B.E, III Semester, Electronics & Communication Engineering

Semester: III		
Maths for AV Communication		
Course Code:	**MVJ22EC31**	**CIE Marks: 50**
Credits:	**L: T:P: 2:2:0**	**SEE Marks: 50**
Hours:	**30L+10T**	**SEE Duration: 3 Hrs.**
Course Learning Objectives: The students will be able to		
1	Understand discrete and continuous probability distributions in analyzing the probability models arising in engineering field.	
2	Recall the concepts of Complex variables and transformation for solving Engineering Problems.	
3	Apprehend and apply Fourier Series.	
4	Demonstrate Fourier Transform as a tool for solving Integral equations	
5	Realize and use of Z-Transforms	

UNIT-I	
Probability Theory: Random variables (discrete and continuous), probability density function, cumulative density function. **Probability Distributions:** Binomial distribution, Poisson distribution. Normal distribution, Exponential distribution. Joint probability distributions. **Self-study:** Discrete and continuous probability problems **Applications:** Discrete and continuous probability distributions help in analysing the probability models arising in engineering field. **Video Link**: 1. https://archive.nptel.ac.in/courses/111/102/111102111/	**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. **Self-study:** Unique Expression Method	**8 Hrs**

Applications: Application to flow problems **Video Link**: 1. https://archive.nptel.ac.in/courses/111/103/111103070/	
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. **Self study:** Complex form of Fourier series. **Applications**: The Fourier series has many such applications in harmonic analysis, vibration analysis,acoustics, optics etc. **Video Link**: 1. https://archive.nptel.ac.in/courses/111/106/111106046/	**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 **Self-study:** Complex form of Fourier series. **Applications:** Fourier transforms used in image **Video Link**: 1. https://archive.nptel.ac.in/courses/111/101/111101164/	**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. **Self-study:** Damping rule and problems on them. **Applications:** Fourier transforms used in image processing and Z-transforms in Digital signal processing. **Video Link**: 1. https://archive.nptel.ac.in/courses/108/106/108106151/	**8 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand 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	Investigate 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	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:	**MVJ22EC32**	**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	Familiarize with the simplification techniques & design various combinational digital circuits using logic gates.
2	Demonstrate the analysis and design procedures for synchronous and asynchronous sequential circuits.
3	Analysing the principles of Combinational & Sequential Circuits
4	Examining the principles of SR, JK, D, T flip-flops and Mealy & Moore machines
5	Modelling 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:** https://nptel.ac.in/courses/108105132	**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. **Laboratory Sessions/ Experimental learning:** 1. Design a full adder with two half adders using logic gates.	**8 Hrs**

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:** https://archive.nptel.ac.in/courses/108/105/108105113/	
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:** https://nptel.ac.in/courses/117106086	**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:** https://www.nptelvideos.com/course.php?id=562	**8 Hrs**
UNIT-V	
Applications of Digital Circuits:	**8 Hrs**

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/117108040/	

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	Investigate 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 onducted along with tests. Test portion is evaluated for 50 marks and quiz is evaluated for 10 marks. aculty may adopt innovative methods for conducting quizzes eeffectively. The number of quizzes may e more than three (conduct additional quizzes aand take best three). The three tests are conducted or 50 marks each and the average of aall the tests are calculated for 50. The marks for the self -study re 20 (2 presentations are b held for 10 marks each). The marks obtained in test, quiz and self -studies re 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 Mapping:

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

Semester: III		
Analog Electronic Circuits		
Course Code:	**MVJ22EC33**	**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	Understand the low frequency response for various configurations of BJT and FET amplifier.	
2	Demonstrate the different topologies of feedback amplifiers and oscillators.	
3	Analyse the 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. Plot 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://archive.nptel.ac.in/courses/108/105/108105158/	**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, shunt-shunt and shunt-series amplifiers. **Laboratory Sessions/ Experimental learning:**	**8 Hrs**

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://onlinecourses.nptel.ac.in/noc23_ee77/preview	
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/108106084**	**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 Controller) **Video link / Additional online information:** https://archive.nptel.ac.in/courses/108/102/108102112/	**8 Hrs**
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://www.nptelvideos.com/course.php?id=524	**8 Hrs**

Laboratory Experiments

Simulation using EDA software (EDWinXP, PSpice, MultiSim, Proteus, Circuit Lab 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	Acquire knowledge of 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	Design of Active Filters, DAC, ADC and Timer.

Reference 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.
3.	Behzad Razavi, "Fundamentals of Microelectronics", John Weily ISBN 2013 978-81- 265-2307-8,2nd Edition, 2013.
4.	K.A.Navas, "Electronics Lab Manual", Volume I, PHI, 5th Edition, 2015, ISBN: 9788120351424.
5	"Operational Amplifiers and Linear IC"s", David A. Bell, 2nd edition, PHI/Pearson, 2004. ISBN 978-81-203-2359-9.
6	"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:	**MVJ22EC34**	**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 basic network concepts emphasizing source transformation source shifting, mesh and nodal techniques to solve for resistance/impedance, voltage, current and power.	
2	Elucidate 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	Demonstrate Series and Parallel Combination of Passive Components as resonating circuits, related parameters and to analyze frequency response.	
4	Examine the behavior of networks subjected to transient conditions. Use applications of Laplace transform to solve network problems.	
5	Inspect 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 **Applications:** Simplification and analysis of analog circuits, microwave circuit analysis **Video link / Additional online information:** **https://archive.nptel.ac.in/courses/108/105/108105159/**	**8 Hrs**
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://archive.nptel.ac.in/noc/courses/noc22/SEM1/noc22-ee07/**	**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://archive.nptel.ac.in/courses/108/104/108104139/	**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. 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/117106116	**8 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand currents and voltages in a circuit using network simplification techniques.
CO2	Solve the network problems using graphical methods.
CO3	Simplify the complex circuits using network theorems.
CO4	Analyze simple DC circuits and applies the concepts to transient conditions.
CO5	Examine 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.

Reference 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.
3.	Hayt, Kemmerly and Durbin –Engineering Circuit Analysis", TMH 7th Edition, 2010.
4.	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:	**MVJ22ECL35**	**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 hardware components.	
2	To be exposed to the operation and application of electronic devices and their circuits.	
3	To analyze circuit characteristics with signal analysis using Op-amp ICs.	
4	To understand the concepts of oscillators	
5	Acquire knowledge on different gates	

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 andcompare the practical frequency with theoretical frequency. 4. Design an oscillator whose frequency is 2MHZ and compare with the theoreticalfrequency. 5. Design active second order Butterworth low pass filters. 6. Design Astable Multivibrator using 555 Timer. 7. Design Monostable Multivibrator using 555 Timer. (a) Full Adder using basic logic gates. (b) Full subtractor using basic logic gates.	
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	

(c) Full Adder using basic logic gates.

(d) 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 IC7483.

12. Realize 4-variable function using IC 74151(8:1MUX)

Course outcomes:

CO1	Demonstrate 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 such as Verilog necessary for engineering practice.
CO5	Implemeting code 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:	**MVJ22EC361**	**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	Study of verilog data flow descriptions.	
3	Study of design and operation of behavioral programming using verilog	
4	Understand the concepts of Verilog Structural Language	
5	Design and diagnosis 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://archive.nptel.ac.in/courses/106/105/106105165/	**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/106105165	**8Hrs.**

2. https://www.youtube.com/watch?v=36hCizOk4PA, 3. https://www.youtube.com/watch?v=397DDnkBm8A	
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/108103179	**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://archive.nptel.ac.in/courses/108/103/108103179/	**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	**8Hrs.**

2. synthesis verilog code for state machine **Video link / Additional online information:** 1. https://onlinecourses.nptel.ac.in/noc24_cs61/preview	

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	Analyze 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 and information d virginia boston, massachusetts new delhi, 2015.

Reference Books:	
1.	Samir Palnitkar "Verilog HDL: A Guide to Digital Design and Synthesis", Pearson Education, Sec Edition
2.	Charles H Roth Jr., Larry L. Kinney "Fundamentals of Logic Design", Cengage Learning, 7th Editio

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

Semester: III		
SENSOR AND INSTRUMENTATION		
Course Code:	**MVJ22EC362**	**CIE Marks:50**
Credits:	**L:T:P: 3:0:0**	**SEE Marks: 50**
Hours:	**40 L**	**SEE Duration: 03 Hours**
Course Learning Objectives: The students will be able to		
1	To understand the basic concepts of transducers.	
2	To identify the mathematical model of transducer and its response for various inputs.	
3	To understand the construction and working principle of resistive type transducers.	
4	To impart knowledge on capacitive type and inductive type transducer.	
5	To examine 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:** https://archive.nptel.ac.in/courses/108/108/108108147/	**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 **Video link / Additional online information:** **https://nptel.ac.in/courses/108106193**	**8 Hrs**
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:** https://nptel.ac.in/courses/108105064	**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:** https://archive.nptel.ac.in/courses/108/105/108105064/	**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. **Applications:** Smart city developments with latest technological sensors. **Video link / Additional online information:** **https://nptel.ac.in/courses/108102191**	**8 Hrs**

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

Semester: III		
COMPUTER ORGANIZATION & ARCHITECTURE		
Course Code:	**MVJ22EC363**	**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	Illustrate the concept of programs as sequences of machine instructions.	
3	To understand the different ways of communicating with I/O devices and to introduce memory types including cache memories.	
4	Infer memory hierarchy and concept of virtual memory.	
5	To analyse 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/106103206**	**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 odd number and simulate the output.	**8Hrs.**

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:** **https://nptel.ac.in/courses/106105163**	
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:** **https://onlinecourses.nptel.ac.in/noc21_cs61/preview**	**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/106103206**	**8Hrs.**
UNIT 5	
Basic Processing Unit: Some Fundamental Concepts, Execution of a Complete Instruction, Multiple Bus Organization, Hardwired Control, Micro programmed Control ,Pipelining ,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	**8Hrs.**

Video link / Additional online information: **https://archive.nptel.ac.in/courses/106/105/106105163/**	
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	Understand the ability to classify the addressing modes, instructions sets and design programs.
CO3	Demonstrate the different ways of accessing an input / output device including interrupts.
CO4	Examine the organization of different types of semiconductor and other secondary storage memories.
CO5	Inspect the simple processor organization based on hardwired control and micro programmed control.

Reference 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.
3.	David A. Patterson, John L. Hennessy: "Computer Organization and Design – The Hardware / Software Interface ARM Edition", 4th Edition, Elsevier, 2009.
4.	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

Semester: IV		
ADVANCED NUMERICAL METHODS		
Course Code:	**MVJ22EC364**	**CIE Marks:50**
Credits:	**L:T:P:S: 2:2:0:0**	**SEE Marks: 50**
Hours:	**20L+20T**	**SEE Duration: 3 Hrs**
Course Learning Objectives: The students will be able to		
1	Understand the importance of error analysis in engineering problems	
2	To represent and solve an application problem using a system of linear equations	
3	Analyze regression data to choose the most appropriate model for a situation.	
4	Elucidate the ways of solving complicated mathematical problems numerically	
5	Examine mathematical models represented by initial or boundary value 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	Understand the algebraic equations using direct and iteration methods.
CO2	Interpret the basic theory underlying the numerical solution of partial differential equations.
CO3	Demonstrate the concepts behind formulation methods in FEM

CO4	Determine the approximate solutions for ODE.
CO5	Solve system of equations using numerical techniques.

Reference Books	
1.	B.S. Grewal, "Higher Engineering Mathematics" Khanna Publishers, 43rd Edition, 2013.
2.	Sastry, S.S: "Introductory Methodsof Numerical Analysis"., Prentice Hall India.
3.	Reddy, J.N: " Finite Element Methods".
4.	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, Electronics & Communication Engineering

Semester: IV		
Engineering Electromagnetics		
Course Code:	**MVJ22EC41**	**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 applications of Coulomb's law and Gauss law to different charge Distributions.	
2	Analyze the physical significance of Biot-Savart's Law, Amperes' Circuital Law and Stokes' theorem for different current distributions.	
3	Interpret of Maxwell's equations and its applications in plane waves.	
4	Acquire knowledge on different types of transmission lines.	
5	Inspect 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.	**8Hrs.**

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 **Video link / Additional online information:** **https://archive.nptel.ac.in/courses/108/104/108104087/**	
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:** **https://archive.nptel.ac.in/courses/108/106/108106073/**	**8Hrs.**
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.	**8Hrs.**

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 :** https://archive.nptel.ac.in/courses/108/102/108102119/	
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 :** **https://nptel.ac.in/courses/108104087**	**8Hrs.**
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 using FEKO software.	**8Hrs.**

Applications: Telephone, Cable TV, Broadband network **Video link / Additional online information:** **https://archive.nptel.ac.in/courses/108/104/108104099/**	

Course Outcomes: After completing the course, the students will be able to	
CO1	Determine the problems on electrostatic force, electric field due to point, linear, surface charge and volume charges.
CO2	Demonstrate 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	Examine Maxwell's equations for time varying fields and evaluate power associated with EM waves using Poynting theorem.
CO5	Evaluate parameters of transmission lines and use Smith chart for determining the impedance and admittance.

Reference Books:	
1.	Matthew N. O. Sadiku, "Elements of Electromagnetics", Oxford University Press, Edition VII, 2018.
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	2	3	-	-	-	-	-	-	-	
CO2	3	3	2	3	-	-	-	-	-	-	-	
CO3	3	3	2	3	1	-	-	-	1	1	-	
CO4	3	3	2	3	-	-	1	-	1	1	-	
CO5	3	3	2	3	1	2	1	1	1	2	1	1

High-3, Medium-2, Low-1

Semester: IV		
Modern Control systems		
Course Code:	**MVJ22EC42**	**CIE Marks:50**
Credits:	**L:T:P: 3:0:0**	**SEE Marks: 50**
Hours:	**40L**	**SEE Duration: 3 Hrs**
Course Learning Objectives: The students will be able to		
1	Formulate the mathematical modelling of systems and understand the concepts of transfer function	
2	Obtain transfer function using block diagram reduction and signal flow graph techniques.	
3	Analyse the response of first and second order systems using standard test signals and analyse steady state error.	
4	Analyse stability of systems using RH criteria, Root Locus, Nyquist, Bode plot and polar plot.	
5	Deduce 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 :** **https://nptel.ac.in/courses/108102043**	**8Hrs.**

UNIT 2	
Time Response of feedback control systems: Standard test signals, Unit step response of First and Second order Systems. Time response specifications, Time response specifications of second order systems for underdamped system, steady state errors and error constants. **Introduction to Controllers:** P, PI, PD and PID Controllers. **Laboratory Sessions/ Experimental learning:** 1. Obtain step and impulse response of a unity feedback first order system for a given forward path transfer function using MATLAB. 2. Obtain step and impulse response of a unity feedback second order system for a given forward path transfer function using MATLAB. **Applications:** Industrial Control systems **Video link / Additional online information :** **https://archive.nptel.ac.in/noc/courses/noc18/SEM2/noc18-ph16/**	**8Hrs.**
UNIT 3	
Stability analysis using RH Criteria and root locus: Concepts of stability, Necessary conditions for stability, Routh Hurwitz stability criterion, Relative stability analysis, Introduction to Root-Locus Techniques, the root locus concepts, Construction of root loci. **Laboratory Sessions/ Experimental learning:** 1. Obtain Root Locus Plot of the system for a given forward path transfer function using MATLAB. **Applications:**Used to determine the dynamic response of a s system **Video link / Additional online information:**	**8Hrs.**
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:**	**8Hrs.**

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:** **https://archive.nptel.ac.in/courses/108/106/108106098/**	
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://archive.nptel.ac.in/courses/107/106/107106081/**	**8Hrs.**

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

CO1	Understand the mathematical model for electrical systems and find the transfer function using block diagram reduction technique and signal flow graph.
CO2	Demonstrate 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	Examine the stability of the system using frequency domain techniques such as Nyquist and Bode plots.
CO5	Deduce state space equations and solutions of a given electrical system.

Reference Books:	
1.	Nagarath and M.Gopal, – Control Systems Engineering‖, New Age International (P) Limited, Publishers, Fifth edition-2005, ISBN: 81-224-2008-
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		
Principles of Communication Systems		
Course Code:	**MVJ22EC43**	**CIE Marks:50**
Credits:	**L:T:P: 3:0:2**	**SEE Marks: 50**
Hours:	**40 L+ 26 P**	**SEE Duration: 03Hours**

Course Learning Objectives: The students will be able to

1	Understand the concepts of Analog Modulation schemes viz; AM, FM.
2	Interpret the different types of noise in communication system.
3	Examine concepts of digitization of signals viz; sampling, quantizing, and encoding.
4	Analyze the Base Band data transmission system.
5	Realize the basic concepts of coherent and non-coherent digital modulation techniques and understand the basics of spread spectrum modulation.

UNIT 1	
Prerequisites: *Modulation, Need for Modulation, and types of Modulation.* **Amplitude Modulation:** Introduction to AM, Time-Domain description, Frequency-Domain description, Generation of AM wave: Square Law Modulator, Switching modulator,Detection of AM waves: Envelop detector. **Double side band suppressed carrier modulation (DSBSC):** Time-Domain description, Frequency-Domain representation, Generation of DSBSC waves: Ring modulator. 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	**8Hrs.**

for generating an SSB modulated wave. **Laboratory Sessions/ Experimental learning:** 1. Generation of AM signal using MATLAB 2. Generation of DSBSC signal using transistor **Applications:** Broadcast transmissions, Air band radio, Quadrature amplitude modulation **Video link / Additional online information :** 1. https://nptel.ac.in/courses/117/105/117105143/ 2. https://youtu.be/00ZbuhPruJw	
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/117/105/117105143/	**8Hrs.**
UNIT 3	
Noise: Shot Noise, Thermal noise, White Noise, Noise Figure, Equivalent Noise Temperature, Noise equivalent Bandwidth.	**8Hrs.**

Noise in Analog Modulation: Introduction, Receiver Model, Noise in DSB-SCreceivers. 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/117/105/117105077/ 2. https://nptel.ac.in/courses/117/101/117101051/	
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/117/105/117105077/ 2. https://nptel.ac.in/courses/117/101/117101051/	**8Hrs.**
UNIT 5	
Prerequisites: *Probability & Random Process* **Pass band transmission:** Digital modulation techniques: Phase shift Keying techniques using Coherent detection: Generation, Detection and Error probabilities of BPSK and QPSK, QAM, Frequency shift keying techniques using Coherent detection: BFSK	**8Hrs.**

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, Bluetooth, RFID, GPS, Wi-Fi, etc.,

Video link / Additional online information :

1. https://nptel.ac.in/courses/117/105/117105077/
2. https://nptel.ac.in/courses/117/101/117101051/
3. https://nptel.ac.in/courses/117/105/117105136/

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

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

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of three quizzes are conducted along with tests. The test portion is evaluated for 50 marks and quiz is evaluated for 10marks. Faculty may adopt innovative methods for conducting quizzes effectively. The number ofquizzes 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 andassignment 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 studentis 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 encouragedto 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 ofobjective 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 questionmay 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		
Communication laboratory		
Course Code:	**MVJ22ECL44**	**CIEMarks:50**
Credits:	**L:T:P:0:0:2**	**SEE Marks: 50**
Hours:	**26P**	**SEEDuration:03Hours**

Course Learning Objectives: The students will be able to	
1	To visualize the effects of sampling and TDM
2	To Implement AM & FM modulation and demodulation
3	To implement PCM & DM
4	To simulate 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	DSBSC Modulation
9	Pre-Emphasis & De-emphasis
10	Pulse Amplitude Modulation and 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	Simulate & validate 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	Exploring towards the improvement of the noise performance of communication system

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

High-3, Medium-2, Low-1

Semester: IV		
SIGNALS & SYSTEMS		
Course Code:	**MVJ22EC451**	**CIE Marks:50**
Credits:	**L:T:P: 3:0:0**	**SEE Marks: 50**
Hours:	**40L**	**SEE Duration: 3 Hrs**

Course objective is to:

- Understand the mathematical description of continuous and discrete time signals and systems.
- Examine the signals in time domain using convolution sum and Integral.
- Determine the response of the LTI system to any input signal.
- Analyse Linear Time Invariant (LTI) systems in time and transform domains
- Apply the knowledge of frequency-domain representation and analysis concepts using Fourier analysis tools and Z-transform.

