Convergence. **Fourier Representation of aperiodic Signals:** Introduction to DTFT, Definition, and basic problems. **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)	**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). Design of Bandpass Analog Butterworth filter.	**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, Hamming & Bartlett windows. FIR filter realization using Direct form and Lattice structure.	**10**	**Apply CO5**

Course Outcomes: After completing the course, the students will be able to	
21ECE142.1	Classify the signals as continuous/discrete, periodic/aperiodic, even/odd, energy/power, and deterministic/random signals.
21ECE142.2	Determine the linearity, causality, time-invariance, and stability properties of continuous & discrete-time systems and compute convolution.
21ECE142.3	Represent signals in the frequency domain using Z-Transforms, DTFT, and compute the DFT of signals.
21ECE142.4	Develop and realize the transfer function of IIR filters
21ECE142.5	Develop and realize the transfer function of FIR filters.
21ECE142.6	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

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 book test	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 must 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.

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: 21ECE143**
L: T: P: J	**3: 0: 2: 0**	**CIA Marks: 50**
Credits:	**4**	**SEA Marks: 50**
Hours/Week (Total)	**3 Hours/ Week (40 Hours)**	**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 Pend able Service Call	**8**	**Understand CO5**

Lab Experiments (12 Lab sessions +1 Revision session+ 1 Lab Test)
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 data
4. ALP to find determine whether the given 16 bit is even or odd
5. ALP to store data in the RAM
6. ALP to reverse the string
7. Interface a simple Switch and display its status through Relay, Buzzer and LED.
8. Interface a Stepper motor and rotate it in clockwise and anti-clockwise direction.
9. Interface a DAC and generate Triangular and Square waveforms.
10. Display the Hex digits 0 to F on a 7-segment LED interface, with an appropriate delay in between.
11. Interface keypad & display the Key Pressed on LCD
12. Toggle the LED when an external interrupt occurs
Revision
Lab Assessment & evaluation

Course Outcomes: After completing the course, the students will be able to	
21ECE143.1	Describe the architectural features of 32-bit microcontroller ARM Cortex M3.
21ECE143.2	Apply the knowledge of instruction set of ARM Cortex M3 for programming.
21ECE143.3	Apply the knowledge of embedded C Programming for ARM Cortex M3 for different applications.
21ECE143.4	Understand the memory map & Bus interface unit of ARM Cortex M3.
21ECE143.5	Describe the exceptions of ARM Cortex M3.
21ECE143.6	Design a 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:

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
	Lab Exam	Average of two Lab Internals, Record and Observation	20
		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(CIA + SEA)	**100**

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: 21ECE144**
L: T: P: J	**3:0:2:0**	**CIA Marks:** 50
Credits:	**4**	**SEA Marks:** 50
Hours/Week (Total)	**5 / 50 hours**	**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 performance of the analog modulation scheme in the presence of the AWGN channel.
4	Understand the concept of signal processing of digital data and signal conversion to symbols at the transmitter and receiver.
5	Understand and analyze concepts of Digital Modulation schemes and Compute performance metrics of bandlimited channel.

Module-1: AMPLITUDE MODULATION	**No. of Hours**	**Blooms Cognitive Levels**
AMPLITUDE MODULATION: Introduction, 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. Frequency- Division Multiplexing, VSB Transmission of Analog and Digital Television	**8**	**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. The Superheterodyne Receiver.	**8**	**Apply CO2**
Module-3: NOISE		
NOISE - Shot Noise, Thermal noise, White Noise, Noise Equivalent Bandwidth **Text 1** **NOISE IN ANALOG MODULATION:** Introduction, Receiver Model, Noise in DSB-SC receivers. Noise in AM receivers, Threshold effect, Noise in FM receivers, Capture effect, FM threshold effect, FM threshold reduction, Pre-emphasis and De-emphasis in FM. Correlation receiver.	**8**	**Apply CO3**
Module-4: 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. Robust quantization, Compander.	**8**	**Apply CO4**
Module-5: DIGITAL MODULATION TECHNIQUES		
Pulse–Code Modulation: Sampling, Quantization, Encoding, Regeneration, Decoding, Filtering, Multiplexing; Delta Modulation. Digital Modulation schemes: Amplitude shift keying, Frequency shift keying, Binary Phase shift keying. Quadrature amplitude modulation, Differential phase shift keying.	**8**	**Apply CO5**

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)

Course Outcomes: After completing the course, the students will be able to	
21ECE144.1	Analyze and compute the performance of Amplitude modulation.
21ECE144.2	Analyze and compute the performance of Frequency modulation.
21ECE144.3	Compute the performance of Analog modulation schemes in presence of an AWGN channel.
21ECE144.4	Analyze and compute the performance of pulse modulation schemes with and without quantization noise.
21ECE145.5	Analyze the performance of digital modulation schemes.
21ECE146.6	Explain functional blocks of signal processing and communication applications.

Reference Books

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

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
	Laboratory	Record and Observation-10 Marks	10
		One Laboratory Internal Assessment-10 Marks	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 (CIA+ SEA)	**100**

Optional/ Not Compulsory:

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

Dept. of Electronics and Communication Engineering Choice Based Credit System (CBCS and Outcome Based Education (OBE)		
Semester: IV		
Course Name: Signal Processing Applications of MATLAB		**Course Code: 21ECE145**
L: T: P: J	**0: 0: 2 :2**	**CIA Marks: 50**
Credits:	**2**	**SEA Marks: 50**
Hours/Week (Total)	**4 / 25 hours**	**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.

List of Programs

1. Plot discrete and continuous time waveforms like rectangular pulse, square wave, triangular pulse, triangular wave, impulse, step, and ramp signal.
2. Verification of sampling theorem (use interpolation function).
3. Computation of Linear convolution of two given sequences. Prove commutative, distributive, and associative property of convolution.
4. Introduction to Image processing toolbox. Perform basic image processing operations like add, subtract, complement, and crop.
5. Computation of N point DFT of a given sequence and to plot magnitude and phase spectrum.
6. Perform the following operations on images: image enhancement, and thresholding on a given gray scale image.
7. Perform the following operations on images: smoothening and sharpening using different filters.
8. Design and implementation of Low pass FIR/IIR filter to meet the desired specifications and test the filter with a speech/audio file. Plot the spectrum of audio signal before and after filtering.
9. Checking Linearity/Non-Linearity of a system using SIMULINK
10. Checking Time variance/invariance of a system using SIMULINK

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

Course Outcomes: After completing the course, the students will be able to	
21ECE145.1	Demonstrate sampling theorem and plot elementary waveforms in continuous and discrete time domains.
21ECE145.2	Analyze the signals using DFT and convolution.
21ECE145.3	Perform basic operations on images.
21ECE145.4	Apply filtering techniques on audio/speech signals.
21ECE145.5	Build a system to verify the properties of a given system using SIMULINK.
21ECE145.6	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:

CIA (50)	**Component**	**Description**	**Marks**
	Practical	Lab records	5
		Performance day wise	5
	Internal Laboratory Test	Conduction	5
		Viva	5
	Project	Demonstration	10
		Presentation	10
		Report	10
		Total Marks	**50**
SEA (50)	**Component**	**Description**	**Marks**
	External Laboratory Exam	External Lab exam will be conducted for 100 marks and scaled down to 50 Marks. The marks allocated is as follows: Write up – 20 Conduction – 70 Viva-voce – 10	**50**
		Total marks (CIA + SEA)	**100**

Additional Assessment Tools (AAT) – Presentations, Open ended experiments, Mini Projects, MATLAB courses.

B.N.M. Institute of Technology

An Autonomous Institution under VTU

Semester: IV		
COURSE: CONSTITUTION OF INDIA AND PROFESSIONAL ETHICS		
Course Code: 21CIP146	**L:T:P:J: 1:0:0:0**	**CIE Marks:** 50
Credits:	**1**	**SEE Marks: 5 0**
Hours:	**15 Hrs**	**SEE Duration:**

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. Senthil kumar
   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

B.N.M. Institute of Technology

An Autonomous Institution under VTU

Semester: III		
COURSE: Environmental Science		
Course Code: 21EVS147	**L: T: P: J: 0:2:0:0**	**CIA Marks:** 50
Credits:	**1**	**SEA Marks:** 50
Hours:	**15 sessions**	**SEE Duration: 1.5 Hrs**

Course Learning Objectives: The students will be able to	
1	To identify the major challenges in environmental issues and evaluate possible solutions.
2	Develop analytical skills, critical thinking and demonstrate socio-economic skills for sustainable development.
3	To analyse an overall impact of specific issues and develop environmental management plan.

Module 1 – Environment	**RBT**	**Hrs**
a) Environment: Definition, **b) Ecology and Ecosystems:** (i) Biomes (ii) Ecosystems & Sustainable Ecosystem (iv) Human Activities & Environment. **c) Human activities and their Impact on Environment:** (i) Agriculture (ii) Industry (iii) Transport (iv) mining. (i) Environmental Impact Assessment (EIA) (ii) Sustainable Development	1,2,3	**6**
Module 2 – Natural Resources	**RBT**	**Hrs**
Natural Resources **a) Forest Resources:** (i) Forest wealth and its conservation (ii)Wood–Major renewable resources (iii) Biodiversity **b) Water resources and its uses:** (i) Quality (ii) Impurities – Fluoride etc **c) Water borne diseases** **d) Energy:** (i) Conventional (ii) Non-conventional (iii) Wind, Solar, Tidal, Hydro Electric, Biomass & Biogas (iv) Alternate source – Hydrogen, Bio fuel, Hybrid & semi hybrid vehicles, etc **e) Life on Earth:** (i) Wild life management, Nature, Genetically Modified (GM Crops), Balance of Nature – Nature pyramid, Floods and droughts	**1,2,3**	6
Module 3 – Pollution and Current Global issues	**RBT**	**Hrs**
a) Pollution i. Types of pollutions, Environmental, Air, Water, Noise, land, Effluents Public Health ii. Carbon foot print, Climate change, Ozone depletion (Chloro Floro carbon) Global warming, Greenhouse effect, Acid Rain. iii. Ground water pollution, (Earth summits for balancing effect on environment).	**1,2,3**	6

b) **Current Global Environmental issues:** (i) Population (ii) Local urbanization - concrete jungles. (iii) waste water management. (iv) Effect on natural drainage in cities, encroachment on lakes, etc.		
Module 4 – Sustainable development	**RBT**	**Hrs**
Sustainable development: i. Solid waste, E-waste and Bio Medical waste management. ii. Waste Water treatment, Encouraging Green buildings. iii. Vermi compost, organic farming, adopting Subhash Palekar farming methods.	**1,2,3**	6
Module 5 – Environmental policies, Protection & Laws	**RBT**	**Hrs**
Environmental policies, Protection & Laws **Regulations & Laws** i. Forest, Wildlife, Water and Air. ii. Environmental movements, NGO's – Chipko, Silent valley, Narmada iii. Environmental Ethics. iv. Resource needs for future generations – for mankind other life forms on this planet. v. Role of individual in sustainable development.	**1,2,3**	6

Textbook/s

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Environmental Studies	Anil Kumar De, Arnab Kumar De	New Age International (P) Limited, Publishers	2018
2.	Environmental Studies	Benny Joseph	Tata Mc Graw – Hill.	2nd Edition, 2012
3.	Environmental Science working with the Earth	G.Tyler Miller Jr.	Thomson Brooks /Cole,	11th Edition, 2006

Course Outcomes: After completing the course, the students shall	
21EVS147.1	CO1: Understand the concepts of ecology, environment and biodiversity and the consequences of their destruction.
21EVS147.2	CO2: Gain awareness about the advances in energy systems as well ways to manage natural resources.
21EVS147.3	CO3: Understand the different kinds of pollution, their impact and manage waste through recycling.
21EVS147.4	CO4: Gain awareness about the current environmental issues and their global impact on various aspects.
21EVS147.5	CO5: Develop critical thinking and apply them to analyse a problem or question related to the environment.

Class Internal Assessment

IA1	30marks	Average of 2 IA will be taken 30 Marks
IA2	30Marks	
Assignment	20 Marks	20 Marks
	Total CIA	**50 Marks**

Semester End Assessment

Semester end Exam	Objective Type Questions	50 Marks
	Total SEA	**50 Marks**

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

Faculties:

1. Sri. Narayan Rao R Maanay, Secretary, BNMIT
2. Dr. Prathibha B S, HoD, Chemistry Dept.

B.N.M. Institute of Technology

An Autonomous Institution under VTU, Approved by AICTE

Department of Mathematics

Syllabus

Semester: IV

Course: BRIDGE MATHEMATICS – II

Course Code: 21MATDIP141

(Mandatory Learning Course: Common to all Programmes)

(Abridge course for Lateral Entry students under Diploma quota to BE programmes)

L:T:P:J	**3:0:0:0**	**CIA**	**: 100**
Credits:	**0**	**SEA**	**: ---**
Hours:	**30**	**SEA Duration**	**: ---**

Course Learning Objectives: The students will be able

1 To provide essential concepts of linear algebra, second & higher order differential equations along with methods to solve them.

2 To provide an insight into elementary probability theory and numerical methods.

Module-1: Linear Algebra	**No. of hours**	**Blooms cognitive Levels**
Introduction - rank of matrix by elementary row operations - Echelon form. Consistency of system of linear equations - Gauss elimination method. Eigen values and Eigen vectors of a square matrix. Problems.	**06**	**Apply**
Module-2: Numerical Methods		
Finite differences. Interpolation / extrapolation using Newton's forward and backward difference formulae-problems. Solution of polynomial and transcendental equations–Newton-Raphson method-problems. Numerical integration: Simpson's one third rule and Weddle's rule- problems (All formulas without proof)	**06**	**Apply**
Module-3: Higher order ordinary differential equations		
Linear differential equations of second order equations with constant coefficients. Homogeneous / non-homogeneous equations. Inverse differential operators on e^{ax}, $\sin(ax + b)$, $\cos(ax + b)$ and a polynomial $P_n(x)$.	**06**	**Apply**
Module-4:Partial Differential Equations (PDE)		
Formation of PDE by elimination of arbitrary constants and functions. Solution of non- homogeneous PDE by direct integration. Homogeneous PDE involving derivatives with respect to one independent variable only.	**06**	**Apply**
Module-5: Probability		
Introduction. Sample space and events. Axioms of probability. Addition & multiplication theorems. Conditional probability, Bayes's theorem, problems	**06**	**Apply**

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. B.V. Ramana: "Higher Engineering Mathematics" 11th Edition, Tata McGraw-Hill, 2010.
4. Srimanta Pal & Subobh C. Bhunia: "Engineering Mathematics", Oxford University Press, 3rd Reprint, 2016.

