B.E, III Semester, Industrial Internet of Things

Semester: III		
Mathematics for AV Communication		
Course Code:	**MVJ22IO31**	**CIE Marks: 50**
Credits:	**L: T:P:S: 2:2:0:0**	**SEE Marks: 50**
Hours:	**30L+10T**	**SEE Duration: 3 Hrs.**
Course Learning Objectives: The students will be able to		
1	Apply discrete and continuous probability distributions in analyzing the probability models arising in engineering field.	
2	Understand the concepts of Complex variables and transformation for solving Engineering Problems.	
3	Apprehend and apply Fourier Series.	
4	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.	**8 Hrs**
UNIT-II	
Complex Variables: Functions of complex variables, Analytic function, Cauchy-Riemann equations in Cartesian and polar coordinates, Construction of analytic function (Using Milne-Thomson method) Consequences of Cauchy-Riemann equations, Properties of analytic functions. Application to flow problems- complex potential, velocity potential, equipotential lines, stream functions, stream lines.	**8 Hrs**
UNIT-III	
Fourier Series: Periodic functions, Dirichlet's condition, Fourier series of periodic functions with period 2π and arbitrary period $2c$. Fourier series of even and odd functions. Half range Fourier Series, Practical harmonic Analysis and Problems.	**8 Hrs**
UNIT-IV	
Fourier Transforms: Infinite Fourier transform, Infinite Fourier sine and cosine transforms, Inverse Fourier transforms, Inverse. Fourier sine and cosine transforms, Convolution theorem	**8 Hrs**
UNIT-V	
Z-Transforms: Definition, standard Z-transforms, properties of Z- transforms- Shifting property, Reversal property, Multiplication by n, initial value and final value theorems. Inverse Z- transform, convolution theorem (proof and problems) Application of Z-	**8 Hrs**

transforms to solve difference equations.	

Course Outcomes: After completing the course, the students will be able to	
CO1	Apply discrete and continuous probability distributions in analyzing the probability models arising in engineering field.
CO2	Make use of the concepts of analytic function and complex potentials to solve the problems arising in electromagnetic field theory
CO3	Develop 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:	**MVJ22IO32**	**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	Identify with the simplification techniques & design various combinational digital circuits using logic gates.
2	Develop the analysis and design procedures for synchronous and asynchronous sequential circuits.
3	Analysing & designing different applications of Combinational & Sequential Circuits
4	Analysing & designing sequential circuits using SR, JK, D, T flip-flops and Mealy & Moore machines
5	Knowledge of the importance of programmable devices used for designing digital circuits.

UNIT-I

Prerequisites: *Number systems, Boolean Algebra, Logic Gates, Comparison of Combinational & Sequential Circuits.* **Principles of combinational logic**: Introduction, Canonical forms, Generation of switching equations from truth tables, Karnaugh maps-3, 4 variables, Incompletely specified functions (Don't care terms), Quine- McClusky techniques- 3 & 4 variables. **Laboratory Sessions/ Experimental learning**: 1. Study of Logic Gates – NOT, OR, AND, NOR, NAND, XOR and XNOR. 2. Design a 4-bit Binary to Gray code converter using logic gates. **Applications:** OR gate in detecting exceed of threshold values and producing command signal for the system and AND gate in frequency measurement. **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=FT03XrQ8Bi4	**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. 2. Design an Adder cum Subtractor circuit which adds when input bit operation=1 or subtract if 0, using logic gates. 3. Design 4-bit comparator using IC7485. 4. Realize a Boolean expression using decoder IC74139. **Applications:** Communication systems, Speed synchronization of multiple motors in industries. **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=RZQTTfU9TNA, 2. https://www.youtube.com/watch?v=36hCizOk4PA, 3. https://www.youtube.com/watch?v=397DDnkBm8A	**8 Hrs**
UNIT-III	
Prerequisites*: *SR, JK, D, T flipflops **Flip-Flops and its Applications:** Latches and Flip Flops, Master-slave JK flip-flop, Timing concerns in sequential circuits, Shift Registers – SISO, SIPO, PISO PIPO, Universal shift register, Counters – Synchronous and Asynchronous. **Laboratory Sessions/ Experimental learning:** 1. Develop SR, D, JK &T flip flop using logic gates 2. Design a 6-bit Register using D-Flipflop **Applications:** Frequency divider circuit, frequency counter. **Video link / Additional online information:** **1.** https://www.youtube.com/watch?v=Nxpei7Kp4Vs	**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.	**8 Hrs**

Laboratory Sessions/ Experimental learning: 1. Design a Synchronous Counter for a given sequence- 0, 2, 4, 6, 0 2. Design a 4-bit Asynchronous up/down counter 3. Design a 4-bit binary Synchronous up/down **Applications:**Data synchronizer, Counter. **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=O3If0Nr9to0	
UNIT-V	
Applications of Digital Circuits: Design of a Sequence Detector, Guidelines for construction of state graphs, Design Example – Code Converter, Design of Binary Multiplier, Design of Binary Divider. **Programmable Logic Devices:** PLA, PAL, FPGA. **Laboratory Sessions/ Experimental learning:** 1. Designing of sequence detector using necessary digital components. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/117108040/	**8 Hrs**
LABORATORY EXPERIMENTS	
Simulate & design the Digital Circuits using NI ELVIS II+ and NI Multisim 1.Design of Logic Gates and Realization using K-Map 2.Design of Half Adder and Half Subtractor 3.Implementation of Binary to Gray Code Converter 4.Realization of SR, JK, D and T flip flop 5.Design of Multiplexer and Demultiplexer 6. Implementation of Encoder and Decoder	

Course outcomes:	
CO1	Illustrate simplification of Algebraic equations using K-map & Quine-McCluskey Technique.
CO2	Design the combinational logic circuits.

CO3	Analyse& design different applications of Combinational & Sequential Circuits to meet desired need within realistic constraints.
CO4	Design the sequential circuits using SR, JK, D, T flip-flops and Mealy & Moore machines
CO5	Understand the digital applications by conducting experiments.
Text Books:	
1.	John M Yarbrough, "Digital Logic Applications and Design", Thomson Learning, 2001.
2.	Donald D. Givone, "Digital Principles and Design", McGraw Hill, 2002.
Reference Books:	
1.	Charles H Roth Jr., Larry L. Kinney —Fundamentals of Logic Design, CengageLearning, 7th Ed
2.	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 ıay be more than three (conduct additional quizzes aand take best three). The three tests are onducted for 50 marks each and the average of aall the tests are calculated for 50. The marks for the elf -study are 20 (2 presentations are b held for 10 marks each). The marks obtained in test, quiz and elf -studies are added to gget marks out of 100 and report CIE for 50 marks.

Semester End Examination (SEE):

Total marks: 50+50=100

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

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

Laboratory- 50 Marks

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

SEE for laboratory is 50 marks.

