IV SEMESTER

Semester: IV		
Probability Theory, Complex variables and Optimization		
Course Code:	MVJ21MA41D	CIE Marks: 50
Credits:	L: T:P:S: 2:2:0:0	SEE Marks: 50
Hours:	20L+20T	SEE Duration: 3 Hrs.
Course Learning Objectives: The students will be able to		
1	Apply discrete and continuous probability distributions in analyzing the probability models arising in engineering field.	
2	Learn the mathematical formulation of linear programming problem	
3	Learn the mathematical formulation of transportation problem.	
4	Understand the concepts of Complex variables and transformation for solving Engineering Problems.	
5	Learn the solutions of partial differential equations numerically	

UNIT-I	
Probability Theory: Random variables (discrete and continuous), probability density function, cumulative density function. **Probability Distributions:** Binomial distribution, Poisson distribution. Normal distribution, Exponential distribution. Joint probability distributions. **Self-study:** Discrete and continuous probability problems **Applications:** Discrete and continuous probability distributions help in analysing the probability models arising in engineering field. **Video Link** : 1. http://nptel.ac.in/courses.php?disciplineID=111	8 Hrs
UNIT-II	
Optimization: Linear Programming, mathematical formulation of linear programming problem (LPP), Types of solutions, Graphical Method, simplex method, big-M method, Dual – simplex method. **Self-study:** Two phase simplex method **Applications:** Applications of transportation Problems **Video Link** : 1. http://nptel.ac.in/courses.php?disciplineID=111	8 Hrs
UNIT-III	
The transportation problem: Initial Basic Feasible Solution (IBFS) by Least Cost Method, North West Corner Rule method, Vogel's Approximation Method, MODI method (Optimal Solution), Salesman problem, Assignment problem. **Self-Study Topic** : Matrix Minima Method	8 Hrs

Video Link : 1. http://nptel.ac.in/courses.php?disciplineID=111	
UNIT-IV	
Complex Variables: Functions of complex variables, Analytic function, Cauchy-Riemann equations in Cartesian and polar coordinates, Construction of analytic function (Using Milne-Thomson method) Consequences of Cauchy-Riemann equations, Properties of analytic functions. Application to flow problems- complex potential, velocity potential, equipotential lines, stream functions, stream lines. **Self-study:** Unique Expression Method **Applications:** Application to flow problems **Video Link** : 1. http://nptel.ac.in/courses.php?disciplineID=111	**8 Hrs**
UNIT-V	
Numerical solutions of PDE – Classification of second order equations, finite difference approximation to derivatives, solution of heat equations, solution of wave equations and solution of Laplace equation. **Self-study:** Crank Nicolson method – problems. **Applications:** To solve boundary value problems **Video Link** : 1. http://nptel.ac.in/courses.php?disciplineID=111	**8 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Apply discrete and continuous probability distributions in analysing the probability models arising in engineering field.
CO2	Learn the mathematical formulation of linear programming problem
CO3	Solve the applications of transport problems
CO4	Use the concepts of analytic function and complex potentials to solve the problems arising in electromagnetic field theory
CO5	Learn the numerical solutions of partial differential equations

Reference Books	
1.	B.S. Grewal, "Higher Engineering Mathematics" Khanna Publishers, 44th Edition, 2013.
2.	Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley-India publishers, 10thedition, 2014.
3.	Prof G.B.Gururajachar "Engineering Mathematics-III , Academic Excellent series Publications, 2016-17

4.	Bali N. P. & Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, 8th Edition

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of three quizzes are conducted along with tests. Test portion is evaluated for 50 marks and quiz is evaluated for 10 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three (conduct additional quizzes and take best three). The three tests are conducted for 50 marks each and the average of all the tests are calculated for 50. The marks for the assignments are 20 (2 assignments for 10 marks each). The marks obtained in test, quiz and assignment are added to get marks out of 100 and report CIE for 50 marks.

Semester End Examination (SEE):

Total marks: 50+50=100

SEE for 50 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the entire syllabus. Part – B Students have to answer five questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have a maximum of three sub divisions. Each unit will have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	0	3	0	0	0	0	0	0	1	1
CO2	3	3	0	3	0	0	0	0	0	0	1	0
CO3	3	2	0	2	0	0	0	0	0	0	0	0
CO4	3	3	0	3	0	0	0	0	0	0	0	1
CO5	3	3	0	3	0	0	0	0	0	0	1	0

Semester: IV		
Basic Signal Processing (Theory)		
Course Code:	MVJ21EC42	CIE Marks: 50
Credits:	L:T:P: 3:0:0	SEE Marks: 50
Hours:	40L	SEE Duration: 3 Hrs.
Course Learning Objectives: The students will be able to		
1	Analyse the mathematical description of continuous and discrete time signals and systems.	
2	Analyse the signals in time domain using convolution sum and Integral.	
3	Determine the response of the LTI system to any input signal.	
4	Analyse Linear Time Invariant (LTI) systems in time and transform domains	
5	Apply the knowledge of frequency-domain representation and analysis concepts using Fourier analysis tools and Z-transform.	