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

CO 1: Solve systems of linear equations using matrix algebra.

CO 2: Apply the knowledge of numerical methods in modelling and solving engineering problems.

CO 3: Make use of analytical methods to solve higher order differential equations.

CO 4: Classify partial differential equations and solve them by exact methods

CO 5: Apply elementary probability theory and solve related problems.

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: V

Course Name: Digital Image Processing		**Course Code: 21ECE151**
L: T: P: J	**3 : 0 : 0 : 0**	**CIA Marks:** 50
Credits:	**3**	**SEA Marks:** 50
Hours/Week (Total)	**3**	**SEA Duration:** 03 Hours

Prerequisite: Nil

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/CO Mapping**
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, Filtering in the Frequency Domain, Image Smoothing and Image Sharpening Using Frequency Domain Filters	**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	
21ECE151.1	Apply image formation techniques and the role human visual system plays in perception of gray and color image data.
21ECE151.2	Apply image processing techniques in both the spatial and frequency (Fourier) domains.
21ECE151.3	Apply image Restoration techniques in the spatial domain.
21ECE151.4	Apply image processing techniques for Color and Morphological Image Processing.
21ECE151.5	Design image analysis techniques in the form of image segmentation evaluate the methodologies for Representation and Description.
21ECE151.6	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 2nd Edition, 2020.
3. Fundamentals of Digital Image Processing-A. K. Jain, Pearson Education, 2nd Edition, 2004.

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			
			AAT	10			
			Total – 50 marks				**Total – 50 marks**

i) CIA: 50%

IA Test: 3 IA tests - Each of 30 Marks	Average of 3 tests – 30 M
Assignment	10 Marks
Additional Assessment Tools (AAT) – Quiz, Presentations, Term Paper, Open ended experiments, Mini Projects, Two-minute video on latest topic, Short MOOC courses	10 Marks
Total	**50 M**

ii) SEA : 50%

Theory Exam	5 questions to answer each of 20 Marks. questions from each module with internal choice udent 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

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

Semester: V		
Course Name: Electromagnetic Waves and Transmission Lines		**Course Code: 21ECE152**
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/ CO Mapping**
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 Wave and Standing Wave Ratio, Calculation of reflection coefficient and standing wave ratio using Smith Chart.	**8**	**Apply CO5**

Course Outcomes: After completing the course, the students will be able to	
21ECE152.1	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
21ECE152.2	Determine potential and energy with respect to point charge. Apply Laplace's equation to determine voltage function, capacitance.
21ECE152.3	Apply Biot-Savart's and Ampere's laws for evaluating Magnetic field for different current configurations, Apply Maxwell's equations for time varying fields.
21ECE152.4	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.
21ECE152.5	Explain propagation of RF signals through transmission line and transmission line basics.
21ECE152.6	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, 2003,3rd Edition.
3. Electromagnetic Waves and Radiating systems, E. C. Jordan and K.G. Balman, PHI,2006 2nd Edition.
4. Elements of Electromagnetics, Matthew N.O., Sadiku, Oxford university press,2007,4th Edition.
5. Electromagnetics, Joseph Edminister, Schaum Outline Series, McGraw Hill,1995,2nd 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			
			AAT	10			
			Total – 50 marks				**Total – 50 marks**

i) CIA: 50%

IA Test: 3 IA tests - Each of 30 Marks	Average of 3 tests – 30 M
Assignment	10 Marks
Additional Assessment Tools (AAT) – Quiz, Presentations, Term Paper, Open ended experiments, Mini Projects, Two-minute video on latest topic, Short MOOC courses	10 Marks
Total	**50 M**

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: 21ECE153**
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 Digital Communication

Course Learning Objectives: The students will be able to

1	Understand the layering architecture of OSI reference model and TCP/IP protocol suite.
2	Understand the protocols associated with each layer.
3	Learn the different networking architectures and their representations.
4	Explain transport layer and application layer protocols.
5	Explain network security services, mechanisms, Transport Level Security and IP Security.

Module-1: Data communication and Physical Layer	**No. of Hours**	**Blooms Cognitive Levels/CO Mapping**
Data communication: Components, Data representation, Data flow. Networks: Network criteria, Physical Structures, Network types: LAN, WAN, Switching, 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. **Physical Layer**: Data and Signals, Transmission impairment.	**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.	**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, Distance Vector Routing, Link State Routing, Path vector routing.	**10**	**Apply CO3**
Module-4: Transport Layer and Application Layer		
Transport Layer: Introduction, Transport Layer Services, Connectionless and Connection-oriented Protocols, Transport Layer Protocols: Simple protocol, Stop and wait protocol, Go-Back-N Protocol, Transport-Layer Protocols in the Internet: User Datagram Protocol: User Datagram, UDP Services, Transmission Control Protocol: TCP Services, TCP Features. **Application Layer:** Introduction, Services, Application - layer paradigms.	**10**	**Understand 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. **Transport Level Security**: Web security consideration, Transport Layer Security (TLS).	**10**	**Understand 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 workstation, class of the address and configure the IP address on a workstation. To share the hardware resources on a network.
Revision
Lab assessment & evaluation

Course Outcomes: After completing the course, the students will be able to	
21ECE153.1	Apply the concepts of networking to create networks thoroughly.
21ECE153.2	Apply the Data Link layer services and protocols to networks.
21ECE153.3	Apply the Network layer services and protocols to networks.
21ECE153.4	Explain the Transport layer and Application layer services and protocols.
21ECE153.5	Explain security concerns in networks, Transport level security and IP security.
21ECE153.6	Discuss and analyze the various applications that can be implemented on networks.

References

1. Forouzan, “Data Communications and Networking”, 5th Edition, McGraw Hill, 2013, 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 Tannenbaum, “Computer Networks”, Prentice Hall, 2003, ISBN: 0-13-066102-3.

<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="5">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

An Autonomous Institution under VTU

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

Semester: V

Course Name: Embedded Systems and RTOS		**CourseCode:21ECE154**
L:T:P:J	**3:0:2:0**	**CIAMarks:50**
Credits:	**4**	**SEAMarks:50**
Hours/Week (Total)	**5**	**SEADuration:03Hours**

Pre-Requisites:Knowledge of microprocessor/microcontroller hardware, programming concept in assembly and C.

Course Learning Objectives:The student will be able to

1	Understand the basic hardware components and their selection method based on the characteristics and attributes of an embedded system
2	Develop an embedded system using hardware software co-design approaches
3	Understanding Advanced Architecture and Processor- Memory Organization
4	Understanding the ESP32 architecture
5	Apply the scheduling techniques for the given real time operating system
6	Design a Embedded system for Societal needs, Health care, Home application

Module-1:Embedded System Components	**No. of Hours**	**BloomsCognitiveLevels /CO Mapping**
Introduction, Embedded Vs General computing system, Classification of Embedded systems, Major applications and purpose of ES. Elements of an Embedded System, Difference between Harvard and Princeton, Big and Little Endian formats, Memory, Sensors, Actuators, LED, 7 segment LED display, Optocoupler, relay, Piezo buzzer, Push button switch,Communication Interface (onboard, external – RS 232, USB, Blue tooth, Wi-Fi types),Embedded firmware	**10**	**Understand CO1**
Module-2:Embedded System Design Concepts		
Introduction, Characteristics, and Quality Attributes of Embedded Systems, Operational and non-operational quality attributes, Embedded Systems – Application and Domain Specific, Hardware Software Co-Design and Program Modelling, Issues in hardware software co design, computational models, hardware software tradeoffs, Embedded firmware design and development: Design approaches, development languages	**10**	**Apply CO2**
Module-3: Advanced Architecture and Processor- Memory Organization		
Processor- Memory Organization, Introduction to Advanced processor Architectures, Processor Organization, Instruction level Parallelism, Intel x86 Architecture, ARM, SHARC, Memory Types & Addresses, Memory Addresses, Memory Hierarchy & Cache, Performance Metrics, Selection of Processor & Memory Devices.	**10**	**Understand CO3**

Module-4: ESP 32 Architecture		
Introduction ,Features, Functional Description, Interrupt Matrix (INTERRUPT),Overview, Features, Reset and Clock, IO_MUX and GPIO Matrix (GPIO, IO_MUX) , Overview, Peripheral Input via GPIO Matrix, DPort Registers, DMA Controller (DMA), Overview, Features, Functional Description, Watchdog Timers (WDT)	**10**	**Understand CO4**
Module-5: Real Time Operating Systems		
Introduction, Operating System basics, Types of operating systems, Task, process and threads excluding programs, Thread preemption, Multi-processing and multitasking, Task scheduling excluding programs	**10**	**Apply CO5**

Lab Experiments
1. ESP32 Basics- Understanding ESP32 Board and Components, Installing and work with Arduino IDE, Program to read the status of push button & control LED & Buzzer.
2. Program to display a message on LCD using ESP32
3. Program to control LED interfaced to ESP32 using Bluetooth (HC-05)
4. Program to control LED interfaced to ESP32 using Wifi (Blynk)
5. Program to control LED interfaced to ESP32 using with Wifi (Google Firebase Cloud)
6. Program for creating child threads
7. Programs to build multithreaded applications
8. Program for FIFO scheduling
9. Program for round robin scheduling
10. Program for Priority Based scheduling
11. Revision
12. Lab Assessment

CourseOutcomes:Aftercompletingthecourse,thestudents willbeableto	
21ECE154.1	Understand the basic hardware components and their selection method based on the characteristics and attributes of an embedded system
21ECE154.2	Develop an embedded system using hardware software co-design approaches
21ECE154.3	Understanding Advanced Architecture and Processor- Memory Organization
21ECE154.4	Understanding the ESP32Architecture
21ECE154.5	Apply the scheduling techniques for the given real time operating system
21ECE154.6	Design a Embedded system for Societal needs, Health care, Home application

Reference Books

1. "Introduction to Embedded Systems", Shibu K V, Tata McGraw Hill Education Private Limited, 2nd Edition,2017.
2. Embedded System: Architecture, Programming and Design by Raj Kamal, TMH Publication,3rd Edition, 2003.
3. ESP32 Technical Reference Manual
4. Embedded Software Primer, David Simon, Pearson Education, 2002.
5. Real Times Systems Theory and Practice by Rajib Mall, Pearson Education, 2006.
6. Embedded Real-time Systems Programming, Sri Ram Iyer and Pankaj Gupta , TMH , 2017.
7. The Linux Programming Interface, Michael Kerrisk,No Starch Press, 2010.

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
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</table>

i) CIA: 50%

Theory	**A Test** (Theory): 3IA 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

An Autonomous Institution under VTU

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 **Course Code: 21ECE155**

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: 03 Hours**

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

Module 1 – Artificial Intelligence	**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, Problem solving state space search and control strategies, introducing machine learning 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	**5**	**Apply CO1**
Module 2: Machine Learning		
Machine Learning: Introduction to Machine Learning. 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.	**5**	**Apply CO2**
Module 3: 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	**5**	**Apply CO3**
Module 4: 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	**5**	**Apply CO4**
Module 5: Regression		
Introduction to Regression, Evaluation Metrics, MATLAB Implementation. **Program:** 1. Write a MATLAB script to implement a Regression Model on a given Dataset	**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. Bitcoin Price Predictor. 6. Music Genre Classification. 7. Wine Quality Test. 8. Titanic Survival Prediction Project.		

Course Outcomes: After completing the course, the students will be able to	
21ECE155.1	Implement data importing and reading using MATLAB
21ECE155.2	Implement Feature Selection and Prediction using MATLAB
21ECE155.3	Design Clustering Algorithms for a given Problem Statement and a Dataset
21ECE155.4	Design suitable Classification Algorithm for a given Problem Statement and a Dataset
21ECE155.5	Design suitable Regression Algorithm for a given Problem Statement and a Dataset
21ECE155.6	Apply Machine Learning algorithms to solve real world problems.

Reference Books

1. Saroj Kaushik, Artificial Intelligence, Cengage learning, 2014, 1st Edition, Cengage Learning India
2. Giuseppe Ciaburro, MATLAB for Machine Learning, Packt Publishing, 2017, ISBN: 978-1-78839-843-5, 2017
3. Elaine Rich, Kevin Knight, Artificial Intelligence, Tata McGraw Hill Education, 3rd edition, 2017
4. Oliver Theobald, Machine Learning for Absolute Beginners, 2017.

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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Assessed for 100 marks.
reduced to 50 Marks</td></tr>
<tr><td>30</td><td>30</td></tr>
<tr><td colspan="2">verage of 2 tests – 30 marks</td></tr>
<tr><td>Practical</td><td colspan="2">eekly Assessment (Record/Project) – 10 Marks
Lab IA test – 10 Marks</td><td></td></tr>
<tr><td colspan="4">Total – 50 Marks</td><td>Total – 50 Marks</td></tr>
</table>

i) CIA: 50%

Theory - 2 IA tests - Each of 30 Marks	30 Marks
Practical **Weekly Assessment** - Lab record/Project – 10 Marks **Lab IA test –** 10 Marks	20 Marks
Total	**50 M**

ii) SEA: 50%

Project	Write up – 10 Marks. Project report – 25 Marks Presentation & Demonstration - 50 Marks Viva-Voce – 15 Marks	**100 Marks reduced to 50 Marks**
	Total	**50 Marks**

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: V

Course Name: Smart Sensor Technologies		**Course Code: 21ECE1561**
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: Basic Engineering Science

Course Learning Objectives: The students will be able to

1	Introducing fundamentals of sensing and exploration of various sensors widely used for real life application.
2	To familiarize the characteristics, working principle and application of special purpose transducers
3	Obtain knowledge on sensors, sensors with microcontrollers and their applications.
4	To develop skillset to implement IoT systems for wearable applications.