CO-PO 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:	**MVJ22IO33**	**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	Illustrate low frequency response for various configurations of BJT and FET amplifier.	
2	Understand the different topologies of feedback amplifiers and oscillators.	
3	Analyse the Power amplifier circuits in different modes of operation	
4	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,	**8 Hrs**

Voltage divider bias, Emitter follower, Analysis of circuits re model. **Laboratory Sessions/ Experimental learning:** 1. 8Plot the transfer and drain characteristics of a BJT and calculate its drain resistance, mutual conductance and amplification factor. **Applications:** Analog switches, Phase shift oscillator, chopper, and current limiter. **Video link/ Additional online information:** http://www.nptelvideos.in/2012/12/electronics.html	
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:** 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://www.youtube.com/watch?v=xHNDrbB-iWY	**8 Hrs**
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:** http://www.nptelvideos.in/2012/12/electronics.html	**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://www.youtube.com/watch?v=GjG8oshYNLQ	**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.youtube.com/watch?v=-KMAQxc3J3g	**8 Hrs**
Laboratory Experiments Simulation using EDA software (EDWinXP, PSpice, MultiSim, Proteus, CircuitLab or any other equivalent tool can be used)	

1. Monostable Multivibrator using 555 Timer.
2. Astable Multivibrator using 555 Timer.
3. RC Phase shift oscillator.
4. Inverting Schmitt Trigger.
5. Narrow Band-pass Filter and Narrow band-reject filter
6. Precision full-wave rectifier.

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

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

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

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

Semester End Examination (SEE):

Total marks: 50+50=100

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

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

Laboratory- 50 Marks

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

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

High-3, Medium-2, Low-1

Semester: III		
NETWORK ANALYSIS		
Course Code:	**MVJ22IO34**	**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	Describe basic network concepts emphasizing source transformation source shifting, mesh and nodal techniques to solve for resistance/impedance, voltage, current and power.	
2	Explain network Thevenin's, Millman's, Superposition, Reciprocity, Maximum Power transfer and Norton's Theorems and apply them in solving the problems related to Electrical Circuits.	
3	Describe Series and Parallel Combination of Passive Components as resonating circuits, related parameters and to analyze frequency response.	
4	Explain the behavior of networks subjected to transient conditions. Use applications of Laplace transform to solve network problems.	
5	List the 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 :** 1. https://www.youtube.com/watch?v=UMhBgyK8F0U	**8 Hrs**
UNIT-II	
Graph Theory and Network equations: Graph of a network, Trees, Co-trees and Loops, Incidence Matrix, Cut-set Matrix, Tie-set Matrix and loop currents, Number of possible trees of a graph, Analysis of networks, Duality. **Laboratory Sessions/ Experimental learning:** NA	**8 Hrs**

Applications: Simplification and analysis of analog circuits, microwave circuit analysis **Video link / Additional online information:** https://www.youtube.com/watch?v=F8qiM3o0Jc0	
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://www.youtube.com/watch?v=bnjiLg4xfh8	**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://www.youtube.com/watch?v=g-CGI7oUSCA	**8 Hrs**
UNIT-V	
Two port network parameters: Introduction, open circuit impedance parameter, short circuit admittance parameter, hybrid parameters, transmission parameter, relationship between parameters. **Laboratory Sessions/ Experimental learning:** 1. Plot the frequency response characteristics for a series RL, RC circuit. 2. Plot the frequency response characteristics for a parallel RL circuit.	**8 Hrs**

3. Measure two port parameters for a given network **Applications:** For analysis of communication systems and antennas. **Video link / Additional online information:** https://www.youtube.com/watch?v=YLGrugmDvc0	

Course Outcomes: After completing the course, the students will be able to	
CO1	Determine currents and voltages in a circuit using network simplification techniques.
CO2	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	Solve the given network using specified two port network parameters like Z or Y or T or h and Evaluate frequency response related parameters through the RLC elements, in resonant circuits.

Text Books	
1.	M.E. Van Valkenberg (2000), "Network analysis", Prentice Hall of India, 3rd edition, 2000, ISBN: 9780136110958.
2.	Roy Choudhury, "Networks and systems", 2nd edition, New Age International Publications, 2006, ISBN: 9788122427677.

Reference Books	
1.	Hayt, Kemmerly and Durbin —Engineering Circuit Analysis", TMH 7th Edition, 2010.
2.	J. David Irwin /R. Mark Nelms, "Basic Engineering Circuit Analysis", John Wiley, 8th edition, 2006.

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

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calculated for 50. The marks for the assignments are 20 (2 assignments for 10 marks each). The marks obtained in test, quiz and assignment are added to get marks out of 100 and report CIE for 50 marks.

Semester End Examination (SEE):

Total marks: 50+50=100

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

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

High-3, Medium-2, Low-1

Semester:III		
Analog and Digital Electronics Laboratory		
Course Code:	**MVJ22IOL35**	**CIE Marks: 50**
Credits:	**L:T:P:0:0:2**	**SEE Marks: 50**
Hours:	**20**	**SEE Duration: 3 Hrs**

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

PART A

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

PART B

8. Verify

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

9. Design and implement

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

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

Course outcomes:

CO1	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	Make use the modern engineering tool such as Verilog necessary for engineering practice.
CO5	Design and Verify functionality of digital circuit/system.

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

High-3, Medium-2, Low-1

Engineering Science Course:

Semester: III		
Digital System Design using Verilog		
Course Code:	**MVJ22IO361**	**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	Make use of verilog data flow descriptions.	
3	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://www.youtube.com/watch?v=FT03XrQ8Bi4	**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://www.youtube.com/watch?v=RZQTTfU9TNA,	**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://www.youtube.com/watch?v=Nxpei7Kp4Vs	**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://www.youtube.com/watch?v=O3If0Nr9to0	**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	**8Hrs.**

Laboratory Sessions/ Experimental learning: 1. Weather analysis of a weak using synthesis module 2. synthesis verilog code for state machine **Video link / Additional online information:** 1. https://nptel.ac.in/courses/117108040/	

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

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

Reference Books:	
1.	Samir Palnitkar "Verilog HDL: A Guide to Digital Design and Synthesis", Pearson Education, 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:	**MVJ22IO362**	**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 basic concepts of transducers.	
2	Identify the mathematical model of transducer and its response for various inputs.	
3	Understand the construction and working principle of resistive type transducers.	
4	Infer knowledge on capacitive type and inductive type transducer.	
5	Understand the construction and working principle of sensors and its real time applications.	