Module-1	
Prerequisites: Definition of step, ramp, impulse response **Introduction and Classification of signals:** Definition of signal and systems, Communication and control system as examples, Classification of signals. **Basic Operations on signals:** Amplitude scaling, addition, multiplication, differentiation, Integration, time scaling, time shift and time reversal. **Elementary signals/Functions**: Exponential, sinusoidal, step, impulse and ramp functions. Expression of triangular, rectangular and other waveforms in terms of elementary signals **Laboratory Sessions/ Experimental learning:** 1. Exploring concepts with MATLAB- Generation of both continuous time and discrete time signals of various kinds. a) Plot $y(x) = x^2\cos(x)$, $g(x) = x\cos(x)$, $f(x) = 2^x\sin(x)$, $0 \leq x \leq 2\pi$ in the same figure. 2. Generation of Signals & Signal Operations Plot in the time interval $-5 \leq t \leq 10$, the following signals: a) $\delta(t) + 2\,\delta(t)$	**8Hrs.**

b) u(t) +2 u(t)+1 c) r(t)+u(t) **Applications**: Time shifting operation can be used in artificial intelligence, such as in systems that use Time Delay Neural Network, Multiplication of signals is exploited in the field of analog communication when performing amplitude modulation (AM), Differentiation of a signal is used in the field of image or video processing. **Video link / Additional online information :** https://nptel.ac.in/courses/108/104/108104100/	
Module-2	**8Hrs.**
System Classification and properties: Linear-nonlinear, Time variant-invariant, Causal-non causal, static-dynamic, stable-unstable, invertible. **Time domain representation of LTI System**: Impulse response of an LTI system, convolution sum, Convolution integral. Properties of convolution - Commutative property, Distributive property, Associative Property and system interconnection. Computation of convolution sum and convolution integral using graphical method for unit step and unit step, unit step and exponential, exponential and exponential, unit step and rectangular, and rectangular and rectangular. **Laboratory Sessions/ Experimental learning:** 1. To compute convolution of two signals using MATLAB. a) A system is described by the impulse response h (t) =t, $0 \le t \le 10$. Compute and plot the response of the system to the input signal $x(t)=0.8^{t}$, $0 \le t \le 10$. b) Compute the convolution between the complex sequence =[3+2j,1+j,4+6j] and h=[1-2j,j,3-2j,2]. **Applications:** Convolution concepts are used in Artificial Intelligence, Image Processing, Signal filtering, Audio processing **Video link / Additional online information :** 1. https://nptel.ac.in/courses/117105134/ http://www.digimat.in/nptel/courses/video/108108109/L63.html	

Module-3	
Prerequisites: Basics of Fourier series concepts **LTI system Properties in terms of impulse response**: Memoryless, Causal, Stable, Invertible, and step response. **Fourier Representation of Periodic Signals:** CTFS and DTFS and basic problems (excluding properties). **Laboratory Sessions/ Experimental learning:** 1. To analyse the spectrum of signal with Fourier series using MATLAB. a) Verify the linearity property of the given periodic signals x(t)=cos(t) and y(t)=sin(2t),scalars are a=3+2j,b=2. b) Verify the time reversal propertyof the given periodic signal x(t)=t cos(t) ,0 ≤ t ≤ 2 Л in one period. **Applications**: Signal Processing, Control Theory, Communications Systems, Image and Video Processing, Biomedical Engineering (ECG, MRI), Oil extraction (Seismology), Music Industry (Audio) and Power Quality Analysis. **Video link / Additional online information :** 1. https://nptel.ac.in/courses/111106046/ **2.** https://nptel.ac.in/courses/111106111/	**8Hrs.**
Module-4	
Prerequisites: Basics of Fourier transform concepts **Fourier Representation of aperiodic Signals**: Introduction to Fourier Transform & DTFT, Definition and basic problems. Properties of Fourier Transform: Linearity, Time shift, Frequency shift, scaling, Differentiation and Integration, Convolution and Modulation, Parseval's theorem and problems on properties of Fourier Transform. **Laboratory Sessions/ Experimental learning:** 1. Application of Fourier Transform in Modulation and Demodulation Technology using MATLAB.	**8Hrs.**

a) Compute the Fourier transform of the function $x(t) = e^{-t} u(t)$ b) Suppose that a signal x(t) is given by $x(t)=te^{-3t}$. Compute the Fourier transform X (w) of the signal of the signal x(t) and plot for $-20 \leq w \leq 20$ rad/sec. **Applications**: Fourier Transform in Modulation and Demodulation Technology, Frequency division multiplexing and time division multiplexing, In Filtering Technology **Video link / Additional online information :** 1. https://nptel.ac.in/courses/111102129/ **2.** https://nptel.ac.in/courses/111106046/	
Module-5	**8Hrs.**
Prerequisites: Basics of Z-transform concepts **The Z-Transforms:** Z transform, properties of the region of convergence, properties of the Z-transform, Inverse Z-transform, Causality and stability, Transform analysis of LTI systems. **Laboratory Sessions/ Experimental learning:** 1. To compute Z-transform of finite duration sequence using MATLAB. a) Compute the z-transform of the sequence fx(n)-[-3,5,6,7,8], $-2 \leq n \leq 2$. b) Compute the z-transform of the discrete-time signal $x(n)= n^2 u(n)$. c) Compute the convolution between the signals $X_1(z)=$ z/z-0.9 and $X_2(z)=$z /z+6 **Applications**: To analysis of digital filters, Used to simulate the continuous systems, Analyse the linear discrete system, Used to finding frequency response, Analysis of discrete signal, Helps in system design and analysis and also checks the systems stability, For automatic controls in telecommunication. **Video link / Additional online information:** https://nptel.ac.in/courses/108104100/	

Course outcomes:

CO1	Understand the different types of signals and systems.
CO2	Develop input output relationship for linear time invariant system and understand the convolution operator for continuous and discrete time system.
CO3	Understand and resolve the signals in frequency domain using Fourier series.
CO4	Determine the spectral characteristics of continuous and discrete time signal using Fourier transform.
CO5	Compute Z-transforms, inverse Z- transforms and transfer functions of complex LTI systems

Text Books:	
1.	Simon Haykins and Barry Van Veen,"Signals and Systems", 2nd Edition, 2008, Wiley India. ISBN 9971-51-239-4.
2.	Ganesh Rao and SatishTunga**,** "Signals and Systems", Pearson/Sanguine,First Edition,2017.
Reference Books:	
1.	Alan V Oppenheim, Alan S, Willsky and A Hamid Nawab,"Signals and Systems" Pearson Education Asia / PHI, 2nd edition, 1997. Indian Reprint 2002.
2.	Michael Roberts**,** "Fundamentals of Signals & Systems", 2nd edition, Tata McGraw-Hill, 2010, ISBN 978-0-07-070221-9.
3.	H.P Hsu, R. Ranjan, "Signals and Systems", Scham's outlines, TMH, 2006.
4.	B. P. Lathi, "Linear Systems and Signals", Oxford University Press, 2005.

CIE Assessment:

CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests

- Quizzes/mini tests (4 marks)

- Mini Project / Case Studies (8 Marks)
- Activities/Experimentations related to courses (8 Marks)

SEE Assessment:

i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.

ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions.

iii. One question must be set from each unit. The duration of examination is 3 hours.

CO-PO Mapping

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

High-3, Medium-2, Low-1

Semester: IV		
Data Structures and Algorithms using Python		
Course Code:	**MVJ22EC452**	**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 fundamentals of data structures and their applications in logic building and project assessment.	
2	Understand the concept of linked lists and sorting techniques.	
3	Acquire the knowledge of algorithms of queues and stacks.	
4	Analyze the concepts of Binary trees.	
5	Examine Graphs and its algorithms.	

UNIT 1	
Python Primer: Python Overview, Objects in Python, Expressions, Operators, Control Flow, Functions, Simple i/p and o/p, Modules. **Basic Concepts of Data Structures and Algorithms:** Introduction- Variables, Datatypes, Data Structures, ADT, what is an algorithm, How to compare algorithms, Rate growth, Types of analysis, Asymptotic Notation, Performance Analysis: Space complexity, Time complexity, Guidelines for asymptotic analysis. **Searching Techniques:** Linear Search and Binary Search Applications: developing computational tools and bioinformatics software, Mathematics. **Video link / Additional online information (related to module if any):** 1. http://www.nptelvideos.com/video.php?id=1442 2 2. https://nptel.ac.in/courses/106105085/ **Laboratory Sessions/ Experimental learning**: 2. Develop a mini project to demonstrate the concept Binary Search. **Applications:** 2. Conversion from one form of expression to another 3. Mathematical calculation for expression evaluation	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:** 2. Programs for Departmental store bills 3. 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:** 2. Towers of Hanoi. 3. Parenthesis matching in an expression **Video link / Additional online information:** 1 .https://nptel.ac.in/courses/106/106/106106127/	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: 3. Print all the nodes of graph using DFS and BFS. 4. Apply various algorithms on a graph and analyse it. Video link / Additional online information: 1. https://nptel.ac.in/courses/106/106/106106133/ 2. https://nptel.ac.in/courses/106/105/106105225/	8Hrs.
Course Outcomes: After completing the course, the students will be able to	
CO1	Acquire knowledge of Python fundamentals and data structures.
CO2	Analyse and design of algorithms for Linked lists and sorting techniques.
CO3	Apply the concepts of Stacks and queues.
CO4	Utilize the operations of search trees and their applications.

CO5	Investigate Graphical algorithms.

Reference Books:	
1.	Rance D Necaise “Data Structures and Algorithms using Python”, Wiley, John Wiley and Sons
2.	Michael T. Goodrich, R. Tamassia and Michael H Goldwasser “Data structures and Algorithms in python”, Wiley student edition, John Wiley and Sons.
3.	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**
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: IV		
Operating System		
Course Code:	**MVJ22EC453**	**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	Demonstrate how processes are synchronized and scheduled.	
3	Identify different approaches of memory management and virtual memory management.	
4	Criticize the structure and organization of the file system	
5	Examine 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 :** **https://archive.nptel.ac.in/courses/106/105/106105214/**	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	8Hrs.

Scheduling- RR and LCN, Long term, medium term and short term scheduling in a time sharing system. **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:** **https://archive.nptel.ac.in/courses/106/102/106102132/**	
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:** **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.	8Hrs.

Laboratory Sessions/ Experimental learning: 1. Case Study on UNIX/ Windows/ Linux File System. **Applications:** • Understand file handling operations (read, write, and append). • Basic understanding of how pointers are used **Video link / Additional online information :** **https://archive.nptel.ac.in/courses/106/102/106102132/**	
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:** **https://archive.nptel.ac.in/courses/106/105/106105214/**	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	Examine message passing, deadlock detection and prevention methods.

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of three quizzes are conducted along with tests. Test portion is evaluated for 50 marks and quiz is evaluated for 10 marks.

Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three (conduct additional quizzes and take best three). The three tests are conducted for 50 marks each and the average of all the tests are calculated for 50. The marks for the assignments are 20 (2 assignments for 10 marks each). The marks obtained in test, quiz and assignment are added to get marks out of 100 and report CIE for 50 marks.

Semester End Examination (SEE):

Total marks: 50+50=100

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

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

High-3, Medium-2, Low-1

B.E, V Semester, Electronics and Communication Engineering

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	
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:** 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

Semester: V		
Digital Communication Systems		
Course Code:	**MVJ22EC52**	**CIE Marks:50**
Credits:	**L: T:P: 3:0:2**	**SEE Marks: 50**
Hours:	**40T+26P**	**SEE Duration: 3 Hrs**
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	Compute performance metrics and parameters for symbol processing and recovery in ideal and corrupted channel conditions.	
3	Demonstrate the principles of spread spectrum communications and the basic principles of information theory and various source coding techniques.	
4	Examine the different types of errors and error detection and controlling codes used in the communication channel.	
5	Analyse the concepts of convolution codes and analyse the code words using time domain and transform domain approach.	

Unit -I	
***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, Types: Ideal, Natural, Flat Top, Sampling theorem for band limited signals, Hartley Shannon Law, Bandwidth-S/N tradeoff. **Laboratory Sessions/ Experimental learning:** Verification of sampling theorem **Applications:** Modern communication systems such as cellular phones **Project:** Generation of S/N trade off value of various modulation techniques **Video link/ Additional online information:** https://nptel.ac.in/courses/108102096	**8 Hrs**
Unit -II	
Pulse Digital Modulation: Elements of PCM: Sampling, Quantization & Coding, Quantization error, Companding in PCM systems, Differential PCM systems (DPCM), 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	**8 Hrs**

Unit -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:** Generation of Hilbert function **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**
Unit -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:** 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	**8 Hrs**
Unit -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.	**8 Hrs**

Applications: Information systems, Data management systems, Data structures, Data layout, Data encryption. **Video link / Additional online information**: https://nptel.ac.in/courses/108102096	

Lab Experiments

1. Verification of Sampling Theorem.
2. Verification of Shannon's Channel Capacity theorem.
3. PCM and DPCM Encoding and Decoding.
4. Study of Time Division Multiplexing and Demultiplexing.
5. Study of Delta modulation.
6. Plot the BER curve for various Digital modulation techniques
7. Simulation of spread spectrum communication
8. Simulation of frequency division multiplexing

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	Analyse of bandpass signals and systems
CO4	Apply the fundamentals of information theory and perform source coding for given message.
CO5	Examine different encoding and decoding techniques with error Detection and Correction.

Text Books	
3.	Simon Haykin, "Digital Communication Systems", John Wiley & sons, First Edition, 2014, ISBN 978-0- 471-64735-5.
4.	John G Proakis and Masoud Salehi, "Fundamentals of Communication Systems", 2014 Edition, Pearson Education, ISBN 978-8-131-70573-5.
3.	Hari Bhat, Ganesh Rao, "Information Theory and Coding", Cengage, 2017.
Reference Books	
4.	Sam Shanmugam, "Digital and analog communication systems", John Wiley India Pvt. Ltd, 1996.
5	Todd K Moon, "Error Correction Coding", Wiley Std. 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 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**	**PSO1**	**PSO2**
CO1	**3**	**3**	**3**	**2**	**2**	**1**	**-**	**-**	**1**	**1**	**1**	**1**	**1**	**2**
CO2	**3**	**3**	**3**	**2**	**2**	**1**	**-**	**1**	**-**	**1**	**-**	**1**	**1**	**2**
CO3	**3**	**3**	**3**	**2**	**2**	**1**	**1**	**1**	**-**	**-**	**-**	**1**	**2**	**1**
CO4	**3**	**3**	**3**	**2**	**2**	**1**	**1**	**-**	**-**	**-**	**1**	**1**	**1**	**1**
CO5	**3**	**3**	**3**	**2**	**2**	**1**	**-**	**-**	**1**	**-**	**1**	**1**	**1**	**2**

High-3, Medium-2, Low-1

Semester: V		
Signal Processing		
Course Code:	**MVJ22EC53**	**CIE Marks: 50**
Credits:	**L:T:P: 3:2:0**	**SEE Marks: 50**
Hours:	**50**	**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	Analyse the properties and the development of efficient algorithms for the computation of DFT.
3	Analyse the procedures to design IIR filters from the analog filters using impulse invariance and bilinear transformation.
4	Apply different windows used in the design of FIR filters and design appropriate filters based on the specifications.
5	Examine DSP Processor Architecture and study the real time applications of DSP

UNIT I	
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**	**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. **Applications:** Frequency domain filtering, video and audio signal processing. **Video link / Additional online information:**	**8Hrs.**

1. https://nptel.ac.in/courses/117105134	
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/	**8Hrs.**
UNIT 4	
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.**
UNIT 5	
Prerequisites: 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)	**8Hrs.**

Applications: Audio, Military, Video & Imaging, Wireless **Video link / Additional online information:** 1. https://nptel.ac.in/courses/108/105/108105055/	

Course Outcomes: After completing the course, the students will be able to	
CO1	Illustrate DFT of real and complex discrete time signals.
CO2	Interpret 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	Examine the DSP processor architecture and to apply knowledge to various real time cases.

Text Books	
1	Proakis & Monalakis, "Digital signal processing – Principles Algorithms & Applications", 4th Edition, Pearson education, New Delhi, 2007. ISBN: 81-317- 1000-9.
2	Dr.D.Ganesh Rao, "Digital Signal Processing", Pearson Education, 2nd edition, 2011
Reference Books	
1	Sanjit K Mitra, "Digital Signal Processing, A Computer Based Approach", 4th Edition, McGraw Hill Education, 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 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**	**-**	**-**	**-**	1	**-**	**-**	**2**	**1**
CO2	**3**	**3**	**3**	**3**	**2**	**1**	**-**	**-**	**1**	**1**	**-**	**-**	**2**	**1**
CO3	**3**	**3**	**3**	**3**	**2**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**2**	**1**
CO4	**3**	**3**	**3**	**3**	**2**	**1**	1	**-**	1	**-**	1	**-**	**2**	**1**
CO5	**3**	**3**	**3**	**3**	**2**	**1**	**1**	**1**	**-**	**-**	**1**	**1**	**2**	**1**

High-3, Medium-2, Low-1

Semester: V		
Signal Processing Laboratory		
Course Code:	**MVJ22ECL54**	**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 basic concepts of Signal processing techniques with their Properties both in time and frequency domain.	
2	Acquire knowledge on different types of signals.	
3	Demonstrate the basic concepts of Signal processing techniques with their Properties both in time and frequency domain.	
4	To Demonstrate the complete experimental process and result	
5	To Implement signal processing techniques/operations and Digital filters using Processor	

PART A (Programming using MATLAB)
1. Verification of sampling theorem 2. Linear and circular convolution of two given sequences, Commutative, distributive, and associative property of convolution 3. Auto and cross correlation of two sequences and verification of their properties 4. Solving a given difference equation. 5. Computation of N point DFT of a given sequence and to plot magnitude and phase spectrum (using DFT equation and verify it by built-in routine). 6. Verification of DFT properties (like Linearity and Parseval's theorem, etc.) 7. Design and implementation of FIR filter using different window techniques. 8. Design and implementation of IIR filter.
PART B (Implementation using DSP Kit)
9. Linear convolution of two sequences. 10. Circular convolution of two sequences. 11. N Point DFT of a given sequence. 12. Impulse response of first order and second order system

Course outcomes:	
CO1	Use computational tools to do basic operations for signal processing.
CO2	Analyze algorithms for designing and implementation of FIR and IIR filters with standard techniques.
CO3	Apply Fast Fourier Transform in a variety of applications including: signal analysis, fast convolution, spectral and temporal interpolation, and filtering

CO4	Select and design digital filters
CO5	Select and Examine appropriate methods for basic signal processing applications

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

High-3, Medium-2, Low-1

Professional Elective I

Semester: V		
Artificial Neural Networks		
Course Code:	**MVJ22EC551**	**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 neural network fundamentals, architectures, and learning processes.	
2	Explore single-layer and multilayer perceptron, their optimization, and learning algorithms.	
3	Understand backpropagation, differentiation, generalization, and techniques for optimizing supervised learning.	
4	Evaluate the basics of Self-Organizing Maps including feature mapping, algorithmic implementation, and adaptive pattern classification.	
5	Analyse Neuro dynamic models for various problems.	

