B.E, III Semester,ADVANCED COMMUNICATION TECHNOLOGY

Semester: III		
Mathematics for AV Communication		
Course Code:	**MVJ22EA31**	**CIE Marks: 50**
Credits:	**L: T:P:S: 3:0:0:0**	**SEE Marks: 50**
Hours:	**30L+10T**	**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	Understand the concepts of Complex variables and transformation for solving Engineering Problems.	
3	Apprehend and apply Fourier Series.	
4	Apply Fourier Transform as a tool for solving Integral equations	
5	Apply Z-Transforms technique to solve various mathematical functions	

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.	**8 Hrs**
UNIT-II	
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.	**8 Hrs**
UNIT-III	
Fourier Series: Periodic functions, Dirichlet's condition, Fourier series of periodic functions with period 2π and arbitrary period $2c$. Fourier series of even and odd functions. Half range Fourier Series, Practical harmonic Analysis and Problems.	**8 Hrs**
UNIT-IV	
Fourier Transforms: Infinite Fourier transform, Infinite Fourier sine and cosine transforms, Inverse Fourier transforms, Inverse. Fourier sine and cosine transforms, Convolution theorem	**8 Hrs**
UNIT-V	
Z-Transforms: Definition, standard Z-transforms, properties of Z- transforms- Shifting property, Reversal property, Multiplication by n, initial value and final value theorems. Inverse Z- transform, convolution theorem (proof and problems) Application of Z-transforms to solve difference equations.	**8 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Apply discrete and continuous probability distributions in analyzing the probability models arising in engineering field.
CO2	Use the concepts of analytic function and complex potentials to solve the problems arising in electromagnetic field theory
CO3	Know the use of periodic signals and Fourier series to analyze circuits and system.
CO4	Demonstrate Fourier Transform as a tool for solving Integral equations.
CO5	Learn to evaluate Z-transform to solve difference 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.	Bali N. P. & Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, 8th Edition
4.	Ramana B. V., "Higher Engineering Mathematics", Tata Mc Graw-Hill, 2006.

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**	**0**	**1**
CO2	**3**	**3**	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
CO3	**3**	**3**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
CO4	**3**	**3**	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
CO5	**3**	**2**	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**

Semester: III		
Analysis and Design of Digital Circuits		
Course Code:	**MVJ22EA32**	**CIE Marks:50**
Credits:	**L:T:P: 3:0:2**	**SEE Marks: 50**
Hours:	**40 L+ 26 P**	**SEE Duration: 03 Hours**

Course Learning Objectives: The students will be able to

1	understand simplification techniques & design various combinational digital circuits using logic gates.
2	Understand design procedures for synchronous and asynchronous sequential circuits.
3	Analyze & design different applications of Combinational & Sequential Circuits
4	Analyze & design sequential circuits using SR, JK, D, T flip-flops and Mealy & Moore machines
5	understand the importance of programmable devices used for designing digital circuits.

UNIT-I

Prerequisites: *Number systems, Boolean Algebra, Logic Gates, Comparison of Combinational & Sequential Circuits.* **Principles of combinational logic**: Introduction, Canonical forms, Generation of switching equations from truth tables, Karnaugh maps-3, 4 variables, Incompletely specified functions (Don't care terms), Quine- McClusky techniques- 3 & 4 variables. **Laboratory Sessions/ Experimental learning**: 1. Study of Logic Gates – NOT, OR, AND, NOR, NAND, XOR and XNOR. 2. Design a 4-bit Binary to Gray code converter using logic gates. **Applications:** OR gate in detecting exceed of threshold values and producing command signal for the system and AND gate in frequency measurement. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/108105113	**8 Hrs**

UNIT-II

Prerequisites**:** *Decoder, Encoders, Multiplexers & Demultiplexer* **Design and Analysis of combinational logic:** Full Adder & Subtractors, Parallel Adder and Subtractor, Look ahead carry Adder, Binary comparators, Decoders & Multiplexers as minterm/maxterm Generator.	**8 Hrs**

Laboratory Sessions/ Experimental learning: 1. Design a full adder with two half adders using logic gates. 2. Design an Adder cum Subtractor circuit which adds when input bit operation=1 or subtract if 0, using logic gates. 3. Design 4-bit comparator using IC7485. 4. Realize a Boolean expression using decoder IC74139. **Applications:** Communication systems, Speed synchronization of multiple motors in industries. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/108105113	
UNIT-III	
Prerequisites**:** *SR, JK, D, T flipflops* **Flip-Flops and its Applications:** Latches and Flip Flops, Master-slave JK flip-flop, Timing concerns in sequential circuits, Shift Registers – SISO, SIPO, PISO PIPO, Universal shift register, Counters – Synchronous and Asynchronous. **Laboratory Sessions/ Experimental learning:** 1. Develop SR, D, JK &T flip flop using logic gates 2. Design a 6-bit Register using D-Flipflop **Applications:** Frequency divider circuit, frequency counter. **Video link / Additional online information:** **1.** https://nptel.ac.in/courses/108105113	**8 Hrs**
UNIT-IV	
Sequential Circuit Design: Characteristic equations, Design of a synchronous mod-n counter using clocked JK, D, T and SR flip-flops, Melay& Moore Models. **Laboratory Sessions/ Experimental learning:** 1. Design a Synchronous Counter for a given sequence- 0, 2, 4, 6, 0 2. Design a 4-bit Asynchronous up/down counter 3. Design a 4-bit binary Synchronous up/down **Applications:**Data synchronizer, Counter. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/108105113	**8 Hrs**

UNIT-V	
Applications of Digital Circuits: Design of a Sequence Detector, Guidelines for construction of state graphs, Design Example – Code Converter, Design of Binary Multiplier, Design of Binary Divider. **Programmable Logic Devices:** PLA, PAL, FPGA. **Laboratory Sessions/ Experimental learning:** 1. Designing of sequence detector using necessary digital components. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/108105113	**8 Hrs**
LABORATORY EXPERIMENTS	
Simulate & design the Digital Circuits using NI ELVIS II+ and NI Multisim 1.Design of Logic Gates and Realization using K-Map 2.Design of Half Adder and Half Subtractor 3.Implementation of Binary to Gray Code Converter 4.Realization of SR, JK, D and T flip flop 5.Design of Multiplexer and Demultiplexer 6. Implementation of Encoder and Decoder	

Course outcomes:	
CO1	Illustrate simplification of Algebraic equations using K-map & Quine-McCluskey Technique.
CO2	Design the combinational logic circuits.
CO3	Analyse& design different applications of Combinational & Sequential Circuits to meet desired need within realistic constraints.
CO4	Design the sequential circuits using SR, JK, D, T flip-flops and Mealy & Moore machines
CO5	Know the importance of programmable devices used for designing digital circuits.
Reference Books:	
1.	John M Yarbrough, “Digital Logic Applications and Design”, Thomson Learning, 2001.

2.	Donald D. Givone, “Digital Principles and Design”, McGraw Hill, 2002.
3.	Charles H Roth Jr., Larry L. Kinney –Fundamentals of Logic Design, CengageLearning, 7th Edi
4.	. Morris Mano, –Digital Design‖, Prentice Hall of India, Third 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 qquizzes 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 eeffectively. The number of quizzes may be more than three (conduct additional quizzes aand take best three). The three tests are conducted for 50 marks each and the average of aall the tests are calculated for 50. The marks for the self -study are 20 (2 presentations are b held for 10 marks each). The marks obtained in test, quiz and self -studies are added to gget marks out of 100 and report CIE for 50 marks.

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 complete 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.

Laboratory- 50 Marks

Experiment Conduction with proper results is evaluated for 40 marks and Viva is for 10 marks. Total SEE for laboratory is 50 marks.

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

High-3, Medium-2, Low-1

Semester: III		
Analog Electronic Circuits		
Course Code:	**MVJ22EA33**	**CIE Marks:50**
Credits:	**L:T:P: 3:0:2**	**SEE Marks: 50**
Hours:	**40 L+ 26 P**	**SEE Duration: 03+03 Hours**
Course Learning Objectives: The students will be able to		
1	solve low frequency response for various configurations of BJT and FET amplifier.	
2	Understand different topologies of feedback amplifiers and oscillators.	
3	Analyze Power amplifier circuits in different modes of operation	
4	Sketch and explain typical Frequency Response graphs for each of the Filter circuits and switching circuits of Op-Amps and analyse its operations.	
5	Differentiate between various types of DACs and ADCs, Timer IC's and evaluate the performance of each with neat circuit diagrams.	

Module -I	
Prerequisites: *Operation of Transistor* **Transistor Biasing:** Fixed bias circuits, Emitter stabilized biased circuits, Voltage divider biased circuits. **Transistor at Low Frequencies:** BJT transistor modeling, CE Fixed bias configuration, Voltage divider bias, Emitter follower, Analysis of circuits re model. **Laboratory Sessions/ Experimental learning:** 1. 8Plot the transfer and drain characteristics of a BJT and calculate its drain resistance, mutual conductance and amplification factor. **Applications:** Analog switches, Phase shift oscillator, chopper, and current limiter. **Video link/ Additional online information:** https://nptel.ac.in/courses/108102112	**8 Hrs**
Module -II	
Prerequisites: *Working of JFET* FET Amplifiers: JFET small signal model, Fixed bias configuration, Voltage divider configuration, Common Gate configuration, **Feedback Amplifier:** The Four Basic Feedback Topologies, The series-shunt, series-series,	**8 Hrs**

shunt-shunt and shunt-series amplifiers. **Laboratory Sessions/ Experimental learning:** 1. Design and test the voltage-shunt feedback amplifier and calculate the parameters using with and without feedback. **Applications:** Radios, Televisions, Communication systems, Computers, Industrial controlled applications. **Video link/ Additional online information:** https://nptel.ac.in/courses/108102112	
Module -III	
Oscillators: Oscillator operation, FET based Phase shift oscillator, Wien bridge oscillator, LC and Crystal Oscillators. **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, Class C tuned Amplifier. **Laboratory Sessions/ Experimental learning:** 1. Plot the frequency response using any class of power amplifier **Applications:** Audio power amplifiers, Switching type power amplifiers, and Wireless Communication **Video link/ Additional online information:** https://nptel.ac.in/courses/108102112	**8 Hrs**
Module -IV	
OP-Amps as DC Amplifiers: Direct coupled voltage followers, Non-inverting amplifiers, inverting amplifiers. **Op-Amps as AC Amplifiers:** Capacitor coupled voltage follower, Capacitor coupled non inverting amplifiers, Capacitor coupled inverting amplifiers, Capacitor coupled difference amplifier. **Application:** Summing, Scaling and Averaging Amplifiers, Instrumentation amplifier, Zero Crossing Detector, Schmitt trigger. **Laboratory Sessions/ Experimental learning:** 1. Design and find the gain of a Differential Amplifier. **Applications:** Industrial areas (Temperature Indicator, Light Intensity Meter, Temperature	**8 Hrs**

Controller) **Video link / Additional online information:** https://nptel.ac.in/courses/108102112	
Module -V	
Op-Amp Circuits: DAC - Weighted resistor and R-2R ladder, ADC- Successive approximation type, Active Filters, First and second order low-pass and high-pass Butterworth filters, Band-pass filters, Band reject filters. **555 Timer and its applications:** Mono-stable and Astable Multivibrators. **Laboratory Sessions/ Experimental learning:** 1. Demonstrate a simple light circuit that uses a decade counter to drive two traffic lights and uses 555 timer chips as clock. **Applications:** PWM (Pulse Width Modulation) & PPM (Pulse Position Modulation), Analog frequency meters, Digital logic probes. **Video link / Additional online information**: https://nptel.ac.in/courses/108102112	**8 Hrs**
Laboratory Experiments Simulation using EDA software (EDWinXP, PSpice, MultiSim, Proteus, CircuitLab or any other equivalent tool can be used) 1. Monostable Multivibrator using 555 Timer. 2. Astable Multivibrator using 555 Timer. 3. RC Phase shift oscillator. 4. Inverting Schmitt Trigger. 5. Narrow Band-pass Filter and Narrow band-reject filter 6. Precision full-wave rectifier.	

Course Outcomes: After completing the course, the students will be able to	
CO1	Analyse the DC biasing & frequency response of BJT Amplifier and FET amplifier
CO2	Design various Feedback amplifiers.
CO3	Evaluate the efficiency of power amplifiers and working of oscillator.
CO4	Describe DC amplifier, AC Amplifiers and its application.
CO5	Acquire knowledge about Active Filters, DAC, ADC and Timer.

Text Books	
1.	Robert L.Boylestad and louis Nashelsky, "Electronic Devices and circuit Theory", PHI/Pearson Education,11 TH Edition.
2.	Adel S Sedra, Kenneth C Smith "Microelectronic Circuits, Theory and Applications", 6th Edition, Oxford, 2015.ISBN:978-0-19-808913-1.
Reference Books	
1	Behzad Razavi, "Fundamentals of Microelectronics", John Weily ISBN 2013 978-81-265-2307-8,2nd Edition, 2013.
2	K.A.Navas, "Electronics Lab Manual", Volume I, PHI, 5th Edition, 2015, ISBN: 9788120351424.
3	"Operational Amplifiers and Linear IC"s", David A. Bell, 2nd edition, PHI/Pearson, 2004. ISBN 978-81-203-2359-9.
4	"Linear Integrated Circuits", D. Roy Choudhury and Shail B. Jain, 4th edition, Reprint 2006, New Age International ISBN 978-81-224-3098-1.

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 self -study are 20 (2 presentations are be held for 10

marks each). The marks obtained in test, quiz and self -studies 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 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 complete 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.

Laboratory- 50 Marks

Experiment Conduction with proper results is evaluated for 40 marks and Viva is for 10 marks. Total SEE for laboratory is 50 marks.

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

High-3, Medium-2, Low-1

Semester: III		
NETWORK ANALYSIS		
Course Code:	**MVJ22EA34**	**CIE Marks: 50**
Credits:	**L: T:P:S 3:0:0:Y**	**SEE Marks: 50**
Hours:	**40L**	**SEE Duration: 3 Hrs.**

Course Learning Objectives: The students will be able to

1	Describe basic network concepts emphasizing source transformation source shifting, mesh and nodal techniques to solve for resistance/impedance, voltage, current and power.
2	Explain network Thevenin's, Millman's, Superposition, Reciprocity, Maximum Power transfer and Norton's Theorems and apply them in solving the problems related to Electrical Circuits.
3	Describe Series and Parallel Combination of Passive Components as resonating circuits, related parameters and to analyze frequency response.
4	Explain the behavior of networks subjected to transient conditions. Use applications of Laplace transform to solve network problems.
5	Execute two port network parameters like Z, Y, T and h and their inter-relationships.

UNIT-I

Prerequisites: *Ohm's law, Kirchhoff's laws* **Basic Concepts:** Introduction, Practical sources, Source transformations, Star – Delta transformation, Loop and node analysis with linearly dependent and independent sources for DC networks, Concepts of super node and super mesh. **Laboratory Sessions/ Experimental learning:** 1. Find the current through and voltage across the load in the given circuit. **Applications:** Simplification and analysis of analog circuits, microwave circuit analysis **Video link / Additional online information :** https://nptel.ac.in/courses/108105159	**8 Hrs**

UNIT-II

Graph Theory and Network equations: Graph of a network, Trees, Co-trees and Loops, Incidence Matrix, Cut-set Matrix, Tie-set Matrix and loop currents, Number of possible trees of a graph, Analysis of networks, Duality. **Laboratory Sessions/ Experimental learning:** NA	**8 Hrs**

Applications: Simplification and analysis of analog circuits, microwave circuit analysis **Video link / Additional online information:** https://nptel.ac.in/courses/108105159	
UNIT-III	
Network Theorems: Superposition Theorem, Millman's theorem, Thevenin's and Norton's theorems, Reciprocity theorem, Maximum Power transfer theorem. **Laboratory Sessions/ Experimental learning**: 1. Verify superposition theorem for a given circuit. **Applications:** Simplification and analysis of analog circuits, microwave circuit analysis. **Video link / Additional online information:** https://nptel.ac.in/courses/108105159	**8 Hrs**
UNIT-IV	
Prerequisites: *Laplace Transforms, Properties of Laplace Transform and Inverse Laplace Transform using partial fraction method.* **Transient behaviour and initial conditions:** Behaviour of circuit elements under switching condition and their Representation, evaluation of initial and final conditions in RL, RC and RLC circuits for DC excitations, Applications of Laplace Transforms in circuit analysis. **Laboratory Sessions/ Experimental learning:** 1. Plot the response of a series RLC circuit. **Applications:** In the analysis of transmission lines and waveguides. **Video link / Additional online information :** https://nptel.ac.in/courses/108105159	**8 Hrs**
UNIT-V	
Two port network parameters: Introduction, open circuit impedance parameter, short circuit admittance parameter, hybrid parameters, transmission parameter, relationship between parameters. **Laboratory Sessions/ Experimental learning:** 1. Plot the frequency response characteristics for a series RL, RC circuit. 2. Plot the frequency response characteristics for a parallel RL circuit.	**8 Hrs**

3. Measure two port parameters for a given network **Applications:** For analysis of communication systems and antennas. **Video link / Additional online information:** https://nptel.ac.in/courses/108105159	

Course Outcomes: After completing the course, the students will be able to	
CO1	Determine currents and voltages in a circuit using network simplification techniques.
CO2	To solve the network problems using graphical methods.
CO3	To simplify the complex circuits using network theorems.
CO4	To analyze simple DC circuits and applies the concepts to transient conditions.
CO5	Solve the given network using specified two port network parameters like Z or Y or T or h and Evaluate frequency response related parameters through the RLC elements, in resonant circuits.

Text Books	
1.	M.E. Van Valkenberg (2000), "Network analysis", Prentice Hall of India, 3rd edition, 2000, ISBN: 9780136110958.
2.	Roy Choudhury, "Networks and systems", 2nd edition, New Age International Publications, 2006, ISBN: 9788122427677.
Reference Books	
1.	Hayt, Kemmerly and Durbin –Engineering Circuit Analysis", TMH 7th Edition, 2010.
2.	J. David Irwin /R. Mark Nelms, "Basic Engineering Circuit Analysis", John Wiley, 8th edition, 2006.

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Theory for 50 Marks

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Semester End Examination (SEE):

Total marks: 50+50=100

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

High-3, Medium-2, Low-1

Semester:III		
Analog and Digital Electronics Laboratory		
Course Code:	**MVJ22EAL35**	**CIE Marks: 50**
Credits:	**L:T:P:0:0:2**	**SEE Marks: 50**
Hours:	**20**	**SEE Duration: 3 Hrs**

Course Learning Objectives: The students will be able to	
1	Demonstrate various circuits using PSPICE and verify functionality.
2	Understand operation and application of electronic devices and their circuits.
3	Analyze circuit characteristics with signal analysis using Op-amp ICs.
4	Execute Modern EDA tool such as Verilog.
5	Solve different types of description in Verilog.

PART A

1. Design and set up the RC coupled Single stage BJT amplifier and determine the gain-frequency response, input, and output impedances
2. Design an oscillator with tank circuit having two inductances and one capacitance and compare the practical frequency with theoretical frequency.
3. Design an oscillator with tank circuit having two capacitance and one inductance and compare the practical frequency with theoretical frequency.
4. Design an oscillator whose frequency is 2MHZ and compare with the theoretical frequency.
5. Design active second order Butterworth low pass filters.
6. Design Astable Multivibrator using 555 Timer.
7. Design Monostable Multivibrator using 555 Timer.

PART B

8. Verify

a) The sum-of product expression using universal gates.
b) The product-of-sum expression using universal gates.

9. Design and implement

(a) Full Adder using basic logic gates.
(b) Full subtractor using basic logic gates.

10. Design and implement 4-bitParallelAdder/ Subtractor using IC 7483.
11. Design and implement BCD to Excess-3 code conversion and vice-versa using IC 7483.
12. Realize 4-variable function using IC 74151(8:1MUX)

Course outcomes:	
CO1	Design various circuits using PSPICE and verify functionality.
CO2	Design and test of analog circuits using OPAMPs
CO3	Design and implement basic circuits using IC (OPAMP and 555 timers).
CO4	Use the modern engineering tool Verilog for engineering practice.
CO5	Design and Verify functionality of digital circuit/system.

CO-PO Mapping

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

High-3, Medium-2, Low-1

Engineering Science Course:

Semester: III		
Digital System Design using Verilog		
Course Code:	**MVJ22EA361**	**CIE Marks:50**
Credits:	**L: T:P: 3:0:0**	**SEE Marks: 50**
Hours:	**40L**	**SEE Duration: 03 Hours**
Course Learning Objectives: The students will be able to		
1	Understand the concepts of Verilog Language	
2	Describe verilog data flow .	
3	Design behavioral programming using verilog	
4	Understand the concepts of Verilog Structural Language	
5	Design of verilog circuits using synthesis module.	

UNIT 1	
Introduction to Verilog: Structure of verilog Module, Operators, Data types, Units and ports, Verilog constructs. **Laboratory Sessions/ Experimental learning:** 1. Develop a mini project to demonstrate the concept of de morgan's theorem. **Applications:** 1. Conversion from one form of expression to another **Video link / Additional online information:** 1. https://nptel.ac.in/courses/106103358	**8Hrs.**
UNIT 2	
Data-Flow Description: Highlights Of Data-Flow Description, Signal Declaration And Assignment Statement , Constant Declaration and Constant Assignment Statements , Assigning a Delay Time to the Signal-Assignment Statement **Laboratory Sessions/ Experimental learning:** 1. Develop an algorithm using data flow description **Applications:** 1. Programs for simple mathematical calculations **Video link / Additional online information:** 1. https://nptel.ac.in/courses/106103358	**8Hrs.**

UNIT 3	
Behavioral Description: Behavioral Description Highlights, Structure of the Verilog Behavioral Description , Sequential Statements: IF Statement , The case Statement , Verilog casex and casez , The wait-for Statement , The Loop Statement: For-Loop, While-Loop , Verilog repeat , Verilog forever **Laboratory Sessions/ Experimental learning:** 1. Develop an algorithm using behavioural description **Applications:** 1. Comparators using behavioural description. 2. Multiplexers using behavioural description. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/106103358	**8Hrs.**
UNIT 4	
Structural Description: Highlights of Structural Description, Organization of Structural Description , Half adder and full adder design using structural description, Half subtractor and full subtractor design using structural description, generate and parameter (Verilog) , Exercises **Laboratory Sessions/ Experimental learning:** 1. Code converters using behavioural description. **Applications:** 1. Decoders using Structural description. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/106103358	**8Hrs.**
UNIT 5	
Synthesis Basics: Highlights of Synthesis, Synthesis Information From Module , Mapping Always in the Hardware Domain ,Mapping the Signal-Assignment Statement to Gate Level, Mapping Logical Operators, Mapping the IF Statement, Mapping the case Statement , Mapping the Loop Statement **Laboratory Sessions/ Experimental learning:** 1. Weather analysis of a weak using synthesis module 2. synthesis verilog code for state machine	**8Hrs.**

Video link / Additional online information: 1. https://nptel.ac.in/courses/106103358	

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand verilog programming basics
CO2	Describe how dataflow description of verilog code works and write simple programs using dataflow description.
CO3	Describe how Behavioural description of verilog code works and write simple programs using dataflow description.
CO4	Design simple circuits using verilog structural description.
CO5	Synthesize different assign statements and simple applications using verilog.

Text Books:	
1.	HDL WITH DIGITAL DESIGN VHDL AND VERILOG, Nazeih Botros, MERCURY LEARNING INFORMATION Dulles, Virginia Boston, Massachusetts New Delhi, 2015.

Reference Books:	
1.	Samir Palnitkar "Verilog HDL: A Guide to Digital Design and Synthesis", Pearson Education, Second Edition
2.	Charles H Roth Jr., Larry L. Kinney "Fundamentals of Logic Design", Cengage Learning, 7th 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 marksis 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**	**-**	**1**	**-**	**-**	**1**	**-**	**-**	**1**
CO2	**3**	**3**	**2**	**2**	**-**	**1**	**-**	**-**	**1**	**-**	**-**	**1**
CO3	**3**	**3**	**2**	**2**	**-**	**1**	**-**	**-**	**1**	**-**	**-**	**1**
CO4	**3**	**3**	**2**	**2**	**-**	**1**	**-**	**-**	**1**	**-**	**-**	**1**
CO5	**3**	**3**	**2**	**2**	**-**	**1**	**-**	**-**	**1**	**-**	**-**	**1**

High-3, Medium-2, Low-1

Operating System		
Course Code:	**MVJ22EA362**	**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	Understand the services provided by an operating system.
2	Describe how processes are synchronized and scheduled.
3	Implement different approaches of memory management and virtual memory management.
4	Explain the structure and organization of file system
5	Understand inter process communication and deadlock situations.

UNIT 1	
Prerequisites: *Computer Organization and Architecture* **Introduction to Operating Systems:** OS, Goals of an OS, Operation of an OS, Program's, Resource allocation techniques, Efficiency, System Performance and User Convenience, Classes of operating System, Batch processing, Multi programming, Time Sharing Systems, Real Time , distributed and modern Operating Systems. **Laboratory Sessions/ Experimental learning:** 1. Case study: Basics of LINUX OS. **Applications:** • Controls the backing store and peripherals such as scanners and printers. • Maintains security and access rights of users. • Spooling (Simultaneous Peripheral Operation on Line) **Video link / Additional online information :** 1. https://nptel.ac.in/courses/106105214	8Hrs.

UNIT 2	
Process Management: OS View of Processes, PCB, Process States and Transitions, Threads, Kernel and User level Threads, Non-preemptive scheduling- FCFS and SRN, Preemptive Scheduling- RR and LCN, Long term, medium term and short term scheduling in a time sharing system.	8Hrs.

Laboratory Sessions/ Experimental learning: 1. Case study on Processes and threads in Linux/ Windows/ UNIX Scheduling Algorithms **Applications:** • Organizes the use of memory between programs. • Organizes processing time between programs and users. • Install Operating Systems - Ubuntu Linux. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/106105214	
UNIT 3	
Memory Management: Static and Dynamic memory allocation, Contiguous Memory allocation, Non-Contiguous Memory Allocation, Paging, Segmentation, Segmentation with paging, Virtual Memory Management, Demand Paging, Paging Hardware, VM handler, Page replacement policies - FIFO, LRU. **Laboratory Sessions/ Experimental learning:** 1. Case Study on Linux/ UNIX Memory Management. **Applications:** • Memory Management deals with the transfer of programs in and out of memory. • Dynamically allocate portions of memory to programs at their request, and free it for reuse when no longer needed. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/106105214	8Hrs.
UNIT 4	
File Systems: File systems and IOCS, Files and File Operations, Fundamental File Organizations, Directory structures, File Protection, Interface between File system and IOCS, Allocation of diskspace, Implementing file access, and File sharing schematics. **Laboratory Sessions/ Experimental learning:** 1. Case Study on UNIX/ Windows/ Linux File System. **Applications:**	8Hrs.

• Understand file handling operations (read, write, and append). • Basic understanding of how pointers are used **Video link / Additional online information :** 1. https://nptel.ac.in/courses/106105214	
UNIT 5	
Message Passing and Deadlocks: Overview of Message Passing, Implementing message passing, Mailboxes, Deadlocks, Deadlocks in resource allocation, Handling Deadlocks, Deadlock detection algorithm, Deadlock Prevention, Deadlock avoidance-Bankers algorithm. **Laboratory Sessions/ Experimental learning:** 1. Simulate Bankers Algorithm for Dead Lock Avoidance. **Applications:** Email management **Video link / Additional online information:** 1. https://nptel.ac.in/courses/106105214	8Hrs.