UNIT-I	
Prerequisites: *knowledge of basic of sensors* General block diagram of measurements systems – Methods of measurements – Classification and selection of transducers – Error analysis – Statistical methods – Odds and uncertainty, classification of instruments, applications of measurement systems. **Laboratory Sessions/ Experimental learning:** Displacement versus output voltage characteristics of a potentiometer transducer. **Applications:** Selection of appropriate sensors for different industrial applications. **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=pFM9K9JrsU4&list=PLm_MSClsnwm9HsQaejIrxvkNPWbvxgwWs	**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.	**8 Hrs**

2. Characteristics of Load cell. **Applications:** Platform Weighing **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=78NpGnA1sX4	
UNIT-III	
Principle of operation – Construction details – Characteristics and application of resistance potentiometer – Strain gauge – Resistance thermometer – Thermistor – Hot-wire anemometer – Humidity sensor – Induction potentiometer – Variable reluctance transducers – LVDT. **Laboratory Sessions/ Experimental learning:** 1. Characteristics of thermocouple. 2. Characteristic of LDR and thermistor. 3. Step response characteristics of RTD. **Applications:** Air conditioning Heating and Ventilation Devices. **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=lUjBmV4wMtA 2. https://www.youtube.com/watch?v=kb3W-1_deLc	**8 Hrs**
UNIT-IV	
Capacitive transducer and types – Capacitor microphone – Frequency response – Piezoelectric transducer – Hall effect transducer – Magnetostrictive – Digital transducers – Fiber optic sensors – Thick and thin film sensors (Bio sensor and chemical sensor) Smart Sensors: Introduction, Primary Sensors, Excitation, Amplification **Laboratory Sessions/ Experimental learning:** 1. Characteristics of LVDT. 2. Characteristics of Hall effect transducer. **Applications:** Power turbines, hydraulics, automation, aircraft, satellites, nuclear reactors, current transformers, Position sensing. **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=emtskVpbtyY 2. https://www.youtube.com/watch?v=E0NMM_Pq0IY	**8 Hrs**

UNIT-V	
Environmental monitoring sensors (Water quality and air pollution) – Photo electric transducer – Vibration sensor – Ultrasonic based sensors – Introduction to MEMS and Nanotechnology – Applications – Robotics – Home appliance. Actuators: Pneumatic and Hydraulic Actuation Systems, Valves, Rotary actuators, Mechanical Actuation Systems Electrical Actuation Systems **Laboratory Sessions/ Experimental learning:** Study of smart transducers. **Applications:** Smart city developments with latest technological sensors. **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=hyHcnZsgbRU 2. https://www.youtube.com/watch?v=jQF4_hO_2qw	**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	Find the mathematical model of the transducer and its response for various inputs.
CO3	Choose appropriate resistive type transducer for the measurement of various physical parameters.
CO4	Select capacitive and inductive type transducers for the measurement of various physical parameters.
CO5	Select the suitable type of sensors for real time applications.

Text Books	
1.	"A Course in Electrical and Electronics Measurements and Instrumentation", Sawhney A K, Dhanpat Rai and Sons, New Delhi, 2013

Reference Books	
1.	"Sensors and Transducers", Patranabis D, Prentice Hall of India, Second Edition, 2010
2.	"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:	**MVJ22IO363**	**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	Understand the different ways of communicating with I/O devices and to introduce memory types including cache memories.	
4	Describe memory hierarchy and concept of virtual memory.	
5	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:** 1. https://www.youtube.com/watch?v=K7fnDf-P6_c#action=share 2. https://www.youtube.com/watch?v=9-9z32T-5WU#action=share 3. https://www.youtube.com/watch?v=Szn_lwHal04#action=share	**8Hrs.**
UNIT 2	
Prerequisite :*Number system* **Addressing Modes:** Assembly Language, Basic Input and Output Operations, Stacks and Queues, Subroutines, Additional Instructions.	**8Hrs.**

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. 2. Write an ALP to transfer a block of data from one location to other and simulate the output. **Applications:** Project based on microprocessor. **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=s4cVdsK3XiQ#action=share 2. https://www.youtube.com/watch?v=xKTNgA_ee58	
UNIT 3	
Input/Output Organization: Accessing I/O Devices, Interrupts – Interrupt Hardware, Enabling and Disabling Interrupts, Handling Multiple Devices, Controlling Device Requests, Direct Memory Access, and Buses. **Laboratory Sessions/ Experimental learning:** Study any one input/output device and examine its various input output ports details. **Applications:** Interfacing of Peripheral devices **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=Y17TLZCSe4M#action=share 2. https://www.youtube.com/watch?v=Zw79moR2gFs	**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 :** 1. https://www.youtube.com/watch?v=lpVyGPNyjEs#action= 2. https://www.youtube.com/watch?v=NhyIUpOj5V8#action=share 3. https://www.youtube.com/watch?v=xXk3WiPGux8#action=share	**8Hrs.**

4. https://www.youtube.com/watch?v=aeDyDIo-G44#action=share	
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 **Video link / Additional online information:** 2. https://www.youtube.com/watch?v=R41DfN3NpIM#action=share 3. https://www.youtube.com/watch?v=b5thcNYBrQc	**8Hrs.**

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

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

2.	William Stallings: “Computer Organization & Architecture”, 7th Edition, PHI, 2006.

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

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

Semester End Examination (SEE):

Total marks: 50+50=100

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

CO-PO Mapping

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

High-3, Medium-2, Low-1

Semester: IV		
Applied Numerical Methods		
Course Code:	**MVJ22IO364**	**CIE Marks:50**
Credits:	**L:T:P:S: 2:2:0:0**	**SEE Marks: 50**
Hours:	**20L+20T**	**SEE Duration: 3 Hrs**
Course Learning Objectives: The students will be able to		
Demonstrate, understanding of common numerical methods and apply to obtain approximate solutions to mathematical problems.		

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

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

Semester: III		
Additional Mathematics-I **(Common to all branches)**		
Course Code:	**MVJ22MATDIP-I**	**CIE Marks:50**
Credits:	**L:T:P:S: 3:0:0:0**	**SEE Marks: 50**
Hours:	**30L**	**SEE Duration: 3 Hrs**

Course Learning Objectives: The students will be able to	
1	Familiarize the important and introductory concepts of Differential calculus
2	Explain the concepts to provide essential concepts integral calculus.
3	Gain knowledge of vector differentiation
4	Apply the basic study of probability.
5	Explain ordinary differential equations of first order and analyze the engineering problems.

UNIT-I	
Differential calculus: Recapitulation of successive differentiation -nth derivative - Leibnitz theorem (without proof) and Problems, Polar curves - angle between the radius vector and tangent, angle between two curves, pedal equation, Taylor's and Maclaurin's series expansions- Illustrative examples.	**8 Hrs**
UNIT-II	
Integral Calculus: Statement of reduction formulae for the integrals of $\sin^n(x)$, $\cos^n(x)$, $\sin^n(x)\cos^n(n)$ and evaluation of these integrals with standard limits-problems. Double and triple integrals-Simple examples.	**8 Hrs**
UNIT-III	
Vector Differentiation: Scalar and Vector point functions, Gradient, Divergence, Curl, Solenoidal and Irrotational vector fields. **Vector identities** - $div(\phi \vec{A}), curl(\phi \vec{A}), curl(grad(\phi)), div(curl \vec{A})$.	**8Hrs**
UNIT-IV	
Probability: Basic terminology, Sample space and events. Axioms of probability. Conditional probability – illustrative examples. Bayes theorem-examples.	**8Hrs**
UNIT-V	
Ordinary Differential Equations of First Order: Introduction – Formation of differential equation, solutions of first order and first degree differential equations: variable separable form, homogeneous, exact, linear differential equations.	**8Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Apply the knowledge of calculus to solve problems related to polar curves and its applications
CO2	Apply the concept of integration and variables to evaluate multiple integrals and their usage in computing the area and volumes.
CO3	Illustrate the applications of multivariate calculus to understand the solenoidal and irrotational vectors and also exhibit the inter dependence of line, surface and volume integrals.
CO4	Understand the basic Concepts of Probability
CO5	Recognize and solve first-order ordinary differential equations occurring in different branches of engineering.