UNIT I	
Prerequisites: Probability **Random Variables:** Random Variables, Several Random Variables, Statistical Averages (Mean, Moment, Central Moment, Mean Square Value, Characteristic Function, Joint Moments). **Random Processes:** Random Processes, Stationary, Mean, Correlation, Covariance functions, Autocorrelation and its properties, Cross correlation and its properties, Ergodicity, Power Spectral Density and its properties. **Laboratory Sessions/ Experimental learning:** To find the basis and properties of statistical averages and correlation. **Applications** : **Video link / Additional online information :** 1. https://nptel.ac.in/courses/108/104/108104100/ https://www.youtube.com/watch?v=ZK3O402wf1c&list=PL49CF3715CB9EF31D&index=1	8Hrs.
UNIT 2	
Introduction and Classification of signals: Definition of signal and systems with examples, Elementary signals/Functions: Exponential, sinusoidal, step, impulse and ramp functions Basic Operations on signals: Amplitude scaling, addition, multiplication, time	8Hrs.

scaling, time shift and time reversal. Expression of triangular, rectangular and other waveforms in terms of elementary signals System Classification and properties: Linear-nonlinear, Time variant -invariant, causal-noncausal, static-dynamic, stable-unstable, invertible. **Laboratory Sessions/ Experimental learning:** To define eigen values and eigen vectors using MATLAB **Applications:** Communication systems,car stereo systems **Video link / Additional online information :** 1. https://nptel.ac.in/courses/117105134/ http://www.digimat.in/nptel/courses/video/108108109/L63.html	
UNIT 3	
Time domain representation of LTI System: Impulse response, convolution sum. Computation of convolution sum using graphical method for unit step and unit step, unit step and exponential, exponential and exponential, unit step and rectangular, and rectangular and rectangular. LTI system Properties in terms of impulse response: System interconnection, Memory less, Causal, Stable, Invertible and Deconvolution and step response **Laboratory Sessions/ Experimental learning:** 1. Exploring concepts with MATLAB- Generation of both continuous time and discrete time signals of various kinds. a) Plot $y(x) = x^2\cos(x)$, $g(x) = x\cos(x)$, $f(x) = 2^x\sin(x)$, $0 \leq x \leq 2\pi$ in the same figure. **Applications**: Signal Processing, Control Theory, Communications Systems, Image and Video Processing, Biomedical Engineering (ECG, MRI), Oil extraction (Seismology), Music Industry (Audio) and Power Quality Analysis. **Video link / Additional online information :** 1. https://nptel.ac.in/courses/111106046/ https://nptel.ac.in/courses/111106111/	**8Hrs.**
UNIT 4	
Fourier Representation of aperiodic Signals: Introduction to Fourier Transform & DTFT, Definition and basic problems. Properties of Fourier Transform: Linearity, Time shift,	**8Hrs.**

Frequency shift, scaling, Differentiation and Integration, Convolution and Modulation, Parseval's theorem and problems on properties of Fourier Transform. **Laboratory Sessions/ Experimental learning:** 1. To analyze the spectrum of the signal with Fourier transform using MATLAB. **Applications:** Image analysis, image filtering, image reconstruction and image compression. **Video link / Additional online information:** https://nptel.ac.in/courses/117104074	
UNIT 5	
Prerequisites: Basics of Z-transform concepts The Z-Transforms: Z transform, properties of the region of convergence, properties of the Z-transform, Inverse Z-transform by partial fraction, Causality and stability, Transform analysis of LTI systems. **Laboratory Sessions/ Experimental learning:** 1. To compute Z-transform of finite duration sequence using MATLAB. a) Compute the z-transform of the sequence fx(n)-[-3,5,6,7,8], $-2 \leq n \leq 2$. b) Compute the z-transform of the discrete-time signal $x(n)= n^2 u(n)$. c) Compute the convolution between the signals $X_1(z)=$ z/z-0.9 and $X_2(z)=$z /z+6 **Applications**: To analysis of digital filters, Used to simulate the continuous systems, Analyse the linear discrete system, Used to finding frequency response, Analysis of discrete signal, Helps in system design and analysis and also checks the systems stability, For automatic controls in telecommunication. **Video link / Additional online information:** https://nptel.ac.in/courses/108104100/	**8Hrs.**

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the basics of Linear Algebra.
CO2	Develop input output relationship for linear time invariant system and understand the convolution operator for continuous and discrete time system.
CO3	Analyse the properties of discrete time signals & systems.

CO4	Determine the spectral characteristics of continuous and discrete time signal using Fourier transform.
CO5	Compute Z-transforms, inverse Z- transforms and transfer functions of complex LTI systems

Reference Books:	
1.	Simon Haykins and Barry Van Veen,"Signals and Systems", 2nd Edition, 2008, Wiley India. ISBN 9971-51-239-4.
2.	Ganesh Rao and SatishTunga, "Signals and Systems", Pearson/Sanguine, Edition,2017.
3	Gilbert Strang, "Linear Algebra and its Applications", Cengage Learning, 4th Edit 2006, ISBN 97809802327
4.	Alan V Oppenheim, Alan S, Willsky and A Hamid Nawab,"Signals and Systems" Pearson Education Asia / PHI, 2nd edition, 1997. Indian Reprint 2002.

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of three quizzes are conducted along with tests. Test portion is evaluated for 50 marks and quiz is evaluated for 10 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three (conduct additional quizzes and take best three). The three tests are conducted for 50 marks each and the average of all the tests are calculated for 50. The marks for the assignments are 20 (2 assignments for 10 marks each). The marks obtained in test, quiz and assignment are added to get marks out of 100 and report CIE for 50 marks.