UNIT I	
Prerequisites: **Linear Algebra, Statistics and Probability** **Introduction to Neural Network**: Neural Network, Human Brain, Models of a Neuron, Neural Networks viewed as Directed Graphs, Feedback, Network Architectures, Knowledge Representation **Learning Process:** Error Correction Learning, Memory Based Learning, Hebbian Learning, Competitive Learning, 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:** To make a successful stock prediction in real time a **Multilayer Perceptron MLP** *(class of feedforward artificial intelligence algorithm)* is employed. Facial Recognition Systems are serving as robust systems of surveillance. As CNN is used in image processing, the medical imaging data retrieved from tests is analyzed and assessed based on neural network models. **Laboratory Sessions/ Experimental learning: Perceptron learning** The objective of this experiment is to illustrate the concept of perceptron learning in the context of pattern classification task. Following are the goals of the experiment: To demonstrate the perceptron learning law.	**8Hrs.**

Project: To illustrate the convergence of the weights for linearly separable classes. **Video link / Additional online information :** https://nptel.ac.in/courses/117105084	
UNIT 2	
Single Layer Perceptron's: Adaptive Filtering Problem, Unconstrained Optimization Techniques, Linear Least-Squares 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 for Making the Back- Propagation Algorithm Perform Better, Output Representation and Decision Rule, Computer Experiment, Feature Detection **Laboratory Sessions/ Experimental learning:** **To Demonstrate Multilayer Feedforward Neural Networks** **Project:** To design a multilayer feedforward neural network (MLFFNN) in solving linearly inseparable pattern classification problems. **Applications: Perceptron is a linear classifier, and is used in supervised learning** **Video link / Additional online information :** https://nptel.ac.in/courses/117105084 https://nptel.ac.in/courses/108108148	**8Hrs.**
UNIT 3	
Back Propagation: Back Propagation and Differentiation, Hessian Matrix, Generalization, Cross Validation, Network Pruning Techniques, Virtues and Limitations of Back Propagation Learning, Accelerated Convergence of Back Propagation Learning, Supervised Learning **Laboratory Sessions/ Experimental learning:** How the choice of activation function effect the output of neuron experiment with the following function backpropagation purelin(n), bimary threshold(hardlim(n) haradlims(n)) ,Tansig(n) logsig(n) **Applications:** The neural network is trained to enunciate each letter of a word and a sentence **Project:** speech recognition **Video link / Additional online information :** http://www.digimat.in/nptel/courses/video/106106211/L38.html	**8Hrs.**

UNIT 4	
Self-Organizing Maps (SOM): Two Basic Feature Mapping Models, Self-Organizing Map, SOM Algorithm, Properties of Feature Map, Computer Simulations, Learning Vector Quantization, Adaptive Pattern Classification **Laboratory Sessions/ Experimental learning:** **Solution to Travelling Salesman Problem Using Self Organizing Maps** To observe the suboptimal nature of the solution provided by SOM To study the effect of structure of SOM on the solution **Applications:** 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. **Project:** To observe the behavior of the neural network for two classes which are not linearly separable. **Video link / Additional online information:** **https://archive.nptel.ac.in/courses/117/105/117105084/**	**8Hrs.**
UNIT 5	
Neuro Dynamics: Dynamical Systems, Stability of Equilibrium States, Attractors, Neurodynamical Models, Manipulation of Attractors as a Recurrent Network Paradigm **Hopfield Models** – Hopfield Models, Computer Experiment to Illustrate the Behavior of the Discrete Hopefield Network as a Content Addressable Memory **Laboratory Sessions/ Experimental learning:** **Hopfield Models for Solution to Optimization Problems** **Weighted matching problem: Deterministic, stochastic and mean field annealing of a Hopfield model** To demonstrates how an optimization problem such as the graph bipartition problem, can be mapped on to a Hopfield model (feedback neural network). **Applications**: Neural Network for Machine Learning **Project:** Face Recognition **Video link / Additional online information:** **https://scte-iitkgp.vlabs.ac.in/exp/neural-networks-perceptron/references.html**	**8Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Identify different neural networks of various architectures both feed forward and backward.

CO2	Demonstrate the training of neural networks using various learning rules.
CO3	Perform the testing of neural networks and do the perform analysis of these networks for various pattern recognition applications.
CO4	Examine the similarity of Biological networks and Neural networks. Perform the training of neural networks using various learning rules.
CO5	Evaluate the concepts of forward and backward propagations. Understand and construct the Hopfield models.

Text Books:	
1.	Neural Networks a Comprehensive Foundations, Simon Haykin, PHI edition.
Reference Books:	
1.	Artificial Neural Networks - B. Vegnanarayana Prentice Hall of India P Ltd 2005
2.	Neural Networks in Computer Inteligance, Li Min Fu MC GRAW HILL EDUCATION 2003
3.	Neural Networks -James A Freeman David M S Kapura 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**	**3**	**1**	**1**	**1**	**-**	**-**	-	1	**-**	**1**	1	2
CO2	**3**	**3**	**3**	**1**	**1**	**1**	**-**	**-**	1	1	1	**1**	**1**	1
CO3	**3**	**3**	**3**	**1**	**1**	**1**	**1**	**-**	1	**-**	**-**	**1**	1	1
CO4	**3**	**3**	**3**	**1**	**1**	**1**	1	1	-	**-**	**-**	**1**	**2**	1
CO5	**3**	**3**	**3**	**1**	**1**	**1**	**-**	1	-	**-**	1	**1**	2	1

High-3, Medium-2, Low-1

Semester: V		
CRYPTOGRAPHY		
Course Code:	**MVJ22EC552**	**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	Outline the basic principles of Cyber security and its applications	
2	Familiarize with Cryptography and very essential algorithms.	
3	Use the theorems needed for cryptographic operations and compare & contrast different types of cryptography.	
4	Examine the concepts & uses of Digital signature and web security.	
5	Demonstrate the need and summarize the concept of Secure Electronic Transactions & Intrusion detection system.	

UNIT 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 **Laboratory Sessions/ Experimental learning:** Breaking the Shift Cipher **Project:** Secure Network Communication **Video link / Additional online information :** **3. https://archive.nptel.ac.in/courses/106/105/106105162/**	**8Hrs.**
UNIT 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	**8Hrs.**

Applications: wireless security, processor security **Project:** File encryption **Video link / Additional online information:** 1. **https://archive.nptel.ac.in/courses/106/105/106105031/**	
UNIT 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:** 1. Diffie-Hellman Key Establishment **Applications:** Random number generator **Project:** Permutation generation **Video link / Additional online information:** 1. **https://archive.nptel.ac.in/courses/106/106/106106241/**	**8Hrs.**
UNIT 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:** 1. Digital Signatures Scheme 2. Cryptographic Hash Functions and Applications (HMAC) **Applications:** Cyber-attacks, Cybercrime, Cyber security. **Project:** Assessment of Diverse Intrusion Detection Methods **Video link / Additional online information :** 2. https://onlinecourses.nptel.ac.in/noc22_cs03/preview	**8Hrs.**
UNIT 5	
Intruders, Intrusion Detection, Password Management, Malicious software programs – Viruses and related Threats, Virus Countermeasures	**8Hrs.**

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 **Project:** Replay attack protection **Video link / Additional online information:** 1. http://digimat.in/nptel/courses/video/106105031/L01.html	

Course Outcomes: After completing the course, the students will be able to	
CO1	Illustrate the importance of security attacks, service mechanism, basic network security model and its applications.
CO2	Analyse simple cryptography algorithms and explain basic structure of DES and AES
CO3	Demonstrate the concept public key cryptography & apply digital signatures in email
CO4	Inspect different techniques used in key exchange protocols.
CO5	Investigate various malicious software and firewalls.

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

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

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

assignments for 10 marks each). The marks obtained in test, quiz and assignment are added to get marks out of 100 and report CIE for 50 marks.

Semester End Examination (SEE):

Total marks: 50+50=100

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

CO-PO/PSO 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**	**2**	**1**
CO2	**3**	**3**	**3**	**2**	**1**	**1**	**-**	**-**	**1**	**-**	**-**	**1**	**2**	**1**
CO3	**3**	**3**	**3**	**2**	**1**	**1**	**-**	**1**	**1**	**-**	**1**	**1**	**2**	**1**
CO4	**3**	**3**	**3**	**2**	**1**	**1**	**-**	**1**	**-**	**1**	**-**	**1**	**2**	**1**
CO5	**3**	**3**	**3**	**2**	**1**	**1**	**-**	**-**	**-**	**1**	**-**	**1**	**2**	**1**

High-3, Medium-2, Low-1

Semester: VI		
SATELLITE COMMUNICATION		
Course Code:	**MVJ22EC553**	**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	Provide a conceptual knowledge of communication through satellites.	
2	Study of 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	Analyze the various application.	
5	Learn the basic principle of Radar and radar equation.	

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. **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 Supply Subsystem- Tracking, Telemetry and Command Subsystem, Payload , Antenna Subsystem **Laboratory Sessions/ Experimental learning:** A Case Study of Using Remote Sensing Data and GIS for Land Management	**8Hrs.**

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. **Multiple Access Techniques:** Frequency Division Multiple Access (FDMA), Demand Assigned FDMA, Pre-assigned FDMA, Calculation of C/N Ration, Time Division Multiple Access(TDMA) ,TDMA Frame Structure, Reference Burst Traffic Burst ,Guard Time ,Code Division Multiple Access(CDMA) ,DS-CDMA Transmission and Reception **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	

Communication Satellites: Introduction, Related Applications, Frequency Bands, Payloads, Satellite Vs. Terrestrial Networks, Satellite Telephony, Satellite Television, Satellite radio, Regional satellite Systems, National Satellite Systems. **Remote Sensing Satellites:** Classification of remote sensing systems, orbits, Payloads, Types of images: Classification, Interpretation, Applications. **Weather Forecasting Satellites:** Fundamentals: Images, Orbits, Payloads, And Applications. **Navigation Satellites**: Development of Satellite Navigation Systems, GPS system, Applications. **Laboratory Sessions/ Experimental learning:** 1. A Case Study of Using Remote Sensing Data and GIS for Land Management **Applications:** Communication, Weather forecasting, Remote sensing, Navigation **Video link / Additional online information:** 1. https://nptel.ac.in/courses/117/105/117105131/# 2. https://nptel.ac.in/courses/121/107/121107009/ 3. https://onlinecourses.nptel.ac.in/noc19_ce45/preview	**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. **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.**
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	Inspect various kinds of satellites used in different applications.
CO5	Analyze how the radar equation is derived and its significance in radar technology.

Text Books:	
1.	Anil K Maini, Varsha Agrawal, Satellite Communication, Wiley India Pvt. Ltd., 2015, ISBN: 978-81265-2071-8.
2.	Merril. I. Skolnik, “Introduction to Radar Systems”, 2/e, MGH, 1981.
Reference Books:	
1.	T. Pratt, C.W. Boastian and Jeremy Allnutt, “Satellite Communication”, 2013, 2nd edition, John Wiley and Sons, Bangalore, India.
2.	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**	**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**	**2**	**2**
CO5	**3**	**3**	**2**	**2**	**1**	**1**	1	1	1	1	1	**1**	**2**	**2**

High-3, Medium-2, Low-1

Semester: V		
Cloud Computing		
Course Code:	**MVJ22EC554**	**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	Discuss the concepts, characteristics, delivery models and benefits of cloud computing.
2	Explore the key technical, organizational and compliance challenges of cloud computing.
3	Grasp the concepts of virtualization efficiently. Gain knowledge on combination of functionalities and services of networking.
4	Able to explain the cloud architecture and applications.
5	Discuss the various cloud services.

UNIT I	
Defining Cloud Computing: Defining cloud computing,, Cloud Types, Examining the Characteristics of Cloud Computing, Assessing the Role of Open Standards. **Understanding Cloud Architecture:** Exploring the Cloud Computing Stack, Connecting to the cloud. **Understanding Services and Applications by Type:** Defining Infrastructure as a Service (IaaS), Defining Platform as a Service (PaaS), Defining Software as a Service (SaaS) **Applications:** A cloud application is software that runs its processing logic and data storage between 2 different systems: client-side and server-side. Some processing takes place on an end user's local hardware, such as a desktop or mobile device, and some takes place on a remote server **Video link / Additional online information:** https://nptel.ac.in/courses/106105167	**8Hrs.**
UNIT 2	
Understanding Abstraction and Virtualization: Using Virtualization Technologies, Load Balancing and Virtualization, Understanding Hypervisors, Understanding Machine Imaging, Porting Applications **Capacity Planning**: Capacity Planning, Defining Baseline and Metrics, Network Capacity, Scaling **Applications:** An application architecture describes the patterns and techniques used to design and build an application.	**8Hrs.**

Video link / Additional online information: https://archive.nptel.ac.in/courses/106/105/106105167/	
UNIT 3	
Managing the Cloud: Administrating the Clouds, Cloud Management Products, Emerging Cloud Management Standards. **Understanding Cloud Security:** Securing the Cloud, Securing Data, Establishing Identity and Presence. **Applications:** Virtualization is technology that can be used to create virtual representations of servers, storage, networks, and other physical machines. Virtual software mimics the functions of physical hardware to run multiple virtual machines simultaneously on a single physical machine. **Video link / Additional online information:** https://archive.nptel.ac.in/courses/106/105/106105223/	**8Hrs.**
UNIT 4	
Understanding Service Oriented Architecture: Introducing Service Oriented Architecture, Defining SOA Communications, Managing and Monitoring SOA, Relating SOA and Cloud Computing. **Moving Applications to the Cloud**: Applications in the Clouds, Applications and Cloud APIs. **Working with Cloud-Based Storage**: - Measuring the Digital Universe, Provisioning Cloud Storage, Exploring Cloud Backup Solutions, Cloud Storage Interoperability. **Applications:** multiple business processes in an organization require the user authentication functionality. Instead of rewriting the authentication code for all business processes, you can create a single authentication service and reuse it for all applications. **Video link / Additional online information:** http://acl.digimat.in/nptel/courses/video/106104182/L01.html	**8Hrs.**
UNIT 5	
Using Google Web Services: Exploring Google Applications, Surveying the Google Application Portfolio, Exploring the Google Toolkit, Working with the Google App Engine **Using Amazon Web Services:** Understanding Amazon Web Services, Amazon Web Service Components and Services, Working with the Elastic Compute Cloud (EC2), Working with Amazon Storage Systems, Understanding Amazon Database Services	**8Hrs.**

Using Microsoft Cloud Services: Exploring Microsoft Cloud Services, Defining the Windows Azure Platform, Using Windows Live **Applications**: loud service providers provide various applications in the field of art, business, data storage and backup services, education, entertainment, management, social networking, etc. **Video link / Additional online information:** https://archive.nptel.ac.in/courses/106/104/106104182/	

Course Outcomes: After completing the course, the students will be able to	
CO1	Elucidate the architecture of cloud computing.
CO2	Analyse about Cloud Virtualization and planning.
CO3	Infer about cloud management and security.
CO4	Analyse about moving applications working with cloud.
CO5	Investigate various cloud services available in day to day life.

Text Books:	
1.	Cloud Computing Bible, Barrie Sosinsky, Wiley-India, 2011.
Reference Books:	
1.	Computing Principles and Paradigms, Rajkumar Buyya , James Broberg, Andrzej Goscinsk, i Willey, 2014.

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

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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/PSO Mapping														
CO/PO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
CO 1	**3**	**2**	**2**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**2**
CO 2	**3**	**2**	**3**	**2**	**3**	**2**	**-**	**1**	**2**	**-**	**-**	**-**	**1**	**2**
CO 3	**3**	**2**	**3**	**2**	**3**	**2**	**-**	**-**	**2**	**-**	**-**	**2**	**1**	**2**
CO 4	**3**	**3**	**3**	**2**	**3**	**2**	**1**	**1**	**2**	**-**	**2**	**-**	**1**	**2**
CO 5	**2**	**2**	**3**	**2**	**3**	**2**	**1**	**1**	**2**	**2**	**2**	**2**	**1**	**2**

High-3, Medium-2, Low-1

Semester: V		
Innovation & Entrepreneurship (Theory)		
Course Code:	**MVJ22EC555**	**CIE Marks:50**
Credits:	**L: T:P: 2:1:0**	**SEE Marks: 50**
Hours:	**40L**	**SEE Duration: 3 Hrs**

Course Learning Objectives: The students will be able to

1	Inspired; develop entrepreneurial mindset and attributes; entrepreneurial skill sets forventure 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 whileusing design thinking principles to refine and pivot their venture idea.
3	Analyze Customer and Market segmentation, estimate Market size, and develop andvalidate 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-I	
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 roleplay-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-II	
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 Designthinking 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	**8Hrs**

of the building', and Venture Activities.	
UNIT-III	
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-IV	
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. **Core Teaching Tool**: Class and Venture Activity 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.	**8Hrs**
UNIT-V	
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. **Core Teaching Tool:** Founder Case Studies – Sama and Securely Share; Class activityand discussions; Venture Activities. **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**

CO	Course Outcomes	POs
CO1	Understand Entrepreneurial Skillset and Mindset	**1,2,3,9,12**
CO2	Understand and analyze industry problems and Enhance customerpersonas based on market/other feedback	**3,4,5,12**
CO3	Understand and develop MVPs	**3,5,6,9,12**
CO4	Understand and apply Business models and Business planning.	**3,5,9,12**
CO5	Develop a go-to-market strategy and build a Persuasive sales pitch	**3,6,7,8,10,12**

Textbooks

1. Robert D. Hisrich, Michael P. Peters, Dean A. Shepherd, Sabyasachi Sinha (2020). Entrepreneurship, McGrawHill, 11th Edition.