Reference Books	
1.	B.S. Grewal, "Higher Engineering Mathematics" Khanna Publishers, 43rd Edition, 2013.
2.	Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley-India publishers, 10th edition,2014.
3.	Ramana B. V., "Higher Engineering Mathematics", Tata Mc Graw-Hill, 2006.
4.	Bali N. P. & Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, 8 Edition.

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

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

Semester End Examination (SEE):

Total marks: 50+50=100

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

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

B.E, IV Semester, Industrial Internet of Things

Semester: IV		
Engineering Electromagnetics		
Course Code:	**MVJ22IO41**	**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	Understand the physical significance of Biot-Savart's Law, Amperes' Circuital Law and Stokes' theorem for different current distributions.	
3	Know the physical interpretation of Maxwell's equations and its applications in plane waves.	
4	Understand the concepts of Smith Chart for impedance matching.	
5	Acquire knowledge on different types of transmission lines.	

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

Video link / Additional online information: 1. https://youtu.be/ckAVB3_NP2Q 2. https://youtu.be/IH2fFNaR9YM 3. https://youtu.be/JhTT-wew-OE	
UNIT 2	
Gauss' law, Divergence, Poisson's and Laplace's Equations: Gauss law, Maxwell's First equation, Application of Gauss' law, Divergence theorem, Current, Current density, Conductor, The continuity equation, Boundary conditions (dielectric-dielectric, conductor-dielectric, conductor-free space), Poisson's and Laplace's Equations, Uniqueness theorem. **Laboratory Sessions/ Experimental learning:** 1. Evaluate the current flowing through a given surface using MATLAB. 2. Verify the Divergence theorem using MATLAB. **Applications:** Used for calculation electrical field for a symmetrical distribution of charges **Video link / Additional online information:** 1. https://youtu.be/N_jUbFnlqEg 2. https://youtu.be/XtH2WAhvYIM 3. https://youtu.be/gu934FBac6g	**8 Hrs.**
UNIT 3	
Magnetostatics: Steady Magnetic Field-Biot-Savart Law, Ampere's circuital law, Curl, Stokes' theorem, Gauss's law for magnetic fields, Magnetic flux and Magnetic flux density, Maxwell's equations for static fields, Magnetic Scalar and Vector Potentials. **Magnetic Forces and magnetic materials:** Force on a moving charge and differential current element, Force between differential current elements, Magnetization, magnetic susceptibility, permeability, Magnetic boundary conditions, Inductances, magnetic energy, magnetic circuit. **Laboratory Sessions/ Experimental learning:** Determine the magnetic field intensity at a point due to magnetic field using MATLAB. **Applications:** Motors, Generators, Loudspeakers, MRI **Video link / Additional online information :** 1. https://youtu.be/ebGM_q19gY0 2. https://youtu.be/uXQbYJVzlQ0	**8 Hrs.**

3. https://youtu.be/aYRBXI63Oqk	
UNIT 4	
Time varying Fields and Electromagnetic wave propagation: Time varying fields & Maxwell's equations, Faraday's law, Transformer and Motional Electro - Motive Forces, Displacement current, Maxwell's equation in differential and integral form, Time varying potentials. **Electromagnetic wave propagation:** Derivation of wave equations from Maxwell's equations, Relation between E and H, Wave propagation in - lossy dielectrics, lossless dielectrics, free space and good conductor, skin-effect, Poynting theorem. **Laboratory Sessions/ Experimental learning:** Determine the parameters of wave using MATLAB. **Applications:** Optoelectronics **Video link / Additional online information :** 1. https://youtu.be/xxIb9Qv6t7E 2. https://youtu.be/_X061_y9Lqw 3. https://youtu.be/OoQS1ex4kJA	**8 Hrs.**
UNIT 5	
Transmission line: Introduction, Transmission line parameters, Transmission line equations, input impedance, standing wave ratio and power, Smith Chart basic fundamentals, types of transmission lines - coaxial line, strip line, micro strip line. **Applications of transmission line**: Impedance matching and tuning: single stub tuning, double stub tuning, and the quarter wave transformer. **Laboratory Sessions/ Experimental learning:** Simulation of micro strip transmission line using FEKO software. **Applications:** Telephone, Cable TV, Broadband network **Video link / Additional online information:** 1. https://youtu.be/z9GbnMPDCVA 2. https://youtu.be/yk1Mu9fQ6mA 3. https://youtu.be/PO5ExHOKIJM	**8 Hrs.**
Course Outcomes: After completing the course, the students will be able to	
CO1	Evaluate problems on electrostatic force, electric field due to point, linear, surface charge

	and volume charges.
CO2	Apply Gauss law to evaluate Electric fields due to different charge distributions by using Divergence Theorem. Determine potential and capacitance using Laplace equation and Poisson equation.
CO3	Apply Biot-Savart's and Ampere's laws for evaluating Magnetic field for different current configurations.
CO4	Apply Maxwell's equations for time varying fields and evaluate power associated with EM waves using Poynting theorem.
CO5	Determine the parameters of transmission lines and use Smith chart for determining the impedance and admittance.

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

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

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

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

Semester End Examination (SEE):

Total marks: 50+50=100

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

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

High-3, Medium-2, Low-1

Semester: IV		
Modern Control systems		
Course Code:	**MVJ22IO42**	**CIE Marks:100**
Credits:	**L:T:P: 3:0:0**	**SEE Marks: 100**
Hours:	**40L**	**SEE Duration: 3 Hrs**
Course Learning Objectives: The students will be able to		
1	Formulate the mathematical modelling of systems and understand the concepts of transfer function	
2	Obtain transfer function using block diagram reduction and signal flow graph techniques.	
3	Analyse the response of first and second order systems using standard test signals and analyse steady state error.	
4	Analyse stability of systems using RH criteria, Root Locus, Nyquist, Bode plot and polar plot.	
5	Obtain state variable model for electrical systems.	