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

CO1	Summarize the goals, structure, operation and types of operating systems.
CO2	Apply scheduling techniques to find performance factors.
CO3	Apply suitable techniques for contiguous and non-contiguous memory allocation.
CO4	Interpret the organization of file systems and IOCS.
CO5	Describe message passing, deadlock detection and prevention methods.

Text Books:	
1.	Operating Systems: Internals and Design Principles" by William Stallings,Prentice hall Publisher,2011
2.	Operating System Concepts" by Avi Silberschatz and Peter Galvin,Wiley Publisher,8th Edition 2011.
Reference Books:	
1	Operating Systems: A Concept-Based Approach" by D M Dhamdhere,Mc Graw Hill Education,2017
2	Operating System: A Design-oriented Approach" by Charles Crowley, Mc Graw Hill Education,2017

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**	**PSO1**	**PSO2**
CO1	**3**	**3**	**2**	**2**	**2**	**1**	**-**	**-**	**1**	**-**	**-**	**1**	**1**	**-**
CO2	**3**	**3**	**2**	**2**	**2**	**1**	**-**	**-**	**1**	**-**	**-**	**1**	**1**	**-**
CO3	**3**	**3**	**2**	**2**	**2**	**1**	**-**	**-**	**1**	**-**	**-**	**1**	**1**	**-**
CO4	**3**	**3**	**2**	**2**	**2**	**1**	**-**	**-**	**1**	**-**	**-**	**1**	**1**	**-**
CO5	**3**	**3**	**2**	**2**	**2**	**1**	**-**	**-**	**1**	**-**	**-**	**1**	**1**	**-**

High-3, Medium-2, Low-1

Semester: III		
COMPUTER ORGANIZATION & ARCHITECTURE		
Course Code:	**MVJ22EA363**	**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	Explain the basic sub systems of a computer, their organization, structure and Operation.	
2	Execute programs as sequences of machine instructions.	
3	understand different ways of communicating with I/O devices and to introduce memory types including cache memories.	
4	Describe memory hierarchy and concept of virtual memory.	
5	Analyze concepts of Pipelining and other computing systems.	

UNIT 1	
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. **Laboratory Sessions/ Experimental learning:** 1. Understanding various parts of CPU of a PC. 2. Study of Microprocessor and understanding of its various instruction **Applications:** Understand the functionality of the various units of computer. **Video link / Additional online information:** https://nptel.ac.in/courses/106102157	**8Hrs.**
UNIT 2	
Prerequisite :*Number system* **Addressing Modes:** Assembly Language, Basic Input and Output Operations, Stacks and Queues, Subroutines, Additional Instructions. **Laboratory Sessions/ Experimental learning:** 1. Write an ALP to find the sum of two numbers and verify if the sum is an even or	**8Hrs.**

odd number and simulate the output. 2. Write an ALP to transfer a block of data from one location to other and simulate the output. **Applications:** Project based on microprocessor. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/106102157	
UNIT 3	
Input/Output Organization: Accessing I/O Devices, Interrupts – Interrupt Hardware, Enabling and Disabling Interrupts, Handling Multiple Devices, Controlling Device Requests, Direct Memory Access, and Buses. **Laboratory Sessions/ Experimental learning:** Study any one input/output device and examine its various input output ports details. **Applications:** Interfacing of Peripheral devices **Video link / Additional online information:** 1. https://nptel.ac.in/courses/106102157	**8Hrs.**
UNIT 4	
Memory System: Basic Concepts, Semiconductor RAM Memories-Internal organization of memory chips, Static memories, Asynchronous DRAMS, Read Only Memories, Cash Memories, Mapping Functions, Replacement Algorithm, Virtual Memories, Secondary Storage-Magnetic Hard Disks. **Laboratory Sessions/ Experimental learning:** Implement and simulate a simple memory unit which is capable of reading and writing data within a single clock cycle. **Applications:** Understanding the various memories **Video link / Additional online information :** https://nptel.ac.in/courses/106102157	**8Hrs.**
UNIT 5	
Basic Processing Unit: Some Fundamental Concepts, Execution of a Complete Instruction, Multiple Bus Organization, Hardwired Control, Micro programmed Control ,Pipelining	**8Hrs.**

,Basic concepts, Role of Cache memory, Pipeline Performance **Laboratory Sessions/ Experimental learning:** Evaluate the possible control sequence for implementing a multiplication instruction using registers for a single bus organization **Applications:** Microprocessor **Video link / Additional online information:** https://nptel.ac.in/courses/106102157	

Course Outcomes: After completing the course, the students will be able to	
CO1	Identify the functional units of the processor and the factors affecting the performance of a computer
CO2	Demonstrate the ability to classify the addressing modes, instructions sets and design programs.
CO3	Understand the different ways of accessing an input / output device including interrupts.
CO4	Illustrate the organization of different types of semiconductor and other secondary storage memories.
CO5	Illustrate the simple processor organization based on hard wired control and micro programmed control.

Text Books:	
1.	Carl Hamacher, ZvonkoVranesic, SafwatZaky: "Computer Organization", 6th Edition, Tata McGraw Hill, 2011.
2.	Andrew S. Tanenbaum, Todd Austin, "Structured Computer Organization", 6th Edition, Pearson, 2013.
Reference Books:	
1	David A. Patterson, John L. Hennessy: "Computer Organization and Design – The Hardware / Software Interface ARM Edition", 4th Edition, Elsevier, 2009.
2	William Stallings: "Computer Organization & Architecture", 7th Edition, PHI, 2006.

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**	**-**	**1**	**-**	**-**	**1**	**-**	**-**	**1**
CO2	**3**	**3**	**2**	**2**	**-**	**1**	**-**	**-**	**1**	**-**	**-**	**1**
CO3	**3**	**3**	**2**	**2**	**-**	**1**	**-**	**-**	**1**	**-**	**-**	**1**
CO4	**3**	**3**	**2**	**2**	**-**	**1**	**-**	**-**	**1**	**-**	**-**	**1**
CO5	**3**	**3**	**2**	**2**	**-**	**1**	**-**	**-**	**1**	**-**	**-**	**1**

High-3, Medium-2, Low-1

Applied Numerical Methods		
Course Code:	**MVJ22EA364**	**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		
Demonstrate and understand of common numerical methods and apply to obtain approximate solutions to mathematical problems.		

UNIT-I	
Algebraic equations: Systems of linear equations: Gauss Elimination method, Thomas algorithm for tridiagonal system – Jacobi, Gauss Seidel, SOR iteration methods - Systems of nonlinear equations: Fixed point iterations, Newton Method, Eigenvalue problems: power method.	**8 Hrs**
UNIT-II	
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.	**8 Hrs**
UNIT-III	
Finite Element Method: Basic concept of the finite element method. Variational formulation of BVP's, Rayleigh-Ritz approximation, weighted residual methods, finite element analysis of one-dimensional problems.	**8 Hrs**
UNIT-IV	
Numerical Integration: Romberg Integration, Gaussian quadrature, system of first order and higher order differential equations by Euler's and Runge-Kutta methods, The Chebyshev approximation	**8 Hrs**
UNIT-V	
Numerical Methods for the Solution of Systems of Equations: Linear Algebra Review, Linear Systems and Gaussian Elimination, The LU Factorization, Cholesky Decomposition, Iterative Methods for Linear Systems: A Brief Survey, Nonlinear Systems: Newton's Method.	**8 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Solve algebraic equations using direct and iteration methods.
CO2	Understands the basic theory underlying the numerical solution of partial differential equations.
CO3	Understand the concepts behind formulation methods in FEM
CO4	find approximate solutions for ODE.
CO5	Learn to solve system of equations using numerical techniques.

Text Book	
1	B.S. Grewal, "Higher Engineering Mathematics" Khanna Publishers, 43rd Edition, 2013.
Reference Books	
1	Sastry, S.S: "Introductory Methodsof Numerical Analysis"., Prentice Hall India.
2	Jain, M.K, Jain, R.K and Iyenger, S.R.K.: "Numerical Methods for Scientific and Engineering Computations", New Age International Publication Pvt. Ltd.

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	0	0	0	0	0	0	0	1	1
CO2	3	3	2	0	0	0	0	0	0	0	1	1
CO3	3	3	2	0	0	0	0	0	0	0	1	1
CO4	3	3	2	0	0	0	0	0	0	0	1	1
CO5	3	3	2	0	0	0	0	0	0	0	0	0

B.E, IV Semester, Advanced Communication Technology

Semester: IV		
Engineering Electromagnetics		
Course Code:	**MVJ22EA41**	**CIE Marks:50**
Credits:	**L:T:P:S 3:0:0:Y**	**SEE Marks: 50**
Hours:	**40L**	**SEE Duration: 3 Hrs**
Course Learning Objectives: The students will be able to		
1	Understand the applications of Coulomb's law and Gauss law to different charge Distributions.	
2	Understand the physical significance of Biot-Savart's Law, Amperes' Circuital Law and Stokes' theorem for different current distributions.	
3	Apply Maxwell's equations and its applications in plane waves.	
4	Evalute Boundary Conditions and wave equation to solve different field equations	
5	Solve transmission lines problems and Understand the concepts of Smith Chart for impedance matching.	

UNIT 1	
Prerequisites: *Vector Algebra, Coordinate systems (Rectangular Coordinate System, Cylindrical Coordinate System and Spherical Coordinate System), gradient, divergence and curl* **Electrostatics: Coulomb's Law, Electric Field Intensity, Flux density and potential:** Coulomb's law , Electric field intensity, Field due to line charge, Field due to Sheet of charge, Field due to continuous volume charge distribution, Electric flux, Electric flux density, Electric potential, Potential difference, relation between Electric field intensity (E) & potential (V), potential gradient, Electric dipole, Energy density in electrostatic fields. **Laboratory Sessions/ Experimental learning:** 1. Determine the electric field intensity at a point due to uniform linear charge (ρ L) and point charges using MATLAB. 2. Determine the electric field intensity at a point due to surface charge using MATLAB. 3. Determine the potential difference between two points on a ring having linear charge density, ρ L using MALAB. **Applications:** The Van de Graaff generator, Xerography, Ink Jet Printers and Electrostatic Painting, Smoke Precipitators and Electrostatic Air Cleaning	**8 Hrs.**

Video link / Additional online information: 1. https://nptel.ac.in/courses/108104087	
UNIT 2	
Gauss' law, Divergence, Poisson's and Laplace's Equations: Gauss law, Maxwell's First equation, Application of Gauss' law, Divergence theorem, Current, Current density, Conductor, The continuity equation, Boundary conditions (dielectric-dielectric, conductor-dielectric, conductor-free space), Poisson's and Laplace's Equations, Uniqueness theorem. **Laboratory Sessions/ Experimental learning:** 1. Evaluate the current flowing through a given surface using MATLAB. 2. Verify the Divergence theorem using MATLAB. **Applications:** Used for calculation electrical field for a symmetrical distribution of charges **Video link / Additional online information:** 1. https://nptel.ac.in/courses/108104087	**8 Hrs.**
UNIT 3	
Magnetostatics: Steady Magnetic Field-Biot-Savart Law, Ampere's circuital law, Curl, Stokes' theorem, Gauss's law for magnetic fields, Magnetic flux and Magnetic flux density, Maxwell's equations for static fields, Magnetic Scalar and Vector Potentials. **Magnetic Forces and magnetic materials:** Force on a moving charge and differential current element, Force between differential current elements, Magnetization, magnetic susceptibility, permeability, Magnetic boundary conditions, Inductances, magnetic energy, magnetic circuit. **Laboratory Sessions/ Experimental learning:** Determine the magnetic field intensity at a point due to magnetic field using MATLAB. **Applications:** Motors, Generators, Loudspeakers, MRI **Video link / Additional online information :** 1. https://nptel.ac.in/courses/108104087	**8 Hrs.**

UNIT 4	
Time varying Fields and Electromagnetic wave propagation: Time varying fields & Maxwell's equations, Faraday's law, Transformer and Motional Electro - Motive Forces, Displacement current, Maxwell's equation in differential and integral form, Time varying potentials. **Electromagnetic wave propagation:** Derivation of wave equations from Maxwell's equations, Relation between E and H, Wave propagation in - lossy dielectrics, lossless dielectrics, free space and good conductor, skin-effect, Poynting theorem. **Laboratory Sessions/ Experimental learning:** Determine the parameters of wave using MATLAB. **Applications:** Optoelectronics **Video link / Additional online information :** 1. https://nptel.ac.in/courses/108104087	**8 Hrs.**
UNIT 5	
Transmission line: Introduction, Transmission line parameters, Transmission line equations, input impedance, standing wave ratio and power, Smith Chart basic fundamentals, types of transmission lines - coaxial line, strip line, micro strip line. **Applications of transmission line**: Impedance matching and tuning: single stub tuning, double stub tuning, and the quarter wave transformer. **Laboratory Sessions/ Experimental learning:** Simulation of micro strip transmission line **Applications:** Telephone, Cable TV, Broadband network **Video link / Additional online information:** 1. https://nptel.ac.in/courses/108104087	**8 Hrs.**

Course Outcomes: After completing the course, the students will be able to	
CO1	Evaluate problems on electrostatic force, electric field due to point, linear, surface charge and volume charges.
CO2	Apply Gauss law to evaluate Electric fields due to different charge distributions by using Divergence Theorem. Determine potential and capacitance using Laplace equation and Poisson equation.

CO3	Apply Biot-Savart's and Ampere's laws for evaluating Magnetic field for different current configurations.
CO4	Apply Maxwell's equations for time varying fields and evaluate power associated with EM waves using Poynting theorem.
CO5	Execute transmission lines and use Smith chart for determining the impedance and admittance.

Text Book:	
1.	Matthew N. O. Sadiku, "Elements of Electromagnetics", Oxford University Press, Edition VII, 2018.

Reference Books	
2.	David M Pozar, "Microwave Engineering", John Wiley & Sons, Inc., 4th edition, 2014.
3.	W.H. Hayt. J.A. Buck & M Jaleel Akhtar, "Engineering Electromagnetics", Tata McGraw – Hill, Edition VIII, 2014.

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	3	2	2	1	-	-	-	-	-	1
CO2	3	3	3	2	2	1	-	-	-	-	-	1
CO3	3	3	3	2	2	1	-	-	-	-	-	1
CO4	3	3	3	2	2	1	-	-	-	-	-	1
CO5	3	3	3	2	2	1	-	-	-	-	-	1

High-3, Medium-2, Low-1

Semester: IV		
Principles of Communication Systems		
Course Code:	**MVJ22EA42**	**CIE Marks:50**
Credits:	**L:T:P: 3:0:2**	**SEE Marks: 50**
Hours:	**40 L+ 26 P**	**SEE Duration: 03 Hours**

Course Learning Objectives: The students will be able to	
1	Understand the concepts of Analog Modulation schemes viz; AM, FM.
2	Describe different types of noise in communication system.
3	Understand the concepts of digitization of signals viz; sampling, quantizing, and encoding.
4	Analyze the Base Band data transmission system.
5	Distinguish 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. Coherentdetection 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 :**	**8Hrs.**

1. https://nptel.ac.in/courses/108104091	
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 – lockedloop, Linear model of the phase – locked loop, Nonlinear effects in FM systems. **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-born 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/108104091	**8 Hrs.**
UNIT 3	
NOISE: Shot Noise, Thermal noise, White Noise, Noise Figure, Equivalent noise temperature, 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, Capture effect, FM threshold effect, FM threshold reduction, Pre-emphasis, 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/108104091	**8 Hrs.**

UNIT 4	
Inter-symbol 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/108104091	**8 Hrs.**
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. **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. Analyze 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,	**8 Hrs.**

Bluetooth, RFID, GPS, Wi-Fi, etc., **Video link / Additional online information :** 1. https://nptel.ac.in/courses/108104091	

Lab Experiments

1. Simulation of ASK, FSK, and BPSK generation schemes
2. Simulation of DPSK, QPSK and QAM generation schemes
3. Simulation of signal constellations of BPSK, QPSK and QAM
4. Simulation of ASK, FSK and BPSK detection schemes
5. Simulation of Linear Block and Cyclic error control coding schemes
6. Simulation of Convolutional coding scheme
7. Communication link simulation

Course outcomes:	
CO1	Examine the concepts of analog modulation techniques such as amplitude, modulations andits 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 pre-emphasis and deemphasis circuit.
CO4	Analyze the signal space representation of digital signals.
CO5	Simulate different digital modulation techniques and error coding schemes

Text 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.

Reference Books	
1	John G Proakis and MasoudSalehi, “Fundamentals of Communication Systems”, 2014 Edition, Pearson Education, ISBN 978-8-131-70573-5.
2	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. The 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 tests, quizzes 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 timetable 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 marksfor the laboratory are 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 subdivisions. Each unit will have an

internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

Laboratory- 50 Marks

Experiment Conduction with proper results is evaluated for 40 marks and Viva is for 10 marks. Total SEE for laboratory is 50 marks.

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: IV		
Modern Control systems		
Course Code:	**MVJ22EA43**	**CIE Marks:100**
Credits:	**L:T:P: 3:0:0**	**SEE Marks: 100**
Hours:	**40L**	**SEE Duration: 3 Hrs**
Course Learning Objectives: The students will be able to		
1	Execute mathematical modelling of systems and understand the concepts of transfer function	
2	Solve transfer function using block diagram reduction and signal flow graph techniques.	
3	Analyze the response of first and second order systems using standard test signals and analyze steady state error.	
4	Analyze stability of systems using RH criteria, Root Locus, Nyquist, Bode plot and polar plot.	
5	Derive 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://nptel.ac.in/courses/107106081	**10Hrs.**
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	**10Hrs.**

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 :** https://nptel.ac.in/courses/107106081	
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://nptel.ac.in/courses/107106081	**10Hrs.**
UNIT 4	
Stability analysis using Nyquist criteria and Bode plots: Polar plot, Nyquist Stability criterion, Nyquist plots, Bode plots, Gain and phase margin. **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:**	**10Hrs.**

1. https://nptel.ac.in/courses/107106081	
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.Lag, lead and lag lead compensation. **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://nptel.ac.in/courses/107106081**	**10Hrs.**

Course Outcomes: After completing the course, the students will be able to	
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	Derive space equations and solutions of a given electrical system.

Text Book:	
1.	Nagarath and M.Gopal, — Control Systems Engineering‖, New Age International (P) Limited, Publishers, Fifth edition-2005, ISBN: 81-224-2008-

Reference Books	
2.	Modern Control Engineering, K.Ogata, Pearson Education Asia/PHI, 4th Edition, 2002. ISBN 978-81-203-4010-7.
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		
Communication laboratory		
Course Code:	**MVJ22EAL44**	**CIEMarks:50**
Credits:	**L:T:P:0:0:2**	**SEEMarks: 50**
Hours:	**26P**	**SEEDuration:03Hours**
Course Learning Objectives: The students will be able to		
1	Evaluate the effects of sampling and TDM	
2	Evaluate AM & FM modulation and demodulation	
3	Analyze PCM & DM	
4	Evaluate Digital Modulation schemes	

	EXPERIMENTS
1	Signal Sampling and reconstruction
2	Time Division Multiplexing
3	AM Modulator and Demodulator
4	FM Modulator and Demodulator
5	Pulse Code Modulation and Demodulation
6	Delta Modulation and Demodulation
7	Line coding schemes
8	DSB SC Modulation
9	Pre-Emphasis & de-emphasis
10	Pulse Amplitude Modulation abd Detection
11	Generation of PWM/PPM Signal
12	Generation and Detection of ASK Waveform

Course Outcomes: After completing the course, the students will be able to	
CO1	Validation of the the various functional modules of a communication system.
CO2	Demonstrate their knowledge in base band signaling schemes through Implementation of digital modulation schemes.
CO3	Apply various channel coding schemes & demonstrate their capabilities.
CO4	Execute different modulation techniques

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: IV		
Digital Communication		
Course Code:	**MVJ22EA451**	**CIE Marks:50**
Credits:	**L:T:P: 3:0:2**	**SEE Marks: 50**
Hours:	**40T**	**SEE Duration: 03 Hours**
Course Learning Objectives: The students will be able to		
1	Understand the concept of signal processing of digital data and signal conversion to symbols at the transmitter and receiver.	
2	Analyze performance metrics and parameters for symbol processing and recovery in ideal and corrupted channel conditions.	
3	Understand the principles of spread spectrum communications and the basic principles of information theory and various source coding techniques.	
4	Analyze different types of errors and error detection and controlling codes used in the communication channel.	
5	Execute convolution codes and analyze the code words using time domain and transform domain approach.	
Module -I		
Prerequisites: *Basics of signal processing* ***Elements of Digital Communication Systems*:** Elements of Communication System, Block diagram of digital communication system, Certain issues in Digital Transmission, Advantages of Digital Communication, Channels for Digital communication, Digital Representation of Analog Signal – Sampling, Sampling theorem for band limited signals, Hartley Shannon Law, Bandwidth-S/N tradeoff. **Laboratory Sessions/ Experimental learning:** FSK generation and detection PSK generation and detection **Applications:** Modern communication systems, such as cellular phones, Wi-Fi, and Bluetooth **Video link/ Additional online information:** https://nptel.ac.in/courses/108102096		**8 Hrs**
Module -II		
Pulse Digital Modulation: Elements of PCM: Sampling, Quantization & Coding, Quantization error, Companding in PCM systems, Differential PCM systems (DPCM),		**8 Hrs**

Time Division Multiplexing & Demultiplexing.Delta modulation, its draw backs, adaptive delta modulation, comparison of PCM and DM systems, Noise in PCM and DM systems **Laboratory Sessions/ Experimental learning:** Generation and detection of PCM signal. **Applications:** Communications, radars, positioning, sensing, and remote control. **Video link/ Additional online information:** https://nptel.ac.in/courses/108102096	
Module -III	
Bandpass Signal to Equivalent Low pass: Hilbert Transform, Pre-envelopes, Complex envelopes, Canonical representation of bandpass signals, Complex low pass representation of bandpass systems, Complex representation of band pass signals and systems, Coherent and Non-Coherent ASK detector ,Coherent reception of BPSK, DPSK, QPSK. **Laboratory Sessions/ Experimental learning:** Hilbert Transform. **Applications:** Establishment of secure communications, increasing resistance to natural interference, noise, and jamming, to prevent detection, to limit power flux density (e.g., in satellite downlinks) **Video link/ Additional online information:** https://nptel.ac.in/courses/108102096	**8 Hrs**
Module -IV	
Introduction to Information Theory: Measure of information, Average information content of symbols in long independent sequences. **Source Coding:** Encoding of the Source Output, Shannon's Encoding Algorithm, Shannon-Fano Encoding Algorithm, Huffman coding. **Error Control Coding:** Introduction, Examples of Error control coding, methods of Controlling Errors, Types of Errors, types of Codes. **Laboratory Sessions/ Experimental learning:** Write a program to encode binary data using Huffman code and decode it. **Applications:**	**8 Hrs**

Quantum computing, molecular codes, thermal physics, anomaly detection, black hole, intelligence gathering, cryptography, linguistics, molecular dynamics, information retrieval, complex art, and statistical inference. **Video link / Additional online information:** https://nptel.ac.in/courses/108102096	
Module -V	
Linear Block Codes: Matrix description of Linear Block Codes, Error Detection & Correction capabilities of Linear Block Codes, Single error correction Hamming code, Table lookup Decoding using Standard Array. **Convolution codes:** Convolution Encoder, Time domain approach, Transform domain approach, Code Tree, Trellis and State Diagram. **Laboratory Sessions/ Experimental learning:** Write a program to encode binary data using a (7,4) Hamming code and decode it. **Applications:** Information systems, Data management systems, Data structures, Data layout, Data encryption. **Video link / Additional online information**: https://nptel.ac.in/courses/108102096	**8 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Explain the conventional digital communication system.
CO2	Discuss the pulse digital modulation schemes such as PCM, DPCM and DM.
CO3	Analysis of bandpass signals and systems
CO4	Apply the fundamentals of information theory and perform source coding for given message.
CO5	Apply different encoding and decoding techniques with error Detection and Correction.

Text Books	
1.	Simon Haykin, “Digital Communication Systems”, John Wiley & sons, First Edition, 2014, ISBN 978-0- 471-64735-5.
2.	John G Proakis and Masoud Salehi, “Fundamentals of Communication Systems”, 2014 Edition, Pearson Education, ISBN 978-8-131-70573-5.

Reference Books	
1	K Sam Shanmugam, “Digital and analog communication systems”, John Wiley India Pvt. Ltd, 1996.
2	Hari Bhat, Ganesh Rao, “Information Theory and Coding”, Cengage, 2017.
3	Todd K Moon, “Error Correction Coding”, Wiley Std. Edition, 2006
4	Bernard Sklar, “Digital Communications – Fundamentals and Applications”, Second Edition, Pearson Education, 2016, ISBN: 9780134724058.

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 self -study are 20 (2 presentations are be held for 10 marks each). The marks obtained in test, quiz and self -studies 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 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 complete 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.

Laboratory- 50 Marks

Experiment Conduction with proper results is evaluated for 40 marks and Viva is for 10 marks. Total SEE for laboratory is 50 marks.

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

High-3, Medium-2, Low-1

Semester: IV		
Data Structures Using C++		
Course Code:	**MVJ22EA452**	**CIE Marks:100**
Credits:	**L:T:P: 3:0:0**	**SEE Marks: 100**
Hours:	**40L**	**SEE Duration: 3 Hrs**
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	Apply the knowledge of algorithms of queues and stacks.	
4	Analyze the concepts of Binary trees.	
5	Execute different 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. **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 **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/	8Hrs.

UNIT 2	
Prerequisites: Programming using the concept of Arrays and pointers **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:** 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	8Hrs.
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:** 1. Towers of Hanoi. 2. 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. 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/	8Hrs.
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 analyze it. Video link / Additional online information: 1. https://nptel.ac.in/courses/106/106/106106133/ 2. https://nptel.ac.in/courses/106/105/106105225/ 1. https://nptel.ac.in/courses/106/102/106102064/	8Hrs.

Course Outcomes: After completing the course, the students will be able to	
CO1	Acquire knowledge of Python fundamentals and data structures.
CO2	Analyze 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	Execute Graphical algorithms.

Text Books:	
1.	Rance D Necaise “Data Structures and Algorithms using Python”, Wiley, John Wiley and Sons.
2	Yeshavant Kanetkar”Data Structure using C++”bpb Publisher-March 2022

Reference Books	
1.	Michael T. Goodrich, R. Tamassia and Michael H Goldwasser “Data structures and Algorithms in python”, Wiley student edition, John Wiley and Sons.
2.	Narasimha Karumanchi “Data Structures and Algorithmic Thinking with Python”, CareerMonk Publications.

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 marksis 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	PSO1	PSO2
CO1	3	3	2	2	-	1	-	-	1	-	-	1	1	1
CO2	3	3	2	2	-	1	-	-	1	-	-	1	1	1
CO3	3	3	2	2	-	1	-	-	1	-	-	1	1	1
CO4	3	3	2	2	-	1	-	-	1	-	-	1	1	1
CO5	3	3	2	2	-	1	-	-	1	-	-	1	1	1

Semester:IV		
ARM MICROCONTROLLER		
Course Code:	**MVJ22EA453**	**CIE Marks:50**
Credits:	**L:T:P: 3:0:2**	**SEE Marks: 50**
Hours:	**40 L**	**SEE Duration: 03Hours**

Course Learning Objectives: The students will be able to

1	Explain the fundamentals of ARM based system, basic hardware components, selection methods and attributes of an ARM Controller.
2	Design ARM controller using various instructions.
3	Understand the fundamentals of Exception, Interrupt Handling and Memory Management Unit of ARM Controller.
4	Implement Embedded System Design applications.
5	Evaluate real time operating system for embedded system design.