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

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

4. Chowdhry Ajay, (2023) Just Aspire: Notes on Technology, Entrepreneurship and the Future.

5. Simon Sinek (2011) Start with Why, Penguin Books limited.

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

7. Namita Thapar (2022) The Dolphin and the Shark: Stories on Entrepreneurship, Penguin Books Limited.

References

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

2. Burlington Bo, (2016) Small Giants: Companies That Choose to Be Great Instead of Big3..

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

Web Resources

• Learning resource- IgniteX Course Wadhwani platform (Includes 200+ components of custom created modular content + 500+ components of the most relevant curated content)

MAPPING OF COs AND POs:

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**2**	**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**			

Semester: V		
RESEARCH METHODOLOGY AND IPR		
Course Code:	**MVJ22RMI57**	**CIE Marks:50**
Credits: L:T:P:S:	**3:0:0:0**	**SEE Marks: 50**
Hours:	**40**	**SEE Duration: 3 Hrs**
Course Learning Objectives: The students will be able to		
1	To give an overview of the research methodology and explain the technique. of defining a research problem and explain the basic ethics in research.	
2	To develop a suitable outline for research studies through various sources of information from literature review and data collection.	
3	To develop an understanding of the results and on analysis of the work carried.	
4	To Demonstrate enhanced Scientific writing skills.	
5	To Develop an Understanding on Various Intellectual Property Rights and importance of filing patents.	

UNIT-I	
Research Methodology: Introduction, Meaning of Research, Objectives of Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Research Process, Criteria of Good Research, Defining the Research Problem: Research Problem, Selecting the Problem, Necessity of Defining the Problem. Technique Involved in defining a problem and Illustrations. ***Ethics in Engineering Research:*** Ethics in Engineering Research Practice, Types of Research Misconduct, Ethical Issues Related to Authorship.	**8 Hrs**
UNIT-II	
Research Writing and Journal Publication Skills: Understanding the importance of quality research papers, Differences between conference papers, journal articles, and other academic publications, criteria for selecting a journal, understanding impact factors and journal rankings. place of the literature review in research, how to review the literature, structure of a research paper, effective use of figures and tables, preparing a cover letter and author contributions, Responding to reviewers' comments.	**8 Hrs**

Attributions and Citations: Giving Credit Wherever Due, Citations: Functions and Attributes, Impact of Title and Keywords on Citations, Knowledge Flow through Citation, Citing Datasets, Styles for Citations, Tools for citation management, Acknowledgments and Attributions, What Should Be Acknowledged, Acknowledgments in, Books Dissertations, Dedication or Acknowledgments.	
UNIT-III	
Research Design: Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs case of Exploratory research studies, case of descriptive and diagnostic research, case of hypothesis -testing , Basic Principles of Experimental Designs, Important Experimental Designs. ***Results and Analysis:*** Importance and scientific methodology in recording results, importance of negative results, different ways of recording, industrial requirement, artifacts versus true results, types of analysis (analytical, objective, subjective), outcome as new idea, hypothesis, concept, theory, model etc.	**8 Hrs**
UNIT-IV	
Interpretation and Report Writing: Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, types of reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports.	**8 Hrs**
UNIT-V	
Introduction to Intellectual Property Rights: Meaning of property, Origin, Nature, Meaning of Intellectual Property Rights. **Kinds of Intellectual property rights**—Copy Right, Patent, Trademark, Trade Secret and trade dress, Design, Layout Design, Geographical Indication, Plant Varieties and Traditional Knowledge.	**8 Hrs**

Patents: Trips Definition, Patentable and Non-Patentable inventions, Legal requirements for patents. **Patent application process:** Prior art search, drafting of a patent, Filing of a patent, Patent document: specification and claims, Granting of patent, Management of IP, Commercialization of IP – Assignment, licensing and infringement.	

Course Outcomes: After completing the course, the students will be able to	
CO1	Formulate the research problem and follow research ethics.
CO2	Carry out a Literature survey for the topic identified
CO3	Analyse the research and interpret the outcomes of the research.
CO4	Enhance their technical writing skills
CO5	Understand the importance of Patenting, Licensing and technology transfer.

Text Books	
1.	C.R. Kothari, Research Methodology, Methods and Techniques, 2nd Revised edition, New Age International Publishers, 2015
2.	Neeraj Pandey and Khushdeep Dharni, Intellectual Property Rights, PHI Learning Pvt Ltd, 2014

Reference Books	
1.	Geoffrey Marczyk, David De Matteo, David Festinger (2005) Essentials of Research Design and Methodology, John Wiley & Sons, Inc.
2.	Carol Ellison (2010) McGraw-Hill's Concise Guide to Writing Research Papers, McGraw-Hill
3.	Sinha, S.C. and Dhiman, A.K., (2002). Research Methodology, Ess Publications. 2nd volume.
4.	Wadehra, B.L. (2000). Law relating to patents, trademarks, copyright designs and geographical indications. Universal Law Publishing

Assessment Details (both CIE and SEE)

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

· The student has to obtain a minimum of 40% of maximum marks in CIE and a minimum of 40% of maximum marks in SEE.

· Semester End Exam (SEE) is conducted for 50 marks (2 hours duration).

· Based on this grading will be awarded.

· The student has to score 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:

· Three Unit Tests each of 30 Marks (30 MCQ's) (duration 01 hour)

1. First test at the end of 5th week of the semester.

2. Second test at the end of the 10th week of the semester.

3. Third test at the end of the 15th week of the semester.

· Report Writing /Presentation/ Assignment to attain the COs and POs for 20 Marks, (Students can decide the topic for Mini Project and start doing literature survey, report of literature survey can be considered for assignments) At the end of the 13th week of the semester

· The average of three tests and report writing/presentation/Assignment summing to 50 marks

Semester End Examination:

· Theory SEE will be conducted by College as per the scheduled timetable, with common question paper for the subject

· SEE paper will be set for 50 questions of each of 01 marks. The pattern of the question paper is MCQ. The time allotted for SEE is 02 hours.

CO-PO/PSO Mapping														
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSOL2
CO1	3	2	-	1	2	2	-	-	1	1	1	2	1	1
CO2	3	2	3	2	2	2	-	1	1	1	-	1	2	2
CO3	1	2	3	3	2	2	-	1	1	1	-	1	1	2
CO4	1	2	3	3	3	2	-	1	1	-	1	2	1	2
CO5	1	1	1	2	2	1							2	2

High-3, Medium-2, Low-1

B.E, VI Semester, Electronics & Communication Engineering

Semester: VI		
ARM Microcontroller		
Course Code:	**MVJ22EC61**	**CIE Marks:50**
Credits:	**L:T:P: 3:0:2**	**SEE Marks: 50**
Hours:	**40 L+ 26 P**	**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	Demonstrate the Program of ARM controller using the various instructions.	
3	Inspect the fundamentals of Exception, Interrupt Handling and Memory Management Unit of ARM Controller.	
4	Investigate the Embedded System Design applications.	
5	Utilize the real time operating system for the embedded system design.	

UNIT-I	
ARM EMBEDDED SYSTEMS: **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 H/W and S/W Model **Applications:** Smartphones, Tablets, Wearables **Video link / Additional online information:** **https://archive.nptel.ac.in/courses/106/105/106105193/**	**8 Hrs**
UNIT-II	
ARM Instruction Set and Programming **Introduction to the ARM Instruction Set :** Data Processing Instructions , Programme Instructions, Software Interrupt Instructions, Program Status Register Instructions, Coprocessor Instructions, Loading Constants **Introduction to Thumb Instruction Set:** Thumb Register Usage, ARM-Thumb Interworking, Other Branch Instructions, Data Processing Instructions, Single-Register	**8 Hrs**

Load-Store Instructions, Multiple-Register Load-Store Instructions, Stack Instructions, Software Interrupt Instruction **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://archive.nptel.ac.in/courses/117/106/117106111/	
UNIT-III	
Interrupt and Memory Management Unit: **ARM programming using Assembly language:** Writing Assembly code, Profiling and cycle counting, instruction scheduling, Register Allocation, Conditional Execution, Looping Constructs, Bit Manipulation **Exception, Interrupt Handling :** Exception handling, Interrupts, Interrupt handling Schemes **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. **Video link / Additional online information:** **https://archive.nptel.ac.in/courses/117/106/117106111/**	**8 Hrs**
UNIT-IV	
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.	**8 Hrs**

Laboratory Sessions/ Experimental learning: Battery operated Smartcard Reader **Applications:** Home Appliances, Office Automation, Security, Telecommunication **Video link / Additional online information:** **https://onlinecourses.nptel.ac.in/noc22_cs93/preview**	
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:** 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=3OmyM4-zuQw	**8 Hrs**

LABORATORY EXPERIMENTS

1.Write a program to find the sum of first 10 integer numbers.

2.Write a program to find factorial of a number.

3. Write a program to add an array of 16 bit numbers and store the 32 bit result in internal RAM.

4.Write a program to find the square of a number (1 to 10) using look-up table.

5. Write a program to find the largest/smallest number in an array of 32 numbers

6. Write a program to arrange a series of 32 bit numbers in ascending/descending order

7. Write a program to count the number of ones and zeros in two consecutive memory locations

8. Write an ARM assembly program that checks if a 32-bit number is a palindrome. Assume that the input is available in r 3. The program should set r 4 to 1 if it is a

palindrome, otherwise r 4 should have 0. A palindrome is a number which is the same when read from both sides. For example, 1001 is a 4 bit palindrome.

9. Demonstrate the use of external interrupt to toggle an LED On/Off.

10. Interface a simple switch and display its status through Relay, Buzzer and LED.

11. Interface a Stepper motor and rotate it in clockwise and anti-clockwise direction

12. Interface a DAC and generate Triangular and Square waveforms.

13. Display the Hex digits 0 to F on a 7-segment LED interface, with an appropriate delay in between.

STUDY EXPERIMENT

Interface a 4x4 keyboard and display the key code on an LCD

Any 12 experiments to be conducted

Sl No	**List of Projects**
1	Gas Leakage Detection
2	Design of currency counting machine
3	Design of digital watch
4	Automated Meter Reading System (AMR)
5	Service Requests Management

Course Outcomes: After completing the course, the students will be able to	
CO1	Demonstrate the architectural features and instructions of ARM microcontroller
CO2	Develop Assembly Programs in ARM for Embedded applications.
CO3	Analyse the fundamentals of Exception, Interrupt Handling and Memory Management Unit of ARM Controller
CO4	Investigate the interfacing of external devices and I/O with ARM microcontroller.
CO5	Examine 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.	"The Insider's Guide to the ARM7 Based Microcontrollers", Hitex Ltd., 1st edition, 2005.

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Theory for 50 Marks

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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/PSO Mapping														
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PS01**	**PSO2**
CO1	**3**	**1**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**
CO2	**3**	**2**	**1**	**3**	**3**	**2**	**1**	**2**	**2**	**-**	**1**	**-**	**1**	**2**
CO3	**3**	**2**	**1**	**3**	**-**	**2**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**2**
CO4	**3**	**3**	**2**	**3**	**3**	**2**	**-**	**1**	**2**	**2**	**2**	**-**	**2**	**1**
CO5	**3**	**2**	**3**	**3**	**3**	**2**	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**-**

High-3, Medium-2, Low-1

Semester: VI		
VLSI Design and Testing		
Course Code:	**MVJ22EC62**	**CIE Marks:50**
Credits:	**L:T:P: 3:0:0**	**SEE Marks: 50**
Hours:	**40 L**	**SEE Duration: 03Hours**
Course Learning Objectives: The students will be able to		
1	Understand the characteristics of CMOS circuit construction.	
2	Illustrate the concepts and techniques of modern integrated circuit design and testing (CMOS VLSI).	
3	Demonstrate CMOS combinational and sequential logic at the transistor level, with mask layout.	
4	Examine the general steps required for processing of CMOS integrated circuits.	
5	Design functional units including adders, multipliers, ROMs, SRAMs.	

UNIT-I	
Prerequisites: *Basics of transistor* **Introduction to MOS Technology**: Semiconductor materials, enhancement mode MOS transistor, depletion mode MOS transistor, NMOS fabrication, CMOS fabrication, comparison of NMOS, CMOS, BICMOS, GaAs technologies. **Introduction to ASICs :** Field Programmable gate array, Full custom, Semi-custom , ASIC Design flow. **Laboratory Sessions/ Experimental learning:** 1. Design and demonstrate the MOS transistor connected as a diode using any CAD tool. **Video link / Additional online information :** **1.** https://nptel.ac.in/courses/108101089	**8 Hrs**
UNIT-II	
Basic Electrical Properties of MOS Circuits: Drain-to-Source current vs. voltage relationships, aspects of MOS transistor threshold voltage, MOS transistor transconductance and output conductance, the pass transistor, the NMOS inverter, determination of pull up to pull down ratio of NMOS transistor driven by another NMOS transistor, alternate forms of pull up, the CMOS inverter, MOS transistor circuit model, latch up in CMOS circuits. **Laboratory Sessions / Experimental learning:**	**8 Hrs**

1. Simulation of CMOS Inverter characteristics with different values of Inverter Ratio (Kr) using LTspice / pspice software. **Applications:** Design of nMOS and CMOS inverter circuit. **Video link / Additional online information:** 1. https://archive.nptel.ac.in/courses/108/107/108107129/	
UNIT-III	
MOS Circuit Design Process: MOS layers, stick diagrams, design rules and layout, 2ìm, 1.2ìm CMOS rules. Layout diagrams, symbolic diagrams. Basic circuit concepts: Sheet resistance, area capacitance of layers, delay model, wiring capacitances, choice of layers. Scaling of MOS circuits: Scaling models, scaling function for device parameters and limitation of scaling. **Laboratory Sessions/ Experimental learning:** **1.** Draw layout of inverter using Cadence Tool **Applications:** Design of CMOS inverter circuit with different scaling functions. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/108106158	**8 Hrs**
UNIT-IV	
Sub System Design and Layout: Architectural issues, switch logic, gate logic, examples of structural design (Combinational logic) and some clocked sequential circuits. Memory register and aspects of system timing, Some commonly used storage/memory elements, Subsystem design process, General arrangement of 4-bit arithmetic processor, regularity, Design of an ALU subsystem. **Laboratory Sessions/ Experimental learning:** 1. Design Manchester Carry-chain using CMOS transistors using any CAD tool **Applications:** Designing of PLA **Video link / Additional online information :** 1. https://archive.nptel.ac.in/courses/117/106/117106149/	**8 Hrs**
UNIT-V	
Test and Testability: System partitioning, layout and testability, reset/ initialization, design for testability, testing combinational logic, testing sequential logic, practical design for test (DFT) guidelines, scan design techniques, built-in-self-test (BIST).	**8 Hrs**

CMOS design projects: Incrementer/ Decrementer, comparator for two n-bit numbers. **Laboratory Sessions/ Experimental learning:** Perform a survey on Prime Time CAD tool from any open source software for timing Analysis. **Applications:** Testing of Imperfections in chip fabrication. **Video link / Additional online information:** 1. https://archive.nptel.ac.in/courses/117/105/117105137/	

Course Outcomes: After completing the course, the students will be able to	
CO1	Demonstrate MOS transistor theory, CMOS fabrication flow and technology scaling.
CO2	Utilize the knowledge of physical design aspects to draw the basic gates using stick and layout diagrams.
CO3	Analyze Combinational, sequential and dynamic logic circuits as per the requirements.
CO4	Compare Memory elements along with timing considerations.
CO5	Assemble testing and testability issues in VLSI Design.

Reference Books	
1	Douglas A Pucknell & Kamran Eshragian, “Basic VLSI Design”, PHI 3rd Edition
Text Books	
1	Adel Sedra and K. C. Smith, “Microelectronics Circuits Theory and Applications”, 6th or 7th Edition, Oxford University Press, International Version, 2009.
2	Neil H. E. Weste, and David Money Harris, “CMOS VLSI Design- A Circuits and Systems Perspective”- 4th Edition, Pearson Education.

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.

CO-PO/PSO 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**	**1**	**-**	**-**	**-**	**1**	**1**	**2**
CO2	**3**	**3**	**3**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**-**
CO3	**3**	**3**	**3**	**2**	**2**	**1**	**-**	**-**	**1**	**-**	**1**	**1**	**-**	**-**
CO4	**3**	**3**	**3**	**2**	**2**	**1**	**-**	**-**	**-**	**1**	**-**	**1**	**-**	**1**
CO5	**3**	**3**	**3**	**2**	**2**	**1**	**1**	**-**	**1**	**-**	**1**	**1**	**2**	**1**

High-3, Medium-2, Low-1

Professional Elective -II

Semester: VI		
MACHINE LEARNING		
Course Code:	**MVJ22EC631**	**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 basic theory of machine learning.	
2	Analyze the problem and choose the appropriate algorithm to solve it.	
3	To describe the range of machine learning algorithms along with their hypothesis.	
4	To apply the various algorithm for the given problems.	
5	Elucidate the various type of learning methods and real time applications	

UNIT 1	
Introduction to ML: Well posed learning problems, Designing a Learning system, Perspectives and Issues in Machine Learning. **Concept Learning:** Introduction, A Concept Learning Task, Find S algorithm, Candidate Elimination algorithm, Inductive Bias. **Applications:** Data training samples, Speech Recognition algorithm. **Laboratory Sessions/ Experimental learning:** 1. Implement and demonstrate the FIND-S Algorithm for finding the most 2. specific hypothesis based on a given set of training data samples. Read the **3.** training data from a .CSV file. **Video link / Additional online information :** **1.** https://archive.nptel.ac.in/courses/106/106/106106139/	**8Hrs.**
UNIT 2	
Decision Tree Learning: Introduction, Decision Tree Representation, Appropriate Problems, Hypothesis Space Search, Inductive bias in decision tree, issues in Decision tree. **Instance Based Learning:** Introduction, KNN, Locally Weighed Regression, Radial Basis Functions and Case Based Reasoning **Laboratory Sessions/ Experimental learning:** 1. Write a program to demonstrate the working of the decision tree based ID3	**8Hrs.**

algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample. **Applications:** Email Spam and Malware Filtering, ID3 algorithm, Self-driving cars **Video link / Additional online information:** 1. **https://archive.nptel.ac.in/courses/106/106/106106198/**	
UNIT 3	
Bayesian Learning: Introduction, Analyze Bayes theorem, Bayes theorem demonstration and concept learning, ML and LS error hypothesis, ML for predicting probabilities, MDL principle, Optimal Bayes Classifier, Naive Bayes classifier, Bayesian belief networks, EM algorithm. **Laboratory Sessions/ Experimental learning:** 1. Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same dataset for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering **Applications:** Virtual Personal Assistant, Online Fraud Detection. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/106/105/106105215/	**8Hrs.**
UNIT 4	
Artificial Neural Network: Introduction, Appropriate Problems, Perceptron, Multilayer Networks and Backpropagation algorithm. **Genetic Algorithms:** Motivation, Genetic Algorithms, an illustrative example, Hypothesis Space Search, Genetic Programming, Models of Evolution and Learning, Parallelizing Genetic Algorithms. **Laboratory Sessions/ Experimental learning:** 1. Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets. **Applications:** Artificial Neural Network for building linear and non-linear networks. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/106/106/106106198/	**8Hrs.**
UNIT 5	

Analytical Learning: Introduction, Learning with perfect domain theories. **Combining inductive and analytical learning:** Motivation, Inductive – Analytical Approaches to learning. **Reinforcement Learning:** Introduction, The Learning Task, Q Learning **Real Time Applications:** Design an algorithm / flowchart for Autonomous Vehicle, Image Recognition and Traffic Prediction. **Laboratory Sessions/ Experimental learning:** 1. Implementation of game based om action reward strategy. **Applications:** Gaming, NLP **Video link / Additional online information:** 2. https://nptel.ac.in/courses/106106139	**8Hrs.**

Course Outcomes: After completing the course, the students will be able to	
CO1	Identify the learning techniques and investigate concept learning.
CO2	Demonstrate the characteristics of decision tree and solve problems associated with it.
CO3	Apply Bayesian techniques and derive effectively learning rules
CO4	Apply effectively neural networks for appropriate applications.
CO5	Evaluate hypothesis and investigate analytical learning and reinforcement learning.