UNIT 1	
Introduction to Control Systems: open loop and closed loop systems, Types of feedback, Differential equation of Physical Systems – Mechanical Systems, Electrical Systems, Analogous Systems. **Block diagrams and signal flow graphs:** Transfer functions, Block diagram algebra and Signal Flow graphs. **Laboratory Sessions/ Experimental learning:** 1. Determine and plot poles and zeros from the transfer function using MATLAB. **Applications:** Electric Hand Drier, Automatic Washing Machine, DC motor,Automatic Electric Iron, Voltage Stabilizer **Video link / Additional online information :** 1. https://youtu.be/R0E3uKSKdME 2. https://youtu.be/zXMklO-jxIo	**10Hrs.**
UNIT 2	
Time Response of feedback control systems: Standard test signals, Unit step response of First and Second order Systems. Time response specifications, Time response specifications of second order systems for underdamped system, steady state errors and	**10Hrs.**

error constants. **Introduction to Controllers:** P, PI, PD and PID Controllers. **Laboratory Sessions/ Experimental learning:** 1. Obtain step and impulse response of a unity feedback first order system for a given forward path transfer function using MATLAB. 2. Obtain step and impulse response of a unity feedback second order system for a given forward path transfer function using MATLAB. **Applications:** Industrial Control systems **Video link / Additional online information :** 1. https://youtu.be/ziu1OTwUrbw https://youtu.be/YuZ3iwA-47I	
UNIT 3	
Stability analysis using RH Criteria and root locus: Concepts of stability, Necessary conditions for stability, Routh Hurwitz stability criterion, Relative stability analysis, Introduction to Root-Locus Techniques, the root locus concepts, Construction of root loci. **Laboratory Sessions/ Experimental learning:** 1. Obtain Root Locus Plot of the system for a given forward path transfer function using MATLAB. **Applications:**Used to determine the dynamic response of a s system **Video link / Additional online information:** 1. https://youtu.be/cez4InLZ7Pw 2. https://youtu.be/sUDoTw_LIbk 3. https://youtu.be/Irxppc_LCUk	**10Hrs.**
UNIT 4	
Stability analysis using Nyquist criteria and Bode plots: Polar plot, Nyquist Stability criterion, Nyquist plots, Bode plots, Gain and phase margin. **Laboratory Sessions/ Experimental learning:** 1. Obtain Bode Plot of the system for a given forward path transfer function using MATLAB. 2. Obtain Nyquist Plot of the system for a given forward path transfer function using MATLAB. **Applications:** To determine a stability of a system	**10Hrs.**

Video link / Additional online information: **1.** https://youtu.be/QzTCRk4nkDg	
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://youtu.be/xajgSUci9zs	**10Hrs.**

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

Text 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.

Reference Books:	
1.	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:	**MVJ22IO43**	**CIE Marks:50**
Credits:	**L:T:P: 3:0:2**	**SEE Marks: 50**
Hours:	**40 L+ 26 P**	**SEE Duration: 03 Hours**

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

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

1. https://nptel.ac.in/courses/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/	**8 Hrs.**
UNIT 3	
NOISE: Shot Noise, Thermal noise, White Noise, Noise Figure, Equivalent noise temperature, Noise Equivalent Bandwidth. NOISE IN ANALOG MODULATION: Introduction, Receiver Model, Noise in DSB-SC receivers. Noise in AM receivers, Threshold effect, Noise in FM receivers, Capture effect, FM threshold effect, FM threshold reduction, Pre-emphasis, and De-emphasis in FM **Laboratory Sessions/ Experimental learning:** ASK modulation and demodulation. **Applications:** Biomedical engineering, communication system **Video link / Additional online information:** 1. https://nptel.ac.in/courses/117/105/117105077/ 2. https://nptel.ac.in/courses/117/101/117101051/	**8 Hrs.**
UNIT 4	

Inter-symbol Interference & Signal Space representation: Base band transmission: Discrete PAM Signals, Power spectra of Discrete PAM Signals, Inter Symbol Interference, Nyquist criterion for Distortion less Base band Binary Transmission, Eye diagram, Geometric representation of signals, Gram-Schmidt Orthogonalization procedure, Optimum receivers for coherent detection: Correlation Receivers and Matched Filter receiver. **Laboratory Sessions/ Experimental learning:** 1. Eye diagram using MATLAB **Applications:** Ethernet, RFID marker localization signals, Radar Systems **Video link / Additional online information:** 1. https://nptel.ac.in/courses/117/105/117105077/ 2. https://nptel.ac.in/courses/117/101/117101051/	**8 Hrs.**
UNIT 5	
Prerequisites: *Probability & Random Process* **Pass band transmission:** Digital modulation techniques: Phase shift Keying techniques using Coherent detection: Generation, Detection and Error probabilities of BPSK and QPSK, QAM, Frequency shift keying techniques using Coherent detection: BFSK generation, detection, and error probability. **Non-coherent orthogonal modulation techniques:** BFSK, DPSK Symbol representation, Block diagrams of Transmitter and Receiver, Probability of error (without derivation of probability of error equation) **Principles of Spread Spectrum Communication Systems:** Model of a Spread Spectrum, Digital Communication System, Direct Sequence Spread Spectrum Systems (DSSS),Some applications of DS Spread Spectrum Signals, Generation of PN Sequences, Frequency Hopped Spread Spectrum (FHSS). **Laboratory Sessions/ Experimental learning:** 1. Analyze constellation of 16-QAM Using MATLAB **Applications:** CDMA, WiMAX (16d, 16e), telemetry, caller ID, garage door openers, wireless communication, mobile communication and Satellite Communication, LANs, Bluetooth, RFID, GPS, Wi-Fi, etc., **Video link / Additional online information :**	**8 Hrs.**

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

Text Books:	
1.	Simon Haykins& Moher, Communication Systems, 5th Edition, John Wiley, India Pvt. Ltd, 2010, ISBN 978 – 81 – 265 – 2151 – 7.
2.	Simon Haykins, “An Introduction to Analog and Digital Communication”, John Wiley, 2003.

Reference Books:	
1.	John G Proakis and MasoudSalehi, “Fundamentals of Communication Systems”, 2014 Edition, Pearson Education, ISBN 978-8-131-70573-5.
2.	B P Lathi and Zhi Ding, Modern Digital and Analog Communication Systems, Oxford University Press., 4th edition, 2010, ISBN: 97801980738002.

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of three quizzes are conducted along with tests. The test portion is evaluated for 50 marks and quiz is evaluated for 10 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The number 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 student is evaluated in every session. The average of the marks over number of weeks is considered for 30 marks. At the end of the semester a test is conducted for 10 marks. The students are 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 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 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:	**MVJ22IOL44**	**CIEMarks:50**
Credits:	**L:T:P:0:0:2**	**SEEMarks: 50**
Hours:	**26P**	**SEEDuration:03Hours**

Course Learning Objectives: The students will be able to	
1	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	DSB SC Modulation
9	Pre-Emphasis & de-emphasis
10	Pulse Amplitude Modulation abd Detection
11	Generation of PWM/PPM Signal
12	Generation and Detection of ASK Waveform

Course Outcomes: After completing the course, the students will be able to	
CO1	Validation of the the various functional modules of a communication system.
CO2	Demonstrate their knowledge in base band signaling schemes through Implementation of digital modulation schemes.