Semester End Examination (SEE):

Total marks: 50+50=100

SEE for 50 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the entire syllabus. Part – B Students have to answer five questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have a maximum of three sub divisions. Each unit will have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	-	-	-	-	-	1	1
CO2	3	3	2	3	3	-	-	-	-	-	3	2
CO3	3	3	2	3	3	-	-	-	-	-	3	1
CO4	3	3	2	2	3	-	-	-	-	-	3	1
CO5	3	2	2	3	2	-	-	-	-	-	3	2

High-3, Medium-2, Low-1

Semester: IV		
CONTROL SYSTEM (Theory)		
Course Code:	MVJ21EC43	CIE Marks: 50
Credits:	L:T:P: 3:0:0	SEE Marks: 50
Hours:	40L	SEE Duration: 3 Hrs.
Course Learning Objectives: The students will be able to		
1	Formulate the mathematical modelling of systems and understand the concepts of transfer function	
2	Obtain transfer function using block diagram reduction and signal flow graph techniques.	
3	Analyse the response of first and second order systems using standard test signals and analyse steady state error.	
4	Analyse stability of systems using RH criteria, Root Locus, Nyquist, Bode plot and polar plot.	
5	Obtain state variable model for electrical systems.	

UNIT 1	
Introduction to Control Systems : open loop and closed loop systems, Types of feedback, Differential equation of Physical Systems – Mechanical Systems, Electrical Systems, Analogous Systems. **Block diagrams and signal flow graphs:** Transfer functions, Block diagram algebra and Signal Flow graphs. **Laboratory Sessions/ Experimental learning:** 1. Determine and plot poles and zeros from the transfer function using MATLAB. **Applications:** Electric Hand Drier, Automatic Washing Machine, DC motor,Automatic Electric Iron, Voltage Stabilizer **Video link / Additional online information :** 1. https://youtu.be/R0E3uKSKdME 2. https://youtu.be/zXMklO-jxIo 3. https://youtu.be/tDXgiStzbcY	**8Hrs.**
UNIT 2	

Time Response of feedback control systems: Standard test signals, Unit step response of First and Second order Systems. Time response specifications, Time response specifications of second order systems for underdamped system, steady state errors and error constants. **Introduction to Controllers:** P, PI, PD and PID Controllers. **Laboratory Sessions/ Experimental learning:** 1. Obtain step and impulse response of a unity feedback first order system for a given forward path transfer function using MATLAB. 2. Obtain step and impulse response of a unity feedback second order system for a given forward path transfer function using MATLAB. **Applications:** Industrial Control systems **Video link / Additional online information :** 1. https://youtu.be/ziu1OTwUrbw 2. https://youtu.be/YuZ3iwA-47I	**8Hrs.**
UNIT 3	
Stability analysis using RH Criteria and root locus: Concepts of stability, Necessary conditions for stability, Routh Hurwitz stability criterion, Relative stability analysis, Introduction to Root-Locus Techniques, the root locus concepts, Construction of root loci. **Laboratory Sessions/ Experimental learning:** 1. Obtain Root Locus Plot of the system for a given forward path transfer function using MATLAB. **Applications:** Used to determine the dynamic response of a s system **Video link / Additional online information:** 1. https://youtu.be/cez4InLZ7Pw 2. https://youtu.be/sUDoTw_LIbk 3. https://youtu.be/Irxppc_LCUk	**8Hrs.**
UNIT 4	
Stability analysis using Nyquist criteria and Bode plots: Polar plot, Nyquist Stability criterion, Nyquist plots, Bode plots, Gain and phase margin.	**8Hrs.**

Laboratory Sessions/ Experimental learning: 1. Obtain Bode Plot of the system for a given forward path transfer function using MATLAB. 2. Obtain Nyquist Plot of the system for a given forward path transfer function using MATLAB. **Applications:** To determine a stability of a system **Video link / Additional online information:** 1. https://youtu.be/QzTCRk4nkDg 2. https://youtu.be/Wi6xt7IyjA0	
UNIT 5	
Introduction to State variable analysis: Concepts of state, state variable and state models for electrical systems, Solution of state equations, State transition matrix and its properties. **Laboratory Sessions/ Experimental learning:** 1. Determining the solution of state equations using MATLAB. **Applications:** State variables are used to describe the future response of a dynamic response **Video link / Additional online information:** https://youtu.be/xajgSUci9zs	**8Hrs.**

Course outcomes:	
CO1	Write the mathematical model for electrical systems and find the transfer function using block diagram reduction technique and signal flow graph.
CO2	Analyze transient and steady state response of second order systems using standard test signals and analyze steady state error.
CO3	Analyze the stability of the systems by applying RH criteria and root locus techniques.
CO4	Analyze the stability of the system using frequency domain techniques such as Nyquist and Bode plots.
CO5	Write state space equations and solutions of a given electrical system.

Reference Books:	
1.	Modern Control Engineering, K.Ogata, Pearson Education Asia/PHI, 4th Edition, 2002. ISBN 978-81-203-4010-7.
2.	Nagarath and M.Gopal, – Control Systems Engineering‖, New Age International (P) Limited, Publishers, Fifth edition-2005, ISBN: 81-224-2008-
3.	Automatic Control Systems‖, Benjamin C. Kuo, John Wiley India Pvt. Ltd., 8th Edition, 2008.

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of three quizzes are conducted along with tests. Test portion is evaluated for 50 marks and quiz is evaluated for 10 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three (conduct additional quizzes and take best three). The three tests are conducted for 50 marks each and the average of all the tests are calculated for 50. The marks for the assignments are 20 (2 assignments for 10 marks each). The marks obtained in test, quiz and assignment are added to get marks out of 100 and report CIE for 50 marks.