Module-1: An Introduction to Smart Technologies	**No. of Hours**	**Blooms cognitive Levels/CO Mapping**
Introduction, Sensor Requirement in Smart Systems, Sensor Technologies for Smart systems, General concepts and terminology of Sensor systems, Transducers classification-sensors and actuators, General input-output configurations, Static and dynamic characteristics of measurement system.	**8**	**Understand CO1**
Module-2: Smart Sensors and Applications		
Integrated and Smart sensors, IEEE 1451 standard & Transducer Electronic Datasheets (TEDs), Overview of various smart sensors: Digital temperature sensor (DS1621, TMP36GZ), Humidity sensor (DHT11, DHT22, FC28), IR sensor (FC51), Gas sensor (MQ2, MQ8), Pressure sensors (BMP180), Accelerometers (ADXL335)	**8**	**Understand CO2**
Module-3: Sensors with Microcontroller		
Introduction, Separate Vs Integrated Signal Conditioning, Digital Conversion, Online Tool for Evaluating a Sensor Interface Design, MCU Control, MCUs for Sensor Interface, Sensor Integration, Application Examples.	**8**	**Understand CO3**
Module-4: 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 CO4**
Module-5: Smart Devices Case Study		
Wearable devices use cases- Smart watches, Android wear, Smart glasses/ Google Glass, fitness trackers, health care devices, sports, smart clothing, defense and security. Wearables: Challenges and Opportunities, Future and Research Roadmap	**8**	**Understand CO5**

Course Outcomes: After completing the course, the students will be able to	
21ECE1561.1	Understand the working principle and behavior of sensors
21ECE1561.2	Understand the working principle of special purpose sensors and the need for developing smart sensors
21ECE1561.3	Able to understand how microcontroller is implemented in sensor technologies.
21ECE1561.4	Relate and realize the importance automotive sensors and bio medical sensors
21ECE1561.5	Design and develop IoT end points for wearable applications.
21ECE1561.6	Able to design and perform experiments on the sensors and develop the projects based on the customer needs.

Reference Books

1. Jacob Fraden, "Handbook of Modern Sensors: Physics, Designs, and Applications", 5th Edition, Springer, 2016.
2. Frank, Randy, "Understanding smart sensors", Artech House integrated microsystems series, 3rd Edition, 2013.
3. John Turner, Automotive Sensors, 2012, Momentum Press, USA.
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.
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:

<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>
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<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>
</table>

i) CIA: 50%

IA Test: 3 IA tests - Each of 30 Marks	Average of 3 tests – 30 M
Assignment	10 Marks
Additional Assessment Tools (AAT) – Quiz, Presentations, Term Paper, Open ended experiments, Mini Projects, Two-minute video on latest topic, Short MOOC courses	10 Marks
Total	**50 M**

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**

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: V

Course Name: Mobile Communication and Processor		**Course Code: 21ECE1562**
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: 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 Concept of System on Chip

Module-1: Evolution of Wireless Communications Technology	**No. of Hours**	**Blooms Cognitive Levels/CO Mapping**
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: Mobile Phone Basic Block Diagram		
Study of BGA IC's, Block diagram of IC and Installation of software, Flashing, PC based diagnostic tools, mobile sets formatting, used of secret codes. Types of Mobile software, Data cable, Card reader, Mobile display, Remove/replace Component & Mobile phone hardware design of (transmitter filter, microphone, receptor, Antenna, RF power amplifier, local oscillator, Audio IC, speaker, charger etc.).	**8**	**Understand CO2**
Module-3: Hardware and Software Architecture of Mobile Phone		
Introduction to Mobile Architecture: Mobile Architecture, Mobile Hardware Architecture, Mobile Software Architecture, Mobile Architecture Vs Computer Architecture, Memory organization, Input and output devices for handled devices and Booting of Mobile devices.	**8**	**Understand CO3**
Module-4: System on Chip Architecture		
Hardware Architecture: Introduction to the processors used for Mobile and Handheld devices and SoC architecture like OMAP and Snap Dragon and its case study with reference to protocols, Input and output interfaces, GPU, DSP	**8**	**Understand CO4**
Module-5: Higher Generation Cellular Standards		
Higher Generation Cellular Standards:3G Standards: evolved EDGE, enhancements in 4G standard, Architecture and representative protocols, call flow for LTE, VoLTE, UMTS, introduction to 5G.	**8**	**Understand CO5**

Course Outcomes: After completing the course, the students will be able to	
21ECE1562.1	Understand the different generation wireless communication technology
21ECE1562.2	Understand the basic layout of mobile phone
21ECE1562.3	Understand the difference between the processor used in computers and mobile phone
21ECE1562.4	Understand the standard SoC used in Mobile Phone
21ECE1562.5	Understand the requirements of Next Generation Wireless Communication Technologies
21ECE1562.6	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. Mobile Handset Design, Sajal K. Das, Wiley, 2010 (https://www.oreilly.com/library/view/mobile-handset-design/9780470824672/)
3. Mobile First, Luke Wroblewski, A Book Apart; First Edition , 2011.
4. Tommi Mikkonen, "Programming Mobile Devices: An Introduction for Practitioners", John
5. Wiley & Sons Ltd, 2007.
6. J Scheible and Ville Tuulos John, "Mobile Python Rapid Prototyping of Applications on
7. the Mobile Platform" Wiley India Pvt. Ltd, 2008.
8. S. Poslad, "Ubiquitous Computing: Smart Devices, Environments and Interactions," Wiley,2009.
9. Nick Lecrenski, Karli Watson, "Windows Phone 7 Application Development" version 2011
10. Jermaine G. Anderson "Flash Lite Mobile Development" version 2010.

Marks Distribution for Assessment:

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<tr><td>AAT</td><td colspan="3">10</td></tr>
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i) CIA: 50%

IA Test: 3 IA tests - Each of 30 Marks	Average of 3 tests – 30 M
Assignment	10 Marks
Additional Assessment Tools (AAT) – Quiz, Presentations, Term Paper, Open ended experiments, Mini Projects, Two-minute video on latest topic, Short MOOC courses	10 Marks
Total	**50 M**

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**

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: V

Course Name: Satellite Communication **Course Code: 21ECE1563**

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: Communication concepts, Mathematical Preliminaries

Course Learning Objectives: The students will be able to

1	Understand the basic principle of satellite orbits and trajectories.
2	Study of electronic systems associated with a satellite and the earth station.
3	Understand the various technologies associated with the satellite communication.
4	Focus on a communication satellite and the national satellite system.
5	Study of satellite applications focusing various domains services such as remote sensing, weather forecasting and navigation.

Module-1: Satellite Orbits and Trajectories:	**No. of Hours**	**Blooms Cognitive Levels/CO Mapping**
Definition, Basic Principles, Orbital parameters, Injection velocity and satellite trajectory, Types of Satellite orbits, Orbital perturbations, Satellite stabilization, Orbital effects on satellite's performance, Eclipses, Look angles: Azimuth angle, Elevation angle.	**8**	**Understand CO1**
Module-2: Satellite subsystem and Earth Station:		
Power supply subsystem, Attitude and Orbit control, Tracking, Telemetry and command subsystem, Payload. Types of earth station, Architecture, Design considerations, Testing, Earth station Hardware, Satellite tracking.	**8**	**Apply CO2**
Module-3: Multiple Access Techniques and Satellite Link Design Fundamentals:		
Introduction, FDMA (No derivation), SCPC Systems, MCPC Systems, TDMA, CDMA, SDMA. Transmission Equation, Satellite Link parameters, Propagation considerations.	**8**	**Apply CO3**
Module-4: Communication Satellites:		
Introduction, Related Applications, Frequency Bands, Payloads, Satellite Vs. Terrestrial Networks, Satellite Telephony, Satellite Television, Satellite radio, regional satellite Systems, National Satellite Systems.	**8**	**Understand CO4**
Module-5: Remote Sensing, Weather Forecasting, and Navigation Satellites:		
Classification of remote sensing systems, orbits, Payloads, Types of images: Image Classification, Interpretation, Applications. Fundamentals of Weather Forecasting, Images, Orbits, Payloads, Applications. Development of Satellite Navigation Systems, GPS system, Applications.	**8**	**Understand CO5**

Course Outcomes: After completing the course, the students will be able to	
21ECE1563.1	Describe the satellite orbits and trajectories with the definitions of parameters associated with satellites.
21ECE1563.2	Apply the electronic hardware systems associated with the satellite subsystem and earth station.
21ECE1563.3	Compute the satellite link parameters under various propagation conditions with the illustration of multiple access techniques.
21ECE1563.4	Describe the various applications of satellites with the focus on national satellite system.
21ECE1563.5	Describe the fundamentals and applications of remote sensing, weather forecasting and navigation satellites.
21ECE1563.6	Relate contextual knowledge to assess the solutions for real life applications of communication systems.

Reference Books

1. Anil K. Maini, Varsha Agrawal, Satellite Communications, Wiley India Pvt. Ltd., 2015, ISBN: 978-81-265-2071-8.
2. Dennis Roddy, Satellite Communications, 4th Edition, McGraw- Hill International edition, 2006
3. Timothy Pratt, Charles Bostian, Jeremy Allnutt, Satellite Communications, 2nd Edition, Wiley India Pvt. Ltd , 2017, ISBN: 978-81-265-0833-4

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			
			AAT	10			
			Total – 50 marks				**Total – 50 marks**

i) CIA: 50%

IA Test: 3 IA tests - Each of 30 Marks	Average of 3 tests – 30 M
Assignment	10 Marks
Additional Assessment Tools (AAT) – Quiz, Presentations, Term Paper, Open ended experiments, Mini Projects, Two-minute video on latest topic, Short MOOC courses	10 Marks
Total	**50 M**

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**

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: V

Course Name: Embedded System Design Using Raspberry Pi		**Course Code:21ECE1564**
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: Microprocessor/Microcontroller, Python Basics.

Course Learning Objectives: The students will be able to

1	Understand the basic hardware components and their selection method based on the characteristics and attributes of an embedded system.
2	Gain the knowledge of knowledge of hardware software co-design and firmware approaches.
3	Understand the basics of python programming for Raspberry Pi board.
4	Understand the working principle of Raspberry Pi board and interfacing peripherals.
5	Understand the fundamental aspects of Raspberry Pi interfacing with different cloud services.

Module-1: Embedded System Components	**No. of Hours**	**Blooms Cognitive Levels/CO Mapping**
Introduction, Embedded vs General computing system, Classification of Embedded systems, Major applications and purpose of ES, Elements of an Embedded system (Block diagram and explanation), Differences between RISC and CISC, Harvard and Princeton, Big and Little Endian formats, Memory (ROM and RAM types), Sensors, Actuators, Optocoupler, Communication Interfaces (I2C, SPI, IrDA, Bluetooth, Wi-Fi, Zigbee).	**8**	**Understand CO1**
Module–2: Embedded System Design Concepts		
Characteristics and quality attributes of Embedded Systems, Operational and non-operational quality attributes, Embedded Systems-Application and Domain specific, Hardware Software co-design and Program modeling (excluding UML), Embedded firmware design and development (excluding C language).	**8**	**Apply CO2**
Module–3: Basics of Python Programming		
Python Fundamentals, Variables, Data types, Operators, Flow Control Loop statements and Exception Handling in Python, **Functions:** Creation of functions, passing parameters and return values, **Strings:** String Manipulation, String methods, Lists, Tuples and Dictionary in Python.	**8**	**Apply CO3**
Module–4: Introduction to Raspberry Pi and Interfacing Peripherals		
Introduction to Raspberry Pi architecture, Pin details, technical specifications, Interfacing Raspberry Pi to sensors and output devices: LED, Buzzer, LDR, IR/PIR, DHT11 sensors, Ultrasonic sensors, Interfacing LCD display.	**8**	**Apply CO4**
Module–5: Raspberry Pi Cloud Interface		

Introduction to Thingspeak, Communication using HTTP, Communication using MQTT protocol, Communication using SMTP protocol, Controlling Raspberry Pi peripherals with Flask Programming, Cloud data visualization and analysis.	**8**	**Apply CO5**

Course Outcomes: After completing the course, the students will be able to	
21ECE1564.1	Classify and analyze the different hardware components of Embedded systems.
21ECE1564.2	Develop the hardware software co-design and firmware design approaches.
21ECE1564.3	Apply the fundamentals of python programming for Raspberry Pi board.
21ECE1564.4	Design and Development of Raspberry Pi based Embedded applications.
21ECE1564.5	Development of Raspberry Pi based cloud services.
21ECE1564.6	Apply and analyze the various applications of Embedded systems.

Reference Books

1. Shibu K V, "Introduction to Embedded Systems", Tata McGraw Hill Education, 2rd Edition, 2000.
2. Charles R. Severance, "Python for Everybody: Exploring data using Python 3", Shroff publishers, 2017.
3. Simon Monk, "Raspberry Pi Cookbook", O'Reilly Media, Inc,2014.
4. Volker Ziemann, "A Hands-on course in sensors using Arduino and Raspberry Pi, CRC Press, 2018.
5. Colin Dow, "Internet of Thing: Programming Projects-Build modern IoT solutions with Raspberry Pi3 and Python", Packtpub, 2018.