CO3	Apply various channel coding schemes & demonstrate their capabilities.
CO4	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
CO5	3	3	3	2	1	1	-	-	-	-	-	1

High-3, Medium-2, Low-1

Semester: IV		
Signals and Systems		
Course Code:	**MVJ22IO451**	**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 mathematical description of continuous and discrete time signals and systems.
2	Analyze the signals in time domain using convolution sum and Integral.
3	Determine the response of the LTI system to any input signal.
4	Analyze Linear Time Invariant (LTI) systems in time and transform domains.
5	Apply the knowledge of frequency-domain representation and analysis concepts using Fourier analysis tools and Z-transform.

UNIT I

Prerequisites: Definition of step, ramp, impulse response.

Introduction and Classification of signals: Definition of a 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.

8Hrs.

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) $\delta(t) + 2\,\delta(t)$

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://archive.nptel.ac.in/courses/108/106/108106151/ https://onlinecourses.nptel.ac.in/noc21_ee28/preview https://archive.nptel.ac.in/courses/108/104/108104100/	
UNIT II	
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 ≤ t ≤ 10. Compute and plot the response of the system to the input signal x(t)=0.8 ^{t} , 0 ≤ t ≤ 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 :** https://archive.nptel.ac.in/courses/108/106/108106151/ https://archive.nptel.ac.in/courses/108/106/108106163/ https://archive.nptel.ac.in/courses/108/104/108104100/	**8Hrs.**
UNIT III	

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 definition 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 property of the given periodic signal x(t)=t cos(t) ,$0 \leq t \leq 2\pi$ 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://archive.nptel.ac.in/courses/108/106/108106163/
2. https://archive.nptel.ac.in/courses/108/104/108104100/

8Hrs.

UNIT IV

Prerequisites: Basics of Fourier transform concepts

Fourier Representation of aperiodic Signals: Introduction to Fourier Transform, 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.
    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

8 Hrs

Video link / Additional online information : https://archive.nptel.ac.in/courses/108/106/108106151/ https://archive.nptel.ac.in/courses/108/106/108106163/ https://archive.nptel.ac.in/courses/108/104/108104100/	
UNIT V	
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≤ n ≤ 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**: In 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:** 1. https://archive.nptel.ac.in/courses/108/106/108106151/ 2. https://archive.nptel.ac.in/courses/108/106/108106163/ 3. https://archive.nptel.ac.in/courses/108/104/108104100/	8Hrs.

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

CO1	Analyze 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	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.

Reference Books:	
1	Simon Haykins and Barry Van Veen, "Signals and Systems", 2nd Edition, 2008, Wiley India. ISBN 9971-51-239-4.
2	H.P Hsu, R. Ranjan, "Signals and Systems", Scham's outlines, TMH, 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 for50 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 threetests are conducted for 50 marks each and the average of all the tests are calculated for 50. The marks for the assignments are 20 (2 assignments for 10 marks each). The marks obtained in test, quiz and assignment are added to get marks out of 100 and report CIE for 50 marks.

Semester End Examination (SEE):

Total marks: 50+50=100

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

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

High-3, Medium-2, Low-1

Semester: IV		
OBJECT ORIENTED CONCEPTS WITH JAVA		
Course Code:	**MVJ22IO452**	**CIE Marks:100**
Credits:	**L:T:P: 3:0:0**	**SEE Marks: 100**
Hours:	**40L**	**SEE Duration: 3 Hrs**
Course Learning Objectives: The students will be able to		
1	Identify the need for Java - an object-oriented language. Set up Java JDK environment to create, debug and run simple Java programs.	
2	Illustrate the use of classes and distinguish the usage of different types of Inheritance and constructors in real world.	
3	Demonstrate the use of exceptions and to create multi-threaded program	
4	Illustrate the use of Collections with elements in Java program	
5	Develop Java Application using JDBC connectivity.	

UNIT 1	
Prerequisites: Basic Knowledge about C or C++ **Introduction to Object Oriented Concepts and Java:** Java's Magic: The Byte code; Java Development Kit (JDK); The Java Buzz words, Object Oriented Programming - Two Paradigms, Abstraction, The Three OOP Principles and its advantages, Simple Java programs. Data types, variables and arrays, Operators, Control Statements. **Laboratory Sessions/ Experimental learning:** A professor in college will allow a student to be excused from the final exam if either of the following is true: • They have a 90% average or higher in the class and have missed 3 or less class lectures. • They have a 80% average or higher in the class and have not missed any class lectures. The program below will determine whether a student can get out of the exam or not. Rewrite the program so only one if statement is used. **Applications:** Arrays in mathematical vectors, matrices. **Video link / Additional online information (related to module if any):** • Differences between JVM vs JRE vs JDK in Java: 1. https://www.youtube.com/watch?v=5Bp6GLU6HKE	8Hrs.
UNIT 2	
Classes, Inheritance, Packages, and Interfaces: Classes fundamentals; Declaring objects; Assigning object reference variables; Introducing Methods, Constructors, this keyword,	8Hrs.

Finalize Method. Inheritance: Inheritance basics, using super, creating multi-level hierarchy, when constructors are called, method overriding, using abstract classes. Packages, Access Protection, Importing Packages, Interfaces. **Laboratory Sessions/ Experimental learning:** Write a program that calculates the number of buckets of paint to use for a room and the optimal number of cans to purchase. You need to ask the height of the room and the length and width of the room. The room is rectangular. You must paint the walls and the ceiling but not the floor. There are no windows or skylights. You can purchase the following size buckets of paint. • 5-liter bucket costs $15 each and covers 1500 square feet. • 1-liter bucket costs $4 and covers 300 square feet. **Applications:** Inheritance in Banking Sectors **Video link / Additional online information (related to module if any):** 1. Types of Inheritance: https://www.youtube.com/watch?v=ZP27c7i5zpg	
UNIT 3	
Exception Handling and Multi-Threaded Programming: Exception Handling fundamentals, Exception Types, Uncaught Exceptions, Using try catch, Multiple catch clauses, Nested try statements, throw, throws, finally, Java's built-in exceptions, Programming Examples. **Multi-Threaded Programming**: The java thread model, Main thread, Creating Thread, creating multiple threads, Using is Alive () and join (), Thread priorities, Synchronization; Inter Thread Communication - Bounded buffer problem. **Laboratory Sessions/ Experimental learning:** The Producer-Consumer problem describes two processes, the producer, and the consumer, which share a common, fixed-size buffer used as a queue. The producer's job is to generate data, put it into the buffer, and start again. At the same time, the consumer is consuming the data (i.e., removing it from the buffer), one piece at a time. Make sure that the producer won't try to add data into the buffer if it's full and that the consumer won't try to remove data from an empty buffer. Write a java code to get the solution for this multi-process synchronization problem. **Applications:** Multithreads in Browsers, Servers **Video link / Additional online information (related to module if any):**	8Hrs.