UNIT-I	
ARM EMBEDDED SYSTEMS: ***Prerequisites:*** **ARM DESIGN PHILOSOPHY, ARM DATAFLOW MODEL** **Microprocessors versus Microcontrollers, ARM Embedded Systems**: The RISC design philosophy, The ARM Design Philosophy, Embedded System Hardware, Embedded System Software. **ARM Processor Fundamentals**: Registers, Current Program Status Register, Pipeline, Exceptions, Interrupts, and the Vector Table, Core Extensions **Laboratory Sessions/ Experimental learning:** **1.Comparision of Microprocessor and Microcontroller hardware Model** **2.Comparing the Microprocessor and Microcontroller Software Model** **Applications:** Smartphones, Tablets, Wearables **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=DMsL6TVS0IQ https://www.youtube.com/watch?v=JPfG0UQd3x4	**8 Hrs**
UNIT-II	
ARM Instruction Set and Programming ***Prerequisites:*** **ARM INSTRUCTION SET,ARM ASSEMBLY PROGRAMMING** **Introduction to the ARM Instruction Set :** Data Processing Instructions , Programme Instructions, Software Interrupt Instructions, Program Status Register Instructions, Coprocessor Instructions, Loading Constants	**8 Hrs**

ARM programming using Assembly language: Writing Assembly code, Profiling and cycle counting, instruction scheduling **Laboratory Sessions/ Experimental learning:** **1.Writing ARM Assembly program for Embedded System Applications** **Applications:** Coding Device Drivers, Real-Time Systems, Low-Level Embedded Systems, Boot Codes, Reverse Engineering **Video link / Additional online information:** https://www.youtube.com/watch?v=gfmRrPjnEw4	
UNIT-III	
Interrupt and Memory Management Unit: ***Prerequisites:*** **Interrupt, Exception, Memory Management unit** **Exception, Interrupt Handling :** Exception handling, Interrupts, Interrupt handling Schemes **Memory Management Unit :** The Memory Hierarchy and Cache Memory, Cache Architecture, Cache Policy, Moving from MPU to an MMU, How Virtual Memory Works, Details of ARM MMU **Laboratory Sessions/ Experimental learning:** **1) Use of External interrupt0 to turn ON/OFF led connected to Pin P1.25 of ARM Processor.** **2) Use of Software Interrupt SWI instruction in programming.** **3) Calculating physical memory address from logical address**. **Applications: Internal Errors and Special Conditions Management, Hardware Concurrency, and Service Requests Management.** **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=-Dt9EDsMHiI https://www.youtube.com/watch?v=Kju5UMLC7hg	**8 Hrs**
UNIT-IV	
Prerequisites: Embedded systems, Embedded Applications **Embedded System Components:** Embedded Vs General computing system, History of embedded systems, Classification of Embedded systems, Major applications areas of embedded systems, purpose of embedded systems Core of an Embedded System including all types of processor/controller, Memory, Sensors, Actuators, LED, 7 segment LED display, stepper motor, Keyboard, Push button switch, Communication Interface (on board and external types), Embedded firmware, Other system components. **Laboratory Sessions/ Experimental learning:** Digital Clock, Battery operated Smartcard Reader	**8 Hrs**

Applications: Home Appliances, Office Automation, Security, Telecommunication **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=SD65b5cYfdI https://www.youtube.com/watch?v=obknO3gA92E	
UNIT-V	
Prerequisites: Real time operating system **Real Time Operating System (RTOS) based Embedded System Design:** Operating System basics, Types of operating systems, Task, process and threads (Only POSIX Threads with an example program), Thread pre-emption, Multiprocessing and Multitasking, Task Communication (without any program), Task synchronization issues – Racing and Deadlock, Concept of Binary and counting semaphores (Mutex example without any program), How to choose an RTOS **Laboratory Sessions/ Experimental learning:** Automated Meter Reading System (AMR) and Digital Camera, Real time concepts **Applications: Industrial Control, Telephone Switching Equipment, Flight Control, and Real-Time Simulations** **Video link / Additional online information:** https://www.youtube.com/watch?v=T54qJMqpim8	**8 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Describe the architectural features and instructions of ARM microcontroller
CO2	Develop Assembly Programs in ARM for Embedded applications.
CO3	Describe the fundamentals of Exception, Interrupt Handling and Memory Management Unit of ARM Controller
CO4	Interface external devices and I/O with ARM microcontroller.
CO5	Demonstrate the need of real time operating system for embedded system applications

Text Books	
1.	Andrew N Sloss, Dominic Symes and Chris Wright, ARM system developer's guide, Elsevier, Morgan Kaufman publishers, 2008.
2.	Shibu K V, "Introduction to Embedded Systems", Tata McGraw Hill Education, Private Limited, 2nd Edition.
Reference Books	
1.	Raghunandan.G.H, "Microcontroller (ARM) and Embedded System", Cengage learning Publication, 2019
2.	Hung Le,"ARM Microcontrollers: Theory and Practical Applications ",Cognella, Inc Publications,November 2021

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 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.

Laboratory- 50 Marks

Experiment Conduction with proper results is evaluated for 40 marks and Viva is for 10 marks. Total SEE for laboratory is 50 marks.

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

Semester: IV		
Engineering Statistics and Linear Algebra		
Course Code:	**MVJ22EA454**	**CIE Marks: 50**
Credits:	**L: T:P:S: 2:2:0:0**	**SEE Marks: 50**
Hours:	**30L+10T**	**SEE Duration: 3 Hrs.**

Course Learning Objectives: The students will be able to

- Organize, manage, and present data using statistical methods.
- Demonstrate the important tools of linear algebra, that are essential in all branches of engineering.
- Evaluate linear transformation and decomposition techniques in a comprehensive manner.

UNIT-I	
Correlation and Regression: Correlation, Regression coefficients, line of regression problems. **Curve fitting:** Fitting of the curves of the form $y = ax + b$, $y = ax^2 + bx + c$, $y = ae^{bx}$ by the method of least squares.	**8 Hrs**
UNIT-II	
Design of Experiments (ANOVA): One way and Two way classifications, Completely randomized design, Randomized block design, Latin square design.	**8 Hrs**
UNIT-III	
Linear Equations: Consistent and inconsistent systems and its solution sets; LU-decomposition. **Vector Spaces:** Vector spaces; subspaces, Linearly independent and dependent vectors, Bases and dimension, coordinate vectors, computations concerning subspaces-Illustrative examples.	**8 Hrs**
UNIT-IV	
Linear Transformations: Linear transformations, algebra of transformations, representation of transformations by matrices, linear functional, Non singular Linear transformations, inverse of a linear transformation, Problems on Rank-Nullity theorem.	**8 Hrs**
UNIT-V	
Inner Product Spaces: Inner products, inner product spaces, orthogonal sets and orthogonal projections, Gram-Schmidt orthogonalization process, QR- decomposition.	**8 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Fit a suitable curve by the method of least squares and determine the lines of regression for a set of statistical data.
CO2	Understand the need and application of analytics.
CO3	Analyze whether a system is consistent or inconsistent, its solution is unique or infinite and find bases and dimension of vector spaces required in network analysis.
CO4	Linearly transform the system from one dimension to another in matrix form, required to analyze image processing problems.
CO5	Compute orthogonal and orthonormal basis vectors required to analyze image and signal processing problems.

Text Books	
1.	Introduction to Linear Algebra, Gilbert Strang, Wellesley Cambridge Press, 5th Edition, 2016.
2.	Linear Algebra and its Applications, David C. Lay, Cambridge University Press, 3rd Edition, 2017.
Reference Books	
1	Fundamentals of Statistics, S C Gupta, Himalaya Publications 2012.
2	B.S. Grewal, "Higher Engineering Mathematics" Khanna Publishers, 44th Edition, 2013.

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**	**0**	**1**
CO2	**3**	**3**	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
CO3	**3**	**3**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
CO4	**3**	**3**	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
CO5	**3**	**2**	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**

Semester: V		
TECHNICAL MANAGEMENT		
Course Code:	**MVJ22EA51**	**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	Explain the concepts of management, planning, organizing, and staffing.
2	Apply the knowledge required to become an entrepreneur.
3	Understand and choose the appropriate institutional support to succeed as an entrepreneur.
4	Analyze the requirements towards the small-scale industries and project preparation.
5	Understand the general principles of IPR, Concept and Theories, Criticisms of Intellectual Property Rights.

Module 1	
Prerequisites: Basics of management system, roles and responsibilities. **Management**: Introduction, Meaning, nature and characteristics of Management, Scope and Functional areas of management, Management as a science, art of profession, Management &Administration, Roles of Management, Levels of Management, Managerial Skills, Management & Administration, Development of Management Thought early management approaches, Modern management approaches. **Applications:** IT sectors and Institutional Research sectors. **Video link / Additional online information:** https://nptel.ac.in/courses/110/107/110107150/ https://nptel.ac.in/courses/110/105/110105146/	**8Hrs.**
Module 2	
Planning: Nature, Importance, Types, Steps and Limitations of Planning, Decision Making: Meaning, Types and Steps in Decision Making **Organizing and Staffing:** Nature and purpose of organization, Principles of organization, Span of Management, Types of organization, Departmentation Committees, Centralization Vs Decentralization of authority and responsibility, Span of control, MBO and MBE (Meaning Only) Nature and importance of staffing: Need and Importance, Recruitment and Selection Process. **Applications:** IT sectors, Banking sectors and Institutional Research sectors. **Video link / Additional online information:** https://nptel.ac.in/courses/110/107/110107151/	**8Hrs.**

Module 3	
Directing and Controlling: Meaning and nature of directing Leadership styles, Motivation Theories, Communication: Meaning and importance, Leadership: Meaning, Characteristics, Behavioral Approach of Leadership; Coordination: Meaning, importance and Techniques of Coordination. Meaning and steps in Controlling, Essentials of a sound control system and Methods of establishing control system. **Applications:** Core Industrial sectors, New Enterprises sectors. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/110/106/110106141/	**8Hrs.**
Module 4	
Small Scale Industries: Definition, Characteristics, Need and rationale, Objectives, Scope, role of SSI in Economic Development. Advantages of SSI, Steps to start and SSI-Government policy, Different Policies of SSI, Government Support for SSI during 5year plans. Impact of Liberalization, Privatization, Globalization on SSI Effect of WTO/GATT, Sickness in SSI sector, Problems for Small Scale Industries, Supporting Agencies of Government for SSI, Meaning, Nature of support, Objectives, Functions, Types of Help, Ancillary Industry and Tiny Industry. **Applications:** Industrial sectors, and Institutional Research sectors. **Video link / Additional online information:** https://www.youtube.com/watch?v=2I0XdF_uOuA https://www.youtube.com/watch?v=jmx7SiCzay8	**8Hrs.**
Module 5	
Intellectual Property Rights: Introduction to Intellectual Property Rights, Copyrights, Trademarks, Designs and Design Patents, Semiconductor Integrated Circuits and Layout Designs. Ideas and Intellectual Property Rights, Contents of a Patent, Patent Draft, Filing Patent Applications, IPR Strategy and IPR Policy **Applications:** Research works copyrights, Paper Publication and Patent filing. **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=RLQivEQUgUc https://www.youtube.com/watch?v=NFTBbfYGM6A	**8Hrs.**

Course Outcomes	
CO1	Explain about the management and planning.
CO2	Apply the knowledge on organizing and staffing,
CO3	Analyse the concept of directing, and controlling.
CO4	Choose the requirements towards the small-scale industries and project preparation.
CO5	Understand the Concepts of Intellectual Property Rights
Text Books:	
1.	P.C.Tripathi, P.N.Reddy , "Principles of Management", Tata Mc Graw Hill, 5th edition, 2008.
2.	Poornima M Charantimath, "Entrepreneurship Development Small Business Enterprises", Pearson Education, 2008, ISBN 978-81-7758-260-4.
3.	Rachna Singh Puri & Arvind Viswanathan, "Practical Approach to Intellectual Property Rights", 1/e, I K International Publishing House Pvt. Ltd, 2009.

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	-	-	1	-	3	3	2	2	1
CO2	-	3	3	-	-	1	-	3	3	2	2	1
CO3	-	3	3	-	-	1	-	3	3	2	2	1
CO4	-	3	3	-	-	1	-	3	3	2	2	1
CO5	-	3	3	-	-	1	-	3	3	2	2	1

High-3, Medium-2, Low-1

Semester-V		
MICROWAVE ENGINEERING		
Course Code:	**MVJ22EA52**	**CIE Marks:50**
Credits:	**L: T:P: 3:0:0**	**SEE Marks: 50**
Hours:	**40L**	**SEE Duration: 3 Hrs**

Course objectives:Students will be able to

1	Analyze and study rectangular and circular wave guides using field theory.
2	Understand the theoretical principles underlying microwave devices and networks.
3	Design microwave components such as power dividers, hybrid junctions, Directional Couplers, microwave filters, Microwave Wave-guides and Components, Ferrite Devices.
4	Examine Microwave Solid-State Microwave Devices and Microwave Tubes.
5	Evaluate Microwave Measurement Techniques.

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

Module-1

Introduction, Microwave Spectrum and Bands, Applications of Microwaves, Rectangular Waveguides – TE/TM mode analysis, Expressions for Fields, Characteristic Equation and Cut-off Frequencies, Dominant and Degenerate Modes, Sketches of TE and TM mode fields in the cross section, Mode Characteristics – Phase and Group Velocities, Wavelengths and Impedance Relations; Power Transmission and Power Losses in Rectangular Guide, Impossibility of TEM mode.

Application:Transmitting Power and communication signals,Microwave RADAR,Coupler

Web Reference: https://nptel.ac.in/courses/108103141

Module-2

Circular waveguides- Introduction, Characteristic Equation, Dominant and Degenerate Modes. Microstrip Lines– Introduction, Zo Relations, Effective Dielectric Constant, Losses, Q factor. Cavity Resonators–Types, Resonant Frequencies, Q factor and Coupling Coefficients, Related Problems..

Application:Attenuator,TV Signal Generator, low-noise block converters for TV signal receiving antennas.

Web Reference: https://nptel.ac.in/courses/108103141

Module-3
Terminations, Attenuators, Phase shifters, Directional couplers, Hybrid Junctions, Power dividers, Circulator, Isolator, Impedance matching devices: Tuning screw, Stub and quarter wave transformers. Crystal and Schottkey diode detector and mixers, PIN diode switch, Gunn diode oscillator, IMPATT diode oscillator and amplifier, Varactor diode, Introduction to MIC. **Application: Frequency translators,Amplitude and phase modulation,Phased arrays for the Radar systems,SSPA:linearization / RF distortion,Residual phase noise measurement,Signal phase correction in long-distance fibre optics communication link** **Web Reference:** https://nptel.ac.in/courses/108103141
Module-4
Review of conventional vacuum Triodes, Tetrodes and Pentodes, High frequency effects in vacuum Tubes, Theory and application of Two cavity Klystron Amplifier, Reflex Klystron oscillator, Traveling wave tube amplifier, Magnetron oscillator using Cylindrical, Linear, Coaxial Voltage tunable Magnetrons, Backward wave Crossed field amplifier and oscillator. **Application: Radio receivers. Portable microwave links. Parametric amplifiers. Local oscillators of microwave receivers** **Web Reference:** https://nptel.ac.in/courses/108103141
Module-5
Measuring Instruments : Principle of operation and application of VSWR meter, Power meter, Spectrum analyzer, Network analyzer, Measurement of Impedance, Frequency, Power, VSWR, Q-factor, Dielectric constant, Scattering coefficients, Attenuation, S-parameters. **Application: Microwave leakage meters, area monitors, and power measuring devices are used to detect and measure microwave energy** **Web Reference:** https://nptel.ac.in/courses/108103141

Course outcomes	
1.	Explain different types of waveguides and their respective modes of propagation.
2.	Analyze typical microwave networks using impedance, admittance, transmission and scattering matrix representations.
3.	Design microwave matching networks using L section, single and double stub and quarter
	wave transformer.
4.	Explain working of microwave passive circuits such as isolator, circulator, Directional couplers, attenuators etc.
5.	Describe and explain working of microwave tubes and solid state devices.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- There are 25 marks for the CIE's Assignment component and 25 for the Internal Assessment Test component.
- Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the coverage of the syllabus, and the second test will be administered after 85-90% of the coverage of the syllabus. The average of the two tests shall be scaled down to 25 marks
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The schedule for assignments shall be planned properly by the course teacher. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. Each assignment shall be conducted for 25 marks. (If two assignments are conducted then the sum of the two assignments shall be scaled down to 25 marks)
- The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and assignment/s marks.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.

Suggested Learning Resources:

Books

1. David M. Pozar – Microwave Engineering, 4th Edition, John Wiley & Sons, Inc. 2013
2. E C Jordan and K G Balmain - Electromagnetic Waves and Radiating Systems, 2nd Edition, PHI, 2003.

Web links and Video Lectures (e-Resources):

- http://nptel.ac.in/courses
- https://nptel.ac.in/courses/108103141
- https://nptel.ac.in/courses/108105114

CO-PO Mapping														
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	**3**	**3**	**3**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**3**	**1**
CO2	**3**	**3**	**3**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**3**	**1**
CO3	**3**	**3**	**3**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**3**	**1**
CO4	**3**	**3**	**3**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**3**	**1**
CO5	**3**	**3**	**3**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**3**	**1**

Semester: V		
Signal Processing		
Course Code:	**MVJ22EA53**	**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	Understand the frequency domain sampling and reconstruction of discrete time signals.	
2	Execute the properties and the development of efficient algorithms for the computation of DFT.	
3	Design IIR filters from the analog filters using impulse invariance and bilinear transformation.	
4	Understand different windows used in the design of FIR filters and design appropriate filters based on the specifications.	
5	Explain DSP Processor Architecture and study real time applications of DSP	

UNIT I	
Prerequisites: DTFT and its properties. **Discrete Fourier Transforms (DFT):** Frequency domain sampling and reconstruction of discrete time signals, DFT as a linear transformation, Properties of DFT. **Laboratory Sessions/ Experimental learning:** 1. DFT computation of square pulse and Sinc function using MATLAB. **Applications:** Spectral Analysis of Signals, Frequency Response of Systems, Convolution via the Frequency Domain. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/117/105/117105134/ 2. **https://nptel.ac.in/courses/117102060** **Project: OBJECT DETECTION SYSTEM**	**8Hrs.**
UNIT 2	
Linear filtering methods based on the DFT: Use of DFT in Linear Filtering, Filtering of Long Data Sequences, overlap-save and overlap-add method. **Fast-Fourier-Transform (FFT) algorithms**: Efficient Computation of the DFT: Radix-2 FFT algorithms for the computation of DFT and IDFT, decimation-in-time and decimation-in frequency Algorithms. **Laboratory Sessions/ Experimental learning**: 1. Computation of FFT of a given image and to plot magnitude and phase spectrum using MATLAB.	**8Hrs.**

Applications: Frequency domain filtering, video and audio signal processing. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/117105134 **Project: ECHO CANCELLATION SYSTEM**	
UNIT 3	
Prerequisites: L- Hospital rule, Sinc function **Design of FIR Filters**: Symmetric and Antisymmetric FIR filters, Design of Linear-phase FIR filters using windows - Rectangular, Hamming, Hanning, Bartlett windows. Design of FIR filters using frequency sampling method. **Structure for FIR Systems:** Direct form, Cascade form and Lattice structures. **Laboratory Sessions/ Experimental learning:** 1. Design and implementation of Low pass FIR filter to meet the desired specifications (using different window techniques) and test the filter with an audio file. Plot the spectrum of audio signal before and after filtering. **Applications:** Noise suppression, Enhancement of selected frequency ranges, Removal or attenuation of selected frequencies **Video link / Additional online information:** 1. https://nptel.ac.in/courses/117/102/117102060/ 2. https://nptel.ac.in/courses/108/105/108105055/ **Project: INTELLIGENT SENSOR ANALYSIS SYSTEM**	**8Hrs.**
UNIT 4	
Prerequisites: Types of filters **IIR filter design**: Characteristics of commonly used analog filter – Butterworth and Chebyshev filters, analog to analog frequency transformations. Design of IIR Filters from analog filter using Butterworth filter: Impulse invariance, Bilinear transformation. **Laboratory Sessions/ Experimental learning:** 1. Design and implementation of Low pass IIR filter to meet the desired specifications (using different window techniques) and test the filter with an audio file. Plot the spectrum of audio signal before and after filtering **Applications:** Audio equalization, biomedical sensor signal processing, IoT/IIoT smart sensors and high-speed telecommunication/RF applications. **Video link / Additional online information :** 1. https://nptel.ac.in/courses/117/102/117102060/	**8Hrs.**

Project: VOICE VERIFICATION SYSTEM	
UNIT 5	
Prerequisites: Binary number system, basics of computer architecture **Digital Signal Processors:** DSP Architecture, DSP Hardware Units, Fixed point format, Floating point Format, IEEE Floating point formats, FIR and IIR filter implementations in Fixed point systems. Application of DSP to real systems : Voice Processing, Music processing, Image processing and Radar processing. **Laboratory Sessions/ Experimental learning:** 1. Generation of sinusoid and Plotting with CCS (TMS320C6713) **Applications:** Audio, Military, Video & Imaging, Wireless **Video link / Additional online information:** 1. https://nptel.ac.in/courses/108/105/108105055/ **Project: LANE DETECTION SYSTEM**	**8Hrs.**

Course Outcomes: After completing the course, the students will be able to	
CO1	Compute DFT of real and complex discrete time signals.
CO2	Analyse the computational complexity of DFT and FFT algorithms.
CO3	Solve problems on FIR filter design and realize using digital computations.
CO4	Design and realize IIR digital filters.
CO5	Illustrate the DSP processor architecture and to apply knowledge to various real time cases.

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 self -study are 20 (2 presentations are be held for 10 marks each). The marks obtained in test, quiz and self -studies 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 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 complete 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.

Laboratory- 50 Marks

Experiment Conduction with proper results is evaluated for 40 marks and Viva is for 10 marks. Total SEE for laboratory is 50 marks.

CO-PO-PSO Mapping														
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	**3**	**3**	**3**	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**1**
CO2	**3**	**3**	**3**	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**1**
CO3	**3**	**3**	**3**	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**1**
CO4	**3**	**3**	**3**	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**1**
CO5	**3**	**3**	**3**	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**1**

High-3, Medium-2, Low-1

Semester: V		
Optical Communication Laboratory		
Course Code:	**MVJ22EAL54**	**CIE Marks: 50**
Credits:	**L:T:P:0:0:2**	**SEE Marks: 50**
Hours:	**20**	**SEE Duration: 3 Hrs**

Course Learning Objectives: The students will be able to

1	Evaluate basic concepts of Optical Fibre
2	Execute losses in Optical Fibre
3	Evaluate varius characteristic of LASER and LED
4	Evaluate Varius characteristic of Photo diode and Avalanche Diode
5	Determine bit error rate of Optical Fibre using Analog and Digital Link

PART A

1. Measurement of Numerical Aperture of a fiber, after preparing the fiber ends.
2. Setting up of Fiber optic Digital link.
3. Preparation of a Splice joint and measurement of the splice loss.
4. Power vs Current (P-I) characteristics and measure slope efficiency of Laser Diode.
5. Voltage vs Current (V-I) characteristics of Laser Diode.
6. Power vs Current (P-I) characteristics and measure slope efficiency of LED.
7. Voltage vs Current (V-I) characteristics of LED.
8. Characteristics of Photodiode and measure the responsivity.
9. Characteristics of Avalanche Photo Diode (APD) and measure the responsivity.
10. Measurement of fiber characteristics, fiber damage and splice loss/connector loss
11. Analog communication link using optical fiber
12. Determination of bit error rate using digital link

Course outcomes:

CO1	Measurement of Numerical Aperture of a fiber
CO2	Setting up of Fiber optic Digital link and measurement of splice loss
CO3	Measurement of V-I and P-I characterstic of LASER and LED
CO4	Measure the responsivity of photo diode and avalanche photo diode
CO5	Determination of bit error rate using digital link

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**3**		**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**
CO2	**3**	**3**	**3**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**2**
CO3	**1**		**2**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**2**
CO4	**1**		**2**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**2**
C05	**1**		**2**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**2**

Semester: V		
SATELLITE COMMUNICATION		
Course Code:	**MVJ22EA551**	**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	Understand orbital aspects of satellite communication	
2	Describe electronic systems associated with a satellite and the earth station and understanding satellite applications focusing various domains services	
3	Understand typical challenges of satellite-based systems.	
4	Describe basic principle of RADAR and RADAR equation.	
5	Understand the need and functioning of CW, FM-CW and MTI radars	

UNIT 1	
Prerequisites: Digital Communication Systems **Introduction to Satellite Communication:** Orbital aspects of Satellite Communication, Introduction to geo-synchronous and geo-stationary satellites, Kepler's laws, Locating the satellite with respect to the earth, Sub-satellite point, Look angles, Mechanics of launching a synchronous satellite. **Laboratory Sessions/ Experimental learning:** To study the details regarding satellite communication toolbox in Matlab. **Project:** Calculate look angles for a given Earth station and satellite position using simulations. Analyze the impact of different factors on look angles (e.g., Earth station location, satellite altitude). **Applications:** DTH, or satellite television, services (such as the DirecTV and DISH Network services **Video link / Additional online information:** 1. https://nptel.ac.in/courses/117/105/117105131/# 2. https://nptel.ac.in/courses/117105131	**8Hrs.**
UNIT 2	
Elements of Communication Satellite Design: Satellite subsystems - Attitude and orbit control electronics - Telemetry and tracking - Power subsystems - Communication subsystems - Satellite antennas - Reliability and redundancy- Frequency modulation techniques.	**8Hrs.**

Communication Satellites: Introduction, Related Applications, Frequency Bands, Payloads, Satellite Vs. Terrestrial Networks, Satellite Telephony. **Navigation Satellites:** Development of Satellite Navigation Systems, GPS system, Applications. **Laboratory Sessions/ Experimental learning:** A Case Study of Using Remote Sensing Data and GIS for Land Management **Project:** Investigate the design elements that ensure high reliability and fault tolerance in satellite communication systems. Consider redundancy mechanisms, power backup systems, and error correction techniques to minimize system downtime. **Applications:** Mobile Communication **Video link / Additional online information:** 1. https://nptel.ac.in/courses/117/105/117105131/# 2. https://nptel.ac.in/courses/117/105/117105131/#	
UNIT 3	
Satellite Link Design: Basic transmission theory – System noise temperature and G/T Ratio- Noise figure and noise temperature- Calculation of system noise temperature – G/T ratio for earth stations - Link budgets - Uplink and downlink budget calculations - Error control for digital satellite links - Prediction of rain attenuation and propagation impairment counter measures. **Laboratory Sessions/ Experimental learning:** Simulate system noise temperature, G/T ratio, link budgets, error control schemes, and rain attenuation effects. **Project:** Perform a link budget analysis for a satellite communication system operating in the Ku-band frequency range. Consider the transmitter power, antenna gain, path loss, rain attenuation, and receiver sensitivity to determine the link performance and **Applications:** Error detection and correction in Communication, Weather forecasting, Remote sensing, Navigation satellites. **Video link /Additional online information:** **1.** https://www.digimat.in/nptel/courses/video/117105131/L13.html **2.** https://www.digimat.in/nptel/courses/video/117105131/L14.html **3.** https://onlinecourses.nptel.ac.in/noc19_ce45/preview	**8Hrs.**

UNIT 4	
Introduction to Radar: Radar block diagram and operation, Radar frequencies, Applications of radar, Prediction of range performance, Minimum detectable signal, Receiver noise, Probability density function, SNR, Integration of radar pulses, Radar cross-section of targets, PRF and range ambiguities, Transmitter power, System losses. **Electronically steered Phased Array Antenna in Radar:** Phase shifters, Frequency scan arrays,Array elements, Feeds for arrays, Computer Control of Phased-Array Radar. **Laboratory Sessions/ Experimental learning:** Implement the radar range equations for remote sensing. **Project:** Simulate system losses (e.g., atmospheric attenuation, hardware losses) and their effect on radar performance. **Applications:** Ground surveillance, missile control, fire control, air traffic control (ATC), moving target indication (MTI). **Video link / Additional online information:** 1. https://onlinecourses.nptel.ac.in/noc19_ee58/preview 2. https://nptel.ac.in/courses/108/105/108105154/	**8Hrs.**
UNIT 5	
Radar Technology and Applications: Doppler Effect, CW radar, FM CW radar, Multiple frequency CW radar, MTI radar, Delay line canceller, Range gated MTI radar, Blind speeds, Staggered PRF, Limitations to the performance of MTI radar, Non-coherent MTI radar. Tracking radar: sequential lobing, conical scan, Monopulse: amplitude comparison and phase comparison methods, Radar displays. **Laboratory Sessions/ Experimental learning:** Study the implementation and importance of MTI radar with Power amplifier. **Project:** Design and Simulation of FM-CW Radar for Accurate Range Detection using Simulink. **Applications:** Ground surveillance, weapons location, and vehicle search **Video link / Additional online information:**	**8Hrs.**

1. https://nptel.ac.in/courses/108/105/108105154/ **2.** https://nptel.ac.in/courses/108105154	

Course Outcomes: After completing the course, the students will be able to	
CO1	Describe the satellite orbits and its trajectories with the definitions of parameters associated with it.
CO2	Comprehend the design of satellite subsystems
CO3	Evaluate spacecraft subsystem performance and trades
CO4	Analyze how the radar equation is derived and its significance in radar technology.
CO5	Demonstrate how CW, FM-CW, and MTI radars function in different scenarios.