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			
			AAT	10			
			Total – 50 marks				**Total – 50 marks**

i) CIA: 50%

IA Test: 3 IA tests - Each of 30 Marks	Average of 3 tests – 30 M
Assignment	10 Marks
Additional Assessment Tools (AAT) – Quiz, Presentations, Term Paper, Open ended experiments, Mini Projects, Two-minute video on latest topic, Short MOOC courses	10 Marks
Total	**50 M**

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**

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: Engineering Project Management and Finance		**Course Code: 21ECE161**
L: T: P:	**2 : 0 : 0 : 0**	**CIA Marks: 50**
Credits:	**2**	**SEA Marks: 50**
Hours/Week (Total)	**2 (25)**	**SEA Duration: 03 Hours**
Pre-Requisites:		

Course Learning Objectives: The students will be able to

1	To familiarize the students with basic concepts of project management.
2	To understand risk management and perform technical analysis of market and demand.
3	To evaluate the multiple project with constraints and project financing.
4	To familiarize students with the concept of cost of capital and its relevance.
5	To provide a basic understanding of financial analysis.

Module-1: Project Management	**No. of Hours**	**Blooms Cognitive Levels/CO Mapping**
Structure of projects, phases of project management-planning, scheduling, controlling phase, work breakdown structure, project control charts, network planning, PERT & CPM, Network components & precedence relationships, critical path analysis, probability in PERT analysis, Theory of crashing (Theory Only), Theory of Constraints (Theory only).	**5**	**Apply CO1**
Module-2: Project Risk Management		
Risk Management: Definition, classification of Risk factors, Risk identification process, qualitative and quantitative risk analysis, quantitative risk analysis tools Case study: Challenging Engineering and Technology Projects	**5**	**Analyse CO2**
Module-3: Project financing		
Multiple projects and constraints: Constraints, methods of ranking, mathematical programming approach, linear programming model **Qualitative Analysis:** Qualitative factors in capital budgeting, strategic aspects, strategic planning and financial analysis, informational asymmetry and capital budgeting, and organizational considerations.	**5**	**Analyse CO3**
Module-4: Cost of Capital		
Cost of Capital: Cost of debenture capital; Cost of preferential capital; Cost of term loans; cost of equity capital - Dividend discounting and CAPM	**5**	**Apply CO4**

model; Cost of retained earnings; Determination of Weighted average cost of capital (WACC) and Marginal cost of capital (Problems on WACC)		
Module-5: Financial Analysis		
Financial Analysis: Estimation of cost of project and means of financing, estimates of sales and production, cost of production, working capital requirement and its financing, estimates of working results, breakeven points, projected cash flow statement, projected balance sheet, make or buy decision.	**5**	**Analyse CO5 and CO6**

Course Outcomes: After completing the course, the students will be able to	
21ECE161.1	Apply basic concepts of project management
21ECE161.2	Understand risk management and perform market and demand analysis
21ECE161.3	Understand project financing and evaluate multiple projects with constraints
21ECE161.4	Appreciate different sources of financing and understand the cost of capital
21ECE161.5	Understand the basic concepts of financial analysis
21ECE161.6	Understand and analyze project cash flow

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. Financial Management: Text, Problems and Cases, Khan M. Y.& Jain P. K, TMH, 8/e, 2019.
4. Financial Management, Prasanna Chandra, TMH, 9/e, 2017.
5. Project Management for Business and Technology: Principles and Practice – Nicholas, John M., 2/e, Pearson.
6. Project Management and Control – Narendra Singh, HPH, 2003.
7. Principles of Corporate Finance, Brealey, Myers, Allen & Mohanty, McGraw Hill Education, 11/e, 2014.
8. Cases in Financial Management, I. M. Pandey & Ramesh Bhat, McGraw Hill Education, 3/e, 2015
9. Project Management: The Managerial Process – Gray & Larson, 4/e, TMH, 2011.

Marks Distribution for Assessment:

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i) CIA: 50%

IA Test: 3 IA tests - Each of 30 Marks	Average of 3 tests – 30 M
Assignment	10 Marks
Additional Assessment Tools (AAT) – Quiz, Presentations, Term Paper, Open ended experiments, Mini Projects, Two-minute video on latest topic, Short MOOC courses	10 Marks
Total	**50 M**

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**

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

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

Semester: VI		
Course Name: Microwave and Antennas		**Course Code: 21ECE162**
L: T:P: J	**3:0:2:0**	**CIA Marks:** 50
Credits:	**4**	**SEA Marks:** 50
Hours/week (Total)	**5 (50)**	**SEA Duration:** 03 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 & Sources

	No. of Hrs	**Blooms Cognitive Levels/CO Mapping**
Microwave Waveguides: Introduction, TE, TM waves Rectangular waveguides (qualitative analysis TE, TM modes), group velocity phase velocity, and wave impedance, Microwave cavities, resonant frequency. **Microwave Sources:** Klystron Oscillator, Magnetron, TWT amplifiers.	**10**	Apply CO1

Module–2: S- Parameters & Microwave Passive Devices

S-parameters: Introduction, properties of S matrix **Microwave Passive Devices:** Waveguide Tee's, Directional couplers, circulators, power divider, Faraday Isolator, Phase Shifters (Rotatory type), Attenuators (Rotatory type).	**10**	Apply CO2

Module–3: Antenna Basics & 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).	**10**	Apply CO3

Module–4: Point Sources & Thin linear Antenna

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	**10**	Apply CO4
Module–5: Antenna Types		
Loop Antenna, Horn Antenna, Parabolic Antenna, Helical Antenna, Yagi- Uda Antenna, Log Periodic Antenna, Reflector antenna, Microstrip Patch Antenna.	**10**	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

21ECE162.1	Develop generation and propagation of RF signals using Microwave oscillators through transmission line.
21ECE162.2	Compute the performance parameters and S-Matrix of microwave passive devices by applying the network/field concepts.
21ECE162.3	Determine various antenna parameters for building an RF system
21ECE162.4	Develop expressions for field intensity of a given antenna / an array of antennas. (Point sources, dipole, thin linear antenna)
21ECE162.5	Select suitable antenna configuration according to specific applications.
21ECE162.6	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 & Francis Group, ISBN: 13: 978-1-138-55815-1

Marks Distribution for Assessment:

PCL	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 scaled down to 20 marks			
			Assignment	Average of 2 Assignments – 10M			
			Practical	Weekly Assessment – 10 Marks IA test – 10 Marks			
						Total – 50 Marks	**Total – 50 Marks**

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

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: VLSI Design		**Course Code: 21ECE163**
L: T: P: J	**3:0:2:0**	**CIA Marks: 50**
Credits:	**4**	**SEA Marks: 50**
Hours/Week (Total)	**5 (50)**	**SEA Duration: 03 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	**No. of Hours**	**Blooms Cognitive Levels/CO Mapping**
Brief History, VLSI Design Flow, MOS Transistors – V-I Characteristics, Non-Ideal characteristics, CMOS Logic – Inverter DC Characteristics. Different Logic gates by truth table	**10**	**Understand CO1**
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.	**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	**10**	**Apply CO3**
Module-4: Sequential logic circuits and Semiconductor memories		
Sequential logic circuits – Sequencing methods and timing, Latches and flipflops **Semiconductor Memories** – Memory architecture, SRAM – 6T and 8T and 10T SRAM, DRAM – 1T and 3T	**10**	**Apply CO4**
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	**10**	**Analyse 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
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	
21ECE163.1	Demonstrate understanding of MOS transistor theory, CMOS fabrication flow and technology scaling
21ECE163.2	Design the basic gates using the stick and layout diagrams for physical design and estimate sheet resistance and delays.
21ECE163.3	Analyze logic delay and path delay based on logic effort and path effort.
21ECE163.4	Analyze timing issues with latches and flipflops
21ECE163.5	Analyze timing consideration in Memory elements, Verification methodologies and Testing issues in VLSI Design.
21ECE163.6	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 Integrated Circuits: Analysis and Design** - 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 Theory 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
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<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

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: Java Programming and its Applications		**Course Code: 21ECE164**
L: T: P: J	**0: 0 : 2 : 2**	**CIA Marks: 50**
Credits:	**2**	**SEA Marks: 50**
Hours/Week (Total)	**4 (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 understand life cycle of the applets and its functionality.
5	Using java programming to develop programs for solving real-world problems.

	No. of Hours	**Blooms Cognitive Levels/CO Mapping**
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 ax2+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	**5**	**Apply CO2**

overloading.		
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, Collections		
Exceptions: Definition of Exception, Classification of Exception, Structure of Try & catch block, Error Vs Exception, Throw Keyword, Throws Keyword, Finally Keyword, Custom Exception. Collections: Collections Overview, Iterators, Collection Interfaces: List: ArrayList, Linked List & Vector, Set: Hashset, Linked Hashset, Map: Hashmap, Linked Hashmap, & Hash table. Comparator & Comparable Interface. **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 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	
21ECE164.1	Use Eclipse/NetBeans IDE to design, develop, debug Java Projects
21ECE164.2	Analyze the necessity for Object Oriented Programming paradigm over structured programming and become familiar with the fundamental concepts in OOP.
21ECE164.3	Demonstrate the ability to design and develop java programs, analyze, and interpret object oriented data and document results
21ECE164.4	Apply the concepts of exception/event handling, abstraction to develop robust programs.
21ECE164.5	Develop user friendly applications using GUI concepts
21ECE164.6	Develop a Project using JAVA using the concepts

Reference Books
1. E Balagurusamy, Programming with Java, Graw Hill, 6th Edition, 2019. 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><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="2">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><td rowspan="2"></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>

i) CIA : 50 %

Theory – 2 IA tests- Each of 30 Marks	**30 Marks**
Practical **Weekly Assessment-** Lab Record/Project- 10 Marks **Lab IA Test**-10 Marks	20 Marks
Total	**50 M**

i) SEA : 50 %

Project	**Write up**- 10 Marks **Project Report**- 25 Marks **Presentation & Demonstration**- 50 Marks **Viva-Voce**- 15 Marks	**100 Marks reduced to 50 Marks**
	Total	**50 Marks**

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: Information Theory and Coding		**Course Code: 21ECE1651**
L: T: P: J	**3 : 0 : 0 : 0**	**CIA Marks: 50**
Credits:	**3**	**SEA Marks: 50**
Hours/Week (Total)	**3 hours/week (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/CO Mapping
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**	**Apply 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**	**Apply 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	
21ECE1651.1	Calculate Symbol rate, Self-Information, Entropy and Information Rate as a measure of Information for memory less and dependent sources.
21ECE1651.2	Develop efficient representation of data generated by discrete information source.
21ECE1651.3	Analyze discrete channels using joint, conditional, and mutual entropies of variables in terms of their coupled probabilities.
21ECE1651.4	Develop reliable codes for data on imperfect communication channels.
21ECE1651.5	Apply concept of convolutional codes to carry out encoding and decoding operations.
21ECE1651.6	Relate the basics of Information Theory & coding to find solutions for practical problems in terms of storage and secured communication

Reference 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.

3. ITC and Cryptography, Ranjan Bose, TMH, II Edition, 2007.

4. Principles of digital communication, J. Das, S. K. Mullick, P. K. Chatterjee Wiley Technology & Engineering, 1986.

5. Digital Communications – Fundamentals and Applications, Bernard Sklar, Pearson Education, Second Edition, 2016, ISBN:9780134724058.

6. Information Theory and Coding, Hari Bhat, Ganesh Rao, Cengage, 2017.

7. Error Correction Coding Todd K Moon Wiley Std., Edition, 2006.

Marks Distribution for Assessment:

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

i) CIA: 50%

IA Test: 3 IA tests - Each of 30 Marks	Average of 3 tests – 30 M
Assignment	10 Marks
Additional Assessment Tools (AAT) – Quiz, Presentations, Term Paper, Open ended experiments, Mini Projects, Two-minute video on latest topic, Short MOOC courses	10 Marks
Total	**50 M**

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**

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

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

Semester: VI		
Course Name: Nanoelectronics		**Course Code: 21ECE1652**
L: T: P: J	**3: 0:0:0**	**CIA Marks: 50**
Credits:	**3**	**SEA Marks: 50**
Hours/Week (Total)	**3 (40)**	**SEA Duration: 03 Hours**
Prerequisites:		

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/CO Mapping**
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

21ECE1652.1	Explain the overview and classification of nanostructures.
21ECE1652.2	Explain the top-down and bottom-up fabrication methods and fabrication techniques involved.
21ECE1652.3	Explain Image magnification and microscopic techniques used in characterization.
21ECE1652.4	Explain the Inorganic semiconductor nanostructures with doping and charge effects.
21ECE1652.5	Explain the applications of nano sensors, injection lasers
21ECE1652.6	Analyze the effects of nanotechnology applications

Reference Books

1. Ed Robert Kelsall, Ian Hamley, Mark Geoghegan, "Nanoscale Science and Technology", John Wiley, 2007.
2. Charles P Poole, Jr, Frank J Owens, "Introduction to Nanotechnology", John Wiley, Copyright 2006, Reprint 2011.
3. T Pradeep, "Nano: The Essentials-Understanding Nanoscience and Nanotechnology", TMH.
4. 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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i) CIA: 50%

IA Test: 3 IA tests - Each of 30 Marks	Average of 3 tests – 30 M
Assignment	10 Marks
Additional Assessment Tools (AAT) – Quiz, Presentations, Term Paper, Open ended experiments, Mini Projects, Two-minute video on latest topic, Short MOOC courses	10 Marks
Total	**50 M**

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**

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

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

Semester: VI		
Course Name: Wearable Technology		**Course Code: 21ECE1653**
L: T: P: J	**3 :0 :0 :0**	**CIA Marks: 50**
Credits:	**3**	**SEA Marks: 50**
Hours/Week (Total)	**3 (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	To familiarize the characteristics, working principle and application of special purpose transducers
3	To develop skillset to implement IoT systems for wearable applications.
4	To introduce the concept of the reactive sensors and self-generating sensors and its applications in real life.
5	To 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. Wearing sensors for disease detection: introduction, cardiovascular diseases, neurological diseases, gastrointestinal diseases.	**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 Wearables for Life in Space: Introduction, life aboard the ISS, wearables for life in a protected environment, the extra vehicular activity in the space, life on Moon and Mars	**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: Power and Communication		
Powering and data communication RF energy harvesting fundamentals and practical limitations, impedance mismatch, losses, efficiency, charge pump rectifier topologies.	**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

21ECE1653.1	Identify and understand the need for development of wearable devices and its influence on various sectors.
21ECE1653.2	Understand the working principle of special purpose sensors and the need for developing smart sensors
21ECE1653.3	To identify the real-world problem and give IoT solutions and to analyze and select appropriate protocols, wireless techniques for the problem
21ECE1653.4	Demonstrate the concept of resistive sensors which can be employed for real life applications
21ECE1653.5	Design and develop IoT end points for wearable applications.
21ECE1653.6	Able to design and perform experiments on the sensors and develop the projects based on the customer needs.