Semester End Examination (SEE):

Total marks: 50+50=100

SEE for 50 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the entire syllabus. Part – B Students have to answer five questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have a maximum of three sub divisions. Each unit will have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	-	-	-	-	-	-	-	-
CO2	3	2	2	1	-	-	-	-	-	-	-	-
CO3	3	2	2	2	-	-	-	-	-	-	-	-
CO4	3	2	2	2	-	-	-	-	-	-	-	-
CO5	3	2	2	1	-	-	-	-	-	-	-	-

High-3, Medium-2, Low-1

Semester: IV		
DATA STRUCTURES AND ALGORITHMS USING PYTHON (Theory and Practical)		
Course Code:	MVJ21EC44	CIE Marks:50+50
Credits:	L:T:P: 3:0:2	SEE Marks: 50 +50
Hours:	40 L+ 26 P	SEE Duration: 03+03 Hours
Course Learning Objectives: The students will be able to		

1	Understand the fundamentals of data structures and their applications in logic building and project assessment.
2	Understand the concept of linked lists and sorting techniques.
3	Acquire the knowledge of algorithms of queues and stacks.
4	Analyze the concepts of Binary trees.
5	To Understand Graphs and its algorithms.

UNIT 1	
Python Primer: Python Overview, Objects in Python, Expressions, Operators, Control Flow, Functions, Simple i/p and o/p, Modules. **Basic Concepts of Data Structures and Algorithms:** Introduction- Variables, Datatypes, Data Structures, ADT, what is an algorithm, How to compare algorithms, Rate growth, Types of analysis, Asymptotic Notation, Performance Analysis: Space complexity, Time complexity, Guidelines for asymptotic analysis. **Searching Techniques:** Linear Search and Binary Search **Applications:** developing computational tools and bioinformatics software, Mathematics. **Video link / Additional online information (related to module if any):** 1. http://www.nptelvideos.com/video.php?id=1442 2 2. https://nptel.ac.in/courses/106105085/ **Laboratory Sessions/ Experimental learning:** 1. Develop a mini project to demonstrate the concept Binary Search. **Applications:** 1. Conversion from one form of expression to another 2. Mathematical calculation for expression evaluation.	8Hrs.
UNIT 2	
Prerequisites: *Programming using the concept of Arrays and pointers*	8Hrs.

Linked Lists: Definition, Linked list operations: Traversing, Searching, Insertion, and Deletion. Doubly Linked lists and its operations, Circular linked lists and its operations. **Sorting Techniques:** Bubble Sort, Insertion Sort, Selection Sort, Quick Sort and Merge Sort. **Laboratory Sessions/ Experimental learning:** 1. Develop an algorithm to demonstrate the concept of Linked lists. **Applications:** 1. Programs for Departmental store bills 2. Programs for Railway booking **Video link / Additional online information:** 1. https://nptel.ac.in/courses/106/102/106102064/ 2. https://drive.google.com/file/d/0BzTQ7doC5eGSQTBicHo1UDgtOVU/view	
UNIT 3	
Stacks: Definition, Stack Implementation using arrays/lists and linked lists, Stack ADT, Stack Operations (Insertion and Deletion), Array Representation of Stacks, Stack Applications: Infix to postfix conversion, Tower of Hanoi. **Queues:** Definition, Array Representation, Queue Implementation using arrays/lists and linked lists, Queue ADT, Operations on queues (Insertion and Deletion), Circular Queues and its operations, Priority Queues and its operations. **Laboratory Sessions/ Experimental learning:** 1. Implementation of Towers of Hanoi using Stacks. **Applications:** 2. Towers of Hanoi. 3. Parenthesis matching in an expression **Video link / Additional online information:** 1. https://nptel.ac.in/courses/106/106/106106127/ 2. https://www.youtube.com/playlist?list=PL0gIV7t6l2iIsR55zsSgeiOw9Bd_IUTbY	**8Hrs.**
UNIT 4	
Trees: Terminology, Binary Trees, Types of Binary trees, Properties of Binary trees, Array Representation of Binary Trees, Binary Tree Traversals – Inorder, Postorder, Preorder.	**8Hrs.**

Binary Search Trees – Definition, Insertion, Deletion, Searching, Implementation of Binary tree, Heaps and Heap Sort, Construction of Expression Trees, AVL Trees. **Laboratory Sessions/ Experimental learning:** 1. Solve Parenthesis Matching problem using binary search trees. **Applications:** 1. Can be used for Memory Management. 2. In solving backtracking problems. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/106/106/106106127/ 2. https://nptel.ac.in/courses/106/105/106105225/	
UNIT 5	
Graphs: Definitions, Terminologies, Matrix and Adjacency List Representation of Graphs, Elementary Graph operations, Traversal methods: Breadth First Search and Depth First Search, DAG, Minimum Spanning Trees: Prim – Kruskal algorithm, Single Source Shortest Path: Weighted graphs, Dijkstra algorithm. **Laboratory Sessions/ Experimental learning:** 1. Print all the nodes of graph using DFS and BFS. 2. Apply various algorithms on a graph and analyse it. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/106/106/106106133/ 2. https://nptel.ac.in/courses/106/105/106105225/ 3. https://nptel.ac.in/courses/106/102/106102064/	**8Hrs.**