1. Multithreading: https:/youtu.be/QFbxzynUij4	
UNIT 4	
The collections and Framework: Collections Overview, Recent Changes to Collections, The Collection Interfaces, The Collection Classes, accessing a collection Via an Iterator, Storing User Defined Classes in Collections. **Java Lambda expressions:** Java Lambda expressions, Using Java Lambda expressions, Lambda expression vs method in java, Lambda expression in the array list. **Laboratory Sessions/ Experimental learning:** Write a Java program to iterate through all elements in a array list**.** Write a Java program to create a new array list, add some colours (string) and print out the collection **Applications:** Elements in group **Video link / Additional online information (related to module if any):** 4. https://www.youtube.com/watch?v=Q_9vV3H-dt4	8Hrs.
UNIT 5	
JDBC: The Concept of JDBC; JDBC Driver Types; JDBC Packages; A Brief Overview of the JDBC process; Database Connection; Associating the JDBC/ODBC Bridge with the Database; Statement Objects; Result Set; Transaction Processing; Metadata, Data types; Exceptions. **Laboratory Sessions/ Experimental learning:** Develop Student Management System application with swings as the front end and database as the back end using JDBC connectivity. **Applications:** Scientific Applications, Financial Applications **Video link / Additional online information (related to module if any):** 1. **Java JDBC:** https://www.youtube.com/watch?v=hEWBIJxrLBQ	8Hrs.

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

CO1	Illustrate the Object-Oriented Programming concepts and basic characteristics of Java.
CO2	Demonstrate the principles of classes, inheritance, packages and interfaces.
CO3	Experiment with exception handling Mechanisms and Create multi-threaded programs.
CO4	Interpret the need for advanced Java concepts like collections in developing modular and efficient programs.
CO5	Develop an application with Database using JDBC connectivity.

Text Books	
1.	Herbert Schildt, “Java The Complete Reference”, 7 /9th Edition, Tata McGraw Hill, 2007.
2.	Jim Keogh: “J2EE-The Complete Reference”, McGraw Hill, 2007.

Reference Books	
1.	“Effective Java”, Third Edition, Joshua Bloch, Addison-Wesley Professional,2017
2.	Richard Warburton, Java 8 Lambdas: “Pragmatic Functional Programming” Kindle Edition.

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

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

Semester End Examination (SEE):

Total marks: 50+50=100

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

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

CO3	**1**							**2**	**2**	**2**	**1**	
CO4	**1**	**2**				**2**						**2**
CO5	**1**	**2**				**2**						**2**

High-3, Medium-2, Low-1

Semester: IV		
Operating System		
Course Code:	**MVJ22IO453**	**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	Learn how processes are synchronized and scheduled.	
3	Identify different approaches of memory management and virtual memory management.	
4	Study the structure and organization of the file system	
5	Understand inter process communication and deadlock situations.	

UNIT 1	
Prerequisites: *Computer Organization and Architecture* **Introduction to Operating Systems:** OS, Goals of an OS, Operation of an OS, Program's, Resource allocation techniques, Efficiency, System Performance and User Convenience, Classes of operating System, Batch processing, Multi programming, Time Sharing Systems, Real Time , distributed and modern Operating Systems. **Laboratory Sessions/ Experimental learning:** 1. Case study: Basics of LINUX OS. **Applications:** • Controls the backing store and peripherals such as scanners and printers. • Maintains security and access rights of users. • Spooling (Simultaneous Peripheral Operation on Line) **Video link / Additional online information :** 1. https://nptel.ac.in/courses/106/105/106105214/ 2. https://www.youtube.com/watch?v=qJ_bXhrUOkc&t=12s	8Hrs.
UNIT 2	
Process Management: OS View of Processes, PCB, Process States and Transitions, Threads, Kernel and User level Threads, Non-preemptive scheduling- FCFS and SRN, Preemptive Scheduling- RR and LCN, Long term, medium term and short term scheduling in a time sharing system.	8Hrs.

Laboratory Sessions/ Experimental learning: 1. Case study on Processes and threads in Linux/ Windows/ UNIX Scheduling Algorithms **Applications:** • Organizes the use of memory between programs. • Organizes processing time between programs and users. • Install Operating Systems - Ubuntu Linux. **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=Lf3xYcIzgeQ	
UNIT 3	
Memory Management: Static and Dynamic memory allocation, Contiguous Memory allocation, Non-Contiguous Memory Allocation, Paging, Segmentation, Segmentation with paging, Virtual Memory Management, Demand Paging, Paging Hardware, VM handler, Page replacement policies - FIFO, LRU. **Laboratory Sessions/ Experimental learning:** 1. Case Study on Linux/ UNIX Memory Management. **Applications:** • Memory Management deals with the transfer of programs in and out of memory. • Dynamically allocate portions of memory to programs at their request, and free it for reuse when no longer needed. **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=MLbdsuxYAF4 2. https://www.youtube.com/watch?v=WqnwrWODLKs	8Hrs.
UNIT 4	
File Systems: File systems and IOCS, Files and File Operations, Fundamental File Organizations, Directory structures, File Protection, Interface between File system and IOCS, Allocation of diskspace, Implementing file access, and File sharing schematics. **Laboratory Sessions/ Experimental learning:** 1. Case Study on UNIX/ Windows/ Linux File System. **Applications:**	8Hrs.

• Understand file handling operations (read, write, and append). • Basic understanding of how pointers are used **Video link / Additional online information :** 1. https://www.youtube.com/watch?v=Fjz3PKJGe5s 2. .https://www.youtube.com/watch?v=E3PshX16WEY	
UNIT 5	
Message Passing and Deadlocks: Overview of Message Passing, Implementing message passing, Mailboxes, Deadlocks, Deadlocks in resource allocation, Handling Deadlocks, Deadlock detection algorithm, Deadlock Prevention, Deadlock avoidance-Bankers algorithm. **Laboratory Sessions/ Experimental learning:** 1. Simulate Bankers Algorithm for Dead Lock Avoidance. **Applications:** Email management **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=rCHnS-ZX7PE 2. https://www.youtube.com/watch?v=vOfKOg0rFg4	8Hrs.

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

Text Books:	
1.	Dhamdare, “Operating Systems – A concept-based approach”, by TMH, 2nd edition, 2009.
2.	Silberschatz and Galvin, “Operating systems concepts”, John Wiley India Pvt. Ltd,5th edition, 2001.
Reference Books:	
1.	William Stalling, “Operating system–internals and design system”, Pearson Education, 4th ed, 2006.
2	Tannanbhaum, “Design of operating systems”, TMH, 2001.

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

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

Semester End Examination (SEE):

Total marks: 50+50=100

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

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

Semester: IV		
Engineering Statistics and Linear Algebra		
Course Code:	**MVJ22IO454**	**CIE Marks: 50**
Credits:	**L: T:P:S: 2:2:0:0**	**SEE Marks: 50**
Hours:	**30L+10T**	**SEE Duration: 3 Hrs.**

Course Learning Objectives: The students will be able to

- To organize, manage, and present data using statistical methods.
- To familiarize the important tools of linear algebra, that are essential in all branches of engineering.
- To develop the knowledge/skills of linear transformation and decomposition techniques in a comprehensive manner.