Text Books:	
1.	Tom M. Mitchell, “Machine Learning”, McGraw-Hill Education (INDIAN EDITION), 2013.
Reference Books	
1.	Ethem Alpaydin, “Introduction to Machine Learning”, 2nd Ed., PHI Learning Pvt. Ltd., 2013
2.	T. Hastie, R. Tibshirani, J. H. Friedman, “The Elements of Statistical Learning”, Springer; 1st edition, 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/PSO Mapping														
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	**3**	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**2**	**1**
CO2	**3**	**3**	**3**	**2**	**2**	**1**	**-**	**-**	**2**	**-**	**-**	**1**	**2**	**1**
CO3	**3**	**3**	**3**	**3**	**3**	**1**	**-**	**-**	**-**	**1**	**2**	**1**	**2**	**1**
CO4	**3**	**3**	**3**	**3**	**3**	**1**	**1**	**1**	**-**	**1**	**2**	**1**	**2**	**1**
CO5	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**-**	**2**	**1**	**2**	**1**	**2**	**1**

High-3, Medium-2, Low-1

Semester: VI		
Networks and Cyber Security (Theory)		
Course Code:	**MVJ22EC632**	**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 TLS and SSH.	
2	Recognize security concerns in Email.	
3	Demonstrate the security factors in Internet Protocol.	
4	Illustrate the problems that can arise in cyber security.	
5	Inspect the 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:** 3. Study of HTTP client server 4. Study of SSH session with a laboratory router **Applications:** Encrypting VOIP, Video, Audio. **Project:** Encrypting the communication between web applications and servers **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 protection for mail. **Project: P**hishing protection for mail. **Video link / Additional online information:** 2. https://nptel.ac.in/courses/106105031	8Hrs.

UNIT 3	
IP Security: IP Security Overview, IP Security Policy, Encapsulation Security Payload (ESP), 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. **Project:** Packet Sniffing **Video link / Additional online information:** 2. https://onlinecourses.nptel.ac.in/noc22_cs03/preview	8Hrs.
UNIT 4	
Legal and Ethical Issues: Cybercrime and computer crime, Intellectual Property, Privacy, Ethical Issues **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 **Project:** Design of a simple security scanner **Video link / Additional online information :** 3. https://www.simplilearn.com/tutorials/cyber-security-tutorial/what-is-cyber-security	8Hrs.
UNIT 5	
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, behavioral 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:**	8Hrs.

1. Analysis the Security Vulnerabilities of E-commerce services. **Project:** Testing Password Strength **Applications:** Security of enterprise applications. **Video link / Additional online information:** 3. https://www.simplilearn.com/tutorials/cyber-security-tutorial/what-is-cyber-security	

Course Outcomes: After completing the course, the students will be able to	
CO1	Identify Transport layer network security protocols
CO2	Determine the security principles of Email.
CO3	Examine the IP security policies.
CO4	Investigate Legal and Ethical issues in Cyber Security.
CO5	Analyze the cyber security problems

Text 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.
Reference Books:	
1	Cryptography, Network Security and Cyber Laws – Bernard Menezes, Cengage Learning, 2010 edition.

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

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

obtained in test, quiz and assignment are added to get marks out of 100 and report CIE for 50 marks.

Semester End Examination (SEE):

Total marks: 50+50=100

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

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

High-3, Medium-2, Low-1

Semester: VI		
Digital Image Processing		
Course Code:	**MVJ22EC633**	**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	Illustarte the image transforms and other image enhancement techniques used in digital image processing.
3	Analyze the image restoration techniques and methods used in digital image processing
4	Evaluate region-based segmentation, representation and descriptions
5	Criticize 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:** Implementation and analysis of image sampling methods including uniform, grid, jittered and best candidate algorithms using MATLAB. **Project:** Implement the JPEG compression algorithm 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 **Frequency Domain:** Filtering in the Frequency Domain, Image Smoothing and Image Sharpening Using Frequency Domain Filters **Laboratory Sessions/ Experimental learning:** Implementation and analysis of image smoothing and sharpening algorithms using MATLAB. **Project:** Implement histogram equalization, contrast stretching, noise reduction, sharpening, and edge detection algorithms in MATLAB.Apply each technique to a set of real-world images. **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.**
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:** Write MATLAB code to simulate motion blur on an image. How can the severity of the blur be adjusted? **Project:** 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:** Develop and implement a matlab code for Image segmentation using thresholding technique. **Project:** Provide a case study where different segmentation methods are applied to the same image, and their performances are compared using the discussed metrics. **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.**
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:** Implementation and analysis of multimodal image fusion using MATLAB. **Project:** Provide a step-by-step approach with MATLAB code FOR how morphological operations can be used for text extraction from images. **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	Identify image processing algorithms used for sampling and quantization.

CO2	Summarize 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	Construct independent study and analyze various Morphological Image Processing techniques.

TextBooks:	
1.	Rafel C Gonzalez and Richard E. Woods, "Digital Image Processing"-, PHI 3rd Edition, 2010.
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**	**PSO1**	**PSO2**
CO1	**3**	**3**	**2**	**2**	**-**	**-**	**1**	**-**	**1**	**-**	**-**	**1**	**2**	**1**
CO2	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**1**	**2**	**1**
CO3	**3**	**3**	**2**	**2**	**-**	**1**	**-**	**-**	**1**	**-**	**2**	**1**	**2**	**1**
CO4	**3**	**3**	**2**	**2**	**1**	**1**	**-**	**1**	**1**	**-**	**2**	**1**	**2**	**1**
CO5	**3**	**3**	**2**	**2**	**1**	**1**	**-**	**-**	**1**	**1**	**2**	**1**	**2**	**1**

High-3, Medium-2, Low-1

Semester: VI		
VIRTUAL & AUGMENTED REALITY (Theory)		
Course Code:	**MVJ22EC634**	**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	Establish and cultivate a broad and comprehensive understanding of virtual reality and Augmented Reality.	
2	Exhibit various elements and components used in AR/VR Hardware	
3	Illustrate various factors involved in multisensory action of human being	
4	Analyze 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 use them to build Biomedical, engineering and robotics applications.	

UNIT 1	
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:** 3. https://nptel.ac.in/courses/121/106/121106013/	**8Hrs.**
UNIT 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	**8Hrs.**

Trackers, Navigation and Manipulation Interfaces, Tracker-Based Navigation/Manipulation Interfaces. **Laboratory Sessions/ Experimental learning:** 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:** 3. https://nptel.ac.in/courses/106/106/106106138/	
UNIT 3	
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:** 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/ **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:** Write MATLAB code to simulate motion blur on an image. How can the severity of the blur be adjusted? **Applications:** Image Enhancement, Image Analysis, Error detection and correction. **Video link / Additional online information:** 2. https://nptel.ac.in/courses/117/105/117105079/	**8Hrs.**

3. https://www.tutorialspoint.com/dip/index.htm	
UNIT 4	
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:** Experiment with Photogrammetry 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	**8Hrs.**
UNIT 5	
Medical Applications of XR: Behavioral Therapy, Virtual and Augmented Surgery, Triage and Diagnostics, Applications of VR in Robotics: Robot Programming, Robot Tele operation. **Laboratory Sessions/ Experimental learning:** 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:** 3. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5622235/	**8Hrs.**

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

CO1	Acquire various principles and concepts of virtual reality and its application.
CO2	Understand optical motion tracking and navigation in virtual reality.
CO3	Analyze 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	Investigate the knowledge of integrating hardware, software, tools for AR/VR technology.

TextBooks:	
1.	C. Burdea and Philippe Coiffet, "Virtual Reality Technology", First Edition, Gregory, John Wiley and Sons.
Reference Books:	
1	Steven M. LaValle, "Virtual Reality", 2016. Online version:
2	Alan B. Craig, "Understanding Augmented Reality, Concepts and Applications", Morgan Kaufmann, First 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**	**PSO1**	**PSO2**
CO1	**3**	**3**	**3**	**2**	**3**	**1**	**-**	**-**	**1**	**-**	**-**	**1**	**2**	**2**
CO2	**3**	**3**	**3**	**2**	**3**	**1**	**-**	**-**	**1**	**-**	**-**	**1**	**2**	**2**
CO3	**3**	**3**	**3**	**2**	**3**	**1**	**-**	**-**	**1**	**-1**	**-**	**1**	**2**	**2**
CO4	**3**	**3**	**3**	**2**	**3**	**1**	1	1	**1**	**-**	1	**1**	**2**	**2**
CO5	**3**	**3**	**3**	**2**	**3**	**1**	**-**	1	**1**	**1**	1	**1**	**2**	**2**

High-3, Medium-2, Low-1

PROJECT PHASE – I		
Course Code:	**MVJ22ECP65**	**CIE Marks:100**
Credits:	**L:T:P: 0:0:4**	**SEE Marks: -**
Hours:	**-**	**SEE Duration: -**
Course Learning Objectives: The students will be able to		
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.	

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	Demonstrate the 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	Adapt 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

Semester: VI		
VLSI Laboratory		
Course Code:	**MVJ22ECL66**	**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	Explore the CAD tool and understand the flow of the Full Custom IC design cycle.	
2	Understand DRC, LVS and Parasitic Extraction of the various designs.	
3	Design and simulate the various basic CMOS analog circuits and use them in higher circuits like data converters using design abstraction concepts.	
4	Design and simulate the various basic CMOS digital circuits and use them in higher circuits like adders and shift registers using design abstraction concepts	

PART A
ASIC Digital Design
1.Write Verilog Code for **inverter** and Test Bench for verification, observe the waveform and synthesize the code with technological library with given constraints. Do the initial timing verification with gate level simulation. 2. Write Verilog Code for **buffer** and Test Bench for verification, observe the waveform and synthesize the code with technological library with given constraints. Do the initial timing verification with gate level simulation. 3. Write Verilog Code for **Transmission Gate** and Test Bench for verification, observe the waveform and synthesize the code with technological library with given constraints. Do the initial timing verification with gate level simulation. 4.Write Verilog Code for **Basic/universal gates** and Test Bench for verification, observe the waveform and synthesize the code with technological library with given constraints. Do the initial timing verification with gate level simulation. 5. Write Verilog Code for **Flip flops -RS, D, JK, MS, T** and Test Bench for verification, observe the waveform and synthesize the code with technological library with given constraints. Do the initial timing verification with gate level simulation. 6. Write Verilog Code for **Serial & Parallel adder** and Test Bench for verification, observe the waveform and synthesize the code with technological library with given constraints. Do the initial timing verification with gate level simulation.

7. Write Verilog Code for 4-bit counter [Synchronous and Asynchronous counter] and Test Bench for verification, observe the waveform and synthesize the code with technological library with given constraints. Do the initial timing verification with gate level simulation.

PART B

Analog Design

1.Design an Inverter with given specifications, completing the design flow mentioned below:

- Draw the schematic and verify the following i) DC Analysis ii) Transient Analysis
- Draw the Layout and verify the DRC, ERC
- Check for LVS

Verify & Optimize for Time, Power and Area to the given constraint

2. Design the Common source amplifier with given specifications, completing the design flow mentioned below:

- Draw the schematic and verify the following i) Transient Analysis ii) DC Analysis iii) AC Analysis
- Draw the Layout and verify the DRC, ERC
- Check for LVS
- RC extraction

3. Design the Common Drain amplifier with given specifications, completing the design flow mentioned below:

- Draw the schematic and verify the following i) Transient Analysis ii) DC Analysis iii) AC Analysis
- Draw the Layout and verify the DRC, ERC
- Check for LVS
- RC extraction

4. Design a Single Stage differential amplifier, with given specifications, completing the design flow mentioned below:

- Draw the schematic and verify the following i) Transient Analysis ii) DC Analysis iii) AC Analysis
- Draw the Layout and verify the DRC, ERC
- Check for LVS
- RC extraction

5. Design an Operational-amp with given specification using given differential amplifier Common source and Common Drain amplifier in library and completing the design flow mentioned below:

- Draw the schematic and verify the following i) Transient Analysis ii) DC Analysis iii). AC Analysis
- Draw the Layout and verify the DRC, ERC

• Check for LVS • RC extraction	
Course outcomes:	
CO1	Write test bench to simulate various digital circuits.
CO2	Interpret concepts of DC Analysis, AC Analysis and Transient Analysis in analog circuits.
CO3	Design and simulate basic CMOS circuits like inverter, common source amplifier and differential amplifiers.
CO4	Design higher level circuits like operational amplifier and analog/digital converters to meet desired parameters.
CO5	Examine the use of transistors to design gates and further using gates realize shift registers and adders to meet desired parameters.

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

High-3, Medium-2, Low-1

B.E,VII Semester, Electronics & Communication Engineering

Semester: VII		
Computer Communication Networks (Theory and Lab)		
Course Code:	**MVJ22EC71**	**CIE Marks:50**
Credits:	**L: T:P: 3:0:2**	**SEE Marks: 50**
Hours:	**40L+26P**	**SEE Duration: 3 Hrs**
Course Learning Objectives: The students will be able to		
1	Understand the layering architecture of OSI reference model and TCP/IP protocol suite.	
2	Investigate various the protocols associated with each layer.	
3	Demonstrate networking architectures and their representations.	
4	To impart the knowledge of various routing techniques and the transport layer services.	
5	Evaluate the security features and functionality of application layer protocols.	

UNIT 1	
Prerequisites: Basic knowledge on computers & programming **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. List out the type of cabling involved. **Applications:** Ethernet, Fibernet, Satellite Communication. **Project:** Design of a simple chat application **Video link / Additional online information:** 1.https://nptel.ac.in/courses/106/105/106105080/	**8Hrs.**
UNIT 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	**8Hrs.**

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. **Laboratory Sessions/ Experimental learning:** 3. Study and analyse packet transfer using CSMA/CD and CSMA/CA using NetSim. **Applications:** Collision detection and avoidance in wired and wireless network. **Project:** Design of a prototype for V2V communication for collision avoidance. **Video link / Additional online information:** 4. https://nptel.ac.in/courses/106/105/106105183/	
UNIT 3	
Network Layer: Introduction, IPV4 Addresses, Address Space, Classful Addressing, Classless Addressing, DHCP. **Unicast Routing:** Introduction, Routing Algorithms: Distance Vector Routing, Link State Routing, Path vector routing, Unicast Routing Protocol: Internet Structure, Routing Information Protocol, Open Shortest Path First. **Laboratory Sessions/ Experimental learning**: 3. Study of IP addressing, subnet mask and subnetting. **Applications:** Routing and forwarding packets in routers. **Project:** IP based patient monitoring system. **Video link / Additional online information:** 1 https://nptel.ac.in/content/storage2/courses/106105080/pdf/M6L2.pdf	**8Hrs.**
UNIT 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. **Laboratory Sessions/ Experimental learning**: 1. Transport analysis using TCP/UDP using NetSim. **Applications:** MS Teams, Zoom, Cisco webex	**8Hrs**.

Project: Create a Network Proxy **Video link / Additional online information:** 1. http://www.digimat.in/nptel/courses/video/106105183/L11.html 2. http://www.digimat.in/nptel/courses/video/106105183/L06.html	

UNIT 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.

Project: Design of keylogger.

Video link / Additional online information:

1 https://archive.nptel.ac.in/courses/106/105/106105183/

Lab 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 using C/C++ .

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.

8. 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	Understand the layering architecture of computer networks and distinguish between the OSI reference model and TCP/IP protocol suite.
CO2	Infer the protocols and services of Physical and Data link layer.
CO3	Elucidate the functions associated with network layer and connecting devices.
CO4	Analyze and apply the protocols and services of Transport layer.
CO5	Analyze and apply the protocols and services of application layer.

Text Books:	
1.	Behrouz A Forouzan," Data Communication and Networks", 3rd Ed. TMH.
Reference Books:	
2.	Andrew S Tanebaum, "Computer Networks", 4th Ed. PHI/ Pearson education.
3.	S. Keshav, "An Engineering approach to Computer Networks", 5th Ed. Pearson.

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.

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

High-3, Medium-2, Low-1

Semester: VII		
Microwave and Antenna (Theory and Lab)		
Course Code:	**MVJ22EC72**	**CIE Marks:50**
Credits:	**L: T:P: 3:0:2**	**SEE Marks: 50**
Hours:	**40L+26L**	**SEE Duration: 3 Hrs**
Course Learning Objectives: The students will be able to		
1	Understand the microwave properties and its transmission media.	
2	Demonstrate microwave devices for several applications.	
3	Elucidate the concept behind microwave systems.	
4	Analyze the basics of antenna theory.	
5	Select and analyse antennas for specific applications	

UNIT 1	
Prerequisites: *Electromagnetics, wave propagation, waveguides* **Introduction to Microwaves:** History of Microwaves, Microwave Frequency bands, General Applications of Microwaves, Advantages of Microwaves **Analysis of Microwave Transmission Lines**: Transmission line equations & solutions, Smith Chart Basics, problems on smith chart, impedance matching using stub line, Introduction to strip lines, Micro strip lines, parallel strip lines, coplanar strip lines, shielded strip lines. **Laboratory Sessions/ Experimental learning:** 1. Measurement of frequency, guide wavelength, power, VSWR and attenuation in microwave test bench. **Applications:** Power transmission line, Telephone lines, Traces on Printed Circuit Boards, Traces on Multi-Chip Modules, Traces on Integrated Circuit Packages. **Project:** Design of Microstrip Patch antenna. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/108101092	8 Hrs.
UNIT 2	
Microwave Passive components: Directional Coupler, Power Divider, Magic Tee, Wave-guide Corners, Bends, Twists, Attenuator, Circulator, Isolator and Resonator.	8 Hrs.

Microwave Active components: Tunnel diode, Varactor diodes, Step recovery diodes, Schottky Barrier diodes, PIN diodes, Gunn Diodes, IMPATT and TRAPATT diodes, Parametric Amplifiers, Microwave Transistors, Microwave oscillators and Mixers. Microwave tubes: Klystron and Travelling Wave tubes. **Laboratory Sessions/ Experimental learning:** 1. Study of the characteristics of Klystron tube and to determine its electronic tuning range. **Applications:** Oscillators and mixers, power sources. **Project:** Passive Microwave Component design using Inverse Scattering. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/108101092	
UNIT 3	
Microwave Systems: Wireless Communications system, Radar Systems, Radiometer Systems, Satellite Communication, Remote sensing, Microwave Propagation (Introduction and Block diagrams only) **Antenna Basics:** Introduction, Basic Antenna Parameters, Patterns, Beam Area, Radiation Intensity, Beam Efficiency, Directivity and Gain, Antenna Apertures, Effective Height, Bandwidth, Friis Transmission Equation, Antenna Field Zones & Polarization. **Laboratory Sessions/ Experimental learning:** 1 To perform PC to PC Communication using Microwave test bench **Applications:** Satellite communications, remote sensing, RADAR systems. **Project:** Design of Wide bandwidth and high Gain Antenna. **Video link / Additional online information:** 1 . https://nptel.ac.in/courses/108101092	8 Hrs.
UNIT 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	8 Hrs.