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.

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i) CIA: 50%

IA Test: 3 IA tests - Each of 30 Marks	Average of 3 tests – 30 M
Assignment	10 Marks
Additional Assessment Tools (AAT) – Quiz, Presentations, Term Paper, Open ended experiments, Mini Projects, Two-minute video on latest topic, Short MOOC courses	10 Marks
Total	**50 M**

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**

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

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

Semester: VI		
Course Name: Artificial Neural Network		**Course Code: 21ECE1654**
L: T: P: J	**3 : 0 : 0 : 0**	**CIA Marks: 50**
Credits:	**3**	**SEA Marks: 50**
Hours/Week (Total)	**3 (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: Introduction to Neural Networks	**No. of Hours**	**Blooms Cognitive Levels/CO Mapping**
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		
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		
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		
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-Organisation of Feature Maps		
Self-organization Feature Map: Maximal Eigenvector Filtering, Extracting Principal Components, Generalized Learning Laws, Vector	**8**	**Apply CO5**

Quantization, Self-organization Feature Maps, Application of SOM, Growing Neural Gas.		

Course Outcomes: After completing the course, the students will be able to	
21ECE1654.1	Understand artificial neural model and its architectures.
21ECE1654.2	Apply steepest descent, LMS algorithm and Backpropagation algorithm
21ECE1654.3	Apply support vector machines to classify images.
21ECE1654.4	Understand attractor neural networks and its applications.
21ECE1654.5	Apply self-organization feature maps.
21ECE1654.6	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.

Reference Books

1. **Neural Networks A Classroom Approach**– Satish Kumar, McGraw Hill Education (India) Pvt. Ltd, Second Edition.
2. **Introduction to Artificial Neural Systems**-J.M. Zurada, Jaico Publications, 1994.
3. **Artificial Neural Networks**-B. Yegnanarayana, PHI, New Delhi 1998

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i) CIA: 50%

IA Test: 3 IA tests - Each of 30 Marks	Average of 3 tests – 30 M
Assignment	10 Marks
Additional Assessment Tools (AAT) – Quiz, Presentations, Term Paper, Open ended experiments, Mini Projects, Two-minute video on latest topic, Short MOOC courses	10 Marks
Total	**50 M**

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**

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

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

Semester: VI		
Course Name: Computer Architecture and Organization		**Course Code:21ECE1655**
L: T: P: J	**3 : 0 : 0 : 0**	**CIA Marks: 50**
Credits:	**3**	**SEA Marks: 50**
Hours/Week (Total)	**3 (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	

Module1: Introduction	**No. of Hours**	**Blooms Cognitive Levels/CO Mapping**
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		
Addressing Modes, Assembly Language, Basic Input and Output Operations, Stacks and Queues, Subroutines, Additional Instructions.	**8**	**Apply CO2**
Module-3: IO Organisation		
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		
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		
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	
21ECE1655.1	Explain the basic organization of a computer system.
21ECE1655.2	Explain the different addressing modes and assembly language instructions.
21ECE1655.3	Explain different ways of accessing an input / output device including interrupts.
21ECE1655.4	Illustrate the organization of different types of semiconductor and other secondary storage memories.
21ECE1655.5	Illustrate simple processor organization based on hardwired control and micro programmed control.
21ECE1655.6	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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IA Test: 3 IA tests - Each of 30 Marks	Average of 3 tests – 30 M
Assignment	10 Marks
Additional Assessment Tools (AAT) – Quiz, Presentations, Term Paper, Open ended experiments, Mini Projects, Two-minute video on latest topic, Short MOOC courses	10 Marks
Total	**50 M**

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**

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

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

Semester: VI		
Course Name: Strategic Management		**Course Code: 21ECE1656**
L: T: P:	**3 : 0 : 0 : 0**	**CIA Marks: 50**
Credits:	**3**	**SEA Marks: 50**
Hours/Week (Total)	**3 (40)**	**SEA Duration: 03 Hours**
Pre-Requisites:		

Course Learning Objectives: The students will be able to	
1	To provide a framework for students to understand strategic management concepts and conduct external analysis for competitive advantage.
2	To help students develop a thorough understanding of principles and models related to an organization's internal analysis.
3	To help students understand the different strategy options available for organizations in a complex and dynamic environment.
4	To acquaint students with essential factors in strategy implementation.
5	To provide a basic understanding of how to establish and exert strategic control.

Module-1: Introduction to Strategic Management and External Analysis	**No. of Hours**	**Blooms Cognitive Levels/CO Mapping**
Meaning and Characteristics of Strategic Management; The Strategic Management Process. **External Analysis** Strategically Relevant Components of a Company's External Environment – PESTLE analysis, Environment Threat and Opportunity Profile (ETOP); Industry Analysis –Porter's Dominant Economic Features, Porter's Five Forces Model, Entry and Exit Barriers, Strategic Group Mapping; Industry Key Success Factors, Key Performance Indicators and Key Result Areas.	**8**	**Apply CO1**
Module-2: Internal Analysis		
Strategic Vision, Mission, Goals, Long-Term and Short-Term Objectives and their Value to the Strategic Management Process; Organizational Capability Profile –Resource Based View of the firm (RBV) and VRIN; Business Portfolio Analysis – BCG / Growth Share Matrix, GE 9 Cell Model; Balanced Score Card, SWOC Analysis, Value Chain Analysis, Benchmarking.	**8**	**Apply CO2**
Module-3: Strategy Formulation		
Business Strategies: Porter's Generic Strategies – Low Cost, Differentiation, Best Cost, Focused Low Cost and Focused Differentiation **Corporate Strategies:** Growth Strategies – Internal Growth, External Growth (Integration, Diversification, Mergers, Joint Ventures, Strategic Alliances), Product/Market Expansion grid / Ansoff's Matrix; Stability Strategies – No-Change, Profit and Proceed with Caution; Retrenchment	**8**	**Apply CO3**

Strategies – Turnaround, Divestment and Liquation; International Business Level Strategies.		
Module-4: Strategy Implementation		
Facilitators for implementation of strategy: Organisational Structures – matching structure to strategy, McKinsey's 7S, Changing structure and processes (Business Process Reengineering, Six Sigma); Strategic Leadership; Organisational Culture – Learning organisations, MBO, TQM; Barriers to implementation of strategy. Strategy and Innovation: Introduction to Innovation – Process, Product and Platform; Creative Destruction and Disruptive Technologies; Open Innovation and Open Strategy.	**8**	**Apply CO4**
Module-5: Strategic Control		
Focus of Strategic Control, Establishing Strategic Controls (Premise Control, Strategic Surveillance, Special Alert Control, Implementation Control), Exerting Strategic Control (through Competitive Benchmarking, Performance and Formal and Informal Organisations). Blue Ocean Strategy: Difference between blue & red ocean strategies, principles of blue ocean strategy.	**8**	**Understand CO5 and CO6**

Course Outcomes: After completing the course, the students will be able to	
21ECE1656.1	Understand strategic management concepts and how to conduct external analysis for competitive advantage.
21ECE1656.2	Apply selected models of internal analysis to evaluate an organization.
21ECE1656.3	Understand and analyze the different strategy options available for organizations in a complex and dynamic environment.
21ECE1656.4	Appreciate the essential factors in strategy implementation.
21ECE1656.5	Understand how to establish and exert strategic control.
21ECE1656.6	Understand and analyze blue and red ocean strategies crafted and executed by organizations.

Reference Books

1. Arthur A. Thompson Jr., Margaret A. Peteraf, John E. Gamble, A. J. Strickland III, Arun K. Jain, Crafting and Executing Strategy: The Quest for Competitive Advantage – Concepts and Cases, McGraw Hill Education, 19th Edition, 2017.
2. Robert M Grant, Contemporary Strategy Analysis, Wiley, 11th Edition , 2021.
3. Michael A. Hitt, R. Duane Ireland, Robert E. Hoskisson, S. Manikutty, Strategic Management: A South-Asian Perspective, Cengage Learning, 9th Edition, 2016.
4. Stewart Clegg, Chris Carter, Marting Kornberger, Jochen Schweitzer, Strategy: Theory & Practice, Sage Publications, 3rd Edition, 2020.
5. John Parnell, Strategy Management: Theory & Practice, Biztantra, 2004.
6. John A. Pearce, Richard B. Robinson, Strategic Management: Planning for Domestic and Global Competition, McGraw Hill Education, 14th Edition, 2015.

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IA Test: 3 IA tests - Each of 30 Marks	Average of 3 tests – 30 M
Assignment	10 Marks
Additional Assessment Tools (AAT) – Quiz, Presentations, Term Paper, Open ended experiments, Mini Projects, Two-minute video on latest topic, Short MOOC courses	10 Marks
Total	**50 M**

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**

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

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

Semester: VI		
Course Name: Nanotechnology		**Course Code: 21ECE1671**
L: T: P: J	**3:0:0:0**	**CIA Marks: 50**
Credits:	**3**	**SEA Marks: 50**
Hours/Week (Total)	**3 (40)**	**SEA Duration: 03 Hours**
Prerequisites:		

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/CO Mapping**
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	
21ECE1671.1	Identify various nano materials and describe the basic science behind the properties of materials.
21ECE1671.2	Explain the types and methods of nanomaterial synthesis.
21ECE1671.3	Interpret the creation and characterization of nanoscale materials.
21ECE1671.4	Apply principles of nano materials in describing nanostructures.
21ECE1671.5	Comprehend the applications of nanotechnology at the leading edge of scientific research
21ECE1671.6	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.

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i) CIA: 50%

IA Test: 3 IA tests - Each of 30 Marks	Average of 3 tests – 30 M
Assignment	10 Marks
Additional Assessment Tools (AAT) – Quiz, Presentations, Term Paper, Open ended experiments, Mini Projects, Two-minute video on latest topic, Short MOOC courses	10 Marks
Total	**50 M**

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**

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

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

Semester: VI		
Course Name: Wearable Devices		**Course Code: 21ECE1672**
L: T: P: J	**3 :0 :0 :0**	**CIA Marks: 50**
Credits:	**3**	**SEA Marks: 50**
Hours/Week (Total)	**3 (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/CO Mapping**
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	**08**	**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.	**08**	**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	**08**	**Understand 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	**08**	**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	
21ECE1672.1	Identify and understand the need for development of wearable devices and its influence on various sectors.
21ECE1672.2	Gain the basic idea of measurements, characteristics and the errors associated with measurements
21ECE1672.3	Understand the working principle of special purpose sensors and the need for developing smart sensors
21ECE1672.4	Acquaint the usage of wearable devices as assistive devices, diagnostic devices and other modern applications.
21ECE1672.5	Design and develop various wearable devices for detection of biochemical and physiological body signals, environmental monitoring, safety and navigational assistive devices.
21ECE1672.6	Able to design and perform experiments on the sensors and develop the projects based on the customer needs.

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
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4. “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
5. M. Mardonova and Y. Choi, "Review of Wearable Device Technology and Its Applications to the Mining Industry," Energies, vol. 11, p. 547, 2018.
6. 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">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>
</table>

i) CIA: 50%

IA Test: 3 IA tests - Each of 30 Marks	Average of 3 tests – 30 M
Assignment	10 Marks
Additional Assessment Tools (AAT) – Quiz, Presentations, Term Paper, Open ended experiments, Mini Projects, Two-minute video on latest topic, Short MOOC courses	10 Marks
Total	**50 M**

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**

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

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: 21ECE1673**
L: T: P: J	**3 : 0 : 0 : 0**	**CIA Marks: 50**
Credits:	**3**	**SEA Marks: 50**
Hours/Week (Total)	**3 (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, Sensor Selection	**8**	**Understand CO3**
Module-4: Programming of Robots		
Robot Programming using MATLAB: robot programming workflow, Sensing and Perception, Path Planning and Decision, Control, Programming an Arduino Robot in Simulink, Line Follower Application for Arduino Robot	**8**	**Apply CO4**
Module-5: Hardware interfacing of Robots		
Introduction to Arduino Uno, driver circuits, interfaces used in robotic applications, programming the Arduino for robotic applications. Case studies: Design and Implementation of: 1. Human Following Robot Using Arduino and Ultrasonic Sensor 2. Obstacle Avoiding Robot using Arduino, Servo Motors and Ultrasonic Sensor 3. Bluetooth based Smart Phone Controlled Robot Car 4. WiFi Controlled Robot	**8**	**Apply CO5**

Course Outcomes: After completing the course, the students will be able to	
21ECE1673.1	Understand evolution and basics of robotic system.
21ECE1673.2	Understand various actuators used in robotic applications.
21ECE1673.3	Understand the working of various sensors used in robotic applications
21ECE1673.4	Understand the Robot programming and its languages
21ECE1673.5	Interface hardware and software for building robots
21ECE1673.6	Develop robots for societal applications

Reference Books

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

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			
			AAT	10			
			Total – 50 marks				**Total – 50 marks**

i) CIA: 50%

IA Test: 3 IA tests - Each of 30 Marks	Average of 3 tests – 30 M
Assignment	10 Marks
Additional Assessment Tools (AAT) – Quiz, Presentations, Term Paper, Open ended experiments, Mini Projects, Two-minute video on latest topic, Short MOOC courses	10 Marks
Total	**50 M**

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**

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

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

Semester: VI		
Course Name: Automotive Electronics		**Course Code: 21ECE1674**
L: T: P: J	**3 : 0 :0 :0**	**CIA Marks: 50**
Credits:	**3**	**SEA Marks: 50**
Hours/Week (Total)	**3 (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	
21ECE1674.1	Acquire an overview of automotive components, subsystems, and basics of Electronic Engine Control in today's automotive industry
21ECE1674.2	Understand the automotive sensors and actuators for interfacing with microcontrollers / microprocessors during automotive system design.
21ECE1674.3	Understand the fundamentals of digital engine control systems in today's automotive industry.
21ECE1674.4	Understand the networking of various modules in automotive systems, communication protocols and diagnostics of the sub systems.
21ECE1674.5	Understand the importance of automotive diagnostics and get fair idea on future Automotive Electronic Systems
21ECE1674.6	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:

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**

i) CIA: 50%

IA Test: 3 IA tests - Each of 30 Marks	Average of 3 tests – 30 M
Assignment	10 Marks
Additional Assessment Tools (AAT) – Quiz, Presentations, Term Paper, Open ended experiments, Mini Projects, Two-minute video on latest topic, Short MOOC courses	10 Marks
Total	**50 M**

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**

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

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

Semester: VI		
Course Name: Employability skills (Technical) -2		**Course Code: 21ECE168**
L: T: P:	**0 : 0 : 2 : 0**	**CIA Marks: 100**
Credits:	**1**	**SEA Marks: --**
Hours/Week (Total)	**2 (25)**	**SEA Duration: 03 Hours**

Course Learning Objectives: The students will be able to

1	Understand fundamentals of trending technologies currently used in the industry.
2	Understand the importance of professional etiquettes.
3	Participate in group discussions and various modes of interviews.
4	Solve company simulated aptitude and technical question papers related to campus recruitments.