Laboratory Sessions	
Sl No	**Experiment Name**
1	Write a Python program for implementing the following searching techniques. i. Linear Search ii. Binary Search
2	Write a Python program for implementing the following sorting techniques. i. Bubble Sort ii. Selection Sort iii. Insertion Sort
3	Write a Python program for implementing the following sorting techniques. i. Quick Sort

	ii. Merge Sort
4	Write a Python program to design and implement Linked List and its operations.
5	Write a Python program to design and implement Circular Linked List and its operations.
6	Write a Python program to i. Design and implement Stack and its operations using List. ii. Design and implement Queue and its operations using List.
7	Write a Python program for the following stack applications: i. Infix to postfix conversion ii. Tower of Hanoi
8	Write a Python program to implement the following: i. Create a Binary Search Tree ii. Tree Traversals: Inorder, Preorder, Postorder. iii. Determine the height of the tree. iv. Count the number of elements of tree.
9	Write a Python program to implement the following graph traversal algorithms: i. BFS ii. DFS

Course outcomes:	
CO1	Acquire knowledge of Python fundamentals and data structures.
CO2	Analyse and design of algorithms for Linked lists and sorting techniques.
CO3	Apply the concepts of Stacks and queues.
CO4	Utilize the operations of search trees and their applications.
CO5	Understand the concepts of Graphical algorithms.

Reference Books:	
1.	Rance D Necaise "Data Structures and Algorithms using Python", Wiley, John Wiley Sons.
2.	Michael T. Goodrich, R. Tamassia and Michael H Goldwasser "Data structures Algorithms in python", Wiley student edition, John Wiley and Sons.
3	Narasimha Karumanchi "Data Structures and Algorithmic Thinking with Python", CareerMonk Publications.

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Theory for 50 Marks

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Laboratory- 50 Marks

The laboratory session is held every week as per the time table and the performance of the student is evaluated in every session. The average of the marks over number of weeks is considered for 30 marks. At the end of the semester a test is conducted for 10 marks. The students are encouraged to implement additional innovative experiments in the lab and are awarded 10 marks. Total marks for the laboratory is 50.

Semester End Examination (SEE):

Total marks: 50+50=100

SEE for 50 marks are executed by means of an examination.

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CO4	3	3	2	1	-	-	-	-	-	-	-	-
CO5	3	3	1	1	-	-	-	-	-	-	-	-

High-3, Medium-2, Low-1

Semester: IV		
COMMUNICATION SYSTEMS (Theory and Practice)		
Course Code:	MVJ21EC45	CIE Marks:50+50
Credits:	L:T:P: 3:0:2	SEE Marks: 50 +50
Hours:	40 L+ 26 P	SEE Duration: 03+03 Hours
Course Learning Objectives: The students will be able to		
1	Understand the concepts of Analog Modulation schemes viz; AM, FM.	
2	Interpret the different types of noise in communication system.	
3	Learn the concepts of digitization of signals viz; sampling, quantizing and encoding.	
4	Analyze the Base Band data transmission system.	
5	Realize the basic concepts of coherent and Non-coherent digital modulation techniques and understand the basics of spread spectrum modulation.	

UNIT 1	
Prerequisites: *Modulation, Need for Modulation, and types of Modulation.* **Amplitude Modulation:** Introduction to AM, Time-Domain description, Frequency-Domain description, Generation of AM wave: Square Law Modulator, Switching modulator, Detection of AM waves: Envelop detector. **Double side band suppressed carrier modulation (DSBSC):** Time-Domain description, Frequency-Domain representation, Generation of DSBSC waves: Ring modulator. Coherent detection of DSBSC modulated waves. Costas loop. **Single Side-Band Modulation (SSB):** Single side-band modulation, Time-Domain description, Frequency-Domain description of SSB wave, Phase discrimination method for generating an SSB modulated wave. **Laboratory Sessions/ Experimental learning:** 1. Generation of AM signal using MATLAB 2. Generation of DSBSC signal using transistor **Applications:** Broadcast transmissions, Air band radio, Quadrature amplitude modulation **Video link / Additional online information :** 1. https://nptel.ac.in/courses/117/105/117105143/	8Hrs.

2. https://youtu.be/00ZbuhPruJw 3. https://youtu.be/rt08yTGv_z4 4. https://youtu.be/S8Jod9AtpN4 5. https://youtu.be/SxSPdjwXDQk	
UNIT 2	
Frequency Modulation: Basic definitions, FM, narrow band FM, wide band FM, transmission bandwidth of FM waves, and generation of FM waves: indirect FM and direct FM. **Demodulation of FM waves:** Phase-locked loop, Nonlinear model of the phase – locked loop, Linear model of the phase – locked loop, Nonlinear effects in FM systems. **Noise:** Introduction, Types of noise, Noise Figure, Equivalent noise temperature, Noise in AM receivers, Noise in FM receivers, Pre-emphasis and De-emphasis in FM. **Laboratory Sessions/ Experimental learning:** 1. Generation of FM signal using MATLAB 2. Design of mixer **Applications:** FM radio broadcasting, telemetry, radar, seismic prospecting, and monitoring new-borns for seizures via EEG, two-way radio systems, sound synthesis, magnetic tape-recording systems and some video-transmission systems. **Video link / Additional online information :** 1. https://nptel.ac.in/courses/117/105/117105143/ 2. https://youtu.be/gsUaHawPy-w 3. https://youtu.be/jqJpbPseX2c 4. https://youtu.be/PmuZnJfheK4 5. https://youtu.be/QEubAxBfqKU	8Hrs.
UNIT 3	
NOISE: Shot Noise, Thermal noise, White Noise, Noise Equivalent Bandwidth. NOISE IN ANALOG MODULATION: Introduction, Receiver Model, Noise in DSB-SC receivers. Noise in AM receivers, Threshold effect, Noise in FM receivers,	8Hrs.