Measurements – Patterns Required, Set Up, Distance Criterion, Directivity and Gain Measurements (Comparison, Absolute and 3-Antenna Methods). **Laboratory Sessions/ Experimental learning**: Design of horn antenna **Applications:** TV Signal Broadcasting, Deep space Telemetry Project: Design of Reflector antenna. **Video link / Additional online information:** **1.** https://nptel.ac.in/courses/108101092	

UNIT 5

Antenna Types: Introduction to Loop Antenna, Small loop, Comparison of Far fields of Small Loop and Short Dipole, The Loop Antenna General Case, Far field Patterns of Circular Loop Antenna with Uniform Current, Radiation Resistance of Loops, Directivity of Circular Loop Antennas with Uniform Current.

Microwave antennas, Horn antennas, Helical Antenna, Yagi-Uda array, Parabolic reflectors, Log periodic array antenna.

Laboratory Sessions/ Experimental learning:

1. Measurement of directivity and gain of Helical, Loop, Horn and Yagi antennas
2. Case study on 3-element printed Yagi-Uda antenna

Applications: wave propagation and communications

Project: Design of Loop antenna.

Video link / Additional online information:

1. https://nptel.ac.in/courses/108101092

LABORATORY SESSIONS:

PART A: Hardware Experiments

Sl No	Experiment Name
1	Measurement of attenuation by using microwave test bench.
2	Determination of Coupling and isolation characteristics of microstrip directional coupler.

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	Measurement of directivity and gain of microstrip Yagi antennas.
PART B:Software Experiments.	
8	Measurement of losses in a given optical fiber (propagation loss, bending loss) and numerical aperture
9	Analog communication link using optical fiber.
10	DC characteristics of LED and PIN photodetector
11	Fiber optic digital link characterization.
12	Determination of bit error rate using digital link.

Course Outcomes:	
CO1	Design and analyze microwave transmission lines.
CO2	Identify various passive microwave components for different applications.
CO3	Design and analyze microwave antennas
CO4	Examine various antenna parameters necessary for building an RF system.
CO5	Recommend various antenna configurations according to the applications.

Text Books:	
1.	Annapurna Das, Sisir K Das, “Microwave Engineering”, TMH Publication, 2nd edition, 2010.
2.	John D. Krauss, Ronald J Marhefka and Ahmad S Khan, “Antennas and Wave Propagation”, 4th Special Indian Edition , McGraw- Hill Education Pvt. Ltd., 2010.
Reference Books:	
1.	David M Pozar, “Microwave Engineering”, John Wiley & Sons, Inc., 4th edition, 2014
2.	Liao, “Microwave Devices and Circuits” , Pearson education, 3rd edition, 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.

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	PSO1	PS02
CO1	**3**	**2**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	1	**1**	**2**
CO2	**3**	**2**	**2**	**3**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	1	**2**	**1**
CO3	**3**	**2**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	1	**2**	**1**
CO4	**3**	**2**	**2**	**3**	**2**	**2**	**1**	1	**1**	**-**	**-**	1	**1**	**2**
CO5	**3**	**2**	**2**	**3**	**-**	**2**	**-**	**-**	**-**	**1**	**1**	1	**1**	**2**

High-3, Medium-2, Low-1

Course Title	**WIRELESS CELLULAR COMMUNICATION**	**Semester**	VI
Course Code	MVJ22EC73	**CIE**	50
Total No. of Contact Hours	40	**SEE**	50
No. of Contact Hours/week	3 (L : T : P :: 3 : 0 : 0)	**Total**	100
Credits	3	**Exam. Duration**	3 Hours

Course objective is to:

- Understand mobile radio communication principles and to study the recent trends adopted in cellular systems and wireless standards.
- Familiarize students to radio signal propagation mechanisms and to the characteristics of mobile radio channels, which both are needed in the designing of modern wireless communication systems and networks.
- Study the concepts of cellular communication system, architecture, functioning, various standards
- Learn the concepts of signal propagation in cellular environment
- Study the different multiple access techniques for Wireless Communication

Module-1	
Introduction to Cellular Mobile Systems: The Cellular concept, System design, Capacity improvement in cellular systems, Co-channel interference reduction. Intelligent cell concept and applications, technical Challenges. **Laboratory Sessions/ Experimental learning:** 1. Understand how pulse shaping is realized using MATLAB® functions **Applications:** 1. Transmission of music, news, road conditions, weather reports, and other broadcast information are received via digital audio broadcasting (DAB) with 1.5Mbit/s. 2. A universal mobile telecommunications system (UMTS) phone might be available offering voice and data connectivity with 384kbit/s. **Video link / Additional online information:**	**8Hrs.**
Module-2	**8Hrs.**

Mobile radio propagation: Reflection, Diffraction, Fading, Multipath Propagation, Channel modelling, Diversity Schemes and Combining Techniques. The cellular fundamentals: cellular communication and frequency reuse, general architecture of a cellular system, channel assignment strategies, hand-off in a cellular system. Interference and cellular system capacity: co-channel interference and adjacent channel interference, power control. **Laboratory Sessions/ Experimental learning:** 1. Compute the power of the noise and the original signal. Find signal to noise ratio (SNR), compare it with the desired value and see if they are the same using MATLAB **Applications:** **1.** International broadcasting, long distance aircraft and ship communication, citizen band (CB) radios. **2.** Diffraction and reflection give rise to propagation beyond the horizon. Propagation at large distance propagates well within buildings. **Video link / Additional online information:** **1.** https://nptel.ac.in/courses/108/108/108108148/	
Module-3	**8Hrs.**
Signal propagation in mobile communication: Design parameters at the base station, Practical link budget design using path loss models. propagation path loss, outdoor propagation models (Okumura model & Hata model), indoor propagation models, power delay profile, channel parameters (delay spread, doppler spread, coherence bandwidth, coherence time, Smart antenna systems, Beam forming. MIMO Systems. RAKE receiver. **Laboratory Sessions/ Experimental learning:** 1. Performance of Baseband QAM/QPSK Under AWGN Channel **Applications:** 1. Antennas mounted on these structures pump out wireless communications signals to devices in the field via electromagnetic waves. **2.** Wireless signal propagation is the movement of these radio waves (which move at the speed of light) to and from these sites and devices. **Video link / Additional online information:**	
Module-4	**8Hrs.**

Multiuser Systems: CDMA- Principle, Network design, Link capacity, Power control, WCDMA-Network planning, MC-CDMA, OFDM, Cellular mobile communication beyond 3G. Wireless Personal Area Networks (Bluetooth, UWB and ZigBee), Wireless Local Area Networks (IEEE 802.11, network architecture, medium access methods, WLAN standards), Wireless Metropolitan Area Networks (WiMAX), Ad-hoc Wireless Networks. **Laboratory Sessions/ Experimental learning:** 1. Develop a detector and calculate BER with MATLAB Simulation **Applications:** Radio and TV Broad casting **Video link / Additional online information:**	
Module-5	**8Hrs.**
5G Radio Access Technologies: Access Design Principles for Multi-user Communications – Multi-carrier with Filtering – Non orthogonal Schemes for Efficient Multiple Access – Radio Access for Dense Deployments – Radio Access for V2X Communication – Radio Access for Massive Machine-type Communication. **Laboratory Sessions/ Experimental learning:** 1. Implementation of channel estimation for multipath environment **Applications:** Television remote control, Wi-Fi, Cell phones, wireless power transfer, computer interface devices **Video link / Additional online information:** **1.** https://nptel.ac.in/courses/117/104/117104099/	

Course outcomes:	
CO1	Discuss the cellular system design and technical challenges.
CO2	Analyse the Mobile radio propagation, fading, diversity concepts and the channel modelling.
CO3	Evaluate design parameters involved in the base station.
CO4	Discriminate Multiuser Systems, CDMA, WCDMA network planning and OFDM Concepts.
CO5	Describe the concepts of 5G Radio Access Technologies

Text Books:	
1.	T.S Rapaport, “Wireless Communications” 2 nd edition, Pearson Education, Noida, India.
2.	A.F.Molisch, Wireless Communications, Wiley, 2005.

Reference Books:	
1.	A.Goldsmith, Wireless Communications, Cambridge University Press, 2005.
2.	Andrea Goldsmith, “Wireless Communications”, Cambridge University Press, 2005.
3.	Jonathan Rodriquez, “Fundamentals of 5G Mobile Networks”, Wiley, 2015

CIE Assessment:

CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests

- Quizzes/mini tests (4 marks)
- Mini Project / Case Studies (8 Marks)
- Activities/Experimentations related to courses (8 Marks)

SEE Assessment:

i. Question paper for the SEE consists of two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.

ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions.

iii. One question must be set from each unit. The duration of examination is 3 hours.

CO-PO/PSO 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	-	-	1	-	1	**2**	**1**
CO2	3	3	3	2	2	1	-	1	1	-	-	1	**2**	**1**
CO3	3	3	3	2	2	1	-	-	1	-	-	1	**2**	**1**
CO4	3	3	3	2	2	1	1	1	-	1	1	1	**2**	**1**
CO5	3	3	3	2	2	1	-	-	-	-	1	1	**2**	**1**

High-3, Medium-2, Low-1

Professional Elective Course-III:

VII SEMESTER			
Course Title	**ARTIFICIAL INTELLIGENCE**	**Semester**	VII
Course Code	MVJ21EC741	**CIE**	50
Total No. of Contact Hours	40	**SEE**	50
No. of Contact Hours/week	3 (L : T : P :: 3 : 0 : 0)	**Total**	100
Credits	3	**Exam. Duration**	3 Hours

Course objective is to:

- To learn the distinction between optimal reasoning Vs. human like reasoning.
- To understand the concepts of state space representation, exhaustive search, heuristic search together with the time and space complexities.
- Analyse different knowledge representation techniques.
- Infer the applications of AI, namely game playing, theorem proving, and machine learning.

Module-1	
Prerequisites: *Machine Learning* **Artificial Intelligence:** Introduction to AI - Intelligent Agents, Problem-Solving Agents, Searching for Solutions - Breadth-first search, Depth-first search, Hill-climbing search, Simulated annealing search, Local Search in Continuous Spaces. **Laboratory Sessions/ Experimental learning:** **2.** Write a program to search an element using BFS **Applications:** Astronomy, Health care, Finance, Gaming, Data security **Video link / Additional online information:** 1. https://nptel.ac.in/courses/106/102/106102220/	**8Hrs.**
Module-2	
Games - Optimal Decisions in Games, Alpha–Beta Pruning, Defining Constraint Satisfaction Problems, Constraint Propagation, Backtracking Search for CSPs, Knowledge-Based Agents, Logic Propositional Logic, Propositional Theorem Proving: Inference and proofs, Proof by resolution, Horn clauses and definite clauses. **Laboratory Sessions/ Experimental learning:**	**8Hrs.**

1. Program to Prune an element in a tree. **Applications:** Computer database **Video link / Additional online information:** 1. https://nptel.ac.in/courses/106/105/106105077/	
Module-3	**8Hrs.**
First-Order Logic - Syntax and Semantics of First-Order Logic, Using First Order Logic, Knowledge Engineering in First-Order Logic. Inference in First-Order Logic: Propositional vs. First-Order Inference, Unification, Forward Chaining, Backward Chaining, Resolution. **Knowledge Representation:** Ontological Engineering, Categories and Objects, Events. **Laboratory Sessions/ Experimental learning:** **1.** Solve Robot (traversal) problem using means End Analysis using PROLOG **Applications:** Search Autocorrect and Autocomplete, Language Translator, Social Media Monitoring. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/106/101/106101007/	
Module-4	**8Hrs.**
Planning - Definition of Classical Planning, Algorithms for Planning with State Space Search, Planning Graphs, other Classical Planning Approaches, Analysis of Planning approaches. Hierarchical Planning **Laboratory Sessions/ Experimental learning:** To solve constraint satisfaction problems. **Applications:** Fraud and Risk Detection, Website Recommendations, Advanced Image Recognition, Airline Route Planning **Video link / Additional online information:** 1. https://nptel.ac.in/courses/106/106/106106179/ **2.** https://nptel.ac.in/courses/106/107/106107220/	
Module-5	**8Hrs.**
Probabilistic Reasoning: Acting under Uncertainty, Basic Probability Notation Bayes' Rule and Its Use, Probabilistic Reasoning, Representing Knowledge in an Uncertain Domain, The Semantics of Bayesian Networks, Efficient Representation of Conditional Distributions, Approximate Inference in Bayesian Networks, Relational and First- Order Probability.	

Applications: Customer Relationship management, Health care, Education, Retail, Banking, Financial services, Insurance, Manufacturing, Telecom, Public Sector **Laboratory Sessions/ Experimental learning:** To Implement Mini-max algorithm for game playing **Video link / Additional online information:** 1. https://nptel.ac.in/courses/106/104/106104189/	

Course outcomes:	
CO1	Identify the AI based problems
CO2	Demonstrate learning and various learning techniques
CO3	Apply AI techniques to solve problems of game playing, theorem proving, and machine learning.
CO4	Learn different knowledge representation techniques
CO5	Comprehend the applications of Probabilistic Reasoning and Bayesian Networks.

Text Books:	
1.	"Artificial Intelligence: A Modern Approach", Stuart Rusell, Peter Norving, Pearson Education 2nd Edition.
Reference Books:	
1.	"Artificial Intelligence", 3rd Edn., E. Rich and K. Knight (TMH)
2.	"Artificial Intelligence", 3rd Edn., Patrick Henny Winston, Pearson Education.
3.	"Artificial Intelligence", Shivani Goel, Pearson Education.
4.	"Artificial Intelligence and Expert systems" – Patterson, Pearson Education.

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

High-3, Medium-2, Low-1

Semester: VII		
5G FUNDAMENTALS AND ARCHITECTURE		
Course Code:	**MVJ22EC742**	**CIE Marks:50**
Credits:	**L:T:P: 3:0:0**	**SEE Marks: 50**
Hours:	**40 L**	**SEE Duration: 03 Hours**
Course Learning Objectives: The students will be able to		
1	Understand the essential principles of 5G communications	
2	Describe the 5G architecture and 5G Internet.	
3	Analyze the cognitive radio networks for 5G.	
4	Analyze the 5G spectrum crunch and security issues	

UNIT-I	
History of 5G: Historical background, From ICT to the whole economy, Rationale of 5G **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 **Laboratory Sessions/ Experimental learning:** To simulate and analyze the propagation characteristics of wireless signals in 5G networks using MATLAB. **Applications:** smart street lighting, waste management **Video link / Additional online information:** http://digimat.in/nptel/courses/video/108105134/L22.html	**8 Hrs**
UNIT-II	
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 **Laboratory Sessions/ Experimental learning:** To perform the Model 5G Synchronization Signal Blocks (SSBs) and Bursts in MATLAB software. **Applications:** Factory Automation and video surveillance **Video link / Additional online information:**	**8 Hrs**

https://nptel.ac.in/courses/108105134	
UNIT-III	
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. **Laboratory Sessions/ Experimental learning:** To implement efficient and accurate demodulation of Multi-Band Orthogonal Frequency Division Multiplexing (MB-OFDM) signals using MATLAB. **Applications:** real-time traffic monitoring **Video link / Additional online information:** http://digimat.in/nptel/courses/video/108105134/L22.html	**8 Hrs**
UNIT-IV	
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. **Interference management, mobility management, and dynamic reconfiguration**: Network deployment types, Interference management in 5G, Mobility management in 5G **Laboratory Sessions/ Experimental learning:** To perform Polar Coding and Decoding using MATLAB. **Applications:** Self-driving cars and drones for future goods delivery **Video link / Additional online information:** https://archive.nptel.ac.in/courses/108/105/108105179/	**8 Hrs**
UNIT-V	
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. **The 5G wireless propagation channel models:** Introduction, Modelling requirements and scenarios, The METIS channel models **Laboratory Sessions/ Experimental learning:** To perform the 5G- compliant waveform generation and testing in Matlab software.	**8 Hrs**

Applications: Ultra Reliable Low Latency Communications (URLLC), and Massive **Video link / Additional online information:** https://nptel.ac.in/courses/108105134	

Course Outcomes: After completing the course, the students will be able to	
CO1	Describe the concepts of 5G networks and its architecture.
CO2	Demonstrate M2M and D2D Communication.
CO3	Elucidate 5G NR technology.
CO4	Analyze the management of 5G Network.
CO5	Analyze the 5G spectrum opportunities and challenges.

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

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/PSO Mapping

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

High-3, Medium-2, Low-1

Semester: VII		
Optical Communication		
Course Code:	**MVJ22EC743**	**CIE Marks:50**
Credits:	**L:T:P:3:0:0**	**SEE Marks: 50**
Hours:	**40T**	**SEE Duration: 3 Hrs**
Course Learning Objectives: The students will be able to		
1	Study about The Various Optical Fiber Modes, Configuration of Optical Fibers.	
2	Study transmission characteristics of optical fibre.	
3	Learn about the various optical sources, detectors and transmission techniques.	
4	Explore various ideas about optical fibre measurements and various coupling techniques.	
5.	Enrich the knowledge about optical communication systems and networks.	

UNIT 1	
INTRODUCTION TO OPTICAL FIBER COMMUNICATION- Introduction - The General Systems - Advantages of Optical Fiber Communication- Ray Theory Transmission: Total Internal Reflection, Acceptance Angle, Numerical Aperture, Skew Rays - Electromagnetic Mode Theory for Optical Propagation: Modes in a Planar Guide, Phase and group velocity - Cylindrical Fiber: Step index fibers, Graded index fibers - Single mode fibers: Cut-off wavelength. **Laboratory Sessions/ Experimental learning:** Plot the transcendental equations for the TE modes in a symmetric step index planner waveguide. **Applications:** Modern communication systems, such as cellular phones, Wi-Fi, and Bluetooth Video link / Additional online information: https://nptel.ac.in/courses/108106167	**8Hrs.**
UNIT 2	
TRANSMISSION CHARACTERISTICS OF OPTICAL FIBERS: Attenuation - Material absorption losses in silica glass fibers: Intrinsic absorption, Extrinsic absorption - Linear scattering losses: Rayleigh Scattering, Mie Scattering -Nonlinear scattering losses: Stimulated Brillouin Scattering, Stimulated Raman Scattering – Fiber Bend Loss – Dispersion- Chromatic dispersion: Material dispersion, Waveguide dispersion- Intermodal dispersion: Multimode step index fiber, Multimode graded index fiber. **Laboratory Sessions/ Experimental learning:**	**8Hrs.**

Write a program to study the modes of a step index cylindrical core optical fiber. **Applications:** Communications, radars, positioning, sensing, and remote control. Video link / Additional online information: https://archive.nptel.ac.in/courses/117/101/117101002/	
UNIT 3	
OPTICAL SOURCES AND OPTICAL DETECTORS: **Optical Sources:** Optical emission from semiconductors: The PN junction, Spontaneous emission, Carrier recombination, Stimulated emission and lasing, Hetero junctions- LED: Introduction- Power and Efficiency - LED Characteristics. The laser: Introduction – Basic concepts: Absorption and emission of radiation, Population inversion, Optical feedback and laser oscillation, Threshold condition for laser oscillation. **Optical Detectors:** Introduction, Optical Detection Principles, Quantum Efficiency, Responsivity, P-N Photodiode, P-I-N Photo Diode and Avalanche Photodiode. **Laboratory Sessions/ Experimental learning:** Study of I-V Characteristics of Fiber optic LED and Photodetector. **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/108106167	**8Hrs.**
UNIT 4	
OPTICAL RECEIVER: Introduction, Optical Receiver Operation, receiver sensitivity, quantum limit, eye diagrams, coherent detection, burst mode receiver, operation, Analog receivers. **Laboratory Sessions/ Experimental learning:** Study of Characteristics of LASER diode. **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.	**8Hrs.**

Video link / Additional online information: https://nptel.ac.in/courses/108106167	
UNIT 5	
WDM CONCEPTS: WDM concepts, overview of WDM operation principles, WDM standards, Mach-Zehender interferometer, multiplexer. Optical Amplifiers and Networks: optical amplifiers, basic applications and types, semiconductor optical amplifiers, EDFA. Optical Networks: Introduction, SONET / SDH, Optical Interfaces, SONET/SDH ring. **Laboratory Sessions/ Experimental learning:** Measurement of bending loss and propagation loss in the optical fiber cable. **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: https://nptel.ac.in/courses/108106167	**8Hrs.**

Course outcomes:	
CO1	Realize basic elements in optical fibers, different modes and configurations.
CO2	Analyze the transmission characteristics associated with dispersion and polarization techniques.
CO3	Design optical sources and detectors with their use in optical communication system.
CO4	Construct fiber optic receiver systems, measurements and techniques.
CO5	Design optical communication systems and its networks.