Introductory Courses	**No. of Hours**
Data Science (Data Analytics & Visualization), Cyber Security, Industrial Automation 4.0, & IOT, AWS, & Cloud Computing	**10**
Personality & Grooming Training **Interview Preparation Training**	
Dressing & Group Discussion Etiquettes, Interview Skills, Resume Building(should include introduction to Github, Hackerrank, LeetCode, Codechef), Email & Telephone Etiquettes, Social Media Etiquettes, & LinkedIn Profiling. **<u>Pre-Preparation Formalities</u>** • Training session on Pre-Preparation formalities of Campus Selection should be conducted Job Profiles analysis must be done. • Understanding the salary breakups & other perks, researching about the Company and the work culture through their websites & other digital platforms like Glassdoor & LinkedIn. • Rewriting resumes keeping the job profiles in view. **<u>Group Discussion & Personal Interview</u>** • Pre-Placement Talk, Mock GD & Personal Interview training sessions for each individual student should be conducted by the Industry Experts and they should brief students on the area of improvements, presentation & behavioral skills required during the campus selection process.	**6**
Assessment Tests	

Company Specific Aptitude and Technical Tests	**6**

Course Outcomes: After completing the course, the students will be able to	
21ECE168.1	Analyze the problem and solve it within the allocated time span.
21ECE168.2	Apply the professional etiquettes during the recruitment drives.
21ECE168.3	Implement the techniques and skills during the group discussions and various interview skills.

Assessment process

	Components	Description	Marks
CIA (100)	Continues Evaluation	Students to be evaluated on: 1. Mock G.D. 2. Interview- Offline and Online 3. Resume	50
	Written / Online Test	• **Total Tests: 03** ➢ Assessments with 75 minutes duration & 50 marks each ➢ Average score of 50 Marks from 3 tests will be considered for the final score	50
		Total Marks for the Course	100

BNM Institute of Technology

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

Semester: VII

Course Name: Wireless Communication Technologies
Course Code: 21ECE171

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

Course Learning Objectives: The students will be able to

1	To apply the concepts of Cellular System in capacity expansion techniques.
2	To understand the GSM and TDMA Technology .
3	To apply the concepts of OFDM in LTE.
4	To familiarize the 5G Network architecture and technologies
5	To understand network slicing in 5G and evolution towards 6G.
6	To analyse the ad-hoc networks for real time wireless applications.

Module-1: Evolution and Cellular System Components	**No. of Hours**	**Blooms cognitive Levels**
Different generation of wireless cellular network, 1G, 2G, 2.5G,3G,4G and beyond, Common cellular network components, The Cellular Concept, Cell Fundamentals, Capacity Expansion techniques, Mobility Management	**8**	**Apply CO1**
Module-2: GSM ,TDMA and LTE Technology		
Introduction to GSM and TDMA, GSM Network and System Architecture, GSM Channel Concept, GSM Identities, GSM System Operations, Key enabling technologies and features of LTE, LTE Network architecture	**8**	**Understand CO2**
Module-3: Multicarrier Modulation and LTE standard		
Multicarrier basics, OFDM Basics, OFDM in LTE, Single carrier frequency domain equalization, Overview and channel structure of LTE: Design principles, Network architecture, Radio Interface protocols, Hierarchical channel structure of LTE, Logical channels, Transport channels, Physical Channels, Channel mapping	**8**	**Understand CO3**
Module-4: 5G Overview and Architecture		
5G Overview, Characteristics of 5G, 4G Vs 5G, 5G System Architecture, 5G Deployment architecture, NG core, Network functions in NG core, Communication approach for Core Network Functions, Next Gen Radio Access Networks (NG-RAN), 5G New Radio (5G NR), Technologies accelerating 5G Radio, Small Cells	**8**	**Apply CO4**
Module-5: Network Slicing in 5G and Introduction to 6G		
6Network Slicing in 5G What is network slicing, Requirements for network slicing, Network slicing management, Benefits of network slicing. **Introduction to 6G** Introduction, The societal impact of 6G, Trends and evolution towards 6G, 6G Requirements, The need for a new architecture, Architectural principles.	**8**	**Understand CO5**

Course Outcomes: After completing the course, the students will be able to	
21ECE171.1	Apply the concepts of Cellular System in capacity expansion techniques.
21ECE171.2	Understand the GSM and TDMA Technology .

21ECE171.3	Apply the concepts of OFDM in LTE.
21ECE171.4	Familiarize the 5G Network architecture and technologies.
21ECE171.5	Understand network slicing in 5G and evolution towards 6G.
21ECE171.6	Analyse the ad-hoc networks for real time wireless applications.

Reference Books

1. Introduction to Wireless Telecommunications Systems and Networks, Gary Mullet, First Edition, Cengage Learning India Pvt Ltd., 2013, ISBN -13: 978-8131520123.
2. Introduction to 5G Wireless Networks Saro Velrajan, First edition, 2020, KDP ISBN: 9798643303107
3. "Towards Sustainable and Trustworthy 6g Challenges, Enablers, And Architectural Design", Ömer Bulakçi, Xi Li, Marco Gramaglia, Anastasius Gavras, Mikko Uusitalo, Patrik Rugeland and Mauro Boldi, now Publishers Inc., 2023, ISBN: 978-1-63828-238-9 E-ISBN: 978-1-63828-239-6 DOI: 10.1561/9781638282396
4. Fundamentals of LTE, Arunabha Ghosh, Jan Zhang, Jefferey Andrews, Riaz Mohammed, Prentice Hall, Communications Engg and Emerging Technologies, 2018, ISBN -13: 978-0-13-703311-9
5. Fundamentals of 5G Mobile Networks, Jonathan Rodriguez,Wiley,2015, ISBN:9781118867525
6. Wireless Communications Wireless Communications: Principles and Practice" Theodore Rappaport,2nd Edition, Prentice Hall Communications Engineering and Emerging Technologies Series, 2002, ISBN 0-13-042232-0.

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 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 - Implementation of Wireless protocols using simulation tools.</td></tr>
<tr><td colspan="4">Total – 50 marks</td><td>Total – 50 marks</td></tr>
</table>

BNM Institute of Technology

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

Semester: VII

Course Name: Fiber Optics Communication		**Course Code: 21ECE1721**
L: T: P: J	**3 :0 :0:0**	**CIA Marks:** 50
Credits:	**3**	**SEA Marks:** 50
Hours	**40**	**SEA Duration:** 03 Hours

Pre-Requisites: Concepts of Analog and Digital Communication

Course Learning Objectives: The students will be able to

1	Learn the basic principle of optical fiber communication with different modes of light propagation.
2	Understand the transmission characteristics and losses in optical fiber.
3	Study of optical components and its applications in optical communication networks.
4	Understand the Operational principles of WDM and Optical Components.
5	Understand the working of Optical Amplifiers and Optical Networks

Module-1: Overview of Optical Fiber Communication	**No. of Hours**	**Blooms Cognitive Levels**
Historical development, The general system, Advantages of optical fiber communication, Optical fiber waveguides: Ray theory transmission, Modes in planar guide, Phase and group velocity, cylindrical fiber: Modes, Step index fibers, Graded index fibers, Single mode fibers, Cutoff wavelength, Mode field diameter, effective refractive index. Fiber Materials, Photonic crystal fibers.	**8**	**Apply CO1**
Module-2: Transmission characteristics of optical fiber		
Attenuation, Material absorption losses, Linear scattering losses, Nonlinear scattering losses, Fiber bend loss, Dispersion, Chromatic dispersion, Intermodal dispersion: Multimode step index fiber	**8**	**Understand CO2**
Module-3: Optical sources and Photodetectors		
Light Emitting diodes: LED Structures, Light Source Materials, Quantum Efficiency and LED Power, Modulation. Laser Diodes: Modes and Threshold conditions, Rate equation, External Quantum Efficiency, Resonant frequencies, Laser Diode structures and Radiation Patterns: Single mode lasers, Physical principles of Photodiodes, Photodetector noise, Detector response time.	**8**	**Apply CO3**
Module-4: WDM Concepts and Components		
Overview of WDM: Operational principles of WDM, WDM standards, Mach-Zehnder Interferometer Multiplexers, Isolators and Circulators, Fiber grating filters, Dielectric Thin-Film Filters, Diffraction Gratings, Active Optical Components, Tunable light sources, Fiber splices, fiber connectors and fiber couplers.	**8**	**Understand CO4**
Module-5: Optical Amplifiers and Networks		
Optical Amplifiers and Networks – optical amplifiers, basic applications and types, semiconductor optical amplifiers, EDFA. OPTICAL NETWORKS: Introduction, SONET / SDH, Optical Interfaces, SONET/SDH rings, High – speed light – waveguides.	**8**	**Understand CO5**

Course Outcomes: After completing the course, the students will be able to	
21ECE1721.1	Classification and working of optical fiber with different modes of signal propagation.
21ECE1721.2	Describe the transmission characteristics and losses in optical fiber communication.
21ECE1721.3	Describe the constructional features and the characteristics of optical sources and detectors.
21ECE1721.4	Explain the Operational principles of WDM and Optical Components.
21ECE1721.5	Explain the working of Optical Amplifiers and Optical Networks
21ECE1721.6	Analyze impact of optical fiber communication on human health and society.

Reference Books

1. Gerd Keiser, Optical Fiber Communication, 5th Edition, McGraw Hill Education(India) Private Limited, 2015. ISBN:1-25-900687-5.
2. John M Senior, Optical Fiber Communications, Principles and Practice, 3 d Edition, Pearson Education, 2010, ISBN:978-81-317-3266-3
3. Joseph C Palais, Fiber Optic Communication , Pearson Education, 2005, ISBN:0130085103

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<tr><td>Assignment</td><td colspan="3">Two assignments – Scaled to 10 Marks</td></tr>
<tr><td>AAT</td><td colspan="3">10 Marks - Presentation on topics related to Optical fiber communication.</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

B.E. (Electronics and Communication Engineering)

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

Semester: VII

Course Name: SoC Design		**Course Code: 21ECE1722**
L: T: P: J	**3:0:0:0**	**CIA Marks: 50**
Credits:	**3**	**SEA Marks: 50**
Hours	**40**	**SEA Duration: 03 Hours**

Course Learning Objectives: The students will be able to

1	The objective of this course is to impart a general understanding of the structure, architecture and operation of systems-on-chip.
2	To cover SoC design and modelling techniques with emphasis on architectural exploration, assertion-driven design and the concurrent development of hardware and embedded software used to implement and model inter component communication is SoC.
3	To provide the overall idea how to integrate various building blocks of a system-on-chip, e.g. processor, on-/off-chip memories are interconnected.
4	To apply Implementation methods as well as techniques for low power consumption are addressed.

Module-1: Introduction to System on Chip	**No. of Hours**	**Blooms Cognitive Levels/CO Mapping**
Review of Moore's law and CMOS scaling, benefits of System On Chip integration in terms of cost, power, and performance. Comparison on System on Board, System on Chip, and System-in-Package. Typical goals in SoC design cost reduction, power reduction, design effort reduction, performance maximization. Productivity gap issues and the ways to improve the gap – IP based design and design reuse.	**8**	**Understand CO1**
Module-2: System On Chip Design Process		
System On Chip Design Process: A canonical SoC Design, SoC Design flow, waterfall vs spiral, top-down vs bottom-up, Specification requirement, Types of Specification, System Design Process, System level design issues, Soft IP vs Hard IP, IP verification and Integration, Hardware-Software co design, Design for timing closure, Logic design issues, Verification strategy, On chip buses and interfaces, Low Power, Hardware Accelerators in Soc	**8**	**Apply CO2**
Module-3: Embedded Memories		
Embedded Memories, cache memories, flash memories, embedded DRAM. Topics related to cache memories. Cache coherence. MESI protocol and Directory-based coherence.	**8**	**Apply CO3**
Module-4: Interconnect architectures for SoC		
Interconnect architectures for SoC. Bus architecture and its limitations. Network on Chip (NOC) topologies. Mesh-based NoC. Routing in an NoC. Packet switching and wormhole routing	**8**	**Apply CO4**
Module-5: MPSoCs:		
MPSoCs: What, Why, How MPSoCs, Techniques for designing MPSoCs,Multichip Packages and chipset based design, Performance and flexibility for MPSoCs design Case Study: A Low Power Open Multimedia Application Platform for LTE.	**8**	**Analyse CO5**

Course Outcomes: After completing the course, the students will be able to	
21ECE1722.1	Learn about the blocks in the system on chip design and its performance.
21ECE1722.2	Analyze the design flow and verification of IPs used in system on chip.
21ECE1722.3	Exposure the concepts of different memory and interconnection methods in SoC
21ECE1722.4	Analyze existing Interconnect architectures for SoC and network on chip
21ECE1722.5	Design & develop the algorithms required for the design of IP and SoC and Exposure to the concept of MPSoCs
21ECE1722.6	Understand the complexity of MPSoC design and analyze its usage in real-time applications.