Reference Books:	
1.	T. Pratt, C.W. Boastian and Jeremy Allnutt, "Satellite Communication", 2013, 2nd edition, John Wiley and Sons, Bangalore, India.
2.	Anil K Maini, Varsha Agrawal, Satellite Communication, Wiley India Pvt. Ltd., 2015, ISBN: 978-81265-2071-8.
3.	Merril. I. Skolnik, "Introduction to Radar Systems", 2/e, MGH, 1981.
4.	Dennis Roddy, Satellite Communications, 4th Edition, McGraw- Hill International edition, 2006

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**	**PSO1**	**PSO2**
CO1	**3**	**3**	**2**	**2**	**1**	**1**	**1**	**-**	**1**	**-**	**-**	**1**	**2**	**2**
CO2	**3**	**3**	**2**	**2**	**1**	**1**	**1**	**-**	**1**	**-**	**-**	**1**	**2**	**2**
CO3	**3**	**3**	**2**	**2**	**1**	**1**	**1**	**-**	**1**	**-**	**-**	**1**	**2**	**2**
CO4	**3**	**3**	**2**	**2**	**1**	**1**	**1**	**-**	**1**	**-**	**-**	**1**	**2**	**2**
CO5	**3**	**3**	**2**	**2**	**1**	**1**	**1**	**-**	**1**	**-**	**-**	**1**	**2**	**2**

High-3, Medium-2, Low-1

Semester V			
CRYPTOGRAPHY			
Course Code	**MVJ22EA552**	**CIE Marks**	**50**
Teaching Hours/Week (L: T:P: S)	**3:0:0:0**	**SEE Marks**	**50**
Total Hours of Pedagogy	**30**	**Total Marks**	**100**

Course objectives: The students will be able to

1	Explain the basic principles of Cyber security and its applications
2	Demonstrate Cryptography and very essential algorithms.
3	Execute cryptographic operations and compare & contrast different types of cryptography.
4	Explain the concepts & uses of Digital signature and web security.
5	Demonstrate the need and summarize the concept of Secure Electronic Transactions & Intrusion detection system.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

Module-1

Introduction: Services, Mechanisms, Mechanism Attacks, The OSI Security Architecture, A Model for Network Security, Cyber Attacks, Defence Strategies and Techniques, Guiding Principles.

Mathematical Background of Cryptography: Integer Arithmetic, Modular Arithmetic, Matrices, The Greatest Comma Divisor, Useful Algebraic Structures, Chinese Remainder Theorem.

Applications: Time Stamping, Electronic Money, Secure Network Communication

Laboratory Sessions/ Experimental learning:

Breaking the Shift Cipher

Web Reference:

- https://nptel.ac.in/courses/117101106/
- https://nptel.ac.in/courses/108108114/
- https://nptel.ac.in/courses/108105113/

Module-2	
Basics of Cryptography: Preliminaries, Elementary Substitution Ciphers, Elementary Transport Ciphers, Other Cipher Properties. **Symmetric Ciphers:** Symmetric Ciphers model, Substitution Techniques, Transposition Techniques, Simplified DES, Data encryption Standard (DES), The strength of DES, Differential and Linear Cryptanalysis, Block Cipher Design Principles and modes of operation, Evaluation Criteria for Advanced Encryption standard, The AES Cipher. **Laboratory Sessions/ Experimental learning:** Breaking the Mono-alphabetic Substitution Cipher **Applications:** wireless security, processor security, file encryption **Web Reference:** • https://nptel.ac.in/courses/117101106/ • https://nptel.ac.in/courses/108108114/ • https://nptel.ac.in/courses/108105113/	**8Hrs**
Module-3	
Block Cipher Operation: Electronic Codebook, Cipher Block Chaining Mode, Cipher Feedback Mode, Output Feedback Mode, Counter Mode **Public Key Cryptography**: Principles of public key Cryptosystem, The RSA algorithms, Key management, Diffie – Hellman key exchange, Elgamal Cryptographic system, PRNG based on Asymmetric Cipher **Digital Signatures**: Digital Signatures and Digital Signature Standard**.** **Laboratory Sessions/ Experimental learning:** Diffie-Hellman Key Establishment **Applications:** Random number generator, permutation generator **Web Reference:** • https://nptel.ac.in/courses/117101106/ • https://nptel.ac.in/courses/108108114/ • https://nptel.ac.in/courses/108105113/	**8Hrs**
Module-4	
Key Management and Distribution: Symmetric key distribution using symmetric encryption, Symmetric key distribution using asymmetric encryption, Distribution of Public keys, X.509 Certificates, Public key infrastructure. **Laboratory Sessions/ Experimental learning:**	**8Hrs**

1. Digital Signatures Scheme 2. Cryptographic Hash Functions and Applications (HMAC) **Applications:** Cyber-attacks, Cybercrime, Cyber security**.** **Web Reference:** • https://nptel.ac.in/courses/117101106/ • https://nptel.ac.in/courses/108108114/ • https://nptel.ac.in/courses/108105113/	
Module-5	
Intruders, Intrusion Detection, Password Management, Malicious software programs – Viruses and related Threats, Virus Countermeasures **Firewall:** Need of firewalls, Firewall Characteristics, Types of Firewalls, Design Principles, Trusted Systems **Laboratory Sessions/ Experimental learning:** Program for SSL operation. **Applications**: Encryption, message authentication and integrity, and replay attack protection **Web Reference:** • https://nptel.ac.in/courses/117101106/ • https://nptel.ac.in/courses/108108114/ • https://nptel.ac.in/courses/108105113/	**8Hrs**

Course outcome (Course Skill Set)

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

1.	Analyse the importance of security attacks, service mechanism, basic network security model and its applications.
2.	Design and develop simple cryptography algorithms and explain basic structure of DES and AES
3.	Illustrate the concept public key cryptography & apply digital signatures in email
4.	Describe different techniques used in key exchange protocols.
5.	Analyzing various malicious software and firewalls.

Reference Books	
1.	Cryptography and Network Security- Behrouz A Forouzan, Debdeep Mukhopadhyay,Mc-GrawHill, 3rd Edition, 2015
2.	Cryptography and Network Security- William Stallings, Pearson Education, 7th Edition.
3	Cryptography, Network Security and Cyber Laws – Bernard Menezes, Cengage Learning, 2010 edition.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- There are 25 marks for the CIE's Assignment component and 25 for the Internal Assessment Test component.
- Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the coverage of the syllabus, and the second test will be administered after 85-90% of the coverage of the syllabus. The average of the two tests shall be scaled down to 25 marks
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The schedule for assignments shall be planned properly by the course teacher. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. Each assignment shall be conducted for 25 marks. (If two assignments are conducted then the sum of the two assignments shall be scaled down to 25 marks)
- The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and assignment/s marks.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's

Suggested Learning Resources:

3.

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/117101106/
- https://nptel.ac.in/courses/108108114/
- https://nptel.ac.in/courses/108105113/
- https://nptel.ac.in/courses/117106086/

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

CO-PO Mapping													
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	1	1	-	-	1	-	-	1	1	-
CO2	3	3	3	2	1	1	-	-	1	-	-	1	1	-
CO3	3	3	3	2	1	1	-	-	1	-	-	1	1	-
CO4	3	3	3	2	1	1	-	-	1	-	-	1	1	-
CO5	3	3	3	2	1	1	-	-	1	-	-	1	1	-

Semester: V		
INFORMATION THEORY & CODING		
Course Code:	**MVJ22EA553**	**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	Understand the principles and applications of information theory..	
2	Analyze fundamental concept of entropy and information used in communications.	
3	Implement probabilities, entropy & measures of information.	
4	Evaluate coding schemes, including error correcting codes.	
5	Explain quantitative measure of information used in order to build efficient solutions to multitudinous engineering problems.	

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

Module-1	
Introduction: Measure of information, Information content of message, Average Information content of symbols in Long Independent sequences, Average Information content of symbols in Long dependent sequences, Markov Statistical Model of Information Sources, Entropy and Information rate of Markoff Sources. **Applications:** Time Stamping, Electronic Money, Secure Network Communication Laboratory Sessions/ Experimental learning: **Web links and Video Lectures (e-Resources):** • https://nptel.ac.in/courses/108102117	**8Hrs**

Module-2	
Source Coding: Source coding theorem, Prefix Codes, Kraft McMillan Inequality property – KMI, Encoding of the Source Output, Shannon's Encoding Algorithm, Shannon Fano Encoding Algorithm, Huffman codes, Extended Huffman coding, Arithmetic Coding, Lempel – Ziv Algorithm.. **Laboratory Sessions/ Experimental learning:** Breaking the Mono-alphabetic Substitution Cipher **Applications:** wireless security, processor security, file encryption **Web links and Video Lectures (e-Resources):** • https://nptel.ac.in/courses/108102117	**8Hrs**
Module-3	
Information Channels: Communication Channels, Channel Models, Channel Matrix, Joint probability Matrix, Binary Symmetric Channel, System Entropies, Mutual Information, Channel Capacity, Channel Capacity of: Binary Symmetric Channel, Binary Erasure Channel, Muroga's Theorem, Continuous Channels **Laboratory Sessions/ Experimental learning:** Diffie-Hellman Key Establishment **Applications:** Random number generator, permutation generator **Web links and Video Lectures (e-Resources):** • https://nptel.ac.in/courses/108102117	**8Hrs**
Module-4	
Error Control Coding: Introduction, Examples of Error control coding, 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, Table lookup Decoding using Standard Array. **Binary Cyclic Codes**:Algebraic Structure of Cyclic Codes, Encoding using an (n-k) Bit Shift register, Syndrome Calculation, Error Detection and Correction **Laboratory Sessions/ Experimental learning:** 1. Digital Signatures Scheme 2. Cryptographic Hash Functions and Applications (HMAC) **Applications:** Cyber-attacks, Cybercrime, Cyber security.	**8Hrs**

Web links and Video Lectures (e-Resources): • https://nptel.ac.in/courses/108102117	
Module-5	
Important Cyclic Codes & Convolution Codes :Golay Codes, BCH Codes. Convolution Encoder, Time domain approach, Transform domain approach, Code Tree, Trellis and State Diagram, The Viterbi Algorithm **Laboratory Sessions/ Experimental learning:** Program for SSL operation. **Applications**: Encryption, message authentication and integrity, and replay attack protection **Web links and Video Lectures (e-Resources):** • https://nptel.ac.in/courses/108102117	**8Hrs**

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- There are 25 marks for the CIE's Assignment component and 25 for the Internal Assessment Test component.
- Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the coverage of the syllabus, and the second test will be administered after 85-90% of the coverage of the syllabus. The average of the two tests shall be scaled down to 25 marks
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The schedule for assignments shall be planned properly by the course teacher. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. Each assignment shall be conducted for 25 marks. (If two assignments are conducted then the sum of the two assignments shall be scaled down to 25 marks)
- The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and assignment/s marks.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

10. The question paper will have ten questions. Each question is set for 20 marks.
11. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
12. The students have to answer 5 full questions, selecting one full question from each module.

Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Text books:

1. Digital and analog communication systems, K. Sam Shanmugam, John Wiley India Pvt. Ltd, 1996.
2. Digital communication, Simon Haykin, John Wiley India Pvt. Ltd, 2008.
3. Information Theory and Coding, Muralidhar Kulkarni, K.S. Shivaprakasha, Wiley India Pvt. Ltd, 2015, ISBN:978-81-265-5305-1.

Reference Books:

4. ITC and Cryptography, Ranjan Bose, TMH, II edition, 2007.
5. Principles of digital communication, J. Das, S. K. Mullick, P. K. Chatterjee, Wiley, 1986 - Technology & Engineering.
6. Digital Communications – Fundamentals and Applications, Bernard Sklar, Second Edition, Pearson Education, 2016, ISBN: 9780134724058.
13. Cryptography, Network Security and Cyber Laws – Bernard Menezes, Cengage Learning, 2010 edition.

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/108102117

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

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO 4	PO 5	PO 6	PO 7	PO8	PO9	PO10	PO1 1	PO12	PSO1	PSO2
CO1	3	3	3	2	1	1	-	-	1	-	-	1	1	-
CO2	3	3	3	2	1	1	-	-	1	-	-	1	1	-
CO3	3	3	3	2	1	1	-	-	1	-	-	1	1	-
CO4	3	3	3	2	1	1	-	-	1	-	-	1	1	-
CO5	3	3	3	2	1	1	-	-	1	-	-	1	1	-

Semester: V		
Optical Communication		
Course Code:	**MVJ22EA554**	**CIE Marks:50**
Credits:	**L:T:P: 3:0:0**	**SEE Marks: 50**
Total Hour Pedagogy:	**40Hrs**	**Total marks:100**

Course Learning Objectives: The students will be able to	
1	Understand the functionality of each of the components that comprise a fiber-optic communication system .
2	Describe properties of optical fiber and the principles of single and multi-mode optical fibers and their characteristics.
3	Understand the operation of LEDs, laser diodes, and PIN photo detectors (spectral properties, bandwidth, and circuits) and apply in optical systems.
4	Explain the concept of power launch to Optical analog and digital receiver
5	Explain the concepts of optical system design and WDM

UNIT 1	
Overview of optical fiber communication - Historical development, The general system, advantages of optical fiber communications. Optical fiber wave guides- Introduction, Ray theory transmission, Total Internal Reflection, Acceptance angle, Numerical Aperture, Skew rays, Cylindrical fibers- Modes, V-number, Mode coupling, Step Index fibers, Graded Index fibers, Single mode fibers- Cut off wavelength, Mode Field Diameter, Effective Refractive Index, Related problems **Application: Telephone. Telephone calls are made between different two locations that are near or far away from each other** **Web References:** **1** **https://nptel.ac.in/courses/108106161** **2** **https://nptel.ac.in/courses/108106167**	**8Hrs.**
UNIT 2	
FIBER MATERIALS: Glass, Halide, Active glass, Chalgenide glass, Plastic optical fibers. Signal distortion in optical fibers- Attenuation, Absorption, Scattering and Bending losses, Core and Cladding losses, Information capacity determination, Group delay. **Application: Medical Applications,CCTV cameras** **Web References** **1** **https://nptel.ac.in/courses/108106161**	**8Hrs.**

UNIT 3	
OPTICAL FIBER CONNECTORS-Connector types, Single mode fiber connectors, Connector return loss, Fiber Splicing- Splicing techniques, Splicing single mode fibers, Fiber alignment and joint loss-Multimode fiber joints, single mode fiber joints. **OPTICAL SOURCES AND DETECTORS:** Optical sources- LEDs, Structures, Materials, Quantum efficiency, Power, Modulation, Power bandwidth product. Injection Laser Diodes- Modes, Threshold conditions, External quantum efficiency, Laser diode rate equations, Resonant frequencies, Reliability of LED&ILD, Optical detectors-Physical principles of PIN and APD, Detector response time, Temperature effect on Avalanche gain, Comparison of Photo detectors, Related problems. **Application: Computer Networking,Internet.** **Web References** **1** **https://nptel.ac.in/courses/108106161** **2** **https://nptel.ac.in/courses/108106167**	**8Hrs.**
UNIT 4	
Source to fiber power launching - Output patterns, Power coupling, Power launching, Equilibrium Numerical Aperture, Laser diode to fiber coupling, Optical receiver operation- Fundamental receiver operation, Digital signal transmission, error sources, Receiver configuration, Digital receiver performance, Probability of Error, Quantum limit, Analog receivers. **Application: Defence and Space related Applications,Automobile Industries.** **Web References** **1** **https://nptel.ac.in/courses/108106161** **2** **https://nptel.ac.in/courses/108106167**	**8Hrs.**
UNIT 5	
Optical system design - Point-to- point links- Component choice and considerations, Link power budget, Rise time budget with examples, Line coding in Optical links, WDM, Necessity, Principles, Measurement of Attenuation and Dispersion, Eye pattern. **Application: Television Cables** **Web References** **3.** **https://nptel.ac.in/courses/108106161** **4.** **https://nptel.ac.in/courses/108106167**	**8Hrs.**

Course Outcomes: After completing the course, the students will be able to	
CO1	Choose necessary components required in modern optical communication systems.
CO2	Design and build optical fiber experiments in laboratory, and learn how to calculate electromagnetic modes in wave guides, the amount of light lost going through an optical system, dispersion of optical fibers.
CO3	Use different types of photo detectors and optical test equipment to analyze optical fiber and light wave systems.
CO4	Choose the optical cables for better communication with minimum losses.
CO5	Design, build and demonstrate optical fiber experiments in the laboratory.

Suggested Learning Resources:

Books

1.	Optical Fiber Communications – Gerd Keiser, McGraw-Hill International edition, 3rd Edition, 2000.
2.	Optical Fiber Communications – John M. Senior, PHI, 2nd Edition, 2002.
3.	Fiber Optic Communications – D.K. Mynbaev , S.C. Gupta and Lowell L. Scheiner, Pearson Education,2005.
4.	Fiber Optic Communication Systems – Govind P. Agarwal , John Wiley, 3rd Ediition, 2004.
5.	Fiber Optic Communications – Joseph C. Palais, 4th Edition, Pearson Education, 2004

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**	**PSO1**	**PSO2**
CO1	**3**	**3**	**2**	**2**	**1**	**1**	**1**	**-**	**1**	**-**	**-**	**1**	**2**	**2**
CO2	**3**	**3**	**2**	**2**	**1**	**1**	**1**	**-**	**1**	**-**	**-**	**1**	**2**	**2**
CO3	**3**	**3**	**2**	**2**	**1**	**1**	**1**	**-**	**1**	**-**	**-**	**1**	**2**	**2**
CO4	**3**	**3**	**2**	**2**	**1**	**1**	**1**	**-**	**1**	**-**	**-**	**1**	**2**	**2**
CO5	**3**	**3**	**2**	**2**	**1**	**1**	**1**	**-**	**1**	**-**	**-**	**1**	**2**	**2**

High-3, Medium-2, Low-1

Semester: V		
Innovation & Entrepreneurship		
Course Code:	**MVJ22EA555**	**CIE Marks:50**
Credits:	**L:T:P: 3:0:0**	**SEE Marks: 50**
Total Hour Pedagogy:	**40Hrs**	**Total marks:100**

Course Learning Objectives: The students will be able to	
1	Inspired; develop entrepreneurial mindset and attributes; entrepreneurial skill sets for venture creation and intrapreneurial leadership
2	Apply the process of problem-opportunity identification and feasibility assessment by developing a macro perspective of the real market, industries, domains, and customers while using design thinking principles to refine and pivot their venture idea.
3	Analyze Customer and Market segmentation, estimate Market size, and develop and validate Customer Persona.
4	Initiate Solution design, develop MVP, and determine Product-Market fit prototypes.
5	Craft initial Business plan, Develop go-to-market strategies apply storytelling skills in presenting a persuasive and defensible Venture Pitch.

UNIT 1	
Entrepreneurship Fundamentals & Context Meaning and concept, attributes and mindset of entrepreneurial and intrapreneurial leadership, role models in each and their role in economic development. Gamified role play-based exploration aligned to one's short-term career aspiration and ambition. An understanding of how to build an entrepreneurial mindset, skillsets, attributes, and networks while on campus. **Core Teaching Tool:** Simulation, Game, Industry Case Studies (Personalized for students – 16 industries to choose from), Venture Activity	**8Hrs.**
UNIT 2	
Problem & Customer Identification: Understanding and analyzing the macro-problem and Industry perspective, technological, socio-economic, and urbanization trends and their implication on new opportunities. Identifying passion, identifying and defining problems using Design thinking principles. Analyzing problems and validating with the potential customer. Iterating problem-customer fit. Understanding customer segmentation, creating and validating customer personas. Competition and Industry trends mapping and assessing initial opportunity. **Core Teaching Tool:** Several types of activities including Class, game, Gen AI, 'Get out of the building', and Venture Activities.	**8Hrs.**

UNIT 3	
Solution design & Prototyping: Understanding Customer Jobs-to-be-done and crafting innovative solution design to map to customers' needs and create a strong value proposition. Developing Problem-solution fit iteratively. Understanding prototyping and MVP. Developing a feasibility prototype with differentiating values, features, and benefits. Initial testing for proof-of-concept and iteration on the prototype. **Core Teaching Tool:** Venture Activity, no code Innovation tools, Class activity	**8Hrs.**
UNIT 4	
Opportunity Assessment and Sizing, Business & Financial Model: Assess relative market position via competition analysis, sizing the market, and assessing the scope and potential scale of the opportunity. Introduction to Business model and types, Lean approach, 9 block lean canvas model, riskiest assumptions to Business models. Importance of Build–Measure–Lean approach. **Business planning:** components of Business plan- Sales plan, People plan, and financial plan. Core Teaching Tool: Class and Venture Activity	**8Hrs.**
UNIT 5	
Go-to-Market Plan, Scale Outlook, and Venture Pitch Readiness: Financial Planning: Types of costs, preparing a financial plan for profitability using a financial template, understanding the basics of Unit economics, and analyzing financial performance. Introduction to Marketing and Sales, Selecting the Right Channel, creating a digital presence, and building customer acquisition strategy. Choosing a form of business organization specific to your venture, identifying sources of funds: Debt & Equity, Map the Start-up Lifecycle to Funding Options. **Scale Outlook and Venture Pitch readiness:** Understand and identify potential and aspiration for scale vis a vis your venture idea. Persuasive Storytelling and its key components. Build an Investor-ready pitch deck. **Core Teaching Tool:** Expert talks; Cases; Class activity and discussions; Venture Activities	**8Hrs.**

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

CO1	Understand Entrepreneurial Skillset and Mindset
CO2	Understand and analyze industry problems and Enhance customer personas based on market/other feedback
CO3	Understand and develop MVPs
CO4	Understand and apply Business models and Business planning.
CO5	Develop a go-to-market strategy and build a Persuasive sales pitch

Suggested Learning Resources:

1.Ries, E. (2011). The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses. Crown Business

2. Osterwalder, A., & Pigneur, Y. (2010). Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers. John Wiley & Sons.

3.Brown Tim (2019) Change by Design Revised & Updated: How Design Thinking Transforms Organizations and Inspires Innovation, Harper Business

4.Collins Jim, Porras Jerry, (2004) Built to Last: Successful Habits of Visionary Companies

5. Burlington Bo, (2016) Small Giants: Companies That Choose to Be Great Instead of Big

6. Saras D. Sarasvathy, (2008) Effectuation: Elements of Entrepreneurial Expertise, Elgar Publishing Ltd

Books

1.	Robert D. Hisrich, Michael P. Peters, Dean A. Shepherd, Sabyasachi Sinha (2020). Entrepreneurship, McGrawHill, 11th Edition.
2.	Namita Thapar (2022) The Dolphin and the Shark: Stories on Entrepreneurship, Penguin Books Limited.
3.	Simon Sinek (2011) Start with Why, Penguin Books limited

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**	**PSO1**	**PSO2**
CO1	**2**	**2**	**2**								**-**	**2**	**2**	
CO2			**2**	**2**	**2**						**-**	**2**		
CO3			**2**		**2**	**2**			**2**		**-**	**2**		
CO4			**2**		**2**				**2**		**-**	**2**		
CO5			**2**			**2**	**2**	**2**		**2**	**-**	**2**		

High-3, Medium-2, Low-1

Antenna and Wave Propagation			
Course Code	**MVJ22EA61**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P: S)	**3:0:2:0**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40 hours Theory + 8-10 Lab slots**	**Total Marks**	**100**

Course objectives:Students will be able to

1	Understand the applications of electromagnetic waves in free space.
2	Explain working principles of various antenna types.
3	Demonstrate major applications of antennas with an emphasis on how antennas are employed.
4	Understand the concept of radiation Mechanism parameters, current distributions and antenna arrays
5	Understand the concept of wave propagation in various layers and losses due to earth effects

Teaching-Learning Process (General Instructions)

These are sample Strategies; that teachers can use to accelerate the attainment of the various course outcomes.