Capture effect, FM threshold effect, FM threshold reduction, Preemphasis and De-emphasis in FM **Laboratory Sessions/ Experimental learning: ASK modulation and demodulation** **Applications: Biomedical engineering, communication system** **Video link / Additional online information:** 1. https://nptel.ac.in/courses/117/105/117105077/ 2. https://nptel.ac.in/courses/117/101/117101051/ 3. https://youtu.be/s6vlXP3mYXk https://youtu.be/HlGJ6xxbz8s	
UNIT 4	
Intersymbol Interference & Signal Space representation: Base band transmission: Discrete PAM Signals, Power spectra of Discrete PAM Signals, Inter Symbol Interference, Nyquist criterion for Distortion less Base band Binary Transmission, Eye diagram, Geometric representation of signals, Gram-Schmidt Orthogonalization procedure, Optimum receivers for coherent detection: Correlation Receivers and Matched Filter receiver. **Laboratory Sessions/ Experimental learning:** 1. Eye diagram using Matlab **Applications:** Ethernet, RFID marker localization signals, Radar Systems **Video link / Additional online information:** 1. https://nptel.ac.in/courses/117/105/117105077/ 2. https://nptel.ac.in/courses/117/101/117101051/	8Hrs.
UNIT 5	
Prerequisites: *Probability & Random Process* **Pass band transmission:** Digital modulation techniques: Phase shift Keying techniques using Coherent detection: Generation, Detection and Error probabilities of BPSK and QPSK, QAM, Frequency shift keying techniques using Coherent detection: BFSK generation, detection and error probability.	8Hrs.

Non-coherent orthogonal modulation techniques: BFSK, DPSK Symbol representation, Block diagrams of Transmitter and Receiver, Probability of error (without derivation of probability of error equation) **Principles of Spread Spectrum Communication Systems:** Model of a Spread Spectrum Digital Communication System, Direct Sequence Spread Spectrum Systems (DSSS), Some applications of DS Spread Spectrum Signals, Generation of PN Sequences, Frequency Hopped Spread Spectrum (FHSS). **Laboratory Sessions/ Experimental learning:** 1. Analyse constellation of 16-QAM Using MATLAB **Applications:** CDMA, WiMAX (16d, 16e), telemetry, caller ID, garage door openers, wireless communication, mobile communication and Satellite Communication, LANs, Bluetooth, RFID, GPS, Wi-Fi, etc., **Video link / Additional online information :** 1. https://nptel.ac.in/courses/117/105/117105077/ 2. https://nptel.ac.in/courses/117/101/117101051/ 3. https://nptel.ac.in/courses/117/105/117105136/ 4. https://youtu.be/Ojmv3I4kDn4	

Laboratory Sessions	
Sl No	**Experiment Name**
Hardware Experiments	
1	Amplitude Modulation and Demodulation using transistor.
2	DSB SC Modulation.
3	Frequency modulation and FSK using IC 8038/2206,.
4	Pre-emphasis & de-emphasis
5	Demonstrate sampling and reconstruction
6	Pulse Amplitude Modulation and Detection.
7	Generation of PWM/PPM signal
8	Generation and detection of ASK Waveform.
9	FSK Generation and detection.
10	TDM of two band limited signals.
Simulation Experiments using SCILAB/MATLAB/Simulink/LabVIEW	

11	Amplitude Modulation using Pspice
12	Simulate NRZ, RZ for polar signaling.
13	Simulate NRZ, RZ for bipolar signaling.
14	Generation of eye diagram.

OPEN ENDED PROJECT:

1. Design and make a simple FM Radio.
2. Design simple circuit for Mobile phone jammer.

Course outcomes:	
CO1	Examine the concepts of analog modulation techniques such as amplitude, modulations and its variations like DSB-SC and SSB-SC.
CO2	Analyze frequency modulation and compute performance of different types of noise.
CO3	Apply the concepts of noise in analog modulation and analysis of preemphasis and deemphasis circuit.
CO4	Analyze the signal space representation of digital signals.
CO5	Evaluate the performance of a baseband and pass band digital communication system and spread spectrum techniques.

Reference Books:	
1.	Simon Haykins& Moher, Communication Systems, 5th Edition, John Wiley, India Pvt. Ltd, 2010, ISBN 978 – 81 – 265 – 2151 – 7.
2.	Simon Haykins, "An Introduction to Analog and Digital Communication", John Wiley, 2003.
3.	John G Proakis and MasoudSalehi, "Fundamentals of Communication Systems", 2014 Edition, Pearson Education, ISBN 978-8-131-70573-5.
4	B P Lathi and Zhi Ding, Modern Digital and Analog Communication Systems, Oxford University Press., 4th edition, 2010, ISBN: 97801980738002.

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of three quizzes are conducted along with tests. Test portion is evaluated for 50 marks and quiz is evaluated for 10 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three (conduct

additional quizzes and take best three). The three tests are conducted for 50 marks each and the average of all the tests are calculated for 50. The marks for the assignments are 20 (2 assignments for 10 marks each). The marks obtained in test, quiz and assignment are added to get marks out of 100 and report CIE for 50 marks.

Laboratory- 50 Marks

The laboratory session is held every week as per the time table and the performance of the student is evaluated in every session. The average of the marks over number of weeks is considered for 30 marks. At the end of the semester a test is conducted for 10 marks. The students are encouraged to implement additional innovative experiments in the lab and are awarded 10 marks. Total marks for the laboratory is 50.