Reference Books

1. SudeepPasricha and NikilDutt, "On-Chip Communication Architectures: System on Chip Interconnect", Morgan Kaufmann Publishers © 2008.
2. Rao R. Tummala, MadhavanSwaminathan, "Introduction to system on package sopMiniaturization of the Entire Syste", McGraw-Hill, 2008.
3. James K. Peckol, "Embedded Systems: A Contemporary Design Tool", Wiley Student Edition.
4. Michael Keating, Pierre Bricaud, "Reuse Methodology Manual for System on Chip designs", Kluwer Academic Publishers, 2nd edition, 2008.

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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: VII

Course Name: Automotive Electronics **Course Code: 21ECE1723**

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

Pre-Requisites: Analog and Digital Circuits, Control Systems, Embedded systems, Transducers.

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 the working principle of sensors and actuators used in the automotive electronics.
3	Study the principles and functionalities of various automotive communication protocols.
4	Explore the future automotive electronic systems.

Module-1: Automotive Fundamentals Overview	**No. of Hours**	**Blooms Cognitive Levels**
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.	**8**	**Understand CO1**
Module-2: Automotive Sensors and Actuators		
Automotive Sensors- Automotive Control System applications of Sensors and Actuators - Variables to be measured, Airflow rate sensor, Strain Gauge MAP sensor, Engine Crankshaft Angular Position Sensor, Magnetic Reluctance Position Sensor, Hall effect Position Sensor, Shielded Field Sensor, Optical Crankshaft Position Sensor, Throttle Angle Sensor (TAS), Engine Coolant Temperature (ECT) Sensor, Exhaust Gas Oxygen (02/EGO) Lambda Sensors, Piezoelectric Knock Sensor. **Automotive Actuators**-Solenoid, Fuel Injector, EGR Actuator, Ignition System.	**8**	**Understand CO2**
Module-3: Digital Engine Control Systems		

Digital Engine control features, Control modes for fuel Control (Seven Modes), EGR Control, Electronic Ignition Control -Closed loop Ignition timing, Spark Advance Correction Scheme, Integrated Engine Control System- Secondary Air Management, Evaporative Emissions Canister Purge, Automatic System Adjustment, System Diagnostics.	**8**	**Understand CO3**
Module-4: 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 and Advanced Automotive Systems		
Automotive Diagnostics-Timing Light, Engine Analyzer, On-board diagnostics, Off-board diagnostics, Expert Systems, Occupant Protection Systems -Accelerometer based Air Bag systems. **Advanced 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	
21ECE1723.1	Acquire an overview of automotive components, subsystems, and basics of Electronic Engine Control in today‘s automotive industry.
21ECE1723.2	Explore the various automotive sensors and actuators used for the development of automotive systems using microcontrollers.
21ECE1723.3	Identify the importance of Control systems in automotive systems.
21ECE1723.4	Understand the networking of various modules in automotive systems, communication protocols and diagnostics of the sub systems.
21ECE1723.5	Highlight the design of the automotive electronic systems and explore the advanced automotive systems.
21ECE1723.6	Apply the fundamentals of electronics in the development of advanced automotive systems.

Reference Books

1. William B. Ribbens, “Understanding Automotive Electronics”, 8th Edition, Newnes, 2017.
2. Ronald K. Jurgen, “Automotive Electronics Handbook”, 2nd Edition, Mcgraw-Hill, 2007.
3. Denton, “Automotive Electrical and Electronic systems”, MA 01803, Elsevier Buttorworth-Heinemann, 2004.
4. Robert Bosch Gmbh (Ed.) Bosch Automotive Electrics and Automotive Electronics Systems and Components, Networking and Hybrid Drive, 5th edition, John Wiley& Sons Inc., 2007.

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

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: VII

Course Name: Natural Language Processing **Course Code: 21ECE1724**

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

Course Learning Objectives: The students will be able to

1	Understand, Natural Language Processing Concepts and their Applications.
2	Analysis of regular expression, parsing.
3	Semantic Analysis of Meaning Representation.
4	Understand and implement N-gram models.
5	Design of information retrieval models.

Module-1: Introduction	**No. of Hours**	**Blooms Cognitive Levels**
Introduction to Natural Language Processing, Stages in Natural Language Processing, Origins and Challenges of NLP Language and Grammar-Processing Indian Languages, Introduction to the corpus, elements in the balanced corpus. Design a Python program to illustrate corpus.	**8**	**Apply CO1**
Module-2: Word level Analysis		
Word level Analysis: Regular Expressions-Finite-State Automata-Morphological Parsing-Spelling Error Detection and correction. Part-of-Speech Tagging- Rule-based tagger, Stochastic tagger. Design python program to perform part-of-speech tagging on the text scraped from a website. Design a python program to group similar words together based on the nature of the word.	**8**	**Apply CO2**
Module-3: N-Grams		
N-Grams: Simple N-grams, Smoothing- Laplace smoothing, Good Turing Discounting, Backoff, Entropy, Morphology: Inflectional morphology, Derivational morphology. Develop a Python program to calculate good Turing frequency.	**8**	**Apply CO3**
Module-4: Lexical Semantics		
Semantic: Meaning Representation, Lexical Semantics, Word Sense Disambiguation –Selectional Restriction-based word sense disambiguation, context-based word sense disambiguation Approaches. Lexical Semantics- Python program to do text classification. Meaning Representation- Python program to represent the meaning of the given text.	**8**	**Apply CO4**
Module-5: Information Retrieval		

Information Retrieval-Design features of information retrieval systems-Indexing, eliminating stop words, Stemming, Classical information retrieval Models-Boolean model, Probabilistic model. Applications: Information extraction, Automatic text summarization, topic modelling, Question –Answer System using Python	**8**	**Apply CO5**

Course Outcomes: After completing the course, the students will be able to	
21ECE1724.1	Apply the fundamental concepts of Natural Language Processing, including its origins, challenges, and applications in processing languages and grammars.
21ECE1724.2	Develop skills to analyze text at the word level using regular expressions, morphological parsing, spelling error detection, and part-of-speech tagging.
21ECE1724.3	Understand and implement N-gram models and various smoothing techniques, including Laplace smoothing and Good Turing Discounting.
21ECE1724.4	Gain expertise in semantic analysis, including meaning representation, lexical semantics, and word sense disambiguation using Selectional restriction-based and context-based approaches.
21ECE1724.5	Design and implement information retrieval systems with features such as indexing, stop word elimination, stemming, and classical models like the Boolean and probabilistic models.
21ECE1724.6	Apply the information retrieval systems to tasks like text summarization, topic modeling, and question-answering systems.

Reference Books

1. Siddiqui T., Tiwary U. S. Natural language processing and Information retrieval, OUP, 2023.
2. James A., Natural language Understanding 2e, Pearson Education, 2019
3. Daniel Jurafsky and James H Martin, “Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics, and 2SpeechRecognition”, 2nd Edition, Prentice Hall, 2013.
4. R. Kibble Introduction to Natural Language Processing CO3354 2013
5. Bharati A., Sangal R., Chaitanya V. Natural language processing: a Paninian perspective, PHI, 2006.

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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: VII

Course Name: Fundamentals of Data Science		**Course Code: 21ECE1725**
L: T: P: J	**3 : 0 : 0 : 0**	**CIA Marks:** 50
Credits:	**3**	**SEA Marks:** 50
Hours	**3**	**SEA Duration:** 03 Hours

Course Learning Objectives: The students will be able to

1	Understand the fundamentals of Data Science
2	Analyze the basic tools of EDA and the data science process
3	Explore the different algorithms used in data science
4	Explore Feature Generation and Feature selection
5	Optimize and solve real life problems with different spam filters

Module-1: Fundamentals	**No. of Hours**	**Blooms Cognitive Levels**
Introduction: What is Data Science? Big Data and Data Science hype – and getting past the hype, Why now? – Datafication, Current landscape of perspectives, A data Science Profile, Skill sets. Statistical Inference, Populations and samples, Big Data, new kinds of data, modelling, statistical modeling probability distributions, fitting a model **Program – 1:** Program to find mean, standard deviation and Baye's Theorem Proof	**8**	**Understand CO1**
Module-2: Exploratory Data Analysis		
Exploratory Data Analysis and the Data Science Process: Basic tools plots, graphs and summary statistics) of EDA, Philosophy of EDA, The Data Science Process, Machine Learning Algorithms. Three Basic Algorithms: Linear Regression, k-Nearest Neighbours (kNN), k-means **Program – 2:** Given a dataset, perform EDA on it using python	**8**	**Apply CO2**
Module-3: Spam Filter		
Spam Filter, Linear Regression and Spam Filter, K-NN and spam Filter, Naïve Bayes Algorithm, Spam Filter using Naïve Bayes **Program-3:** Implementation of Spam filter using kNN algorithm	**8**	**Apply CO3**
Module-4: Feature Engineering		
Feature Generation and Feature Selection (Extracting Meaning from Data): Motivating application: user (customer) retention. Feature Generation (brainstorming, role of domain expertise, and place for imagination), Feature Selection algorithms. Filters; Wrappers; Decision Trees; Random Forests.	**8**	**Apply CO4**

Program-4: Implementation of Feature Extraction using Random Forest.		
Module-5: Recommendation Systems		
Building a User-Facing Data Product, Algorithmic ingredients of a Recommendation Engine, Dimensionality Reduction, Singular Value Decomposition, Principal Component Analysis **Program-5:** Build a recommender system using PCA	**8**	**Apply CO5**

Course Outcomes: After completing the course, the students will be able to	
21ECE1725.1	Explain the fundamentals of data science
21ECE1725.2	Explore Data Analysis and data science process
21ECE1725.3	Understand spam filter implementation using basic Machine Learning algorithms
21ECE1725.4	Understand the working of recommendation systems using ML algorithms
21ECE1725.5	Explain feature selection and extraction algorithms
21ECE1725.6	Conduct independent study and analysis of real-world data science problems

Reference Books

1. Sanjeev J. Wagh, Manisha S. Bhende, Anuradha D. Thakare "Fundamentals of Data Science", CRC Press, 2021
2. B. Uma Maheswari, R. Sujatha, "Introduction to Data Science - Practical Approach with R and Python", Wiley, 2021
3. Cathy O Neil, Rachel Schutt, "Doing Data Science-Straight Talk from the Frontline", Orielly, 2014.
4. Jure Leskovek, Anand Rajaraman, Jeffrey Ullman, "Mining of Massive Data Sets", Cambridge UniversityPress, 2014.

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	Two assignments – Scaled to 10 Marks			
			AAT	10 Marks – Open ended experiments			
			Total – 50 marks				**Total – 50 marks**

Additional Assessment Tools (AAT) –Open ended experiments.

B.N.M. Institute of Technology

An Autonomous Institution under VTU

Semester: B. E		
Course Name : Digital VLSI Testing		**Course Code: 21ECE1732**
L: T:P: J	**3:0:0:0**	**CIA Marks:** 50
Credits:	**3**	**SEA Marks:** 50
Hours:	**40**	**SEA Duration: 0**3 Hours

Pre-Requisites: The Digital Design / Digital Logic course is a pre-requisite for this course.

Course Learning Objectives: The students will be able to

1	Understand Importance, Challenges, Levels of abstraction, Design for Testability
2	Understand the Scan design rules, Scan design flow, Fault Simulation
3	Understand Test Generation, issues in test generation Built-In-Self-Test
4	Understand the Test Compression
5	Understand the Memory Testing, Power and Thermal Aware Test

Module-1: Introduction Digital VLSI Testing		
Introduction: Importance, Challenges, Levels of abstraction, Fault Models, Advanced issues. Design for Testability: Introduction, Testability Analysis, DFT Basics, Scan cell design, Scan Architecture. Scan design rules, Scan design flow. Fault Simulation: Introduction, Simulation models. Logic simulation, Fault simulation	**No. of Hrs** **8**	**Bloom's Cognitive Levels** Understand CO1
Module–2: Test Generation		
Introduction, Exhaustive testing, Boolean difference, Basic ATPG algorithms. ATPG for non-stuck-at faults, other issues in test generation.	**8**	Understand CO2
Module–3: Built-In-Self-Test		
Built-In-Self-Test: Introduction, BIST design rules. Built-In-Self-Test: Test pattern generation, Output response analysis, Logic BIST architectures	**8**	Understand CO3
Module–4: Test Compression		
Introduction, Stimulus compression, Stimulus compression, Response compression	**8**	Understand CO3
Module–5: Memory Testing & Power and Thermal Aware Test		
Introduction, RAM fault models, RAM test generation, Memory BIST Power and Thermal Aware Test: Importance, Power models, Low power ATPG. Power and Thermal Aware Test: Low power BIST, Thermal aware techniques	**8**	Apply CO4

Course Outcomes: After completing the course, the students will be able to	
21ECE1732.1	**Understanding VLSI Testing Fundamentals**: Students will gain a comprehensive understanding of the fundamental concepts of VLSI testing, including the importance of testing, test economics, and the role of testing in the VLSI design flow
21ECE1732.2	**Fault Modeling and Fault Simulation**: Students will learn various fault models (e.g., stuck-at faults, transition faults, bridging faults) and how to perform fault simulation to predict circuit behavior in the presence of faults.
21ECE1732.3	**Design for Testability (DFT)**: Students will understand and apply DFT techniques such as scan design, boundary scan, Built-In Self-Test (BIST), and Logic BIST to enhance the testability of digital circuits.
21ECE1732.4	**Automatic Test Pattern Generation (ATPG)**: Students will acquire knowledge about ATPG algorithms and tools, learning how to generate test patterns that can effectively detect faults in VLSI circuits.
21ECE1732.5	**Test Compression Techniques**: Students will explore methods for reducing the volume of test data through test compression techniques, enabling efficient testing of large-scale VLSI circuits.
21ECE1732.6	**Testing of Memory and Mixed-Signal Circuits**: Students will learn specific testing strategies for memory circuits (e.g., SRAM, DRAM) and mixed-signal circuits, including analog and RF components. Students will gain hands-on experience using industry-standard EDA tools for VLSI testing, such as tools for ATPG, fault simulation, and DFT implementation.