Text Books:	
1.	John M.Senior, “Optical Fiber Communication”, Pearson Education, Fouth Edition.2010.
2.	Gred Keiser,"Optical Fiber Communication”, McGraw Hill Education (India) Private Limited. Fifth Edition, Reprint 2013.

Reference Books:	
1.	Joseph C Palais, Fiber Optic Communication, Pearson Education, 2005, ISBN:0130085103.
2.	J.Gower, "Optical Communication System", Prentice Hall of India, 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**	**PSO1**	**PSO2**
CO1	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	1	**1**	**1**	**1**
CO2	**3**	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	1	**-**	**2**	**1**	**1**
CO3	**3**	**3**	**3**	**-**	1	**-**	1	1	1	1	1	**1**	**2**	**2**
CO4	**3**	**3**	**2**	**2**	**-**	**1**	**-**	**-**	1	1	1	**1**	**1**	**1**
CO5	**3**	**3**	**3**	**3**	1	1	1	1	1	1	1	**1**	**1**	**2**

High-3, Medium-2, Low-1

Semester: VII		
WIRELESS SENSOR NETWORKS		
Course Code:	**MVJ22EC744**	**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	To provide a basic understanding of the important aspects of Wireless sensor networks	
2	To provide a basic understanding of wireless sensor and transmission technology	
3	Understand about middleware, performance and traffic management.	
4	Understand communication protocols to be used for wireless sensor networks	
5	Apply the applications of WSN in various fields	

UNIT 1	
Wireless Sensor Networks: Introduction, applications of sensor networks, basic overview of the technology, basic sensor network architectural elements, present day sensor network research, challenges and hurdles, examples of Category 2 WSN applications, examples of Category 1 WSN applications. **Laboratory Sessions/ Experimental learning:** Do a case study on total energy conservation opportunities in Solar Power **Applications:** Health care monitoring, Area monitoring, Industrial monitoring, **Video link / Additional online information:** 3. https://nptel.ac.in/courses/106/105/106105166/	**8Hrs.**
UNIT 2	
Wireless sensor technology: Introduction, sensor node technology – overview, hardware and software, sensor taxonomy, WN operating environment, WN trends. **Wireless Transmission technology and systems:** Introduction, Campus applications, MAN/WAN applications. **Laboratory Sessions/ Experimental learning:** Assess real-world wireless network performance and metrics on maps using indoor and outdoor propagation scenarios and channel models using matlab **Applications:** Mobile communications through cell phones and satellites, Internet of Things (IoT) connecting various devices **Video link / Additional online information:**	**8Hrs.**

https://nptel.ac.in/courses/106/105/106105160/	
UNIT 3	
Middleware for WSNs: Introduction, WSN Middleware principles, Middleware architecture **Network Management:** Introduction, Network Management Requirements, Traditional Network Management Models, Network Management Design Issues, Example of Management Architecture: MANNA, Other Issues Related to Network Management **Laboratory Sessions/ Experimental learning:** To simulate a Wireless sensor networks using NS2 **Applications**: industrial process monitoring and control **Video link / Additional online information:** https://cse.iitkgp.ac.in/~smisra/course/wasn.html	**8Hrs.**
UNIT 4	
Performance and Traffic Management: Introduction, Background, WSN design issues, Performance Modelling of WSN, Case Study **OS for WSN**: Introduction, Operating System Design Issues, Examples of Operating Systems **Laboratory Sessions/ Experimental learning:**Design an energy efficient system for a WSN using the routing protocols using NetSim or NS2 **Applications:** Air pollution monitoring, Forest fire detection, Landslide detection, Water quality monitoring **Project:** Environmental/Earth sensing **Video link / Additional online information :** 4. https://nptel.ac.in/courses/106/105/106105160/ 5. https://nptel.ac.in/courses/106/105/106105195/	**8Hrs.**
UNIT 5	
APPLICATIONS OF WSN WSN Applications - Home Control - Building Automation - Industrial Automation - Medical Applications - Reconfigurable Sensor Networks - Highway Monitoring - Military Applications - Civil and Environmental Engineering Applications - Wildfire Instrumentation - Habitat Monitoring - Nanoscopic Sensor Applications **Laboratory Sessions/ Experimental learning:** Model a communication architecture of a sensor	**8Hrs.**

Applications: Military **Video link / Additional online information:** 4. https://www.youtube.com/watch?v=GUSrkWJ_Z2g	

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the overview of the Wireless sensor networks characteristics and applications
CO2	Demonstrtae the sensor, transmission technology and systems associated with WSN.
CO3	Understand the concepts of middleware, performance evaluation and traffic management in WSN.
CO4	Apply the knowledge to identify appropriate physical and MAC layer protocol
CO5	Elucidate the applications of WSN in various fields

Text Books:	
1.	'Wireless Sensor Networks', Kazem Sohraby, Daniel Minoli and TaiebZnati, Wiley, 2015.
Reference Books:	
1.	Holger Karl & Andreas Willig, "Protocols And Architectures for Wireless Sensor Networks" , John Wiley, 2005.

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

High-3, Medium-2, Low-1

VII SEMESTER		
MAJOR PROJECT PHASE – II		
Course Code:	**MVJ22ECP76**	**CIE Marks:100**
Credits:	**-**	**SEE Marks: 100**
Hours:	**-**	**SEE Duration: 3 Hrs**
Course Learning Objectives: The students will be able to		
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.	

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 outcomes: At the end of the course the student will be able to:	
CO1	Describe the project and be able to defend it. Develop critical thinking and problem solving skills.
CO2	Learn to use modern tools and techniques. Communicate effectively and to present ideas clearly and coherently both in written and oral forms.
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.

Semester End Examination: SEE marks for the project (50 marks) shall be based on Project report, Presentation and Demonstration of the actual/model/prototype of the project, as per the norms by the examiners appointed

CO-PO Mapping

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

High-3, Medium-2, Low-1

Open Elective I

Semester: VI		
Robotics and Automation		
Course Code:	**MVJ22EC641**	**CIE Marks:50**
Credits:	**L:T:P:3:0:0**	**SEE Marks: 50**
Hours:	**40T**	**SEE Duration: 3 Hrs**
Course Learning Objectives: The students will be able to		
1	Study the history, concept development and key components of robotics technologies.	
2	Elucidate the concept of interfacing actuators and other components	
3	Understand basic mathematics manipulations of spatial coordinate representation and transformation.	
4	Examine basic robot forward and inverse kinematic problems	
5.	Analyze basic robotic dynamics, path planning and control problems	

UNIT 1	
Industrial Robots and Their Applications: Introduction to Robots, Robot Subsystems, Classification of Robots, Industrial Applications. **Actuators and Grippers:** Electric Actuators, Hydraulic Actuators, Pneumatic Actuators, Grippers **Laboratory Sessions/ Experimental learning:** 1. Interface various sensors with Microcontroller. **Applications:** Machine Tending, Picking, Packing and Palletizing, painting, all Industrial applications **Video link / Additional online information:** 1. https://nptel.ac.in/courses/112/105/112105249/ 2. https://nptel.ac.in/courses/112/101/112101098/	**8Hrs.**
UNIT 2	
Sensors, Vision and Signal Conditioning: Sensor Classification, Internal Sensors, External Sensors, Vision, Signal Conditioning, Sensor Selection **Robotic Manipulation:** Robot Classification, Robot Specifications **Laboratory Sessions/ Experimental learning:** 1. Interface motors using various Motor drivers. **Applications:** Industrial application, agriculture robots, surgical robots	**8Hrs.**

Video link / Additional online information: 1. https://nptel.ac.in/courses/112/105/112105249/	
UNIT 3	
Direct Kinematics -The ARM Equation: Dot and Cross Product, Coordinate Frames, Rotations, Homogeneous coordinates, Link coordinates, Arm Equation **Inverse Kinematics – Solving the Arm Equation:** The Inverse Kinematics problem, General properties **Laboratory Sessions/ Experimental learning:** 1. Interface servo motors to form gripper. **Applications:** Pick and Place, Excavators, Robotic ARM. **Project:** Arduino based Smartphone Controlled Robot Car **Video link / Additional online information:** 1. https://nptel.ac.in/courses/112/105/112105249/ 2. https://nptel.ac.in/courses/112/101/112101098/	**8Hrs.**
UNIT 4	
Manipulator Dynamics: Lagrange's Equation, Kinetic and Potential Energy, Generalized force, Lagrange Euler dynamic model **Robot Control:** The Control Problem, State Equations, constant solutions, Linear Feedback Systems. **Laboratory Sessions/ Experimental learning:** 1. Design algorithm for Maze solving robot. **Applications:** Defence, Survillience, Autonomous Vehicle. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/112/105/112105249/ 2. https://nptel.ac.in/courses/112/101/112101098/	**8Hrs.**
UNIT 5	

Control Hardware and Robot Programming: Control Considerations, Hardware Architecture, Hardware for Joint Controllers, Computational Speed, Robot Languages, Robot Programming **Laboratory Sessions/ Experimental learning:** 1. Robots in material handling and assembly. Human Robot Interaction **Project:** Design of HMI-Based Robotic Arm **Video link / Additional online information:** 1. https://nptel.ac.in/courses/112/105/112105249/ 2. https://nptel.ac.in/courses/112/101/112101098/	**8Hrs.**

Course outcomes:	
CO1	Analyze the concept development and key components of robotics technologies
CO2	Select the components for interfacing actuators
CO3	Solve basic robot forward and inverse kinematic problems
CO4	Implement basic mathematics manipulations of spatial coordinate representation and Transformation.
CO5	Design robots which are capable to solve basic robotic dynamics, path planning and control problems.

Text Books:	
1.	Introduction to Robotics By S.K.Saha , Tata McGraw Hill
2.	Robotics Control ,Sensing ,Vision and Intelligence by K.S. Fu, R.C .Gonzalez, C.S.G.Lee , Tata
Reference Books:	
3	McGraw HilL Robert J. Schilling , Fundamentals of Robotics- Analysis and Control, Prentics Hall India.
4	Robotics Technology and Flexible Automation by S.R.Deb, S. Deb, Tata 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**	**PSO1**	**PSO2**
CO1	**3**	**3**	**3**	**2**	**1**	**1**	**-**	**-**	**1**	**-**	**1**	**1**	**1**	**2**
CO2	**3**	**3**	**3**	**2**	**1**	**1**	**-**	**1**	**1**	**-**	**-**	**1**	**2**	**2**
CO3	**3**	**3**	**3**	**2**	**1**	**1**	**-**	**-**	**1**	**-**	**-**	**1**	**1**	**2**
CO4	**3**	**3**	**3**	**2**	**1**	**1**	**-**	**-**	**1**	**1**	**-**	**1**	**2**	**1**
CO5	**3**	**3**	**3**	**2**	**1**	**1**	**2**	**1**	**1**	**1**	**2**	**1**	**2**	**2**

High-3, Medium-2, Low-1

Semester: VI		
Sensor Technology		
Course Code:	**MVJ22EC642**	**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 various technologies associated in manufacturing of sensors	
2	Provide better familiarity with different sensors and their applications in real life.	
3	Acquire knowledge about types of sensors used in modern digital systems.	
4	Evaluate the technological and physical limitations of a specific sensor.	
5	Propose a suitable sensor for a given measurement situation.	

UNIT 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/	**8Hrs.**
UNIT 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:**	**8Hrs.**

1. Strain measurement with Bridge circuit **Applications:** Patient monitoring in medical applications, Manufacturing and industrial equipment and motorsport applications. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/108/105/108105064/	
UNIT 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/	
UNIT 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/	
UNIT 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. **Project:** Control Dino game using eye blinks **Applications:** Industries, digital cameras, photocopiers. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/108/105/108105064/	

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

High-3, Medium-2, Low-1

Course Title	Virtual Instrumentation	Semester	VI
Course Code	MVJ22EC643	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	3 (L : T : P :: 3: 0 : 0)	Total	100
Credits	3	Exam. Duration	3 Hours

Course Learning Objectives: The students will be able to	
1	Explore the basics of Virtual Instrumentation.
2	Differentiate and handle the analog and digital I/Os.
3	Use LabVIEW for real time experiments.
4	Analyze tools and applications in Virtual Instrumentation.

UNIT 1	8Hrs.

Prerequisites: *Fundamentals of C-Programing, Digital Electronics*

GRAPHICAL SYSTEM DESIGN: Graphical System Design (GSD) model, Design flow with GSD, VI and traditional instrument, Hardware and Software in VI, Test, control and design in the engineering process, VI beyond personal computer, GSD using LabView, Graphical Programming and Textual Programming.

INTRODUCTION TO LABVIEW: Introduction, Advantages of LabView, Software environment, Creating and Saving a VI, Front Panel Toolbar, Block Diagram Toolbar, Palettes, Panel Controls and Indicators, Data types, Keyboard Shortcuts.

Laboratory Sessions/Experimental Learning:

1. Perform basic arithmetic & Boolean Operations using LabView

Applications: Instrumentation, Control Systems, Embedded Systems, Speech Signal Processing, Image Processing, Robotics & VLSI.

Video link/ Additional online information:

1. https://nptel.ac.in/courses/108105064

UNIT 2	8Hrs.

MODULAR PROGRAMMING: Modular Programming in LabVIEW, Build A VI Front Panel and Block Diagram, Creating an Icon, Building a Connector Pane, Creating, Opening And Editing SUBVIs,

REPETITION AND LOOPS: For Loops, While Loops, Structure Tunnels, Terminals Inside Or Outside Loops, Shift Registers, Feedback Nodes, Control Timing, Communicating Among Multiple Loops, Local & Global Variables.

ARRAYS: Creating 1-D, 2-D And Multidimensional Arrays, Deleting, Inserting, Replacing, Elements, Array Functions, Matrix Operations with Arrays, Polymorphism.

Laboratory Sessions/ Experimental learning:

1. Find the sum of 'n' numbers using FOR loop using LabView
2. To perform the factorial of a given number using WHILE loop
3. To sort even numbers using WHILE loop in an array
4. To find the maximum and minimum variable from an array.

Applications: Instrumentation, Control Systems, Embedded Systems, Speech Signal Processing, Image Processing, Robotics & VLSI.

Video link/ Additional online information:

1. https://www.youtube.com/watch?v=WKvRDIuUNNs

UNIT 3	8Hrs.

PLOTTING DATA: Types of Waveforms, Graphs, Charts, Data Type, XY Graphs, Intensity Graphs And Charts, Digital Waveform Graphs, 3D Graphs, Customizing Graphs And Charts, Customizing Graphs, Customizing 3D Graphs, and Displaying Special Planes on the XY Graph.

STRUCTURES, STRINGS AND FILE I/O: Case, Sequence, Customizing Structures, Timed Structures, Formula Nodes, Event Structure, String Functions, Formatting Strings, Basics of File Input/Output, File I/O VIs, and Creating a Relative Path.

Laboratory Sessions/ Experimental learning:

1. To bundle and unbundle a cluster.
2. To perform functions using flat and stacked sequence.
3. To create a sine wave using formula node.

Applications: Instrumentation, Control Systems, Embedded Systems, Speech Signal Processing, Image Processing, Robotics & VLSI.

Video link/ Additional online information:

1. https://www.youtube.com/watch?v=kdPyGcJNQbM
2. https://www.youtube.com/watch?v=c6hLkFsQ-VU

UNIT 4	8Hrs.

DATA ACQUISITION: Transducers, Signals and Signal Conditioning, DAQ Hardware Configuration, Analog Inputs & Outputs, Counters, DAG Software Architecture, Assistant, Selecting and Configuring a Data Acquisition Device, Components of Computer Based Measurement System.

Laboratory Sessions/ Experimental learning:

1. Temperature sensor using LabView and NI myDAQ.
2. To apply filtering technique for a given input signal
3. To perform discrete cosine transform on the given signal

Applications: Instrumentation, Control Systems, Embedded Systems, Speech Signal Processing, Image Processing, Robotics & VLSI.

Video link/ Additional online information:

1. https://www.youtube.com/watch?v=fIy6XT3CdPQ

UNIT 5	8Hrs.

IMAQ VISION: Vision Basics, Image Processing and Analysis, Particle Analysis, Machine Vision, Machine Vision Hardware and Software.

Laboratory Sessions/ Experimental learning:

1. Build a complete machine vision system.
2. Acquire and Display images with NI-IMAQ driver software.

Applications: Instrumentation, Control Systems, Embedded Systems, Speech Signal Processing, Image Processing, Robotics & VLSI.

Video link/ Additional online information:

1. https://www.youtube.com/watch?v=4vDS4CRGhL0&list=PL3qqtKcHarV1yCaDZBQHXunX6MAwhXny1

Course outcomes:	
CO1	Familiarize with basic concepts, tools and functions of LabView Programming.
CO2	Develop Virtual Instrumentation using LabVIEW.
CO3	Appreciate the technologies related to VI for Industrial Applications.
CO4	Use DAQ for Real Time Applications.

CO5	Illustrate the basic design approaches for various Tools and Functions in IMAQ Vision.