Semester End Examination (SEE):
Total marks: 50+50=100
SEE for 50 marks are executed by means of an examination.

The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the entire syllabus. Part – B Students have to answer five questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have a maximum of three sub divisions. Each unit will have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	1	1	-	-	-	-	-	1
CO2	3	3	3	2	1	1	-	-	-	-	-	1
CO3	3	3	3	2	1	1	-	-	-	-	-	1
CO4	3	3	3	2	1	1	-	-	-	-	-	1
CO5	3	3	3	2	1	1	-	-	-	-	-	1

High-3, Medium-2, Low-1

Semester: III/IV		
SAMSKRUTHIKA KANNADA (Theory)		
Course Code:	MVJ21EC46	CIE Marks: 50
Credits:	L:T:P: 1:0:0	SEE Marks: 50
Hours:	15L	SEE Duration: 3 Hrs.
Course Learning Objectives: The students will be able to		
1	Samskruthika Kannada –Parichaya (Introduction to Adalithakannada)	
2	Kannada Kavyagalaparichaya (Kannada D Ra Bendre, Siddalingaiha)	
3	Adalithdalli Kannada Padagalu (Kannada KagunithaBalake, Patra Lekhana, Prabhandha)	
4	Kannada Computer Gnyana (Kannada ShabdhaSangraha, Computer Paribashikapadagalu)	
5	Activities in Kannada.	

UNIT 1	
1. ಕನ್ನಡ ಭಾಷೆ–ಸಂಕ್ಷಿಪ್ತ ವಿವರಣೆ. 2. ಭಾಷಾ ಪ್ರಯೋಗಲ್ಲಾಗುವ ಲೋಪದೋಷಗಳು ಮತ್ತು ಅವುಗಳ ನಿವಾರಣೆ	3 Hrs
UNIT 2	
1. ಲೇಖನ ಚಿಹ್ನೆಗಳು ಮತ್ತು ಅವುಗಳ ಉಪಯೋಗ 2. ಪತ್ರ ವ್ಯವಹಾರ.	3 Hrs
UNIT 3	
1. ಆಡಳಿತ ಪತ್ರಗಳು. 2. ಸರ್ಕಾರದಆದೇಶ ಪತ್ರಗಳು	3 Hrs
UNIT 4	
1. ಸಂಕೀಪ್ತ ಪ್ರಬಂಧರಚನೆ, ಪ್ರಬಂಧ ಮತ್ತು ಭಾಷಾಂತರ 2. ಕನ್ನಡ ಶಬ್ದಸಂಗ್ರಹ	3 Hrs
UNIT 5	
1. ಕಂಪ್ಯೂಟರ್ ಹಾಗೂ ಮಾಹಿತಿತಂತ್ರಜ್ಞಾನ 2. ಪಾರಿಭಾಷಿಕ ಆಡಳಿತ ಕನ್ನಡ ಪದಗಳು ಮತ್ತುತಾಂತ್ರಿಕ/ಕಂಪ್ಯೂಟರ್ ಪಾರಿಭಾಷಿಕ ಪದಗಳು.	3 Hrs

Scheme of Evaluation:		
Details		**Marks**
Average of three Internal Assessment (IA) Tests of 30 Marks each i.e. Σ (Marks Obtained in each test) / 3	CIE(50)	30
Assignment / Case Studies / Quiz		20
Semester End Examination	SEE (50)	50
Total		100

Textbooks:	
1.	Adalitha Kannada – Dr. L Thimmesh, Prof. V Keshav Murthy

Semester: III/IV		
BALAKE KANNADA		
Course Code:	MVJ21EC46	CIE Marks: 50
Credits:	L:T:P: 1:0:0	SEE Marks: 50
Hours:	15L	SEE Duration: 3 Hrs.
Course Learning Objectives: The students will be able to		
1	Vyavharika Kannada –Parichaya (Introduction to Vyavharikakannada)	
2	Kannada Aksharamaalehaaguuchcharane(Kannada Alphabets and Pronounciation	
3	Sambhashanegaagi Kannada Padagalu (Kannada Vocubulary for Communication).	
4	Kannada Grammer in Conversations (Sambhasaneyalli Kannada Vyakarana)	
5	Activities in Kannada.	

Course Title	BALAKE KANNADA	Semester	III/IV
Module - 1			
Vyavharika Kannada –Parichaya (Introduction to Vyavharikakannada)			
Module - 2			

Kannada Aksharamaalehaaguuchcharane(Kannada Alphabets and Pronounciation		
Module - 3		
Sambhashanegaagi Kannada Padagalu (Kannada Vocubulary for Communication).		
Module - 4		
Kannada Grammar in Conversations (Sambhasaneyalli Kannada Vyakarana)		
Module - 5		
Activities in Kannada		
Scheme of Evaluation:		
Details		Marks
Average of three Internal Assessment (IA) Tests of 30 Marks each i.e. Σ (Marks Obtained in each test) / 3	CIE(50)	30
Assignment / Case Studies / Quiz		20
Semester End Examination	SEE (50)	50
Total		100

Semester: III/IV		
SUMMER INTERNSHIP-I		
Course Code:	MVJ21INT48	CIE Marks: 50
Credits:	2	SEE Marks: 50
Hours:	Industrial Oriented	SEE Duration: 3 Hrs.
Course Learning Objectives: The students will be able to		
1	To get the field exposure and experience.	
2	To apply the theoretical concept in field application	
3	To prepare the comparison statement of difference activities	

Internship: This shall be carried out by students in industry set-up related to the construction/ materials testing laboratories/research organizations/project management consulting firms/QS and QA organizations/ planning and design offices/Professional organizations and other avenues related to the Electronics and Communication engineering domain in consultation and approval of internship guide/HOD /internship committees of the institutions.