Reference Books
1. "Digital Systems Testing and Testable Design" by Miron Abramovici, Melvin A. Breuer, and Arthur D. Friedman
2. "Essentials of Electronic Testing for Digital, Memory, and Mixed-Signal VLSI Circuits" by Michael L. Bushnell and Vishwani D. Agrawal
3. "VLSI Test Principles and Architectures: Design for Testability" by Laung-Terng Wang, Cheng-Wen Wu, and Xiaoqing Wen
4. "Introduction to VLSI Testing" by Robert J. Feugate and Steven M. McCoy

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B.N.M. Institute of Technology

An Autonomous Institution under VTU

Semester: B. E		
Course Name : Deep Learning for Computer Vision Course		**Code: 21ECE1734**
L: T:P: J	**3:0:0:0**	**CIAMarks:** 50
Credits:	**3**	**SEAMarks:** 50
Hours	**40**	**SEA Duration: 0**3 Hours

Pre-Requisites: Knowledge of basics in probability, linear algebra and calculus and basics of machine learning

Course Learning Objectives: The students will be able to

1	Understand traditional computer vision topics involving Visual Features and Representations.
2	Understand building blocks of deep learning for computer vision where they study convolutions neural networks, various architectures and models.
3	Understand applications and use cases and tasks in which CNNs are used like for recognition, verification, retrieval, detection, segmentation
4	Understand computer vision for video, action recognition, activity recognitions,
5	Understand deep generative models such as GANS and variational auto encoders, Deep Generative Models: Diffusion Models, Vision-Language Models and Recent Developments.

Module-1: Introduction and Overview, Visual Features and Representations

	No. of Hrs	**Bloom's Cognitive Levels**
Image Formation ,Image Representation, Linear Filtering, Correlation, Convolution, Edge Detection From Edges to Blobs and Corners Scale Space, Image Pyramids and Filter Banks SIFT and Variants	**8**	Understand CO1

Module–2: Deep Learning Basics, Convolutional Neural Networks for Image Classification

Neural Networks: A Review , Feedforward Neural Networks and Backpropagation, Gradient Descent and Variants, Regularization in Neural Networks, Improving Training of Neural Networks Convolutional Neural Networks: An Introduction Backpropagation in CNN's ,CNN Architecture for Image Classification	**8**	Understand CO2

Module–3: Beyond Basic CNNs: Architectures, Fine tuning and Visualization, CNNs for Object Detection and Segmentation, Recurrent Neural Networks and their use in Vision

Evolution of CNN Architectures: VGG, Inception, ResNets, ResNet Variants, MobileNet, EfficientNet, Finetuning CNNs, Visualizing CNNs. CNNs for Object Detection: Two-stage Models,Single-stage Models, CNNs for Segmentation Recurrent Neural Networks: Introduction ,Backpropagation in RNNs, LSTMs and GRUs	**8**	Understand CO3

Module–4: Attention Models and Transformers, Vision Transformers and Applications

Attention in Vision Models: An Introduction ,Soft and Hard Attention: Image Captioning. Self-Attention and Transformers, From Transformers to Vision		Apply CO4

Transformers, Transformers for Detection, Transformers for Segmentation		
Module–5: Deep Generative Models: GANs and VAEs, Deep Generative Models: Diffusion Models, Vision-Language Models and Recent Developments		
Deep Generative Models: An Introduction ,Generative Adversarial Networks, GAN Hacks and Improvements, Variational Autoencoders and Disentanglement Introduction to Diffusion Models: DDPMs, Classifier and Classifier-Free Diffusion Guidance,Text-conditioned Diffusion Models, Under the Hood: Sampling, Prediction Space, Noise Schedules, Architectures Self-Supervised Learning: SimCLR, Contrastive Learning, Vision-Language Models	**8**	Apply CO5

Course Outcomes: After completing the course, the students will be able to	
21ECE1734.1	Understand traditional computer vision topics involving Visual Features and Representations.
21ECE1734.2	Understand building blocks of deep learning for computer vision where they study convolutions neural networks, various architectures and models.
21ECE1734.3	Understand applications and use cases and tasks in which CNNs are used like for recognition, verification, retrieval, detection, segmentation
21ECE1734.4	Understand computer vision for video, action recognition, activity recognitions,
21ECE1734.5	Understand deep generative models such as GANS and variational auto encoders, Deep Generative Models: Diffusion Models, Vision-Language Models and Recent Developments.
21ECE1734.6	Identify and apply algorithms to solve real world problems

Reference Books

1. Deep Learning, Ian Goodfellow, Yoshua Bengio, Aaron Courville, 2016
2. Neural Networks and Deep Learning, Michael Nielsen, 2016
3. Learning Deep Architectures for AI, Yoshua Bengio, 2009
4. Computer Vision: Algorithms and Applications, Richard Szeliski, 2010
5. Computer Vision: Models, Learning, and Inference, Simon Prince, 2012
6. Computer Vision: A Modern Approach, David Forsyth, Jean Ponce, 2002

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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: VII

Course Name: Introduction to Industry 4.0 and Industrial Internet of Things

Course Code: 21ECE1735

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

Pre-Requisites: Knowledge on IOT

Course Learning Objectives: The students will be able to

1	Understand What is Industry 4.0? and its associated technologies
2	Understand the role of IOT in industries
3	Understand layers of Industrial IOT
4	Understand role of networking and security in Industrial IOT
5	Work on real time case studies based on the application of Industrial IOT

Module-1: Introduction to Industry 4.0	**No. of Hrs**	**Bloom's Cognitive Levels**
Introduction: Sensing & actuation, Communication-Part I, Part II, Networking-Part I, Part II **Industry 4.0:** Globalization and Emerging Issues, The Fourth Revolution, LEAN Production Systems, Smart and Connected Business Perspective, Smart Factories, Cyber Physical Systems and Next Generation Sensors, Collaborative Platform and Product Lifecycle Management, Augmented Reality and Virtual Reality, Artificial Intelligence, Big Data and Advanced Analysis, Cybersecurity in Industry 4.0	**8**	Understand CO1
Module–2: Introduction to Industrial IOT		
Basics of Industrial IoT: Industrial Processes-Part I, Part II, Industrial Sensing & Actuation, Industrial Internet Systems. **Industrial IoT Introduction:** Business Model and Reference Architecture: IIoT-Business Models-Part I, Part II, IIoT Reference Architecture-Part I, Part II.	**8**	Understand CO2
Module–3: Industrial IOT – Layers		
Industrial IoT- Layers: IIoT Sensing-Part I, Part II, IIoT Processing-Part I, Part II, IIoT Communication-Part I. IIoT Communication-Part II, Part III, IIoT Networking-Part I, Part II, Part III.	**8**	Understand CO3
Module 4: Industrial IOT Analytics – Networking and Security		
Big Data Analytics and Software Defined Networks: IIoT Analytics - Introduction, Machine Learning and Data Science - Part I, Part II, R and Julia Programming, Data Management with Hadoop, SDN in IIoT-Part I, Part II, Data Center Networks, Industrial IoT: Security and Fog Computing: Cloud Computing in IIoT-Part I, Part II. **Security and Fog Computing** - Fog Computing in IIoT, Security in IIoT-Part I, Part II, Industrial IoT- Application Domains: Factories and Assembly Line, Food Industry.	**8**	Understand CO3

Module–5: Application domains of Industrial IOT		
Application Domains: Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security (Including AR and VR safety applications), Facility Management, Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries, Real case studies	**8**	Apply CO5

Course Outcomes: After completing the course, the students will be able to	
21ECE1735.1	Understand What is Industry 4.0? and its associated technologies
21ECE1735.2	Understand the role of IOT in industries
21ECE1735.3	Understand layers of Industrial IOT
21ECE1735.4	Understand role of networking and security in Industrial IOT
21ECE1735.5	Work on real time case studies based on the application of Industrial IOT

Reference Books

1. S. Misra, A. Mukherjee, and A. Roy, 2020. Introduction to IoT. Cambridge University Press.
2. S. Misra, C. Roy, and A. Mukherjee, 2020. Introduction to Industrial Internet of Things and Industry 4.0. CRC Press

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<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>
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BNM Institute of Technology

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

Semester: VII

RESEARCH METHODOLOGY AND IPR

Course Code: 21ECE174	**L:T:P:J: 2:0:0:0**	**CIE Marks :** 50
Credits:	**2**	**SEE Marks:** 50
Hours:	**25**	**SEE Duration: 03** Hours

Pre-Requisites: Use of internet and online database, clarity on research question/problem and basic of statistics

Course Learning Objectives: The students will be able to

1	To give an overview of the research methodology and explain the technique of defining a research problem
2	To explain the functions of literature review, carry out literature search and develop conceptual frameworks
3	To explain various experimental designs in research and data handling like data sampling and data collection methods
4	To interpret the research findings and prepare a research report
5	To build awareness on the various forms of IPR and to build the perspectives on the concepts and to develop the linkages in technology innovation and IPR.

Module-1: Introduction to Research Methodology

	No. of Hrs	Blooms cognitive Levels
Research Methodology: Introduction, Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Importance of Knowing How Research is Done, Research Process, Criteria of Good Research **Defining the Research Problem**: Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, An Illustration Problems Encountered by Researchers in India.	**05**	**Understand CO1**

Module–2: Literature Review

	No. of Hrs	Blooms cognitive Levels
Reviewing the literature: Place of the literature review in research, Bringing clarity and focus to your research problem, Improving research methodology, Broadening knowledge base in research area, enabling contextual findings, How to review the literature, searching the existing literature, reviewing the selected literature, developing a theoretical framework, Developing a conceptual framework, writing about the literature reviewed. **Research Design**: Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs, Important Experimental Designs. Use of Endnote or mendeley	**05**	**Apply CO2**

Module–3: Data Sampling and Testing of Hypothesis		
Design of Sampling: Introduction, Sample Design, Sampling and Non- sampling Errors, Types of Sampling Designs. **Data Collection**: Qualitative and Quantitative Data, Experimental and Surveys, Collection of Primary Data, Collection of Secondary Data, Selection of Appropriate Method for Data Collection. **Testing of Hypotheses**: Hypothesis, Basic Concepts concerning Testing of Hypotheses, Procedure for Hypothesis Testing, P-Value approach, Limitations of the Tests of Hypothesis. Case Study Method, ANOVA test using excel or similar tools.	**No. of Hrs** **05**	**Blooms cognitive Levels** **Apply CO3**
Module–4: Interpretation and Report Writing		
Interpretation: Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation. **Report Writing**: Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports. Introduction to Latex and various templates for report and paper writing.	**No. of Hrs** **05**	**Blooms cognitive Levels** **Analyze CO4**
Module–5: Intellectual Property Rights		
Intellectual Property: The Concept, Intellectual Property System in India, Development of TRIPS Complied, Regime in India, Patents Act, 1970, Trade Mark Act, 1999, The Designs Act, 2000, The Geographical Indications of Goods (Registration and Protection) Act1999, Copyright Act,1957, The Protection of Plant Varieties and Farmers' Rights Act, 2001, The Semi-Conductor Integrated Circuits Layout Design Act, 2000, Trade Secrets, Utility Models, IPR and Biodiversity, The Convention on Biological Diversity (CBD) 1992, Competing Rationales for Protection of IPRs, Leading International Instruments Concerning IPR, World Intellectual Property, Organisation (WIPO), WIPO and WTO, Paris Convention for the Protection of Industrial Property, National Treatment, Right of Priority, Common Rules, Patents, Marks, Industrial Designs, Trade Names, Indications of Source, Unfair Competition, Introduction to Patents and Copyrights. Case study on company IPR	**No. of Hrs** **05**	**Blooms cognitive Levels** **Understand CO5**

Course Outcomes: After completing the course, the students will be able to	
21ECE174.1	Understand and define research problem
21ECE174.2	Explain and carry out literature review based on the research problem
21ECE174.3	Apply sampling and data collection techniques and carry out parametric testsof Hypothesis for the research problem
21ECE174.4	Interpret the research findings and create a report
21ECE174.5	Explain various forms of IPR and develop the linkages in technology innovation and IPR
21ECE174.6	Understand and define research problem

Reference Books

1. C.R. Kothari, Gaurav Garg, "Research Methodology: Methods and Techniques", New Age International 4 th Edition, 2018.
2. Ranjit Kumar, "Research Methodology a step-by-step guide for beginners" (For the topic Reviewing the literature under module 2), SAGE Publications 3 rd Edition, 2011.
3. Firuza Karmali (Aibara), " A Short Introduction to LaTeX: A Book for Beginners", Create space Independent Publishing Platform, 2019.
4. Trochim, "Research Methods: the concise knowledge base", Atomic Dog Publishing 2005.
5. Fink A, "Conducting Research Literature Reviews: From the Internet to Paper", Sage Publications 2009.

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	Review Paper Writing	10
	AAT	Hypothesis testing using Anova	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 must 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