Text Books:	
1.	Jovitha Jerome, “Virtual Instrumentation using LabVIEW”, PHI publications, 2010
2.	BehzadEhsani, “Data Acquisition using LabVIEW”, Packt Publishing, 2016.
Reference Books:	
1.	John Essick, “Hands-On-Introduction to LabVIEW for Scientists and Engineers” – Fourth Edition, OXFORD Publications, 2016
2.	Richard Jennings & Fabiola De La Cueva, “LabVIEW Graphical Programming” - Fifth Edition, McGraw-Hill, 2018.
3.	Robert H. Bishop, ‘Learning with Lab-view’, Prentice Hall, 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/PSO Mapping														
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO8	PO9	PO10	PO11	PO 12	PS O1	PSO 2
CO1	3	2	2	2	3	-	-	-	-	1	-	1	2	1
CO2	3	2	2	2	3	1	-	1	1	-	1	1	2	1
CO3	3	2	2	2	3	1	-	-	1	-	1	1	2	1
CO4	3	2	2	2	3	-	1	-	-	1	-	1	2	1
CO5	3	2	2	2	3	1	-	1	1	-	1	1	2	1

High-3, Medium-2, Low-1

Semester:VI		
Introduction To MATLAB & SIMULINK		
Course Code:	**MVJ22EC644**	**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	To provide a foundation in programming for engineering problem solving using the MATLAB software package.	
2	To acquaint the student with some of the terminology in this very new field and relate it to the basic engineering process of design.	
3	To provide an introduction to the basic analytical fundamentals that are used to create and manipulate geometric models in a computer program.	
4	To develop the skills to analyse and break down an engineering program and solve it orithmically using MATLAB	

UNIT 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 a MATLAB program to demonstrate if and else if statement for comparing Two numbers. **Project:** Write MATLAB commands to analyze vector operations and magic matrixes. **Video link / Additional online information :** 1. https://in.mathworks.com/videos/writing-a-matlab-program-69023.html	**8Hrs.**
UNIT 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 **Laboratory Sessions/ Experimental learning:** Write MATLAB commands to analyze arithmetic, logical and Boolean operations.	**8Hrs.**

Project: Implement the JPEG compression algorithm using MATLAB. **Video link / Additional online information:** 1. https://www.halvorsen.blog/documents/teaching/courses/matlab/matlab3.php	
UNIT 3	**8Hrs.**
Various functions and toolboxes: Documentation, Misc. Useful Functions, Graphical User Interfaces, Simulink, Symbolic Toolbox **Applications:** Image processing **Project:** App Designing using GUI **Video link / Additional online information:** 1. https://nptel.ac.in/courses/103106118	
UNIT 4	**8Hrs.**
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:** Matlab 2D and 3D Plot **Project:** Create a spreadsheet file with some data (or use an existing spreadsheet with data if you have) and import the data into MATLAB. **Video link / Additional online information :** 1. https://in.mathworks.com/learn/tutorials/simulink-onramp.html	
UNIT 5	**8Hrs.**
Applications of Matlab: Diode Characteristics, Fourier Analysis, Signal Processing, Deep learning, Image processing **Laboratory Sessions/ Experimental learning:** 1. Morphological and Other Set Operations **2.** Two-Dimensional Fast Fourier Transform **Project:** Image Enhancement Using Intensity Transformations, **Video link / Additional online information:**	

1. https://in.mathworks.com/videos/image-processing-and-computer-vision-in-matlab-and-simulink-96760.html	

Course outcomes:	
CO1	Understand computer methods for solving a wide range of engineering problems.
CO2	Elucidate computer engineering software to solve and present problem solutions in a technical format.
CO3	Utilize computer skills to enhance learning and performance in other engineering and science courses.
CO4	Analyze how signals, images, and data are represented and manipulated in MATLAB
CO5	Apply 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**	**PSO1**	**PSO2**
CO1	**3**	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**2**	**1**	**1**	**2**	**1**	**2**
CO2	**3**	**3**	**3**	**2**	**2**	**-**	**1**	**1**	**2**	**1**	**1**	**2**	**2**	**2**
CO3	**3**	**3**	**3**	**3**	**2**	**-**	**-**	**-**	**2**	**1**	**1**	**2**	**1**	**1**
CO4	**3**	**3**	**3**	**3**	**2**	**1**	**-**	**-**	**2**	**1**	**1**	**2**	**1**	**1**
CO5	**3**	**3**	**2**	**3**	**2**	**1**	**-**	**-**	**3**	**1**	**3**	**3**	**2**	**2**

High-3, Medium-2, Low-1

Open Elective Course II

Semester: VII		
Medical Electronics		
Course Code:	**MVJ22EC751**	**CIE Marks:50**
Credits:	**L:T:P:3:0:0**	**SEE Marks: 50**
Hours:	**40T**	**SEE Duration: 3 Hrs**
Course Learning Objectives: The students will be able to		
1	Explain foundations of Medical instrumentation	
2	Learn the methods used for recording and measuring the biological signals.	
3	Explain the telemetry systems and know the various aspects of telemedicine	
4	Illustrate the various Medical devices used for patient monitoring system and patient safety..	
5.	Understand the various laboratory Devices and know about the devices used in surgery.	

UNIT 1	
Fundamentals of Medical Instrumentation: Physiological Systems of the Body, Sources of Biomedical Signals, Basic Medical Instrumentation System, Performance Requirements of Medical Instrumentation Systems, Intelligent Medical Instrumentation Systems, Consumer and Portable Medical Equipment, Implantable Medical Devices, Wireless Connectivity in Medical Instruments, General Constraints in Design of Medical Instrumentation Systems, Regulation of Medical Devices **Laboratory Sessions/ Experimental learning:** 1. Practical applications of electrodes in medical field. Applications: Ultrasonic scanning devices, Measures skin and body temperature, Measures Respiratory rate **Video link / Additional online information :** 1. https://nptel.ac.in/courses/102/104/102104043/	**8Hrs.**
UNIT 2	
Electrical and Non-Electrical Parameter Measurement:	**8Hrs.**

Bioelectric Signals and Electrodes: Recording Electrodes, Silver-Silver Chloride Electrodes, Electrodes for ECG, Electrodes for EMG , Electrical Conductivity of Eleectrode Jellies and Creams, Microelectrodes **Physiological Transducers:** What is a Transducer? Classification of Transducers, Performance Characteristics of Transducers, Displacement, Position and Motion Transducers, Pressure Transducers, Transducers for Body Temperature Measurement, Photoelectric Transducers, Optical Fibre Sensors, Biosensors, Smart Sensors **Laboratory Sessions/ Experimental learning:** 1. Measure the "PQRST ECG" signal in both normal and abnormal conditions. **Applications:** Psychology and Neuroscience, Brain Computer Interfaces (BCI) **Video link / Additional online information:** 1. https://nptel.ac.in/courses/108/108/108108167/	
UNIT 3	
Biomedical Telemetry: Biotelemetry, Single Channel Telemetry Systems, Multi-Channel Wireless Telemetry Systems, Multi-Patient Telemetry, Implantable Telemetry Systems **Telemedicine Technology**: What is Telemedicine? ,Essential Parameters for Telemedicine, Delivery Modes in Telemedicine, Telemedicine System, Cyber Medicine, Applications of Telemedicine **Laboratory Sessions/ Experimental learning:** 1. Graphical results of all Medical Images. **Applications:** Diagnose disease, blood clots, tumours, bone fractures ,inflammation or infection in an organ ,degenerative diseases ,strokes **Video link / Additional online information:** **https://archive.nptel.ac.in/courses/108/108/108108180/**	**8Hrs.**
UNIT 4	
Patient Monitoring Systems: System Concepts, Cardiac Monitor, Bedside Patient Monitoring Systems, Central Monitors, Measurement of Heart Rate, Measurement of Temperature, Measurement of Respiration Rate, Catheterization Laboratory Instrumentation	**8Hrs.**

Patient Safety: Electric Shock Hazards, Leakage Currents, Safety Codes for Electromedical Equipment, Electrical Safety Analyser, Testing of Biomedical Equipment **Laboratory Sessions/ Experimental learning:** 1. Practical applications of telemetry in medical systems. **Applications:** In the branch of Ophthalmology **Video link / Additional online information :** https://onlinecourses.nptel.ac.in/noc21_ee105/preview	
UNIT 5	
Clinical Laboratory Instruments: Medical Diagnosis with Chemical Tests, Spectrophotometry, Spectrophotometer Type Instruments, Colorimeters, Spectrophotometers, Clinical Flame Photometers, Selective-Ion Electrodes Based Electrolytes Analyser, Automated Biochemical Analysis Systems **Instruments for Surgery:** Principle of Surgical Diathermy, Surgical Diathermy Machine, Safety Aspects in Electrosurgical Units **Laser Applications in Biomedical Field:** The Laser, Types of Lasers, Laser Safety **Laboratory Sessions/ Experimental learning:** 1. Functions of ICCU patient Monitoring Systems. **Applications:** Diagnosis of the gastrointestinal tract. Applications of BCI are neuroergonomics, medical, smart environment, education and self-regulation, games and entertainment, neuro marketing and advertisement **Video link / Additional online information:** https://nptel.ac.in/courses/108108180	**8Hrs.**

Course outcomes:	
CO1	Analyse the operation and characteristics of Electronic devices and use of them in applications.
CO2	Evaluate the performance of electronic circuits.
CO3	Elucidate the Telemetry and Telemedicine technology
CO4	Analyse requirement of Patient monitoring system.
CO5	Design a simple prototype for a certain application.

Text Books:	
2.	Mandeep Singh, “Introduction to Biomedical Instrumentation”, ISBN-13: 9788120350236
3	S.K. Guha, “Principles of Medical Electronics and biomedical Instrumentation” - ISBN-13: 978-8173712579.
4	J.G.Webster(Wiley India), “Medical instrumentation Application and Design”, ISBN-13: 978-0471676003.
5	Joseph D. Bronzino, “The Biomedical Engineering Handbook”, Third Edition, CRC Press-2006.
6	John D. Enderle and Joseph D. Bronzino, “Introduction to Biomedical Engineering”, Third Edition, Elsevier Inc.-2012.

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

Semester: VII		
IoT and Wireless Sensor Networks		
Course Code:	**MVJ22EC752**	**CIE Marks:50**
Credits:	**L:T:P:3:0:0**	**SEE Marks: 50**
Hours:	**40T**	**SEE Duration: 3 Hrs**
Course Learning Objectives: The students will be able to		
1	Provide knowledge about IoT and M2M architecture.	
2	Understand various layers of IoT and their functionality.	
3	Describe the various objects used in IOT.	
4	Understand the fundamentals of WSN.	
5.	Provide knowledge traffic management in WSN	

UNIT 1	
Prerequisites: *Knowledge on Computer Networks* **Introduction to IoT:** Genesis, Digitization, Impact- Connected Roadways, Buildings, IoT Challenges, Network Architecture and Design, Drivers Behind New Network Architectures, Security, Constrained Devices and Networks Comparing IoT Architectures, M2M architecture, IoT world forum standard, IoT Reference Model, Simplified IoT Architecture. **Laboratory Sessions/ Experimental learning:** Comparative study of Oracle, IBM and Cisco Architectures of IoT **Applications:** Smart Cities **Video link / Additional online information :** https://nptel.ac.in/courses/106/105/106105166/	**8Hrs.**
UNIT 2	
IoT Layers and functionality : IoT Network Architecture and Design Core IoT Functional Stack, Layer1(Sensors and Actuators) , Layer 2(Communications Sublayer), Access network sublayer, Gateways and backhaul sublayer, Network transport sublayer, IoT Network management. Layer 3(Applications and Analytics), Analytics vs Control, Data vs Network Analytics IoT Data Management and Compute Stack. **Laboratory Sessions/ Experimental learning:** Implement an IoT architecture to design an application of your own. **Applications:** Home Automation System	**8Hrs.**

Video link / Additional online information: https://nptel.ac.in/courses/108/108/108108147/	
UNIT 3	
Smart Objects: The "Things" in IoT: Sensors, Actuators, and Smart Objects, Sensors, Actuators, Micro-Electro-Mechanical Systems (MEMS), Smart Objects 84 Smart Objects: A Definition, Trends in Smart Objects, Sensor Networks. **Wireless Sensor Networks:** Introduction, applications of sensor networks, basic overview of the technology, basic sensor network architectural elements **Laboratory Sessions/ Experimental learning:** 1. Design a people counter using Node MCU 2. Christmas light show with Arduino **Applications:** Google Cloud, SAAS, PAAS, Sensor applications **Video link / Additional online information:** 1. https://nptel.ac.in/courses/106/105/106105167/	**8Hrs.**
UNIT 4	
Wireless sensor technology: Introduction, sensor node technology – overview, hardware and software, sensor taxonomy, WN operating environment, WN trends. **Wireless Transmission technology and systems:** Introduction, Campus applications, MAN/WAN applications. **Laboratory Sessions/ Experimental learning:** Do a case study on total energy conservation opportunities in Solar Power **Applications:** Health care monitoring, Area monitoring, Industrial monitoring, Threat detection. **Video link / Additional online information :** 1. https://nptel.ac.in/courses/106/105/106105166/ 2. https://nptel.ac.in/courses/106/105/106105160/	**8Hrs.**
UNIT 5	
Middleware for WSNs: Introduction, WSN Middleware principles, Middleware architecture **Performance and Traffic Management:** Introduction, Background, WSN design issues, Performance Modelling of WSN, Case Study	**8Hrs.**

Laboratory Sessions/ Experimental learning: 1. Design an energy efficient system for a WSN using the routing protocols using NetSim or NS2 **Applications:** Environmental/Earth sensing, Air pollution monitoring, Forest fire detection, Landslide detection, Water quality monitoring **Video link / Additional online information:** 1. https://nptel.ac.in/courses/106/105/106105160/ 2. https://nptel.ac.in/courses/106/105/106105195/	

Course outcomes:	
CO1	Analyze different IOT Architecture and select them for a particular application.
CO2	Evaluate the sensor data generated and map it to IOT protocol stack.
CO3	Implement and execute programs using development tools
CO4	Develop an energy efficient system for WSN.
CO5	Create a real life application involving Wireless Sensor Networks using IoT concepts.

Text Books:	
1.	Cisco, IOT Fundamentals – Networking Technologies, Protocols, Use Cases for IOT, Pearson Education; First edition (16 August 2017). ISBN-10: 9386873745, ISBN-13: 978-9386873743
2.	'Wireless Sensor Networks', Kazem Sohraby, Daniel Minoli and TaiebZnati, Wiley, 2015.
Reference Books:	
1	Holger Karl & Andreas Willig, "Protocols And Architectures for Wireless Sensor Networks" , John Wiley, 2005.

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

High-3, Medium-2, Low-1

Semester: VII		
Digital Image Processing		
Course Code:	**MVJ22EC753**	**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	Learn the fundamentals of digital image processing	
2	Understand the image transforms and other image enhancement techniques used in digital image processing.	
3	Elucidate the image restoration techniques and methods used in digital image processing	
4	Understand region-based segmentation, representation and descriptions	
5	Analyze the color fundamentals and various morphological image processing techniques	

UNIT 1	
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, Image Sensing and Acquisition, Image Sampling and Quantization **Applications of Image Processing:** Medical imaging, Robot vision, Character recognition, Remote Sensing. **Laboratory Sessions/ Experimental learning:** 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 :** 4. https://nptel.ac.in/courses/117/105/117105079/	**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:** Implementation and analysis of image smoothing and sharpening algorithms using MATLAB. **Applications:** Image Enhancement, Image Analysis **Video link / Additional online information:** 4. https://nptel.ac.in/courses/117/105/117105079/	
UNIT 3	
Restoration: Noise models, Restoration in the Presence of Noise Only using Spatial Filtering and Frequency Domain Filtering, Estimating the Degradation Function, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering **Laboratory Sessions/ Experimental learning:** Write MATLAB code to simulate motion blur on an image. How can the severity of the blur be adjusted? **Applications:** Image Enhancement, Image Analysis, Error detection and correction. **Video link / Additional online information:** 3. https://nptel.ac.in/courses/117/105/117105079/	**8Hrs.**
UNIT 4	
Segmentation: Point, Line, and Edge Detection: Detection of Isolated Points, Line Detection, Edge Models, Basic 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:** 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/	**8Hrs.**

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

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand 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.
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

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

High-3, Medium-2, Low-1

Semester: VII		
SATELLITE COMMUNICATION		
Course Code:	**MVJ22EC754**	**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	Provide a conceptual knowledge of communication through satellites.	
2	Study of 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	Analyze the various application.	
5	Learn the basic principle of Radar and radar equation.	

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. **Laboratory Sessions/ Experimental learning:** To study the details regarding satellite communication toolbox in Matlab. **Applications:** DTH, or satellite television, services (such as the DirecTV and DISH Network services **Video link / Additional online information:** 3. https://nptel.ac.in/courses/117/105/117105131/# 4. 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 Supply Subsystem- Tracking, Telemetry and Command Subsystem, Payload , Antenna Subsystem **Laboratory Sessions/ Experimental learning:** A Case Study of Using Remote Sensing Data and GIS for Land Management **Applications:** Mobile Communication	**8Hrs.**

Video link / Additional online information: 3. https://nptel.ac.in/courses/117/105/117105131/# 4. 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. **Multiple Access Techniques:** Frequency Division Multiple Access (FDMA), Demand Assigned FDMA, Pre-assigned FDMA, Calculation of C/N Ration, Time Division Multiple Access(TDMA) ,TDMA Frame Structure, Reference Burst Traffic Burst ,Guard Time ,Code Division Multiple Access(CDMA) ,DS-CDMA Transmission and Reception **Laboratory Sessions/ Experimental learning:** Simulate system noise temperature, G/T ratio, link budgets, error control schemes, and rain attenuation effects. **Applications:** Error detection and correction in Communication, Weather forecasting, Remote sensing, Navigation satellites. **Video link /Additional online information:** **4.** https://www.digimat.in/nptel/courses/video/117105131/L13.html **5.** https://www.digimat.in/nptel/courses/video/117105131/L14.html **6.** https://onlinecourses.nptel.ac.in/noc19_ce45/preview	**8Hrs.**
UNIT 4	
Communication Satellites: Introduction, Related Applications, Frequency Bands, Payloads, Satellite Vs. Terrestrial Networks, Satellite Telephony, Satellite Television, Satellite radio, Regional satellite Systems, National Satellite Systems. **Remote Sensing Satellites:** Classification of remote sensing systems, orbits, Payloads, Types of images: Classification, Interpretation, Applications.. **Navigation Satellites**: Development of Satellite Navigation Systems, GPS system, Applications. **Laboratory Sessions/ Experimental learning:**	**8Hrs.**

2. A Case Study of Using Remote Sensing Data and GIS for Land Management **Applications:** Communication, Weather forecasting, Remote sensing, Navigation **Video link / Additional online information:** 4. https://nptel.ac.in/courses/117/105/117105131/# 5. https://nptel.ac.in/courses/121/107/121107009/ 6. https://onlinecourses.nptel.ac.in/noc19_ce45/preview	
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. **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. **Applications:** Ground surveillance, missile control, fire control, air traffic control (ATC), moving target indication (MTI). **Video link / Additional online information:** **3.** https://onlinecourses.nptel.ac.in/noc19_ee58/preview **4.** https://nptel.ac.in/courses/108/105/108105154/	**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	Inspect various kinds of satellites used in different applications.
CO5	Analyze how the radar equation is derived and its significance in radar technology.

Text Books:

1.	Anil K Maini, Varsha Agrawal, Satellite Communication, Wiley India Pvt. Ltd., 2015, ISBN: 978-81265-2071-8.
2.	Merril. I. Skolnik, “Introduction to Radar Systems”, 2/e, MGH, 1981.
Reference Books:	
1.	T. Pratt, C.W. Boastian and Jeremy Allnutt, “Satellite Communication”, 2013, 2nd edition, John Wiley and Sons, Bangalore, India.
2.	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**	**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**	**2**	**2**
CO5	**3**	**3**	**2**	**2**	**1**	**1**	1	1	1	1	1	**1**	**2**	**2**

High-3, Medium-2, Low-1