1. **Group discussion, MCQ, Pooling question**

MODULE-1

Antenna Fundamentals Antenna Parameters - Radiation Patterns and Mechanism, Patterns in Principal Planes, Main Lobe and Side Lobes, Beam widths, Polarization, Beam Area, Radiation Intensity, Beam Efficiency, Directivity, Gain and Resolution, Antenna Apertures, Aperture Efficiency, Effective Height, Illustrated problems. **Thin Linear Wire Antennas:** Potential function and electromagnetic field: Heuristic Approach, Maxwell Equation approach, Potential function for time periodic fields, Radiation from an oscillating Dipole and alternating current element, The Hertzian Dipole. **Video link / Additional online information:** Antennas - Course (nptel.ac.in) (By Prof.Girish Kumar-IIT-Bombay)	**8 Hrs**

MODULE-2	
Antenna Arrays Two element arrays – different cases, Principle of Pattern Multiplication, N element Uniform Linear Arrays – Broadside, End fire Arrays, EFA with Increased Directivity, Derivation of their characteristics and comparison; Concept of Scanning Arrays, Directivity Relations (no derivations). Related Problems. Binomial Arrays, Effects of Uniform and Non-uniform Amplitude Distributions, Design Relations. Arrays with Parasitic Elements, Yagi-Uda Arrays, Smart antennas. **Video link / Additional online information:** Antennas - Course (nptel.ac.in) (By Prof.Girish Kumar-IIT-Bombay)	**8 Hrs**
MODULE-3	
Non-Resonant Radiators Introduction, Traveling wave radiators – Basic concepts, Long wire antennas – Field strength calculations and Patterns, Micro Strip Antennas-Introduction, Features, Advantages and Limitations. Rectangular Patch Antennas –Geometry and Parameters, Impact of different parameters on characteristics. Broadband Antennas: Helical Antennas – Significance, Geometry, Basic properties. Design considerations for mono-filer helical antennas in Axial Mode and Normal Modes (Qualitative Treatment). **Video link / Additional online information:** Antennas - Course (nptel.ac.in) (By Prof.Girish Kumar-IIT-Bombay)	**8 Hrs**
MODULE-4	
VHF, UHF and Microwave Antennas Reflector Antennas: Flat Sheet and Corner Reflectors. Paraboloidal Reflectors – Geometry, characteristics, types of feeds, F/D Ratio, Spill Over, Back Lobes, Aperture Blocking, Off-set Feeds, Cassegrain Feeds. Horn Antennas– Types, Optimum Horns, Design Characteristics of Pyramidal Horns; Lens Antennas – Geometry, Features, Dielectric Lenses and Zoning, Applications, Antenna Measurements – Patterns Required, Set Up, Distance Criterion, Directivity and Gain Measurements (Comparison, Absolute and 3-Antenna Methods). **Video link / Additional online information: https://youtu.be/t-AP3ya8Pao** Antennas - Course (nptel.ac.in)(By Prof.Girish Kumar-IIT-Bombay)	**8 Hrs**

MODULE-5	
WAVE PROPAGATION Concepts of Propagation – Frequency ranges and types of propagations. Friis Free Space Equation, Reflection of radio waves from plane surface of earth, Reflection coefficient for horizontal and vertical polarization, Ground Wave Propagation–Field strength, Attenuation Characteristic for vertical and Horizontal polarized wave, Sky Wave Propagation – Formation of Ionospheric Layers and their Characteristics, Mechanism of Reflection and Refraction, Critical Frequency, MUF Calculations for flat and spherical earth cases. Video link / Additional online information: Antennas - Course (nptel.ac.in)(By Prof.Girish Kumar-IIT-Bombay)	**8 Hrs**

PRACTICAL COMPONENT OF IPCC*(May cover all / major modules)*

Sl.NO	Experiments
1	Measurement of attenuation by using microwave test bench.
2	Determination of Coupling and isolation characteristics of microstrip directional
3	Study of Isolator. Extraction of S- parameters.
4	Study of Circulator. Extraction of S- parameters
5	Study the I-V Characteristics of Gunn Diode.
6	Reflex klystron X-Y Characteristic
7	Design of a monopole antenna
8	Design of a Dipole Antenna
9	Measurement of directivity and gain of microstrip Yagi antennas.
10	Design of Rectangular and circular Microstrip Patch Antenna
11	Design of horn antenna
12	Design of a Parabolic Reflector Antenna

Course outcomes (Course Skill Set):

1	Acquire knowledge of basic antenna parameters
2	Design and analyze wire antennas, loop antennas, reflector antennas, lens antennas, horn antennas and micro-strip antennas.
3	Analyze the field patterns radiated by various types of antennas.
4	Understand the working and characteristics of antenna arrays.
5	Compute several antenna parameters to assess antenna's performance.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is

50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

The IPCC means the practical portion integrated with the theory of the course. CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.

CIE for the theory component of the IPCC

- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.
- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks)**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of the IPCC

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.

2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored by the student shall be proportionally scaled down to 50 Marks

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component.

- The minimum marks to be secured in CIE to appear for SEE shall be 10 (40% of maximum marks-25) in the theory component and 10 (40% of maximum marks -25) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included**.** The maximum of 04/05 sub-questions are to be set from the practical component of IPCC, the total marks of all questions should not be more than 20 marks.
- SEE will be conducted for 100 marks and students shall secure 35% of the maximum marks to qualify for the SEE. Marks secured will be scaled down to 50.
- The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Suggested Learning Resources:

Books

1.	Antennas for All Applications – John D. Kraus and Ronald J. Marhefka, 3rdEdition, TMH, 2003.
2.	Electromagnetic Waves and Radiating Systems – E.C. Jordan and K.G. Balmain, PHI, 2nd Edition, 2000.
3.	Antennas and Wave Propagation – K.D. Prasad, SatyaPrakashan, Tech India Publications, New Delhi, 2001.
4.	Antenna Theory - C.A. Balanis, John Wiley and Sons, 2ndEdition, 2001.
5.	Transmission and Propagation – E.V.D. Glazier and H.R.L. Lamont, The Services Text Book of Radio, vol. 5, Standard Publishers Distributors, Delhi.

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

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

5G & Beyond			
Course Code	**MVJ22EA62**	**CIE Marks**	**50**
Teaching Hours/Week (L: T:P: S)	**3 Hours/Week (L:T:P: 3:0:0)**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40L**	**Total Marks**	**100**

Course objectives:

1	Understand the essential principles of 5G communications
2	Describe the 5G architecture and 5G Internet.
3	Analyze cognitive radio networks for 5G.
4	Analyze 5G spectrum crunch and security issues.

Module-1	
History of 5G: Historical background, 5G use cases, and system concept: Use case requirements, 5G system concept. **The 5G Architecture:** Introduction, High-level requirements for the 5G architecture, Functional architecture and 5G flexibility, Physical architecture and 5G deployment **Application: High-speed mobile network** **Web Reference:** **https://nptel.ac.in/courses/108105134** https://nptel.ac.in/courses/108105179 https://nptel.ac.in/courses/117104484	**8Hrs**
Module-2	
Machine-type communications: Introduction, Fundamental techniques for MTC, Massive MTC, Massive MTC, Summary of uMTC features. **Device to Device (D2D) communications:** From 4G to 5G, Radio resource management for mobile broadband D2D, Multi-hop D2D communications for proximity and emergency services, Multi operator D2D communication **Application: high-definition video streaming, Efficient use of RFID tags** **Web Reference** https://nptel.ac.in/courses/108105134 https://nptel.ac.in/courses/108105179 https://nptel.ac.in/courses/117104484	**8Hrs**

Module-3	
The 5G radio-access technologies: Access design principles for multi-user communications, Multi-carrier with filtering: a new waveform, Non-orthogonal schemes for efficient multiple access, Radio access for dense deployments, Radio access for V2X communication, Radio access for massive machine-type communication. **Application: Internet of Things – Connecting everything, Smart Home** **Web Reference** https://nptel.ac.in/courses/108105134 https://nptel.ac.in/courses/108105179 https://nptel.ac.in/courses/117104484	**8Hrs**
Module-4	
Relaying and wireless network coding: The role of relaying and network coding in 5G wireless networks, Multi-flow wireless backhauling, Highly flexible multi-flow relaying,Buffer-aided relaying. **Application: Use of smart tracking devices for accurate monitoring of temperature, shock, light exposure, humidity, etc…** **Web Reference** https://nptel.ac.in/courses/108105134 https://nptel.ac.in/courses/108105179 https://nptel.ac.in/courses/117104484	**8Hrs**
Module-5	
Mobility management in 5G, Dynamic network reconfiguration in 5G **Spectrum:** Introduction, 5G spectrum landscape and requirements, Spectrum access modes and sharing scenarios, 5G spectrum technologies, Value of spectrum for 5G: a techno-economic perspective . **Application: Efficient monitoring minimizes theft risk and misplacing of items,Realtime delivery tracking and reporting,Self-driving cars and drones for future goods delivery** **Web Reference** https://nptel.ac.in/courses/108105134 https://nptel.ac.in/courses/108105179 https://nptel.ac.in/courses/117104484	**8Hrs**

Course outcome (Course Skill Set), At the end of the course, the student will be able to :

Course outcomes:	
CO1	Describe the concepts of 5G networks and its architecture.
CO2	Analyze the spectrum optimization using cognitive radio in 5G network.
CO3	Analyze the white space spectrum opportunities and challenges
CO4	Analyze the security issues and challenges in 5G communication systems
CO5	Describe the concepts of 5G networks and its architecture

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE)

is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- There are 25 marks for the CIE's Assignment component and 25 for the Internal Assessment Test component.
- Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the coverage of the syllabus, and the second test will be administered after 85-90% of the coverage of the syllabus. The average of the two tests shall be scaled down to 25 marks
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The schedule for assignments shall be planned properly by the course teacher. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. Each assignment shall be conducted for 25 marks. (If two assignments are conducted then the sum of the two assignments shall be scaled down to 25 marks)
- The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and assignment/s marks.

  Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours).

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks.

Suggested Learning Resources:

Books

1.	5G Mobile and Wireless Communication Technology, AfifOsseran, Jose F Monserrat, Patrick Marsch, Cambridge University Press, 2016.
2.	Fundamentals of 5G Mobile Networks, Jonathan Rodriguez, John Wiley & Sons 2015, ISBN: 9781118867525.
3.	5G Core Networks Powering Digitization, Stephen Rommer, Academic Press,2019 ISBN: 978-0-08-1030009-7.

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

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

Semester: VI		
5G & Beyond Laboratory		
Course Code:	**MVJ22EAL66**	**CIE Marks: 50**
Credits:	**L:T:P:0:0:2**	**SEE Marks: 50**
Hours:	**20**	**SEE Duration: 3 Hrs**

Course Learning Objectives: The students will be able to	
1	Understand the fundamentals of SDR and Signal transmission
2	Learn the principles of amplitude and Frequency modulation and Demodulation
3	Perform spectrum analysis of different signals
4	Implement Channel Coding and error correction Techniques
5	Understand the principles and benefits of MIMO systems

PART A

1. Basic Signal transmission and reception using SDR
2. Amplitude modulation and demodulation using USRP B210
3. Frequency Modulation and Demodulation using USRP B210
4. Digital Modulation schemes like QPSK,QAM
5. Spectrum analysis of different signals using USRP B210
6. Channel Coding and Error Correction
7. Multiple Input and Multiple Output Systems
8. Cognitive radio
9. Orthogonal frequency division multiplexing
10. Transmit and receive OFDM signals using USRP B210

Course outcomes:	
CO1	Identify and analyze various signals present in the spectrum
CO2	Encode a data stream using techniques such as Hamming and Convolutional codes
CO3	Transmit and receive signals using MIMO techniques
CO4	Analyze the performance and Efficiency of Cognitive radio systems
CO5	Analyze the performance and benefits of OFDM in multipath environment

CO-PO Mapping

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

Semester: VI		
RADAR SYSTEM ENGINEERING		
Course Code:	**MVJ22EA631**	**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	understand the Radar fundamentals and analyze the radar signals..	
2	understand the basic concepts of CW Radar, FM-CW Radar and their applications.	
3	learn various radars like MTI, Doppler and tracking radars and their comparison.	
4	understand various technologies involved in the design of radar transmitters and receivers.	
5	understand the concept of tracking radar and utilization of radar antenna.	

UNIT 1	
Prerequisites:Electromagnetic theory and Antenna Theory **Basics of Radar:** Introduction, Maximum Unambiguous Range, Radar Waveforms, Definitions with respect to pulse waveform - PRF, PRI, Duty Cycle, Peak Transmitter Power, Average transmitter Power. Simple form of the Radar Equation, Radar Block Diagram and Operation, Radar Frequencies, Applications of Radar, The Origins of Radar, Illustrative Problems. **Applications: detecting incoming signals during war and also used by a geologist for earthquake detection.** **Video link / Additional online information:** 1. https://nptel.ac.in/courses/108105154 2. https://nptel.ac.in/courses/117/105/117105131/# 3. https://nptel.ac.in/courses/117105131	**8Hrs.**
UNIT 2	
Radar Equation and Cross Section of Targets Prediction of Range Performance, Detection of signal in Noise, Minimum Detectable Signal, Receiver Noise, SNR, Modified Radar Range Equation, Envelope Detector — False Alarm Time and Probability, Probability of Detection, Radar Cross Section of Targets: Simple targets –	**8Hrs.**

sphere, cone-sphere, Transmitter Power, PRF and Range Ambiguities, System Losses (qualitative treatment), Illustrative Problems. **Applications: Archaeologists use this technology for detection of buried artifacts. It is also used to understand the environment and climatic changes** **Video link / Additional online information:** 1. https://nptel.ac.in/courses/108105154 2. https://nptel.ac.in/courses/117/105/117105131/# 3. https://nptel.ac.in/courses/117/105/117105131/#	
UNIT 3	
MTI and Pulse Doppler Radar: Introduction, Principle, Doppler Frequency Shift, Simple CW Radar, Sweep to Sweep subtraction and Delay Line Canceler, MTI Radar with – Power Amplifier Transmitter, Delay Line Cancelers — Frequency Response of Single Delay, Line Canceler, Blind Speeds, Clutter Attenuation, MTI Improvement Factor, N- Pulse Delay-Line Canceler, Digital MTI Processing – Blind phases, I and Q Channels, Digital MTI Doppler signal processor, Moving Target Detector- Original MTD. **Applications: Military,Remote Sensing,Air Traffic Control** **Video link /Additional online information:** 1. https://nptel.ac.in/courses/108105154 **2.** https://www.digimat.in/nptel/courses/video/117105131/L13.html **3.** https://www.digimat.in/nptel/courses/video/117105131/L14.html	**8Hrs.**
UNIT 4	
Tracking Radar: Tracking with Radar - Types of Tracking Radar Systems, Monopulse Tracking - Amplitude Comparison Monopulse (one-and two-coordinates), Phase Comparison Monopulse. Sequential Lobing, Conical Scan Tracking, Block Diagram of Conical Scan Tracking Radar, Tracking in Range, Comparison of Trackers. **Applications: Ground surveillance, missile control, fire control, air traffic control (ATC), moving target indication (MTI).** **Video link / Additional online information:** 1. https://nptel.ac.in/courses/108105154 2. https://onlinecourses.nptel.ac.in/noc19_ee58/preview 3. https://nptel.ac.in/courses/108/105/108105154/	**8Hrs.**
UNIT 5	

Radar Antenna and Receiver: Functions of The Radar Antenna, Antenna Parameters, Reflector Antennas and Electronically Steered Phased Array Antennas. The Radar Receiver, Receiver Noise Figure, Super Heterodyne Receiver, Duplexers and Receivers Protectors, Radar Displays **Applications: Ground surveillance, weapons location, and vehicle search** **Video link / Additional online information:** 1. https://nptel.ac.in/courses/108105154 2. https://nptel.ac.in/courses/108/105/108105154/ **3.** https://nptel.ac.in/courses/108105154	**8Hrs.**

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the radar fundamentals and radar signals
CO2	Explain the working principle of pulse Doppler radars, their applications and limitations.
CO3	Describe the working of various radar transmitters and receivers.
CO4	Discuss different types of tracking radar systems and their application
CO5	Analyze the range parameters of pulse radar system which affect the system performance.

Text/Reference Books:	
1.	Introduction to Radar Systems- Merrill I Skolink, 3e, TMH, 2001.
2.	Radar Principles, Technology, Applications — Byron Edde, Pearson Education, 2004
3.	Principles of Modem Radar: Basic Principles – Mark A. Rkhards, James A. Scheer, William A. Holm. Yesdee, 2013

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	PSO1	PSO2
CO1	3	3	2	2	1	1	1	-	1	-	-	1	2	2
CO2	3	3	2	2	1	1	1	-	1	-	-	1	2	2
CO3	3	3	2	2	1	1	1	-	1	-	-	1	2	2
CO4	3	3	2	2	1	1	1	-	1	-	-	1	2	2
CO5	3	3	2	2	1	1	1	-	1	-	-	1	2	2

High-3, Medium-2, Low-1

Semester: VI		
Network and Cyber Security (Theory)		
Course Code:	**MVJ22EA 632**	**CIE Marks:50**
Credits:	**L:T:P: 3:0:0**	**SEE Marks: 50**
Hours:	**30L**	**SEE Duration: 3 Hrs**
Course Learning Objectives: The students will be able to		
1	Identify security concerns in Email.	
2	Understand the security factors in Internet Protocol.	
3	Understand cyber security concepts.	
4	Identify problems that can arise in cyber security.	
5	Solve various cyber security frame work.	

UNIT 1	
Transport Level Security: Web Security Considerations, Secure Sockets Layer, Transport Layer Security, HTTPS, Secure Shell (SSH) **Laboratory Sessions/ Experimental learning:** 1. Study of HTTP client server 2. Study of SSH session with a laboratory router **Applications: Encrypting the communication between web applications and servers, in VOIP, Video, Audio.** **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=tcQQ9A8M2L0 2. https://www.youtube.com/watch?v=LcdlBTYe6vo	**8Hrs.**
UNIT 2	
E-mail Security: Pretty Good Privacy, S/MIME, Domain keys identified mail **Laboratory Sessions/ Experimental learning:** 1. Study "How to make strong passwords" and "passwords cracking techniques". 2. Analysis of the security vulnerabilities of E-Mail Application. **Applications:** Security of confidential data, Improve spam and phishing protection for mail. **Video link / Additional online information:** 1. https://archive.nptel.ac.in/courses/106/106/106106234/ 2. https://heimdalsecurity.com/blog/email-security/	**8Hrs.**
UNIT 3	
IP Security: IP Security Overview, IP Security Policy, Encapsulation Security Payload (ESP),	**8Hrs.**

Combining security Associations Internet Key Exchange. Cryptographic Suites **Laboratory Sessions/ Experimental learning:** **1.** Study the steps to hack a strong password. **2.** Study the Kali Tools for Cryptography. **Applications:** Remote Internet Access security. **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=ipQkQopBLfU 2. https://www.youtube.com/watch?v=gtFZMvqXD1g	
UNIT 4	
Cyber network security concepts: Security Architecture, anti pattern: signature based malware detection versus polymorphic threads, document driven certification and accreditation, policy driven security certifications. Refactored solution: reputational, behavioural and entropy based malware detection. The problems: cyber anti patterns concept, forces in cyber anti patterns, cyber anti pattern templates, cyber security anti pattern catalog **Laboratory Sessions/ Experimental learning:** 1. Demonstrate how to provide secure data storage, secure data transmission and for creating digital signatures. 2. Demonstrate intrusion detection system (ids) using any tool (snort or any other s/w) **Applications:** Network and software security, Security against DDOS **Video link / Additional online information :** 1. https://www.simplilearn.com/tutorials/cyber-security-tutorial/what-is-cyber-security 2. https://onlinecourses.nptel.ac.in/noc23_cs127/preview	**8Hrs.**
UNIT 5	
Cyber network security concepts contd. : Enterprise security using Zachman framework Zachman framework for enterprise architecture, primitive models versus composite models, architectural problem solving patterns, enterprise workshop, matrix mining, mini patterns for problem solving meetings. Case study: cyber security hands on – managing administrations and root accounts, installing hardware, reimaging OS, installing system protection/ antimalware, configuring firewalls **Laboratory Sessions/ Experimental learning:** 1. Analysis the Security Vulnerabilities of E-commerce services. **Applications:** Security of enterprise applications. **Video link / Additional online information:**	**8Hrs.**

1.	

Course Outcomes: After completing the course, the students will be able to	
CO1	Explain network security protocols
CO2	Understand the basic concepts of cyber security
CO3	Discuss the cyber security problems
CO4	Explain Enterprise Security Framework
CO5	Apply concept of cyber security framework in computer system administration

Reference Books:	
1.	William Stallings, Cryptography and Network Security Principles and Practice, Pearson Education Inc., 6th Edition, 2014, ISBN: 978-93-3251877-3.
2.	Thomas J. Mowbray, Cyber Security – Managing Systems, Conducting Testing, and Investigating Intrusions, Wiley.
3.	Cryptography and Network Security, Behrouz A. Forouzan, TMH, 200
4.	Cryptography and Network Security, Atul Kahate, TMH, 2003

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**	**PSO1**	**PSO2**
CO1	**3**	**3**	**2**	**2**	**-**	**1**	**-**	**-**	**1**	**-**	**-**	**1**		
CO2	**3**	**3**	**2**	**2**	**-**	**1**	**-**	**-**	**1**	**-**	**-**	**1**		
CO3	**3**	**3**	**2**	**2**	**-**	**1**	**-**	**-**	**1**	**-**	**-**	**1**		
CO4	**3**	**3**	**2**	**2**	**-**	**1**	**-**	**-**	**1**	**-**	**-**	**1**		
CO5	**3**	**3**	**2**	**2**	**-**	**1**	**-**	**-**	**1**	**-**	**-**	**1**		

High-3, Medium-2, Low-1

Semester: VI		
SENSOR AND VIRTUAL INSTRUMENTATION		
Course Code:	**MVJ22EA633**	**CIE Marks:50**
Credits:	**L:T:P: 3:0:0**	**SEE Marks: 50**
Hours:	**40 L**	**Total Marks:100**

Course Learning Objectives: The students will be able to

1	understand the basic concepts of transducers.
2	identify the mathematical model of transducer and its response for various inputs.
3	understand the construction and working principle of resistive type transducers.
4	Describe capacitive type and inductive type transducer.
5	understand the construction and working principle of sensors and its real time applications.

UNIT-I	
Prerequisites: *knowledge of basic of sensors* General block diagram of measurements systems – Methods of measurements – Classification and selection of transducers – Error analysis – Statistical methods – Odds and uncertainty, classification of instruments, applications of measurement systems. **Laboratory Sessions/ Experimental learning:** Displacement versus output voltage characteristics of a potentiometer transducer. **Applications:** Selection of appropriate sensors for different industrial applications. **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=pFM9K9JrsU4&list=PLm_MSClsnwm9HsQaejlrxvkNPWbvxgwWs 2. https://www.youtube.com/watch?v=Z6evuxYjYMs&list=PLSGws_74K019wiWyVU3CnVMMqAcF3_sxz	**8 Hrs**
UNIT-II	
Static characteristics – Accuracy, precision, resolution, sensitivity, linearity – Dynamic characteristics – Mathematical model of transducer – Zero, first and second order transducers – Response for impulse, step, ramp and sinusoidal inputs **Laboratory Sessions/ Experimental learning:** 1. Characteristics of Strain gauge. 2. Characteristics of Load cell. **Applications:** Platform Weighing	**8 Hrs**

Video link / Additional online information: 1. https://www.youtube.com/watch?v=78NpGnA1sX4	
UNIT-III	
Principle of operation – Construction details – Characteristics and application of resistance potentiometer – Strain gauge – Resistance thermometer – Thermistor – Hot-wire anemometer – Humidity sensor – Induction potentiometer – Variable reluctance transducers – LVDT. **Laboratory Sessions/ Experimental learning:** 1. Characteristics of thermocouple. 2. Characteristic of LDR and thermistor. 3. Step response characteristics of RTD. **Applications:** Air conditioning Heating and Ventilation Devices. **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=lUjBmV4wMtA 2. https://www.youtube.com/watch?v=kb3W-1_deLc	**8 Hrs**
UNIT-IV	
Capacitive transducer and types – Capacitor microphone – Frequency response – Piezoelectric transducer – Hall effect transducer – Magnetostrictive – Digital transducers – Fiber optic sensors – Thick and thin film sensors (Bio sensor and chemical sensor) **Laboratory Sessions/ Experimental learning:** 1. Characteristics of LVDT. 2. Characteristics of Hall effect transducer. **Applications:** Power turbines, hydraulics, automation, aircraft, satellites, nuclear reactors, current transformers, Position sensing. **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=emtskVpbtyY 2. https://www.youtube.com/watch?v=E0NMM_Pq0IY	**8 Hrs**
UNIT-V	
Environmental monitoring sensors (Water quality and air pollution) – Photo electric transducer – Vibration sensor – Ultrasonic based sensors – Introduction to MEMS and Nanotechnology – Applications – Robotics – Home appliance. **Laboratory Sessions/ Experimental learning:** Study of smart transducers.	**8 Hrs**

Applications: Smart city developments with latest technological sensors. **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=hyHcnZsgbRU 2. https://www.youtube.com/watch?v=jQF4_hO_2qw	

Course Outcomes: After completing the course, the students will be able to	
CO1	Choose appropriate sensors for the measurement of various physical parameters.
CO2	Obtain the mathematical model of the transducer and its response for various inputs.
CO3	Choose appropriate resistive type transducer for the measurement of various physical parameters.
CO4	Select capacitive and inductive type transducers for the measurement of various physical parameters.
CO5	Select the suitable type of sensors for real time applications.

Reference Books	
1.	"A Course in Electrical and Electronics Measurements and Instrumentation", Sawhney A K, Dhanpat Rai and Sons, New Delhi, 2013
2.	"Sensors and Transducers", Patranabis D, Prentice Hall of India, Second Edition, 2010
3.	"Transducers and Instrumentation", Murthy D V S, Prentice Hall of India, New Delhi, Second Edition, 2010.

Continuous Internal Evaluation (CIE):

Theory for 100 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 100 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**	**2**	**3**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**1**
CO2	**3**	**3**	**2**	**2**	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**2**
CO3	**3**	**3**	**3**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**1**
CO4	**3**	**2**	**2**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**1**
CO5	**3**	**2**	**3**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**1**

Artificial Neural Networks			
Course Code	**MVJ22EA634**	**CIE Marks**	**50**
Teaching Hours/Week (L: T:P: S)	**3:0:0:0**	**SEE Marks**	**50**
Total Hours of Pedagogy	**30**	**Total Marks**	**100**

Course objectives:St

1	understand the biological neural network and to model equivalent neuron models.
2	understand the architecture, learning algorithm and issues of various feed forward and feedback neural networks
3	understand the architecture, learning algorithms
4	Describe various feed forward and feedback neural networks.
5	Solve Neuro dynamic models for various problems.

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

Module-1	
Prerequisites: Linear Algebra, Statistics and Probability will smoothen the process of learning the surface of the subject **Introduction:** A Neural Network, Human Brain, Models of a Neuron, Neural Networks viewed as Directed Graphs, Network Architectures, Knowledge Representation **Learning Process:** Error Correction Learning, Memory Based Learning, Hebbian Learning, Competitive, Boltzmann Learning, Credit Assignment Problem, Memory, Adaption, Statistical Nature of the Learning Process **Laboratory Sessions/ Experimental learning:** To find the basis and properties of statistical nature learning process. **Applications:** As CNN is used in image processing, the medical imaging data retrieved from tests is analyzed and assessed based on neural network models. **Web Reference:** https://nptel.ac.in/courses/117105084	**8Hrs**

Module-2	
Single Layer Perceptron's: Adaptive Filtering Problem, Unconstrained Organization Techniques, Linear Least Square Filters, Least Mean Square Algorithm, Learning Curves, Learning Rate Annealing Techniques, Perceptron –Convergence Theorem, Relation Between Perceptron and Bayes Classifier for a Gaussian Environment **Multilayer Perceptron:** Back Propagation Algorithm XOR Problem, Heuristics, Output Representation and Decision Rule, Computer Experiment, Feature Detection **Applications**: Perceptron is a linear classifier, and is used in supervised learning **Web Reference: https://nptel.ac.in/courses/117105084**	**8Hrs**
Module-3	
Back Propagation: Back Propagation and Differentiation, Hessian Matrix, Generalization, Cross Validation, Network Pruning Techniques, Virtues and Limitations of Back Propagation Learning, Accelerated Convergence, Supervised Learning **Applications:** The neural network is trained to enunciate each letter of a word and a sentence It is used in the field of speech recognition It is used in the field of character and face recognition. **Web Reference: https://nptel.ac.in/courses/117105084**	**8Hrs**
Module-4	
Self-Organization Maps (SOM): Two Basic Feature Mapping Models, Self-Organization Map, SOM Algorithm, Properties of Feature Map, Computer Simulations, Learning Vector Quantization, Adaptive Patter Classification **Applications:** One of the earliest and well-known applications of the SOM is the phonetic typewriter of Kohonen. It is set in the field of speech recognition, and the problem is to classify phonemes in real time so that they could be used to drive a typewriter from dictation. **Web Reference: https://nptel.ac.in/courses/117105084**	**8Hrs**
Module-5	
Neuro Dynamics: Dynamical Systems, Stability of Equilibrium States, Attractors, Neuro Dynamical Models, Manipulation of Attractors as a Recurrent Network Paradigm Hopfield Models – Hopfield Models, Computer Experiment	**8Hrs**

Weighted matching problem: Deterministic, stochastic and mean field annealing of a Hopfield model **Applications:** Neural Network for Machine Learning Face Recognition using it Neuro-Fuzzy Model and its applications Neural Networks for data-intensive applications **Web Reference:** https://nptel.ac.in/courses/117105084	

Course outcome (Course Skill Set)

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

1. Create different neural networks of various architectures both feed forward and feed backward
2. Perform the training of neural networks using various learning rules
3. Perform the testing of neural networks and do the perform analysis of these networks for various pattern recognition applications.
4. Understand the similarity of Biological networks and Neural networks
5. Perform the training of neural networks using various learning rules.
6. Understanding the concepts of forward and backward propagations.
7. Understand and Construct the Hopfield models.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1 There are 25 marks for the CIE's Assignment component and 25 for the Internal Assessment Test component.

- Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the coverage of the syllabus, and the second test will be administered after 85-90% of the coverage of the syllabus. The average of the two tests shall be scaled down to 25 marks
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The schedule for assignments shall be planned properly by the course teacher. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. Each assignment shall be conducted for 25 marks. (If two assignments are conducted then the sum of the two assignments shall be scaled down to 25 marks)
- The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and assignment/s marks.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours).

1. The question paper will have ten questions. Each question is set for 20 marks.

2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks.

Suggested Learning Resources:

Books

1.	Neural Networks a Comprehensive Foundations, Simon Haykin, PHI edition.
2.	Artificial Neural Networks - B. Vegnanarayana Prentice Hall of India P Ltd 2005
3.	Neural Networks in Computer Inteligance, Li Min Fu MC GRAW HILL EDUCATION 2003
4.	Neural Networks -James A Freeman David M S Kapura Pearson Education 2004.
5.	Introduction to Artificial Neural Systems Jacek M. Zurada, JAICO Publishing House Ed.

Web links and Video Lectures (e-Resources):

6 https://archive.nptel.ac.in/courses/117/105/117105084/
7 https://cosmolearning.org/courses/intelligent-systems-and-control/video-lectures/
8 https://nptel.ac.in/courses/101104061
9 https://scte-iitkgp.vlabs.ac.in/exp/neural-networks-perceptron/references.html

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

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CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	1	1	1	-	-	1	-	-	1	1	-
CO2	3	3	3	1	1	1	-	-	1	-	-	1	1	-
CO3	3	3	3	1	1	1	-	-	1	-	-	1	1	-
CO4	3	3	3	1	1	1	-	-	1	-	-	1	1	-
CO5	3	3	3	1	1	1	-	-	1	-	-	1	1	-

Semester:VI		
Sensor Technology		
Course Code:	**MVJ22EA641**	**CIE Marks: 50**
Credits:	**L:T:P: 3:0:0**	**SEE Marks: 50**
Hours:	**30**	**SEE Duration: 3 Hrs**
Course Learning Objectives: The students will be able to		
1	Understand various technologies associated in manufacturing of sensors	
2	Understand different sensors and their applications in real life.	
3	Describe types of sensors used in modern digital systems	
4	Demonstrate the technological and physical limitations of a specific sensor.	
5	Classify suitable sensor for a given measurement situation.	

Module-1	
Prerequisite: *Basic Electronics, Knowledge on physical quantities* **Sensors Fundamentals and Characteristics:** General Concepts and Terminology, Sensor Classification, Static Characteristics, Dynamic Characteristics, Materials for Sensors, Microsensor Technology. **Laboratory Sessions/ Experimental learning:** 1. Study on applications of sensors **Applications:** Biological, Chemical, Electric, magnetic, or electromagnetic wave, Heat, temperature, Mechanical displacement or wave, Radioactivity, radiation and other. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/108/105/108105064/ https://nptel.ac.in/courses/108/108/108108147/	**8Hrs.**
Module-2	
Primary sensors: Temperature sensors, Pressure sensors, Flow-velocity and flow-rate sensors, Level sensors, Force and torque sensors, Acceleration and inclination sensors and Velocity sensors. **Resistive Sensors:** Resistive Temperature Detectors (RTDs),Thermistors, Magneto resistors, Light-Dependent Resistors (LDRs), Resistive Hygrometers, Resistive Gas sensors. **Laboratory Sessions/ Experimental learning:** 1. Strain measurement with Bridge circuit **Applications:** Patient monitoring in medical applications, Manufacturing and industrial equipment and motorsport applications. **Video link / Additional online information:**	**8Hrs.**

1. https://nptel.ac.in/courses/108/105/108105064/ https://nptel.ac.in/courses/108/106/108106165/	
Module-3	**8Hrs.**
Reactance Variation and Electromagnetic Sensors: Capacitive sensors: Variable capacitor and Differential capacitor**,** Inductive sensors:Variable reluctance sensors, Eddy current sensors, Linear Variable Differential Transformers (LVDTs), Electromagnetic sensors: Sensors based on Faraday's Law and Hall effect sensors. **Laboratory Sessions/ Experimental learning:** 1. Develop a displacement measurement system with inductive sensors (LVDT) **Applications:** Smart phones, Industrial automation, Communication, automobile and aerospace. **Video link / Additional online information:** https://nptel.ac.in/courses/108/105/108105064/	
Module-4	**8Hrs.**
Self-Generating sensors: Thermoelectric sensors, Piezoelectric sensors, Pyroelectric sensors, Photovoltaic sensors, Electrochemical sensors, Proximity sensors. **Laboratory Sessions/ Experimental learning:** 1. Develop a sensor system for force measurement using piezoelectric sensors **Applications:** Temperature controlled devices: refrigeration and air conditioning, Alarm clocks, Medical devices, PIN pads, photonics and pharmaceutical compositions, Robotics. **Video link / Additional online information:** https://nptel.ac.in/courses/108/105/108105064/	
Module-5	**8Hrs.**
Digital sensors: Position encoders,Resonant sensors: SAW sensors, Vibrating wire strain gages, Vibrating cylinder sensors, Digital flow meters **Other sensing methods:** Charge-Coupled sensors – Fundamentals & types of CCD, Fiber-Optic sensors, Ultrasonic-based sensors, Gyroscope sensors, optical sensors, IR sensors. **Laboratory Sessions/ Experimental learning:** 1. Measure strain, temperature and pressure using LabVIEW. **Applications:** Industries, digital cameras, photocopiers. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/108/105/108105064/ https://nptel.ac.in/courses/112/103/112103174/	

Course outcomes:	
CO1	Understand the concept of sensors and its characteristics.
CO2	Explain the working principles of primary and resistive sensors.
CO3	Understand the inductive, capacitive and Electromagnetic sensors and its applications
CO4	Identify alternative methods to measure common quantities such as temperature, pressure, force and acceleration.
CO5	Select appropriate sensors used for various applications
Text Books:	
1.	Ramon Pallas & John G.Webster, "Sensors and signal conditioning", John Wiley & Sons., 2nd Ed.,2001.
2.	J. Fraden, "Handbook of Modern Sensors: Physical, Designs, and Applications", AIP Press, Springer, 3rd Ed.,2004.
Reference Books:	
1.	D. Patranabis, "Sensors and Transducers", PHI Publication, 2nd Ed.,2004 New Delhi.
2.	Webster John G, "Instrumentation and sensors Handbook", CRC Press, 1st Ed., 1999.
3.	Shawhney A.K., "Electrical and Electronics Measurements and Instrumentation", Dhanpat Rai & Sons, 1994.

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**	**2**	**1**	**-**	**2**	**-**	**-**	**-**	**-**	**2**	**1**
CO2	**3**	**2**	**2**	**1**	**1**	**2**	**-**	**-**	**-**	**-**	**2**	**1**
CO3	**3**	**2**	**2**	**1**	**1**	**2**	**-**	**-**	**-**	**-**	**2**	**1**
CO4	**3**	**2**	**2**	**1**	**1**	**2**	**-**	**-**	**-**	**-**	**2**	**1**
CO5	**3**	**2**	**2**	**1**	**2**	**2**	**-**	**-**	**-**	**-**	**2**	**1**

High-3, Medium-2, Low-1

Semester:VI		
Introduction To MATLAB & SIMULINK		
Course Code:	**MVJ22EA642**	**CIE Marks: 50**
Credits:	**L:T:P: 3:0:0**	**SEE Marks: 50**
Hours:	**30**	**SEE Duration: 3 Hrs**
Course Learning Objectives: The students will be able to		
1	Execute programming for engineering problem solving using MATLAB software package.	
2	Solve different mathematical function using MATLAB	
3	Understand Graphical User Interface	
4	Create and manipulate geometric models in a computer program.	
5	Develop skills to analyze and break down an engineering program and solve it algorithmically using MATLAB	

Module-1	
Introduction to Matlab, Creating Variables, Some Useful MATLAB Functions Data Types creating simple and multiple data set in single plot, Matrix generation, Array operations and Linear equations Introduction to programming in MATLAB, Visualization and Programming ,Control flow and operators **Laboratory Sessions/ Experimental learning:** 1. Write MATLAB commands to analyze arithmetic, logical and Boolean operations. 2. Write MATLAB commands to analyze vector operations and magic matrixes. 3. Write a MATLAB program to demonstrate if and else if statement for comparing Two numbers. **Video link / Additional online information :** 1. https://in.mathworks.com/videos/writing-a-matlab-program-69023.html	**8Hrs.**
Module-2	
Solving Equations, Curve Fitting, and Numerical Techniques :Linear Algebra, Polynomials, Optimization, Differentiation/Integration, Differential Equations **Advanced Methods**: Probability and Statistics, Data Structures, Images, File I/O **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=14H4UFoxZjs 2. https://www.youtube.com/watch?v=fqS873TnMDs	**8Hrs.**

Module-3	
Various functions and toolboxes: Documentation, Misc. Useful Functions, Graphical User Interfaces, Simulink, Symbolic Toolbox **Applications:** App Designing using GUI, Image processing **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=fqS873TnMDs https://www.youtube.com/watch?v=14H4UFoxZjs	**8Hrs.**
Module-4	
Prerequisites: *Types of filters* **Introduction to SIMULINK:** Multiple plots creating models, blocks, Systems and sub-systems, Simulating Dynamic System, Solving a model, solvers, MATLAB SIMULINK integration, S-function); MATLAB Toolboxes training (Signal Processing, Neural Network, FUZZY logic, Control System, Communication, Power System toolboxes); **Laboratory Sessions/ Experimental learning:** **1.** Create a spreadsheet file with some data (or use an existing spreadsheet with data if you have) and import the data into MATLAB. 2. Matlab 2D and 3D Plot **Video link / Additional online information :** 1. https://www.youtube.com/watch?v=iOmqgewj5XI 2. https://in.mathworks.com/learn/tutorials/simulink-onramp.html	**8Hrs.**
Module-5	
Applications of Matlab: Diode Characteristics, Fourier Analysis, Signal Processing, Deep learning, Image processing **Laboratory Sessions/ Experimental learning:** 1. Image Enhancement Using Intensity Transformations, 2. Morphological and Other Set Operations **3.** Two-Dimensional Fast Fourier Transform **Video link / Additional online information:** 1. https://in.mathworks.com/videos/image-processing-and-computer-vision-in-matlab-and-simulink-96760.html	**8Hrs.**

Course outcomes:	
CO1	Students should be able to apply computer methods for solving a wide range of engineering problems.
CO2	Students should be able to use computer engineering software to solve and present problem solutions in a technical format.
CO3	Students should be able to utilize computer skills to enhance learning and performance in other engineering and science courses.
CO4	Understand how signals, images, and data are represented and manipulated in MATLAB
CO5	Students should be able understand the various programming constructs and how they can be used to solve a computational problem.

Text Books:	
1.	Proakis & Monalakis, “Digital signal processing – Principles Algorithms & Applications”, 4th Edition, Pearson education, New Delhi, 2007. ISBN: 81-317-1000-9.
2.	Li Tan, Jean Jiang, “Digital Signal processing – Fundamentals and Applications”, Academic Press, 2013, ISBN: 978-0-12-415893.
Reference Books:	
1.	S. Salivahanan, C. Gnanpriya, Digital Signal processing , McGraw Hill

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**	**3**	**2**	**-**	**-**	**-**	**-**	**2**	**1**	**1**	**2**
CO2	**3**	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**2**	**1**	**1**	**2**
CO3	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**2**	**1**	**1**	**2**
CO4	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**2**	**1**	**1**	**2**
CO5	**3**	**3**	**2**	**-**	**3**	**-**	**-**	**-**	**3**	**1**	**3**	**3**

High-3, Medium-2, Low-1

Semester:VI		
Digital Image Processing		
Course Code:	**MVJ22EA643**	**CIE Marks: 50**
Credits:	**L:T:P: 3:0:0**	**SEE Marks: 50**
Hours:	**40**	**SEE Duration: 3 Hrs**
Course Learning Objectives: The students will be able to		
1	Understand the fundamentals of digital image processing	
2	Understand the image transforms and other image enhancement techniques used in digital image processing.	
3	Explain image restoration techniques and methods used in digital image processing	
4	Understand region-based segmentation, representation and descriptions	
5	Describe color fundamentals and various morphological image processing techniques	

UNIT 1	
Prerequisites: *Discrete Fourier Transform, MATLAB Basics* **Introduction to Digital Image Processing:** What is Digital Image Processing? Origin of Digital Image Processing, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Elements of Visual Perception, Image Sensing and Acquisition, Image Sampling and Quantization **Applications of Image Processing:** Medical imaging, Robot vision, Character recognition, Remote Sensing. **Laboratory Sessions/ Experimental learning:** 1. Implementation and analysis of image sampling methods including uniform, grid, jittered and best candidate algorithms using MATLAB **Applications:** Medical imaging, Robot vision, Character recognition, Remote Sensing. **Video link / Additional online information :** **1.** https://nptel.ac.in/courses/117/105/117105079/ **2.** https://www.tutorialspoint.com/dip/index.htm	**8Hrs.**
UNIT 2	
Image Enhancement in the Spatial Domain: Some Basic Relationships Between Pixels, Linear and Nonlinear Operations, Some Basic Intensity Transformation Functions, Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters	**8Hrs.**

Frequency Domain: Filtering in the Frequency Domain, Image Smoothing and Image Sharpening Using Frequency Domain Filters **Laboratory Sessions/ Experimental learning:** 1. Implementation and analysis of image smoothing and sharpening algorithms using MATLAB. **Applications:** Image Enhancement, Image Analysis **Video link / Additional online information:** 1. https://nptel.ac.in/courses/117/105/117105079/ 2. https://www.tutorialspoint.com/dip/index.htm	
UNIT 3	
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 **Laboratory Sessions/ Experimental learning:** **1.** Test the restoration with the Inverse Filter for deblurring and denoising. Identify the problem with the Inverse Filter and discuss the solution for the same. **Applications:** Image Enhancement, Image Analysis, Error detection and correction **Video link / Additional online information:** 1. https://nptel.ac.in/courses/117/105/117105079/ 2. https://www.tutorialspoint.com/dip/index.htm	**8Hrs.**
UNIT 4	
Segmentation: Point, Line, and Edge Detection: Detection of Isolated Points, Line Detection, Edge Models, Basic Edge Detection, Advanced Technique for Edge Detection, Thresholding: Optimum Global Thresholding Using Otsu's Method, Region-Based Segmentation: Region growing, Region splitting and merging **Representation and Description:** Representation, Boundary descriptors. **Laboratory Sessions/ Experimental learning:** **1.** Develop and implement a matlab code for Image segmentation using thresholding technique. **Applications:** Object tracking, Pattern recognition	**8Hrs.**

Video link / Additional online information : 1. https://nptel.ac.in/courses/117/105/117105079/ 2 . https://www.tutorialspoint.com/dip/index.htm	
UNIT 5	
Color Image Processing: Color Fundamentals, Color Models, Pseudo color Image Processing. **Morphological Image Processing:** Preliminaries, Erosion and Dilation, Opening and Closing, The Hit-or-Miss Transforms, Some Basic Morphological Algorithms. **Laboratory Sessions/ Experimental learning:** 1. Implementation and analysis of multimodal image fusion using MATLAB. **Applications:** Color conversion, Object marking **Video link / Additional online information:** 1. https://nptel.ac.in/courses/117/105/117105079/ 2. https://www.tutorialspoint.com/dip/index.htm	**8Hrs.**

Course Outcomes: After completing the course, the students will be able to	
CO1	Analyze image processing algorithms used for sampling and quantization.
CO2	Apply and analyze image processing techniques in both the spatial and frequency (Fourier) domains.
CO3	Implement and analyse various image restoration algorithms
CO4	Design image analysis techniques for image segmentation and evaluate the methodologies for segmentation.
CO5	Conduct independent study and analyze various Morphological Image Processing techniques.

Text Books:

1.	Rafel C Gonzalez and Richard E. Woods, "Digital Image Processing"-, PHI 3rd Edition, 2010.
2.	Milan Sonka, Vaclav Hlavac, Roger Boyle, —"Image Processing, Analysis, and Machine Vision‖", Cengage Learning, Fourth Edition, 2013, ISBN: 978-81-315-1883-0

Reference Books:

1.	S.Jayaraman, S.Esakkirajan, T.Veerakumar, "Digital Image Processing"- Tata McGraw Hill 2014.
2.	A. K. Jain, "Fundamentals of Digital Image Processing"- Pearson 2004.

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**	**3**	**2**	**2**	**1**	**-**	**-**	**1**	**-**	**-**	**1**
CO2	**3**	**3**	**3**	**2**	**2**	**1**	**-**	**-**	**1**	**-**	**-**	**1**
CO3	**3**	**3**	**3**	**2**	**2**	**1**	**-**	**-**	**1**	**-**	**-**	**1**
CO4	**3**	**3**	**3**	**2**	**2**	**1**	**-**	**-**	**1**	**-**	**-**	**1**
CO5	**3**	**3**	**3**	**2**	**2**	**1**	**-**	**-**	**1**	**-**	**-**	**1**

Semester:VI		
Principles of Communication Systems		
Course Code:	**MVJ22EA644**	**CIE Marks: 50**
Credits:	**L:T:P: 3:0:0**	**SEE Marks: 50**
Hours:	**40**	**SEE Duration: 3 Hrs**
Course Learning Objectives: The students will be able to		
1	Understand and analyze the concepts of Analog Modulation schemes viz; AM, FM.	
2	Describe concepts of digitization of signals viz; sampling, quantizing and encoding.	
3	Understand basic concepts of various digital modulation techniques.	
4	Explain the principles behind information theory and coding.	
5	Understand the basics of spread spectrum modulation.	

Module-1	
Prerequisites: *Modulation, Need for Modulation and types of Modulation.* **Analog Modulation:** Amplitude Modulation - AM, DSBSC, SSBSC, VSB - PSD, modulators and demodulators, Angle modulation - PM and FM - PSD, modulators and demodulators - Super heterodyne receivers. **Laboratory Sessions/ Experimental learning:** 1. Introduction to Matlab 2. Generation of AM signal using Matlab **Applications:** Broadcast transmissions, Air band radio, Quadrature amplitude modulation **Video link / Additional online information :** 1. https://nptel.ac.in/courses/117/105/117105143/ 2. https://youtu.be/00ZbuhPruJw 3. https://youtu.be/rt08yTGv_z4	**8Hrs.**

Module-2	8Hrs.
Pulse Modulation: Low pass sampling theorem, Quantization, PAM, Line coding, PCM, DPCM, DM, and ADPCM and ADM, Channel Vocoder, Time Division Multiplexing, Frequency Division Multiplexing. **Laboratory Sessions/ Experimental learning:** 1. Delta modulation using Matlab **Applications:** Speech recognition systems, pattern recognition systems, digital audio in computers, CDs, digital telephony, telephone and radio communications, television systems. **Video link / Additional online information :** 1. https://nptel.ac.in/courses/117/105/117105077/ 2. https://nptel.ac.in/courses/117/101/117101051/	
Module-3	**8Hrs.**
Digital Modulation And Transmission: Phase shift keying, BPSK, DPSK, QPSK, Principles of M-ary signaling M-ary PSK & QAM, Comparison, ISI Pulse shaping, Duo binary encoding, Cosine filters, Eye pattern, equalizers. **Laboratory Sessions/ Experimental learning:** 1. Eye diagram using Matlab 2. Generation of BPSK Using LabVIEW **Applications:** LAN, CDMA, WiMAX**,** wireless communication, mobile communication, Satellite Communication, Bluetooth, RFID. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/117/105/117105077/ 2. https://nptel.ac.in/courses/117/101/117101051/	
Module-4	**8Hrs.**
Information Theory and Coding: Measure of information, Entropy, Source coding theorem – Shannon Fanon coding, Huffman Coding, LZ Coding, Channel capacity, Shannon-Hartley law – Shannon's limit, Error control codes, Cyclic codes, Syndrome calculation, Convolution Coding, Sequential and Viterbi decoding. **Laboratory Sessions/ Experimental learning:** 1. Huffman coding using Matlab **Applications:** Data Compression, audio/video transmission, data transmission and file transfer **Video link / Additional online information:** 1. https://nptel.ac.in/courses/108/102/108102117/	

https://nptel.ac.in/courses/117/104/117104129/	
Module-5	
Spread Spectrum Multiple Access Techniques: PN sequences, properties, m-sequence, DSSS – Processing gain, Jamming, FHSS, Synchronization and tracking, Multiple Access FDMA, TDMA, CDMA. **Laboratory Sessions/ Experimental learning:** 1. Direct Sequence Spread spectrum Signal Generation & Detection using Matlab **Applications:** CDMA, Wi-Fi, WPAN, 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/ https://youtu.be/Ojmv3I4kDn4	**8Hrs.**

Course outcomes:	
CO1	Examine the concepts of AM and FM modulation and demodulation.
CO2	Apply the concepts of sampling, quantization and encoding for digitization of signals.
CO3	Evaluate the performance of a baseband and pass band digital communication system in terms of error rate and spectral efficiency.
CO4	Analyze source and error control coding.
CO5	Illustrate the digital communication system with spread spectrum modulation.

Text Books:	
1.	H Taub, D L Schilling, G Saha, “Principles of Communication Systems” 3/e, TMH 2007
2.	Simon Haykins, “An Introduction to Analog and Digital Communication”, John Wiley, 2003.
Reference Books:	
1.	Simon Haykin, “Digital Communication Systems”, John Wiley & sons, First Edition, 2014, ISBN 978-0-471-64735-5.
2.	B.P.Lathi, “Modern Digital and Analog Communication systems”, 3rd edition, Oxford University Press, 2007
3.	H P Hsu, Schaum Outline Series – “Analog and Digital Communications” TMH 2006
4.	B.Sklar, “Digital Communications Fundamentals and Applications” 2/e Pearson Education 2007
5.	K Giridhar, “Information Theory And Coding”, 4th Edition, Pooja Publication, Bangalore, 2001.

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**	**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

PROJECT PHASE – I		
Course Code:	**MVJ22EA65**	**CIE Marks:100**
Credits:	**L:T:P: 0:0:4**	**SEE Marks: 100**
Hours:	**-**	**SEE Duration: 3 Hrs**
Course Learning Objectives: The students will be able to		
1	Develop independent learning.	
2	Develop interactive, communication, organization, time management, and presentation skills.	
3	Appraise flexibility and adaptability.	
4	present the topic of project work in a seminar without any fear, face audience confidently, enhance communication skill, involve in group discussion to present and exchange ideas.	

Project Work Phase - I: Each student of the project batch shall involve in carrying out the project work jointly in constant consultation with internal guide, co-guide, and external guide and prepare the project report as per the norms avoiding plagiarism.	
Course outcomes: At the end of the course the student will be able to:	
CO1	Describe the project and be able to defend it.
CO2	Learn to use modern tools and techniques.
CO3	Develop skills to work in a team to achieve common goal. Develop skills of project management and finance.
CO4	Develop skills of self-learning, evaluate their learning and take appropriate actions to improve it.
CO5	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 Phase wise completion of the

project work, Project report, Presentation and Demonstration of the actual/model/prototype of the project.

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

High-3, Medium-2, Low-1

Computer Communication Networks			
Course Code	**MVJ22EA71**	**CIE**	**50**
Total No. of Contact Hours	**40**	**SEE**	**50**
No. of Contact Hours/week	**3 (L : T : P :: 3 : 0 : 2)**	**Total**	**100**

Course objectives:Students will be able to

1	Understand the layering architecture of OSI reference model and TCP/IP protocol suite.
2	Describe about the protocols associated with each layer.
3	Explain different networking architectures and their representations.
4	Describe various routing techniques and the transport layer services.
5	Identify security features and functionality of application layer protocols.

Module-1

Prerequisites: Basic knowledge on computers **Introduction:** Data Communications: Components, Representations, Data Flow, Networks: Network criteria, Physical Structures, Network Types: LAN, WAN, Switching, Internet. **Network Models:** Protocol Layering: Scenarios, Principles, Logical Connections, TCP/IP Protocol Suite: Layered Architecture, Layers in TCP/IP suite, Description of layers, Encapsulation and Decapsulation, Addressing, Multiplexing and Demultiplexing, The OSI Model: OSI Versus TCP/IP **Laboratory Sessions/ Experimental learning:** 1. Study and draw the layout of LAN connection in Computer Networks Lab in NetSim. 2. List out the type of cabling involved. **Applications:** Ethernet, Fibernet, Satellite Communication. **Video link / Additional online information:** https://nptel.ac.in/courses/106/106/106106091/	**8Hrs**

Module-2

Data-Link Layer: Introduction: Nodes and Links, Services, Categories of link, 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, Piggybacking. **Media Access Control:** Random Access: ALOHA, CSMA, CSMA/CD, CSMA/CA. Wired LANs: Ethernet: Ethernet Protocol: IEEE802, Ethernet Evolution, Standard Ethernet: Characteristics, Addressing, Access Method, Efficiency, and Implementation. **Laboratory Sessions/ Experimental learning:** Study and analyse packet transfer using CSMA/CD and CSMA/CA using NetSim. **Applications:** Collision detection and avoidance in wired and wireless network. **Video link / Additional online information:** https://nptel.ac.in/courses/106/105/106105183/	**8Hrs**

Module-3

Wireless LANs: Introduction: Architectural Comparison, Characteristics, IEEE 802.11: Architecture, MAC Sublayer, Addressing Mechanism. **Network Layer:** Introduction, Network Layer services: Packetizing, Routing and Forwarding, Other services, Packet Switching: Datagram Approach, Virtual Circuit Approach, IPV4 Addresses, Address Space, Classful Addressing, Classless Addressing, DHCP. **Unicast Routing:** Introduction, Routing Algorithms: Distance Vector Routing, Link State Routing. **Laboratory Sessions/ Experimental learning:** 1. Study of IP addressing, subnet mask and subnetting. **Applications:** Routing and forwarding packets in routers. **Video link / Additional online information:** https://nptel.ac.in/content/storage2/courses/106105080/pdf/M6L2.pdf	**8Hrs**
Module-4	
Transport Layer: Introduction: Transport Layer Services, Connectionless and Connection oriented Protocols, Transport Layer Protocols: Simple protocol, Stop and wait protocol, Go-Back-N Protocol, Selective repeat protocol. **Transport-Layer Protocols in the Internet**: User Datagram Protocol: User Datagram, UDP Services, UDP Applications, Transmission Control Protocol: TCP Services, TCP Features, Segment, Connection, State Transition diagram, Windows in TCP, Flow control, Error control, TCP congestion control. **Laboratory Sessions/ Experimental learning:** Transport analysis using TCP/UDP using NetSim. **Applications:** MS Teams, Zoom, Cisco webex **Video link / Additional online information:** http://www.digimat.in/nptel/courses/video/106105183/L11.html	**8Hrs**
Module-5	
Application Layer: Introduction: providing services, Application- layer paradigms, Standard Client - Server Protocols: World wide web, Hyper Text Transfer Protocol, FTP: Two connections, Control Connection, Data Connection, Electronic Mail: Architecture, Wed Based Mail, Telnet: Local versus remote logging, Domain Name system: Name space, DNS in internet, Resolution, DNS Messages, Registrars, DDNS, security of DNS. **Laboratory Sessions/ Experimental learning:** **Applications:** All applications like MS Office, Facebook, Instagram, etc. **Video link / Additional online information:** https://archive.nptel.ac.in/courses/106/105/106105183/2	**8Hrs**
LABORATORY EXPERIMENTS 1. Implement a point-to-point network with four nodes and duplex links between them. Analyze the network performance by setting the queue size and varying the bandwidth. 2. Implement a four-node point to point network with links n0-n1, n1-n2 and n2-n3. Apply TCP agent between n1-n2 and UDP between n1-n3. Apply relevant applications over TCP and UDP agents changing the parameter and determine the number of packets sent by TCP/UDP. 3. Implement Ethernet LAN using n (6-10) nodes. Compare the throughput by changing the error rate and data rate. 4. Implement ESS with transmission nodes in Wireless LAN and obtain the performance parameters.	