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

CO1	Develop skills to work in a team to achieve common goal. Develop skills of project management and finance.
CO2	Develop skills of self-learning, evaluate their learning and take appropriate actions to improve it.
CO3	Prepare them for life-long learning to face the challenges and support the technological changes to meet the societal needs.

Scheme of Evaluation:

Internal Marks: The Internal marks (50 marks) evaluation shall be based on midterm and final presentation of the activities undertaken during the internship, to a panel comprising internship guide, a senior faculty from the department and head of the department. Each student should submit the internship report at the end of semester with internship certificate.

Semester End Examination: Viva-Voce examination shall be conducted by a panel of examiners consisting of internship supervisor, a senior faculty from the department and head of the department.

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	3	3	2	1	1	2	1	1	2
CO2	2	2	2	3	3	2	1	1	2	1	2	2
CO3	2	2	2	3	3	2	1	1	2	1	2	2

High-3, Medium-2, Low-1

Semester: IV		
Additional Mathematics-II (Common to all branches)		
Course Code:	MVJ21MATDIP2	CIE Marks:50
Credits:	L:T:P:S: 4:0:0:0	SEE Marks: 50
Hours:	40L	SEE Duration: 3 Hrs
Course Learning Objectives: The students will be able to		
1	To familiarize the important concepts of linear algebra.	
2	Aims to provide essential concepts differential calculus, beta and gamma functions.	
3	Introductory concepts of three-dimensional geometry along with methods to solve them.	
4	Linear differential equations	
5	Formation of partial differential equations.	

UNIT-I	
Linear Algebra: 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. Diagonalization of a square matrix of order two. **Self study** : Application of Cayley-Hamilton theorem (without proof) to compute the inverse of a matrix-Examples. **Video Link** : 1. http://nptel.ac.in/courses.php?disciplineID=111	8 Hrs
UNIT-II	
Differential calculus: Indeterminate forms: L-Hospital rule (without proof), Total derivatives, and Composite functions. Maxima and minima for a function of two variables. **Beta and Gamma functions:** Beta and Gamma functions, Relation between Beta and Gamma function-simple problems. **Self study** : Curve tracing. **Video Link** : 1. http://nptel.ac.in/courses.php?disciplineID=111	8Hrs
UNIT-III	
Analytical solid geometry : Introduction –Directional cosine and Directional ratio of a line, Equation of line in space- different forms, Angle between two line, shortest distance between two line, plane and equation of plane in different forms and problems. **Self study** : Volume tetrahedron. **Video Link** : 1. http://nptel.ac.in/courses.php?disciplineID=111	8Hrs
UNIT-IV	

Differential Equations of higher order: Linear differential equations of second and higher order equations with constant coefficients. Inverse Differential operator, Operators methods for finding particular integrals , and Euler –Cauchy equation. **Self study** : Method of variation of parameters **Video Link** : 1. http://nptel.ac.in/courses.php?disciplineID=111	8 Hrs
UNIT-V	
Partial differential equation: Introduction- Classification of partial differential equations, formation of partial differential equations. Method of elimination of arbitrary constants and functions. Solutions of non-homogeneous partial differential equations by direct integration. Solution of Lagrange's linear PDE. **Self study:** One dimensional heat and wave equations and solutions by the method of separable of variable **Video Link** : 1. http://nptel.ac.in/courses.php?disciplineID=111	8 Hrs

Course Outcomes: After completing the course, the students will be able to	
CO1	Make use of matrix theory for solving system of linear equations and compute eigenvalues and eigen vectors required for matrix diagonalization process.
CO2	Learn the notion of partial differentiation to calculate rates of change of multivariate functions and solve problems related to composite functions and Jacobians.
CO3	Understand the Three-Dimensional geometry basic, Equation of line in space- different forms, Angle between two line and studying the shortest distance .
CO4	Demonstrate various physical models through higher order differential equations and solve such linear ordinary differential equations.
CO5	Construct a variety of partial differential equations and solution by exact methods.

Reference Books	
1.	B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 43rd Edition, 2013, .
2.	G. B. Gururajachar, Calculus and Linear Algebra, Academic Excellent Serie Publication, 2018-19
3.	Chandrashekar K. S, Engineering Mathematics-I, Sudha Publications, 2010.

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of three quizzes are conducted along with tests. Test portion is evaluated for 50 marks and quiz is evaluated for 10 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three (conduct additional quizzes and take best three). The three tests are conducted for 50 marks each and the average of all the tests are calculated for 50. The marks for the assignments are 20 (2 assignments for 10 marks each). The marks obtained in test, quiz and assignment are added to get marks out of 100 and report CIE for 50 marks.

Semester End Examination (SEE):

Total marks: 50+50=100

SEE for 50 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the entire syllabus. Part – B Students have to answer five questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have a maximum of three sub divisions. Each unit will have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
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CO1	3	3	0	2	0	0	0	0	0	0	1	1
CO2	3	3	0	2	0	0	0	0	0	0	1	1
CO3	3	3	0	3	0	0	0	0	0	0	0	1
CO4	2	2	0	3	0	0	0	0	0	0	1	1
CO5	2	2	0	2	0	0	0	0	0	0	0	1