5. Implementation of Link state routing algorithm. Implement the following in C/C++ in Linux platform 6. Write a program for a HLDC frame to perform the following. i) Bit stuffing ii) Character stuffing. 7. Write a program for distance vector algorithm to find suitable path for transmission. For the given data, use CRC-CCITT polynomial to obtain CRC code. Verify the program for the cases. a. Without error b. With error 8.Implementation of Sliding Window Protocol. 9. Write a program for congestion control using leaky bucket algorithm.

Course outcomes:	
CO1	Analyse the layering architecture of computer networks and distinguish between the OSI reference model and TCP/IP protocol suite.
CO2	Apply the protocols and services of Physical and Data link layer.
CO3	Describe functions associated with network layer and connecting devices.
CO4	Analyse and apply the protocols and services of Transport layer.
CO5	Analyse and apply the protocols and services of application layer.
Text Books:	
1.	Behrouz A Forouzan, “Data Communication and Networks”, 5th Ed. TMH.
2.	Andrew S Tanebaum, “Computer Networks”, 4th Ed. PHI/ Pearson education.
Reference Books:	
1.	S. Keshav, “An Engineering approach to Computer Networks”, 5th Ed. Pearson.
2.	W.A. Shay, “Understanding communication and Networks”, Thomson.

CO-PO Mapping

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

High-3, Medium-2, Low-1

Semester-VII			
Digial Image Processing			
Course Code	**MVJ22EA72**	**CIE Marks**	**50**
Teaching Hours/Week (L: T:P: S)	**3 Hours/Week (L:T:P: 3:0:2)**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40L+10P**	**Total Marks**	**100**

Course objectives:
Learn the fundamentals of digital image processing
Understand the image transforms and other image enhancement techniques used in digital image processing.
Study the image restoration techniques and methods used in digital image processing
Understand region-based segmentation and segmentation using morphological watersheds.
Know the colour fundamentals and various morphological image processing techniques.

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

Module-1

Prerequisites: Discrete Fourier Transform, MATLAB Basics **Introduction to Digital Image Processing:** What is Digital Image Processing? Origin of Digital Image Processing, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Elements of Visual Perception, Image Sensing and Acquisition, Image Sampling and Quantization **Laboratory Sessions/ Experimental learning:** 1. Implementation and analysis of image sampling methods including uniform, grid, jittered and best candidate algorithms using MATLAB **Applications:** Medical imaging, Robot vision, Character recognition, Remote Sensing. **Video link / Additional online information :** **1.** https://nptel.ac.in/courses/117/105/117105079/ **2.** https://www.tutorialspoint.com/dip/index.htm	**8Hrs**

Module-2	
Spatial Domain: Some Basic Relationships Between Pixels, Linear and Nonlinear Operations, Some Basic Intensity Transformation Functions, Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters **Frequency Domain:** Filtering in the Frequency Domain, Image, Smoothing and Image Sharpening Using Frequency Domain Filters. **Laboratory Sessions/ Experimental learning:** 1. Implementation and analysis of image smoothing and sharpening algorithms using MATLAB. **Applications:** Image Enhancement, Image Analysis **Video link / Additional online information:** 1. https://nptel.ac.in/courses/117/105/117105079/ 2. https://www.tutorialspoint.com/dip/index.htm	**8Hrs**
Module-3	
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. **Laboratory Sessions/ Experimental learning:** **1.** Test the restoration with the Inverse Filter for deblurring and denoising. Identify the problem with the Inverse Filter and discuss the solution for the same. **Applications:** Image Enhancement, Image Analysis, Error detection and correction **Video link / Additional online information:** 1. https://nptel.ac.in/courses/117/105/117105079/ 2. https://www.tutorialspoint.com/dip/index.htm	**8Hrs**
Module-4	
Segmentation: Point, Line, and Edge Detection: Detection of Isolated Points, Line Detection, Edge Models, Basic Edge Detection, Advanced Technique for Edge Detection, Thresholding: Optimum Global Thresholding Using Otsu's Method, Region-Based Segmentation: Region growing, Region splitting and merging **Laboratory Sessions/ Experimental learning:** **1.** Develop and implement a matlab code for Image segmentation using thresholding technique. **Applications:** Object tracking, Pattern recognition **Video link / Additional online information :** 1. https://nptel.ac.in/courses/117/105/117105079/ 2. https://www.tutorialspoint.com/dip/index.htm	**8Hrs**

Module-5	
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, Some Basic Morphological Algorithms **Laboratory Sessions/ Experimental learning:** 1. Implementation and analysis of multimodal image fusion using MATLAB. **Applications:** Color conversion, Object marking **Video link / Additional online information:** 1. https://nptel.ac.in/courses/117/105/117105079/ 2. https://www.tutorialspoint.com/dip/index.htm	**8Hrs**

Lab Experiments

1. Read a gray-scale image. Convert it to binary image using thresholding. Also draw the histogram
2. Read an image and perform histogram equalization of the input image
3. Read an image and perform geometric transformation
   a) Rotation of image 15 degree anticlockwise and 30 degree clockwise.
   b) Change in scale or resize the image.
4. Read an image and corrupt it using salt and pepper noise. Apply mean filtering to corrupted image.
5. Generate an image showing text “Digital Image Processing” and save the image as DIP.bmp and convert it to grayscale
6. Perform wiener filtering on the modular image matrix f(m,n). Select suitable S matrix
7. Perform Digital image arithmetic in spatial domain
   a) Addition of digital images
   b) Subtraction
   c) Multiplication
   d) Division
   e) Complement of any of the image
8. Read an image. Perform mean filtering using a 3*3 box filter. Analyze the effect when increasing the mask size.
9. Read an image corrupted using salt and pepper noise. Apply averaging filter and analyse the result.
10. Read an image and perform the following edge detection algorithm
    1) Sobel 2) Prewitt 3) Roberts 4) Log 5) Canny edge detection
11. Read an image and perform erosion and dialation operations.
12. Perform opening and closing operations on an image

Text Books:

1.	Rafel C Gonzalez and Richard E. Woods , “Digital Image Processing”-, PHI 3rdEdition 2010.
2.	Milan Sonka, Vaclav Hlavac, Roger Boyle, ”Image Processing, Analysis, and Machine Vision‖”, Cengage Learning, 2013, ISBN: 978-81-315-1883-0

Reference Books:

1.	S.Jayaraman, S Esakkirajan, T.Veerakumar, “Digital Image Processing”, Tata McGraw Hill, 2011
2.	S.Jayaraman, S.Esakkirajan, T.Veerakumar, “Digital Image Processing”- Tata McGraw Hill 2014.
3.	A. K. Jain, “Fundamentals of Digital Image Processing”- Pearson 2004.

Course outcome (Course Skill Set)

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

1.	Analyze image processing algorithms used for sampling and quantization.
2.	Apply and analyze image processing techniques in both the spatial and frequency (Fourier) domains.
3.	Implement and analyse various image restoration algorithms
4.	Design image analysis techniques for image segmentation and evaluate the methodologies for segmentation.
5.	Conduct independent study and analyze various Morphological Image Processing techniques.

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 self - study are 20 (2 presentations are be held for 10 marks each). The marks obtained in test, quiz and self -studies 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 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 complete 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.

Laboratory- 50 Marks
Experiment Conduction with proper results is evaluated for 40 marks and Viva is for 10 marks.

CO-PO Mapping

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

Wireless Cellular Communication		Semester	VII
Course Code	**MVJ22EA73**	**50**	**50**
Teaching Hours/Week (L: T:P: S)	**3 Hours/Week (L:T:P: 3:0:0)**	**50**	**50**
Total Hours of Pedagogy	**30L**	**100**	**100**

Course objectives:

- Understand the basics of LTE standardization phases and specifications.
- Explain the system architecture of LTE and E-UTRAN, the layer of LTE, based on the use of OFDMA and SC-FDMA principles.
- Analyze the role of LTE radio interface protocols to set up, reconfigure and release the Radio Bearer, for transferring the EPS bearer.
- Analyze the main factors affecting LTE performance including mobile speed and transmission bandwidth.

Module-1

Key Enablers for LTE features: OFDM, Single carrier FDMA, Single carrier FDE, Channel Dependent Multiuser Resource Scheduling, Multi antenna Techniques, IP based Flat network Architecture, LTE Network Architecture. **Wireless Fundamentals:** Cellular concept, Broadband wireless channel (BWC), Fading in BWC, Modeling BWC – Empirical and Statistical models, Mitigation of Narrow band and Broadband Fading. **Application: Android Based Smart Phone Used for Induction Motor Control, Robotic Vehicle Movement By Cell Phone** **Web Reference: https://nptel.ac.in/courses/106106167**	**8Hrs**

Module-2	
Multicarrier Modulation: OFDM basics, OFDM in LTE, Timing and Frequency Synchronization, PAR, SC-FDE . **OFDMA and SC-FDMA:** OFDM with FDMA,TDMA,CDMA, OFDMA, SC-FDMA, OFDMA and SC-FDMA in LTE . **Multiple Antenna Transmission and Reception:** Spatial Diversity overview, Receive Diversity, Transmit Diversity, Interference cancellation and signal enhancement, Spatial Multiplexing, Choice between Diversity, Interference suppression and Spatial Multiplexing **Application: Dialed Telephone Number LED Based Display System, DTMF based Load Control System** **Web Reference: https://nptel.ac.in/courses/106106167**	**8Hrs**
Module-3	
Overview and Channel Structure of LTE: Introduction to LTE, Channel Structure of LTE, Downlink OFDMA Radio Resource, Uplink L1, L2 146 SC-FDMA Radio Resource. **Downlink Transport Channel Processing:** Overview, Downlink shared channels, Downlink Control Channels, Broadcast channels, Multicast channels, Downlink physical channels, H-ARQ on Downlink. **Application: Wireless Message Communication between Two Computers** **Web Reference: https://nptel.ac.in/courses/106106167**	**8Hrs**
Module-4	
Uplink Channel Transport Processing: Overview, Uplink shared channels, Uplink Control Information, Uplink Reference signals, Random Access Channels, H-ARQ on uplink. **Physical Layer Procedures:** Hybrid – ARQ procedures, Channel Quality Indicator CQI feedback, Precoder for closed loop MIMO Operations, Uplink channel sounding, Buffer status Reporting in uplink, Scheduling and Resource Allocation, Cell Search, Random Access Procedures, Power Control in uplink. **Application: Remotely Controlled Android based Electronic Notice Board, Remote Operated Domestic Appliances Control by Android Application** **Web Reference: https://nptel.ac.in/courses/106106167**	**8Hrs**

Module-5	
Radio Resource Management and Mobility Management: PDCP overview, MAC/RLC overview, RRC overview, Mobility Management, Inter-cell Interference Coordination **Application: Home Automation by Android Application based Remote Control** **Web Reference: https://nptel.ac.in/courses/106106167**	**8Hrs**

Course outcome (Course Skill Set)

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

1.	Understand the system architecture and the functional standard specified in LTE 4G.
2.	Analyze the role of LTE radio interface protocols and EPS Data convergence protocols to set up, reconfigure and release data and voice from users.
3.	Demonstrate the UTRAN and EPS handling processes from set up to release including mobility management for a variety of data call scenarios.
4.	Test and Evaluate the Performance of resource management and packet data processing and transport algorithms.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- There are 25 marks for the CIE's Assignment component and 25 for the Internal Assessment Test component.
- Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the coverage of the syllabus, and the second test will be administered after 85-90% of the coverage of the syllabus. The average of the two tests shall be scaled down to 25 marks
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The schedule for assignments shall be planned properly by the course teacher. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. Each assignment shall be conducted for 25 marks. (If two assignments are conducted then the sum of the two assignments shall be scaled down to 25 marks)
- The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and assignment/s marks.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:	
Books	
1.	Arunabha Ghosh, Jan Zhang, Jefferey Andrews, Riaz Mohammed, 'Fundamentals of LTE', Prentice Hall, Communications Engg. and Emerging Technologies.
2.	LTE for UMTS Evolution to LTE-Advanced' Harri Holma and Antti Toskala, Second Edition - 2011, John Wiley & Sons, Ltd. Print ISBN: 9780470660003.
3.	'EVOLVED PACKET SYSTEM (EPS) ; THE LTE AND SAE EVOLUTION OF 3G UMTS' by Pierre Lescuyer and Thierry Lucidarme, 2008, John Wiley & Sons, Ltd. Print ISBN:978-0-470-05976-0.
4.	'LTE – The UMTS Long Term Evolution ; From Theory to Practice' by Stefania Sesia, Issam Toufik, and Matthew Baker, 2009 John Wiley & Sons Ltd, ISBN 978-0-470-69716-0.
Web links and Video Lectures (e-Resources):	
• https://archive.nptel.ac.in/courses/117/102/117102062/ • https://nptel.ac.in/courses/106105160	
Activity Based Learning (Suggested Activities in Class)/ Practical Based learning	

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

Semester-VII			
Industrial IOT			
Course Code	**MVJ22EA741**	**CIE Marks**	**50**
Teaching Hours/Week (L: T:P: S)	**3 Hours/Week (L:T:P: 3:0:2)**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40L**	**Total Marks**	**100**

Course objectives:The students will be able to	
1	Design Industrial IOT Systems for various application.
2	Develop systems for IioT
3	Understand IIoT Data Monitoring & Control techniques
4	Analyze Cyber Physical Systems
5	Understand various Industrial IoT- Applications:

Module-1	
Prerequisites: Basic knowledge on computers **Introduction to Industrial IoT (IIoT) Systems:** The Various Industrial Revolutions, Role of Internet of Things (IoT) & Industrial Internet of Things (IIoT) in Industry, Industry 4.0 revolutions, Support System for Industry 4.0, Smart Factories. **Applications:IoT devices improve entertainment, network connectivity, health, and fitness.** **Video link / Additional online information: https://nptel.ac.in/courses/106104242**	**8Hrs**
Module-2	
Implementation systems for IIoT:: Sensors and Actuators for Industrial Processes, Sensor networks, Process automation and Data Acquisitions on IoT Platform, Microcontrollers and Embedded PC roles in IIoT, Wireless Sensor nodes with Bluetooth, WiFi, and LoRa Protocols and IoT Hub systems **Applications: RFID and GPS technology can help a manufacturer track a product from its start on the factory floor to its placement in the destination store, the whole supply chain from start to finish** **Video link / Additional online information: https://nptel.ac.in/courses/106104242**	**8Hrs**
Module-3	
IIoT Data Monitoring & Control: IoT Gate way, IoT Edge Systems and It's Programming, Cloud computing, Real Time Dashboard for Data Monitoring, Data Analytics and Predictive Maintenance with IIoT technology. **Applications: IoT makes monitoring and management of micro-climate conditions a reality, which in turn increases production** **Video link / Additional online information: https://nptel.ac.in/courses/106104242**	**8Hrs**

Module-4	
Cyber Physical Systems: Next Generation Sensors, Collaborative Platform and Product Lifecycle Management, Augmented Reality and Virtual Reality, Artifical Intelligence, Big Data and Advanced Analysis **Applications: Smart Grid and Energy Saving, Fleet Management** **Video link / Additional online information: https://nptel.ac.in/courses/106104242**	**8Hrs**
Module-5	
Industrial IoT- Applications: Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security (Including AR and VR safety applications), Facility Management. **Applications: Maintenance Management, Smart Pollution Control** **Video link / Additional online information: https://nptel.ac.in/courses/106104242**	**8Hrs**

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

There are 25 marks for the CIE's Assignment component and 25 for the Internal Assessment Test component.

- Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the coverage of the syllabus, and the second test will be administered after 85-90% of the coverage of the syllabus. The average of the two tests shall be scaled down to 25 marks
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The schedule for assignments shall be planned properly by the course teacher. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. Each assignment shall be conducted for 25 marks. (If two assignments are conducted then the sum of the two assignments shall be scaled down to 25 marks)
- The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and assignment/s marks.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).** 1. The question paper will have ten questions. Each question is set for 20 marks. 2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module. 3. The students have to answer 5 full questions, selecting one full question from each module. Marks scored shall be proportionally reduced to 50 marks

Course outcomes:	
CO1	Understand Revolution of Industrial IoT
CO2	Understand Use of Sensors and Actuators in Industry application
CO3	Understand IoT Gateways,Edge System and Programming
CO4	Acquire knowledge of next Generation Sensors
CO5	Industrial IoT applications
Text Books:	
1.	INTERNET OF THINGS,Architecture and Design Principles.Raj Kamal,TataMcGrawHill-ISBN-13: 978-93-5260-523-1
2.	Industrial IoT,Challenges,Design Principles,Application and security, Ismail Butun,Springer Nature,1 July 2020
Reference Books:	
1.	Introduction to Industrial Internet of Things and Industry 4.0, Sudip Misra, Chandana Roy, Anandarup Mukherjee, 1st Edition,CRC Press
2.	W.A. Shay, “Understanding communication and Networks”, Thomson.

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

Semester: VII		
VIRTUAL & AUGMENTED REALITY (Theory)		
Course Code:	**MVJ22EA554**	**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	Understand virtual and Augmented Reality.	
2	Describe various elements and components used in AR/VR Hardware	
3	Explain various factors involved in multisensory action of human being	
4	Execute detail analysis of the engineering, scientific and functional aspects of VR systems and the fundamentals of VR/AR modelling and programming.	
5	Understand virtual reality, augmented reality and using them to build Biomedical, engineering and robotics application.	

Module-1	
Prerequisites: *Intermediate programming ability in object-oriented languages**,** Basic linear algebra* **Introduction to Immersive Technologies**: A Brief History of Virtual Reality, The five Classic Components of a VR System, Early Commercial VR Technology , VR becomes an Industry, Reality, Virtuality and Immersion , VR, AR, MR, xR: similarities and differences. **Laboratory Sessions/ Experimental learning:** 1. Choose an existing VR application and write a summary including a personal critical reflection on its look and feel especially in relation to immersion, presence, agency and interactivity. **Applications:** VR in Sport**,** Mental Health**,** Medical Training. **Video link / Additional online information:** https://nptel.ac.in/courses/121/106/121106013/	**8Hrs.**
Module-2	
Motion Tracking and Navigation: Position and Motion Trackers , Inside Out/Outside In , Tracker Performance Parameters , Optical, Active and Passive Trackers , Inertial and Hybrid Trackers, HMD Trackers , Magnetic Trackers , Mechanical Trackers , Ultrasonic Trackers , Navigation and Manipulation Interfaces , Tracker-Based Navigation/Manipulation Interfaces. **Laboratory Sessions/ Experimental learning:**	**8Hrs.**

1. Design an immersive environment in Unity-3D or Unreal that will develop and enhance Work in groups. Start by building a simple 3D world that an interactive player can move around in. Connect the controllers and create a simple interaction loop. Measure velocity, acceleration, distances, and other motion and spatial parameters of the user and the controllers. **Applications:** Industrial Training and Simulation, Flight Training and Simulation, Pilot Head Tracking, Live Aircraft, Sports motion Analysis. **Video link / Additional online information:** https://nptel.ac.in/courses/106/106/106106138/	
Module-3	**8Hrs.**
The Human behind the lenses: Human Perception and Cognition , The Human Visual System, VR Health and Safety Issues, Effects of VR Simulations on Users , Cyber sickness, before and now Guidelines for Proper VR Usage. **Laboratory Sessions/ Experimental learning:** 1. Create a well-rounded multisensory action that is meaningful, safe and accommodates all senses, visual, auditory and tactile. **Applications:** Human–Computer Interaction**,** e-Sports, Games**,** Cultural heritage **Video link / Additional online information:** https://nptel.ac.in/noc/courses/noc18/SEM1/noc18-ge08/	
Module-4	**8Hrs.**
Augmented and Mixed Reality: Taxonomy, technology and features of augmented reality, difference between AR and VR, Challenges with AR, AR systems and functionality, Augmented reality methods, visualization techniques for augmented reality, wireless displays in educational augmented reality applications, mobile projection interfaces, marker-less tracking for augmented reality, enhancing interactivity in AR environments, evaluating AR systems. **Laboratory Sessions/ Experimental learning:** 1. Experiment with Photo grammetry and improve the visual look and feel of your environment **Applications:** Healthcare **Video link / Additional online information:** https://www.coursera.org/learn/ar-technologies-video-streaming	

Module-5	
Medical Applications of xR: Behavioural Therapy, Virtual and Augmented Surgery, Triage and Diagnostics, Applications of VR in Robotics: Robot Programming, Robot Tele operation. **Laboratory Sessions/ Experimental learning:** 1. Add a training component to your existing prototype. Define the mechanics that will progressively improve user's performance to mastery through an interaction loop using the dual concept of challenge / reinforcing. **Video link / Additional online information:** https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5622235/	**8Hrs.**

Course outcomes:	
CO1	Acquire various principles and concepts of virtual reality and its application.
CO2	Understand the optical motion tracking and navigation in virtual reality.
CO3	Analyse and solve problems related to their expertise in Augment and Virtual Environments.
CO4	Develop detailed analysis of the engineering, scientific and functional aspects of VR systems and the fundamentals of VR modelling and programming.
CO5	Illustrate the knowledge of integrating hardware, software, tools for AR/VR technology.
Text Books:	
2.	C. Burdea and Philippe Coiffet, "Virtual Reality Technology", First Edition, Gregory, John Wiley and Sons, Inc.,2008
3.	Steven M. LaValle, "Virtual Reality", 2016. Online version: http://msl.cs.uiuc.edu/vr/
4.	Alan B. Craig, "Understanding Augmented Reality, Concepts and Applications", Morgan Kaufmann, First Edition, 2013.
5.	Dieter Schmalstieg and Tobias Hollerer, "Augmented Reality: Principles and Practice (Usability)" by Pearson Education (US), Addison-Wesley Educational Publishers Inc, New Jersey, United States, 2016. ISBN: 9780321883575
Reference Books:	
1.	Jason Jerald.,"The VR Book: Human-Centred Design for Virtual Reality", Association for Computing Machinery and Morgan and Claypool, New York, NY, USA, First Edition, 2015

2.	Steve Aukstakalnis, "Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR (Usability)", Addison-Wesley Professional; 1st edition, 2016.
3.	Robert Scoble and Shel Israel, "The Fourth Transformation: How Augmented Reality and Artificial Intelligence Will Change Everything", Patrick Brewster Press; 1st edition, 2016.
4.	Tony Parisi, "Learning Virtual Reality: Developing Immersive Experiences and Applications for Desktop, Web, and Mobile", OReilly Media; 1st edition, 2015.
5.	Tony Parisi, "Programming 3D Applications with HTML5 and WebGL: 3D Animation and Visualization for Web Pages", OReilly Media; 1st edition, 2014.

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	PSO1	PSO2
CO1	3	3	3	2	3	1	-	-	1	-	-	1	-	1
CO2	3	3	3	2	3	1	-	-	1	-	-	1	-	1
CO3	3	3	3	2	3	1	-	-	1	-	-	1	-	1
CO4	3	3	3	2	3	1	-	-	1	-	-	1	-	1
CO5	3	3	3	2	3	1	-	-	1	-	-	1	-	1

High-3, Medium-2, Low-1

Scripting Language For Communication			
Course Code	**MVJ22EA743**	**CIE Marks**	**50**
Teaching Hours/Week (L: T:P: S)	**3 Hours/Week (L:T:P: 3:0:0)**	**SEE Marks**	**50**
Total Hours of Pedagogy	**30L**	**Total Marks**	**100**

Course objectives:Students will be able to

1	study the basics of scripting languages like Java script, Perl, PHP and Ruby.
2	understand the requirements of Scripting Languages.
3	identify the uses of Scripting Languages
4	Explain programming features of Perl and PHP.
5	Demonstrate the implementation and applications of Scripting

Module-1	
Introduction to Scripts and Scripting Languages–Scripts and Programs, Uses for Scripting Languages, Web Scripting. **Java Script:** Variables, Data Types, Operators, Conditional statements, Loops, Arrays, Functions, Objects-Predefined objects, accessing objects, object Methods. **Application: useful for extracting information from a dataset** **Web Reference: https://nptel.ac.in/courses/117106113**	**8Hrs**
Module-2	
JavaScript programming of reactive web pages elements: JavaScript Events-Mouse events, Keyboard events, Form events, window events, Event handlers, Frames, Form object, JavaScript Form Validation. **Application: allows users to control an application's behavior by writing scripts.** **Web Reference: https://nptel.ac.in/courses/117106113**	**8Hrs**
Module-3	
PERL: Data Types, Variables, Scalars, Operators, Conditional statements, Loops, Arrays, Strings, Hashes, Lists, Built-in Functions, Pattern matching and regular expression operators **Application** **Web Reference: https://nptel.ac.in/courses/117106113**	**8Hrs**
Module-4	
PHP: Data Types, Variables, Operators, Conditional statements, Loops, Arrays-Indexed Array, Associative Array, String Functions, Functions-Parameterized Function, Call by Value, Call by Reference, File Handling, PHP Form handling **Application: front-end and back-end developers** **Web Reference:** https://nptel.ac.in/courses/117106113	**8Hrs**

Module-5	
Ruby: Data types, Variables, Operators, Conditional statements, Loops, Methods, Blocks, Modules, Arrays, Strings, Hashes, File I/O, Ruby Form handling. **Application: for formatting documents** **Web Reference: https://nptel.ac.in/courses/117106113**	**8Hrs**

Course outcome (Course Skill Set), At the end of the course, the student will be able to :

Course outcomes:	
CO1	To comprehend the differences between typical scripting languages, typical system and application programming languages
CO2	To implement the design of programs for simple applications.
CO3	To write and apply Perl & PHP scripts.
CO4	Gain knowledge of the strengths and weakness of Perl, and Ruby.
CO5	To create software systems using scripting languages such as Perl, PHP, and Ruby

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

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- There are 25 marks for the CIE's Assignment component and 25 for the Internal Assessment Test component.
- Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the coverage of the syllabus, and the second test will be administered after 85-90% of the coverage of the syllabus. The average of the two tests shall be scaled down to 25 marks
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The schedule for assignments shall be planned properly by the course teacher. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. Each assignment shall be conducted for 25 marks. (If two assignments are conducted then the sum of the two assignments shall be scaled down to 25 marks)
- The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and assignment/s marks.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours).

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks.

Suggested Learning Resources:

Books

1.	The World of Scripting Languages, David Barron, Wiley Publications.
2.	Learning PHP, MySQL, JavaScript, CSS&HTML5: A Step-byStep Guide to Creating Dynamic Websites 3rdEdition, O'Reilly Publications..
3.	The Ruby Programming Language, David Flanagan and Yukihiro Matsumoto, O'Reilly Publications.
4.	Beginning JavaScript with Dom scripting and AJAX, Russ Ferguson, Christian Heilmann, Apress.
5.	Programming Perl, Larry Wall, T. Christiansen and J. Orwant, O'Reilly, SPD.
6.	Open-source Web Development with LAMP using Linux Apache, MySQL, Perl and PHP, J. Lee and B. Ware (Addison Wesley) Pearson Education.

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

CO-PO Mapping

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

Nano Electronics			
Course Code	**MVJ22EA744**	**CIE Marks**	**50**
Teaching Hours/Week (L: T:P: S)	**3 Hours/Week (L:T:P: 3:0:0)**	**SEE Marks**	**50**
Total Hours of Pedagogy	**30L**	**Total Marks**	**100**

Course objectives:Students will be able to

1	Understand the principles behind Nano science engineering and Nanoelectronics.
2	Apply the knowledge to prepare and characterize nanomaterials.
3	Understand the effect of particles size on mechanical,thermal,optical and electrical properties of nanomaterials.
4	Design the process flow required to fabricate state of the art transistor technology.
5	Analyze the requirements for new materials and device structure in the future technologies

Module-1	
Introduction: Overview of nanoscience and engineering. Development milestones in microfabrication andelectronic industry. Moores' law and continued miniaturization, Classification of Nanostructures, Electronicproperties of atoms and solids: Isolated atom, Bonding between atoms, Giant molecular solids, Free electronmodels and energy bands, crystalline solids, Periodicity of crystal lattices, Electronic conduction,effects of nano meter length scale, Fabrication methods:Top-down processes,Bottom-up processes methods for templating the growth of nano materials,ordering of nano systems. **Application: Nanobiotechnology** **Web Reference:** **https://nptel.ac.in/courses/108106186** **https://nptel.ac.in/courses/103105122** **https://nptel.ac.in/courses/112106222**	**8Hrs**
Module-2	
Characterization: Classification, Microscopic techniques, Field ion microscopy, scanning probe techniques,diffraction techniques:bulk and surface diffraction techniques,spectro scopy techniques:photon, radio frequency,electron, surface analysis and dept, mass, Ionbeam profiling:electron,Reflectometry,Techniques for property measurement: mechanical,electron, magnetic,thermal properties **Application: The energy applications of nanotechnology relates to using the small size of nanoparticles to store energy more efficiently** **Web Reference:** https://nptel.ac.in/courses/108106186 https://nptel.ac.in/courses/103105122	**8Hrs**

Module-3	
Inorganic semiconductor nanostructures: overview of semiconductor physics. Quantum confinement in semiconductor nanostructures: quantum wells, quantum wires, quantum dots, super-lattices, band offsets, andelectronicdensityof states. **Carbon Nanostructures:**Carbon molecules,Carbon Clusters,Carbon Nanotubes,application of Carbon Nanotubes. **Application: Nanotubes show promise in treating cardiovascular disease. They could play an important role in blood vessel cleanup** **Web Reference** https://nptel.ac.in/courses/108106186 https://nptel.ac.in/courses/103105122 https://nptel.ac.in/courses/112106222	**8Hrs**
Module-4	
Fabrication techniques: requirements of ideal semiconductor, epitaxial growth of quantum wells, lithography and etching,cleaved edge over growth,growth of vicinal substrates,strain induced dotsandwires,electrostatically induced dots and wires, Quantum well width fluctuations, thermally annealed quantum wells,semi conductor nanocrystals, colloidal quantum dots, self-assemblytechniques. **Application: use of renewable energy through green nanotechnology by generating, storing, and using energy without emitting harmful greenhouse gases such as carbon dioxide.** **Web Reference** https://nptel.ac.in/courses/108106186 https://nptel.ac.in/courses/103105122 https://nptel.ac.in/courses/112106222	**8Hrs**
Module-5	
Physical processes: modulation doping, quantum hall effect, resonant tunnelling, charging effects, ballistic carrier transport, Inter band absorption, intra band absorption, Light emission processes, phonon bottleneck,quantum confined stark effect,nonlinear effects,coherence and dephasing,characterization of semiconductor nanostructures:optical electrical and structural.. **Application: Nanotechnology is enabling the use of hydrogen energy at a much higher capacity.Hydrogen fuel cells, while they are not an energy source themselves, allow for storing energy from sunlight and other renewable sources in an environmentally-friendly fashion without any CO_2 emissions** **Web Reference:** **https://nptel.ac.in/courses/108106186** **https://nptel.ac.in/courses/103105122** **https://nptel.ac.in/courses/112106222**	**8Hrs**

Course outcome (Course Skill Set), At the end of the course, the student will be able to :

Course outcomes:	
CO1	Know the principles behind Nano scienc eengineering and Nanoelectronics.
CO2	Apply the knowledge to prepare and characterize nano materials.
CO3	Know the effect of particles size on mechanical,thermal,optical and electrical Properties of nano materials
CO4	Design the process flow required to fabricate state of the art transistor technology
CO5	Analyze the requirements for newmaterials and device structure in the future technologies.

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

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- There are 25 marks for the CIE's Assignment component and 25 for the Internal Assessment Test component.
- Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the coverage of the syllabus, and the second test will be administered after 85-90% of the coverage of the syllabus. The average of the two tests shall be scaled down to 25 marks
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The schedule for assignments shall be planned properly by the course teacher. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. Each assignment shall be conducted for 25 marks. (If two assignments are conducted then the sum of the two assignments shall be scaled down to 25 marks)
- The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and assignment/s marks.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours).

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module.

3. The students have to answer 5 full questions, selecting one full question from each module. 4. Marks scored shall be proportionally reduced to 50 marks.	
Suggested Learning Resources: **Books**	
1.	Nano scale Science and Technology',Ed Robert Kelsall, Ian Hamley, Mark Geoghegan, JohnWiley, 2007
2.	'Introduction to Nano technology', Charles P Poole, Jr,Frank JOwens, John Wiley, Copyright 2006, Reprint 2011.
1.	**ReferenceBook**: 'HandBook of Nano science Engineering and Technology',Ed William A Goddard III, Donald WBrenner, Sergey E. Lyshevski, Gerald JIafrate,CRCpress, 2003
Activity Based Learning (Suggested Activities in Class)/ Practical Based learning	

CO-PO Mapping

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

Mobile Communication			
Course Code	**MVJ22EA751**	**CIE Marks**	**50**
Teaching Hours/Week (L: T:P: S)	**3 Hours/Week (L:T:P: 3:0:0)**	**SEE Marks**	**50**
Total Hours of Pedagogy	**30L**	**Total Marks**	**100**

Course objectives:Students will be able to

1	Understand the basic concepts of mobile computing
2	Understand Wireless LAN, Bluetooth and WiFi Technologies
3	Understand network protocol stack
4	Define basics of mobile telecommunication system
5	Explain Ad-Hoc networks

Module-1	
Introduction: Introduction to Mobile Computing – Applications of Mobile Computing- Generations of Mobile Communication Technologies-MAC Protocols – SDMA- TDMA- FDMA- CDMA **Application: Android Based Smart Phone Used for Induction Motor Control, Robotic Vehicle Movement By Cell Phone** **Web Reference: https://nptel.ac.in/courses/106106167**	**8Hrs**
Module-2	
MOBILE TELECOMMUNICATION SYSTEM : GSM – Architecture – Protocols – Connection Establishment – Frequency Allocation – Routing – Mobility Management – Security –GPRS- UMTS- Architecture **Application: Dialed Telephone Number LED Based Display System, DTMF based Load Control System** **Web Reference: https://nptel.ac.in/courses/106106167**	**8Hrs**
Module-3	
WIRELESS NETWORKS: Wireless LANs and PANs – IEEE 802.11 Standard – Architecture – Services – Blue Tooth- Wi-Fi – WiMAX **Application: Wireless Message Communication between Two Computers** **Web Reference: https://nptel.ac.in/courses/106106167**	**8Hrs**
Module-4	
MOBILE NETWORK LAYER: Mobile IP – DHCP – AdHoc– Proactive and Reactive Routing Protocols – Multicast RoutingVehicular Ad Hoc networks (VANET) – MANET Vs VANET – Sec. **Application: Remotely Controlled Android based Electronic Notice Board, Remote Operated Domestic Appliances Control by Android Application**	**8Hrs**

Web Reference: https://nptel.ac.in/courses/106106167	

Module-5	
MOBILE TRANSPORT AND APPLICATION LAYER: Mobile TCP– WAP – Architecture – WDP – WTLS – WTP –WSP – WAE – WTA Architecture –WML **Application: Home Automation by Android Application based Remote Control** **Web Reference: https://nptel.ac.in/courses/106106167**	**8Hrs**

Course outcome (Course Skill Set), At the end of the course, the student will be able to :

Course outcomes:	
CO1	Explain the basics of mobile telecommunication system.
CO2	Illustrate the generations of telecommunication systems in wireless network
CO3	Understand the architecture of Wireless LAN technologies
CO4	Determine the functionality of network layer and Identify a routing protocol for a given Ad hoc networks
CO5	Explain the functionality of Transport and Application layer

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

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- There are 25 marks for the CIE's Assignment component and 25 for the Internal Assessment Test component.
- Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the coverage of the syllabus, and the second test will be administered after 85-90% of the coverage of the syllabus. The average of the two tests shall be scaled down to 25 marks
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The schedule for assignments shall be planned properly by the course teacher. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. Each assignment shall be conducted for 25 marks. (If two assignments are conducted then the sum of the two assignments shall be scaled down to 25 marks)
- The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and assignment/s marks.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours).

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks.

Suggested Learning Resources:

Books

1.	Jochen Schiller, —Mobile Communications‖, PHI, Second Edition, 2003.
2.	Prasant Kumar Pattnaik, Rajib Mall, —Fundamentals of Mobile Computing‖, PHI Learning Pvt.Ltd, New Delhi – 2012.
	ReferenceBook:
1.	Dharma Prakash Agarval, Qing and An Zeng, "Introduction to Wireless and Mobile systems",Thomson Asia Pvt Ltd, 2005.
2.	Uwe Hansmann, Lothar Merk, Martin S. Nicklons and Thomas Stober, —Principles of Mobile Computing, Springer, 2003.
3.	William.C.Y.Lee,—Mobile Cellular Telecommunications-Analog and Digital Systems, Second Edition,Tata Mc Graw Hill Edition ,2006.
4.	C.K.Toh, —AdHoc Mobile Wireless Networks‖, First Edition, Pearson Education, 2002.

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

CO-PO Mapping

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

Semester: VII		
SATELLITE COMMUNICATION		
Course Code:	**MVJ22EA752**	**CIE Marks:50**
Credits:	**L:T:P: 3:0:0**	**SEE Marks: 50**
Hours:	**30L**	**SEE Duration: 3 Hrs**

Course Learning Objectives: The students will be able to	
1	Understand orbital aspects of satellite communication
2	Describe electronic systems associated with a satellite and the earth station and understanding satellite applications focusing various domains services
3	Understand typical challenges of satellite-based systems.
4	Describe basic principle of RADAR and RADAR equation.
5	Understand the need and functioning of CW, FM-CW and MTI radars

UNIT 1	
Prerequisites: Digital Communication Systems **Introduction to Satellite Communication:** Orbital aspects of Satellite Communication, Introduction to geo-synchronous and geo-stationary satellites, Kepler's laws, Locating the satellite with respect to the earth, Sub-satellite point, Look angles, Mechanics of launching a synchronous satellite. **Applications:** DTH, or satellite television, services (such as the DirecTV and DISH Network services **Video link / Additional online information:** 1. https://nptel.ac.in/courses/117/105/117105131/# 2. https://nptel.ac.in/courses/117105131	**8Hrs.**
UNIT 2	
Elements of Communication Satellite Design: Satellite subsystems - Attitude and orbit control electronics - Telemetry and tracking - Power subsystems - Communication subsystems - Satellite antennas - Reliability and redundancy- Frequency modulation techniques. **Applications:** Mobile Communication **Video link / Additional online information:** 1. https://nptel.ac.in/courses/117/105/117105131/# 2. https://nptel.ac.in/courses/117/105/117105131/#	**8Hrs.**

UNIT 3	
Communication Satellites: Introduction, Related Applications, Frequency Bands, Payloads, Satellite Vs. Terrestrial Networks, Satellite Telephony. **Navigation Satellites:** Development of Satellite Navigation Systems, GPS system, Applications. **Applications:** Error detection and correction in Communication, Weather forecasting, Remote sensing, Navigation satellites. **Video link /Additional online information:** **1.** https://www.digimat.in/nptel/courses/video/117105131/L13.html **2.** https://www.digimat.in/nptel/courses/video/117105131/L14.html **3.** https://onlinecourses.nptel.ac.in/noc19_ce45/preview	**8Hrs.**
UNIT 4	
Satellite Link Design: Basic transmission theory – System noise temperature and G/T Ratio- Noise figure and noise temperature- Calculation of system noise temperature – G/T ratio for earth stations - Link budgets - Uplink and downlink budget calculations - Error control for digital satellite links - Prediction of rain attenuation and propagation impairment counter measures.**Video link / Applications:** Error detection and correction in Communication, Weather forecasting, Remote sensing, Navigation satellites. **Video link /Additional online information:** 1. https://onlinecourses.nptel.ac.in/noc19_ee58/preview 2. https://nptel.ac.in/courses/108/105/108105154/	**8Hrs.**
UNIT 5	
Introduction to Radar: Radar block diagram and operation, Radar frequencies, Applications of radar, Prediction of range performance, Minimum detectable signal, Receiver noise, Probability density function, SNR, Integration of radar pulses, Radar cross-section of targets, PRF and range ambiguities, Transmitter power, System losses. **Applications:** Ground surveillance, weapons location, and vehicle search **Video link / Additional online information:** 1. https://nptel.ac.in/courses/108/105/108105154/ **2.** https://nptel.ac.in/courses/108105154	**8Hrs.**

Course Outcomes: After completing the course, the students will be able to	
CO1	Describe the satellite orbits and its trajectories with the definitions of parameters associated with it.
CO2	Comprehend the design of satellite subsystems
CO3	Evaluate spacecraft subsystem performance and trades
CO4	Analyze how the radar equation is derived and its significance in radar technology.
CO5	Demonstrate how CW, FM-CW, and MTI radars function in different scenarios.

Reference Books:	
1.	T. Pratt, C.W. Boastian and Jeremy Allnutt, "Satellite Communication", 2013, 2nd edition, John Wiley and Sons, Bangalore, India.
2.	Anil K Maini, Varsha Agrawal, Satellite Communication, Wiley India Pvt. Ltd., 2015, ISBN: 978-81265-2071-8.
3.	Merril. I. Skolnik, "Introduction to Radar Systems", 2/e, MGH, 1981.
4.	Dennis Roddy, Satellite Communications, 4th Edition, McGraw- Hill International edition, 2006

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**	**PSO1**	**PSO2**
CO1	**3**	**3**	**2**	**2**	**1**	**1**	**1**	**-**	**1**	**-**	**-**	**1**	**2**	**2**
CO2	**3**	**3**	**2**	**2**	**1**	**1**	**1**	**-**	**1**	**-**	**-**	**1**	**2**	**2**
CO3	**3**	**3**	**2**	**2**	**1**	**1**	**1**	**-**	**1**	**-**	**-**	**1**	**2**	**2**
CO4	**3**	**3**	**2**	**2**	**1**	**1**	**1**	**-**	**1**	**-**	**-**	**1**	**2**	**2**
CO5	**3**	**3**	**2**	**2**	**1**	**1**	**1**	**-**	**1**	**-**	**-**	**1**	**2**	**2**

High-3, Medium-2, Low-1

Embedded System Design			
Course Code	**MVJ22EA753**	**CIE Marks**	**50**
Teaching Hours/Week (L: T:P: S)	**3 Hours/Week (L:T:P: 3:0:0)**	**SEE Marks**	**50**
Total Hours of Pedagogy	**30L**	**Total Marks**	**100**

Course objectives:Students will be able to

1	Understand the basic concepts of Embedded System
2	Understand different Embedded Hardware
3	Explain MSP430 Processor
4	Demonstarate basics of Timers and state Machines
5	Utilize CC studio suite

Module-1

Introduction: Introduction to Embedded Electronic Systems and Microcontrollers: An Embedded System-Definition, Embedded System Design and Development Life Cycle, An Introduction to Embedded system Architecture, The Embedded Systems Model, **Embedded Hardware:** The Embedded Board and the von Neumann Model, Embedded Processors: ISAArchitectureModels,Internal Processor Design, Processor Performance, Board Memory: Read-Only Memory (ROM),Random-Access Memory (RAM), Auxiliary Memory, Memory Management of External Memory and Performance, Approaches to Embedded Systems, Small Microcontrollers, Anatomy of a Typical Small Microcontroller, Small Microcontrollers Memory, Embedded Software, Introduction to small microcontroller (MSP430). **Application: PCs, audio/video systems, weather monitoring systems, multimedia systems, etc.** **Web Reference** https://nptel.ac.in/courses/106103182 https://nptel.ac.in/courses/106105159 https://nptel.ac.in/courses/108102045	**8Hrs**

Module-2	
MSP430 – I: Architecture of the MSP430 Processor: Central Processing Unit, Addressing Modes, Constant Generator and Emulated Instructions, Instruction Set, Examples, Reflections on the CPU and Instruction Set, Resets, Clock System, Memory and Memory Organization. Functions, Interrupts, and Low-Power Mode: Functions and Subroutines, Storage for Local Variables, Passing Parameters to a Subroutine and Returning a Result, Mixing C and Assembly Language, Interrupts, Interrupt Service Routines, Issues Associated with Interrupts, Low-Power Modes of Operation. **Application: video conferencing, voice over Internet Protocol, instant messaging (IM), and ecommerce applications.** **Web Reference** **https://nptel.ac.in/courses/106103182** https://nptel.ac.in/courses/106105159 https://nptel.ac.in/courses/108102045	**8Hrs**
Module-3	
MSP430 – II: Digital Input, Output, and Displays:Parallel Ports, Digital Inputs, Switch Debounce, Digital Outputs, Interface between Systems, Driving Heavier Loads, Liquid Crystal Displays, Simple Applications of the LCD. **Timers:** Watchdog Timer, Timer_A, Timer_A Modes, Timer_B,Timer_B Modes, Setting the Real-Time Clock, State Machines. **Application: light control systems, missile guidance systems, weapons defense systems, medical systems, and air traffic control systems.** **Web Reference** **https://nptel.ac.in/courses/106103182** **https://nptel.ac.in/courses/106105159** **https://nptel.ac.in/courses/108102045**	**8Hrs**
Module-4	
MSP430 Communication: Communication Peripherals in the MSP430, Serial Peripheral Interface, SPI with the USI, SPI with the USCI, A Thermometer Using SPI Modes, Inter-integrated Circuit Bus(I^2C) and its operations, State Machines for I^2C Communication, A Thermometer Using I^2C, Asynchronous Serial Communication, Asynchronous Communication with the USCI_A, A Software UART Using Timer_A, Other Types of Communication. **Application: Home/office security systems, ATMs, and POS systems.** **Web Reference** **https://nptel.ac.in/courses/106103182** **https://nptel.ac.in/courses/106105159** **https://nptel.ac.in/courses/108102045**	**8Hrs**

Module-5	
MSP430 Case Studies: Introduction to Code Composer studio (CC Studio Ver. 6.1) a tutorial, A Study of blinking LED,Enabling LED using Switches, UART Communication, LCD interfacing, Interrupts, Analog to Digital Conversion, General Purpose input and output ports, I2C. **Application** **Web Reference** https://nptel.ac.in/courses/106103182 https://nptel.ac.in/courses/106105159 https://nptel.ac.in/courses/108102045	**8Hrs**

Course outcome (Course Skill Set), At the end of the course, the student will be able to :

Course outcomes:	
CO1	Be familiar with the composition, design, and implementation of embedded systems
CO2	Be familiar with reading and understanding processor and component datasheets
CO3	Be familiar with driving use contexts, including human-computer interaction, environmental sensing and actuation, etc.,
CO4	Be familiar with the basics of interfacing hardware and software
CO5	Be familiar with working on a team to create and apply embedded systems

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

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- There are 25 marks for the CIE's Assignment component and 25 for the Internal Assessment Test component.
- Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the coverage of the syllabus, and the second test will be administered after 85-90% of the coverage of the syllabus. The average of the two tests shall be scaled down to 25 marks
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The schedule for assignments shall be planned properly by the course teacher. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. Each assignment shall be conducted for 25

marks. (If two assignments are conducted then the sum of the two assignments shall be scaled down to 25 marks)

- The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and assignment/s marks.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours).

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks.

Suggested Learning Resources:

Books

1. Tammy Noergaard "Embedded Systems Architecture: A Comprehensive Guide for Engineers and Programmers", Elsevier(Singapore) Pvt.Ltd.Publications, 2005.
2. John H. Davies "MSP430 Microcontroller Basics",Elsevier Ltd Publications, Copyright 2008

ReferenceBook:

1. Manuel Jiménez Rogelio,PalomeraIsidoroCouvertier "Introduction to Embedded SystemsUsing Microcontrollers and the MSP430" Springer Publications, 2014.
2. Frank Vahid, Tony D. Givargis, "Embedded system Design: A Unified Hardware/Software Introduction", John Wily & Sons Inc.2002.
3. Peter Marwedel, "Embedded System Design", Science Publishers, 2007.
4. Arnold S Burger, "Embedded System Design", CMP Books, 2002.
5. Rajkamal, "Embedded Systems: Architecture, Programming and Design", TMH Publications,Second Edition, 2008.

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

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

Semester-VII		
MICROWAVE ENGINEERING		
Course Code:	**MVJ22EA754**	**CIE Marks:50**
Credits:	**L: T:P: 3:0:0**	**SEE Marks: 50**
Hours:	**30L**	**SEE Duration: 3 Hrs**

Course objectives:Students will be able to

1	Analyze and study rectangular and circular wave guides using field theory.
2	Understand the theoretical principles underlying microwave devices and networks.
3	Design microwave components such as power dividers, hybrid junctions, Directional Couplers, microwave filters, Microwave Wave-guides and Components, Ferrite Devices.
4	Examine Microwave Solid-State Microwave Devices and Microwave Tubes.
5	Evaluate Microwave Measurement Techniques.

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

Module-1	
Introduction, Microwave Spectrum and Bands, Applications of Microwaves, Rectangular Waveguides – TE/TM mode analysis, Expressions for Fields, Characteristic Equation and Cut-off Frequencies, Dominant and Degenerate Modes, Sketches of TE and TM mode fields in the cross section, Mode Characteristics – Phase and Group Velocities, Wavelengths and Impedance Relations; Power Transmission and Power Losses in Rectangular Guide, Impossibility of TEM mode. **Application:Transmitting Power and communication signals,Microwave RADAR,Coupler** **Web Reference:** https://nptel.ac.in/courses/108103141	**8Hrs**
Module-2	
Circular waveguides- Introduction, Characteristic Equation, Dominant and Degenerate Modes. Microstrip Lines– Introduction, Zo Relations, Effective Dielectric Constant, Losses, Q factor. Cavity Resonators–Types, Resonant Frequencies, Q factor and Coupling Coefficients, Related Problems.. **Application:Attenuator,TV Signal Generator, low-noise block converters for TV signal receiving antennas.** **Web Reference:** https://nptel.ac.in/courses/108103141	**8Hrs**

Module-3	
Terminations, Attenuators, Phase shifters, Directional couplers, Hybrid Junctions, Power dividers, Circulator, Isolator, Impedance matching devices: Tuning screw, Stub and quarter wave transformers. Crystal and Schottkey diode detector and mixers, PIN diode switch, Gunn diode oscillator, IMPATT diode oscillator and amplifier, Varactor diode, Introduction to MIC. **Application: Frequency translators,Amplitude and phase modulation,Phased arrays for the Radar systems,SSPA:linearization / RF distortion,Residual phase noise measurement,Signal phase correction in long-distance fibre optics communication link** **Web Reference:** https://nptel.ac.in/courses/108103141	**8Hrs**
Module-4	
Review of conventional vacuum Triodes, Tetrodes and Pentodes, High frequency effects in vacuum Tubes, Theory and application of Two cavity Klystron Amplifier, Reflex Klystron oscillator, Traveling wave tube amplifier, Magnetron oscillator using Cylindrical, Linear, Coaxial Voltage tunable Magnetrons, Backward wave Crossed field amplifier and oscillator. **Application: Radio receivers. Portable microwave links. Parametric amplifiers. Local oscillators of microwave receivers** **Web Reference:** https://nptel.ac.in/courses/108103141	**8Hrs**
Module-5	
Measuring Instruments : Principle of operation and application of VSWR meter, Power meter, Spectrum analyzer, Network analyzer, Measurement of Impedance, Frequency, Power, VSWR, Q-factor, Dielectric constant, Scattering coefficients, Attenuation, S-parameters. **Application: Microwave leakage meters, area monitors, and power measuring devices are used to detect and measure microwave energy** **Web Reference:** https://nptel.ac.in/courses/108103141	**8Hrs**

Course outcome (Course Skill Set)

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

1. Explain different types of waveguides and their respective modes of propagation.
2. Analyze typical microwave networks using impedance, admittance, transmission and scattering matrix representations.

3. Design microwave matching networks using L section, single and double stub and quarter wave transformer.
4. Explain working of microwave passive circuits such as isolator, circulator, Directional couplers, attenuators etc.
5. Describe and explain working of microwave tubes and solid state devices.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

6 There are 25 marks for the CIE's Assignment component and 25 for the Internal Assessment Test component.

- Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the coverage of the syllabus, and the second test will be administered after 85-90% of the coverage of the syllabus. The average of the two tests shall be scaled down to 25 marks
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The schedule for assignments shall be planned properly by the course teacher. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. Each assignment shall be conducted for 25 marks. (If two assignments are conducted then the sum of the two assignments shall be scaled down to 25 marks)
- The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and assignment/s marks.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.

Suggested Learning Resources:

Books

1. David M. Pozar – Microwave Engineering, 4th Edition, John Wiley & Sons, Inc. 2013
2. E C Jordan and K G Balmain - Electromagnetic Waves and Radiating Systems, 2nd Edition, PHI, 2003.

Web links and Video Lectures (e-Resources):

7	http://nptel.ac.in/courses
8	https://nptel.ac.in/courses/108103141
9	https://nptel.ac.in/courses/108105114

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

CO-PO Mapping														
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	**3**	**3**	**3**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**3**	**1**
CO2	**3**	**3**	**3**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**3**	**1**
CO3	**3**	**3**	**3**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**3**	**1**
CO4	**3**	**3**	**3**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**3**	**1**
CO5	**3**	**3**	**3**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**3**	**1**

PROJECT PHASE – II			
Course Code	**MVJ22EAP76**	**CIE Marks**	**100**
Teaching Hours/Week (L: T:P: S)	**(0:0:12)**	**SEE Marks**	**100**
Total Hours of Pedagogy	**40**	**Total Marks**	

Course objectives:

1 To support independent learning.
2 To develop interactive, communication, organization, time management, and presentation skills.
3 To impart flexibility and adaptability.
4 To train students to present the topic of project work in a seminar without any fear, face audience confidently, enhance communication skill, involve in group discussion to present and exchange ideas.
5 To inspire independent and team working.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

Project Work Phase - II

Project Work Phase - II: Each student of the project batch shall involve in carrying out the project work jointly in constant consultation with internal guide, co-guide, and external guide and prepare the project report as per the norms avoiding plagiarism

Course outcome (Course Skill Set)

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

1. Describe the project and be able to defend it. Develop critical thinking and problem solving skills.
2. Learn to use modern tools and techniques. Communicate effectively and to present ideas clearly and coherently both in written and oral forms.
3. Develop skills to work in a team to achieve common goal. Develop skills of project management and finance.
4. Develop skills of self-learning, evaluate their learning and take appropriate actions to improve it.
5. Prepare them for life-long learning to face the challenges and support the technological changes to meet the societal needs.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

6 There are 25 marks for the CIE's Assignment component and 25 for the Internal Assessment Test component.

- Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the coverage of the syllabus, and the second test will be administered after 85-90% of the coverage of the syllabus. The average of the two tests shall be scaled down to 25 marks
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The schedule for assignments shall be planned properly by the course teacher. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. Each assignment shall be conducted for 25 marks. (If two assignments are conducted then the sum of the two assignments shall be scaled down to 25 marks)
- The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and assignment/s marks.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

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

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