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

Course Outcomes: After completing the course, the students will be able to	
CO1	Fit a suitable curve by the method of least squares and determine the lines of regression for a set of statistical data.
CO2	Understand the need and application of analytics.

CO3	Analyze whether a system is consistent or inconsistent, its solution is unique or infinite and find bases and dimension of vector spaces required in network analysis.
CO4	Linearly transform the system from one dimension to another in matrix form, required to analyze image processing problems.
CO5	Compute orthogonal and orthonormal basis vectors required to analyze image and signal processing problems.

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

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

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

Semester End Examination (SEE):

Total marks: 50+50=100

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

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

Semester: IV		
Additional Mathematics-II (Common to all branches)		
Course Code:	**MVJ22MATDIP-II**	**CIE Marks:50**
Credits:	**L:T:P:S: 3:0:0:0**	**SEE Marks: 50**
Hours:	**30L**	**SEE Duration: 3 Hrs**

Course Learning Objectives: The students will be able to	
1	To familiarize the important concepts of linear algebra.
2	Aims to provide essential concepts differential calculus, beta and gamma functions.
3	Introductory concepts of three-dimensional geometry along with methods to solve them.
4	Linear differential equations
5	Formation of partial differential equations.

UNIT-I	
Linear Algebra: Introduction - Rank of matrix by elementary row operations - Echelon form. Consistency of system of linear equations - Gauss elimination method. Eigen values and eigen vectors of a square matrix. Diagonalization of a square matrix of order two.	**8 Hrs**
UNIT-II	
Differential calculus: Indeterminate forms: L-Hospital rule (without proof), Total derivatives, and Composite functions. Maxima and minima for a function of two variables. **Beta and Gamma functions:** Beta and Gamma functions, Relation between Beta and Gamma function-simple problems.	**8Hrs**
UNIT-III	
Analytical solid geometry : Introduction –Directional cosine and Directional ratio of a line, Equation of line in space- differentforms, Angle between two line, shortest distance between two line, plane and equation of plane in different forms and problems.	**8Hrs**
UNIT-IV	
Differential Equations of higher order: Linear differential equations of second and higher order equations with constant coefficients. Inverse Differential operator, Operators methods for finding particular integrals , and Euler –Cauchy equation.	**8 Hrs**
UNIT-V	
Partial differential equation: Introduction- Classification of partial differential equations, formation of partial differential equations. Method of elimination of arbitrary constants and functions. Solutions of non-homogeneous partial differential equations by direct integration. Solution of Lagrange's linear PDE.	**8 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Make use of matrix theory for solving system of linear equations and

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

Reference Books	
3.	B.S. Grewal, "Higher Engineering Mathematics" Khanna Publishers, 43rd Edition, 2013.
4.	Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley-India publishers 10th edition,2014.
3.	Ramana B. V., "Higher Engineering Mathematics", Tata Mc Graw-Hill, 2006.
4.	Bali N. P. & Manish Goyal, "A text book of Engineering Mathematics", Laxm Publications, 8th Edition.

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

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

Semester End Examination (SEE):

Total marks: 50+50=100

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

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

B.E, V Semester, Industrial Internet of Things

Semester: V		
TECHNICAL MANAGEMENT		
Course Code:	**MVJ22IO51**	**CIE Marks:50**
Credits:	**L: T:P: 3:0:0**	**SEE Marks: 50**
Hours:	**40L**	**SEE Duration: 3 Hrs**

Course Learning Objectives: The students will be able to	
1	Explain the concepts of management, planning, organizing, and staffing.
2	Apply the knowledge required to become an entrepreneur.
3	Understand and choose the appropriate institutional support to succeed as an entrepreneur.
4	Analyze the requirements towards the small-scale industries and project preparation.
5	Understand the general principles of IPR, Concept and Theories, Criticisms of Intellectual Property Rights.

Module 1	
Prerequisites: Basics of management system, roles and responsibilities. **Management**: Introduction, Meaning, nature and characteristics of Management, Scope and Functional areas of management, Management as a science, art of profession, Management &Administration, Roles of Management, Levels of Management, Managerial Skills, Management & Administration, Development of Management Thought early management approaches, Modern management approaches. **Applications:** IT sectors and Institutional Research sectors. **Video link / Additional online information:** https://nptel.ac.in/courses/110/107/110107150/ https://nptel.ac.in/courses/110/105/110105146/	**8Hrs.**

Module 2	
Planning: Nature, Importance, Types, Steps and Limitations of Planning, Decision Making: Meaning, Types and Steps in Decision Making **Organizing and Staffing:** Nature and purpose of organization, Principles of organization, Span of Management, Types of organization, Departmentation Committees, Centralization Vs Decentralization of authority and responsibility, Span of control, MBO and MBE (Meaning Only) Nature and importance of staffing: Need and Importance, Recruitment and Selection Process. **Applications:** IT sectors, Banking sectors and Institutional Research sectors. **Video link / Additional online information:** https://nptel.ac.in/courses/110/107/110107151/	**8Hrs.**

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

Course Outcomes	
CO1	Explain about the management and planning.
CO2	Apply the knowledge on organizing and staffing,
CO3	Analyse the concept of directing, and controlling.
CO4	Choose the requirements towards the small-scale industries and project preparation.
CO5	Understand the Concepts of Intellectual Property Rights

Text Books:

1.	P.C.Tripathi, P.N.Reddy , "Principles of Management", Tata Mc Graw Hill, 5th edition, 2008.
2.	Poornima M Charantimath, "Entrepreneurship Development Small Business Enterprises", Pearson Education, 2008, ISBN 978-81-7758-260-4.
3.	Rachna Singh Puri & Arvind Viswanathan, "Practical Approach to Intellectual Property Rights", 1/e, I K International Publishing House Pvt. Ltd, 2009.

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

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

Semester End Examination (SEE):

Total marks: 50+50=100

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

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

High-3, Medium-2, Low-1

Semester: V		
Computer Communication Networks		
Course Code:	**MVJ22IO52**	**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 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.	**8Hrs.**

Laboratory Sessions/ Experimental learning: 1. 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:** 2. 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**: 1. 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 **Project:** Create a Network Proxy **Video link / Additional online information:** 1. http://www.digimat.in/nptel/courses/video/106105183/L11.html	**8Hrs**.

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	Develop various progams to undrstand the concepts of Networking

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

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

High-3, Medium-2, Low-1

Semester:V		
DATA STRUCTURES AND ALGORITHMS USING PYTHON		
Course Code:	**MVJ22IO53**	**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 fundamentals of data structures and their applications in logic building and project assessment.	
2	Understand the concept of linked lists and sorting techniques.	
3	Acquire the knowledge of algorithms of queues and stacks.	
4	Analyze the concepts of Binary trees.	
5	To Understand Graphs and its algorithms.	

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

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

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

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

Reference Books:	
1.	Rance D Necaise “Data Structures and Algorithms using Python”, Wiley, John Wiley and Sons.
2.	Narasimha Karumanchi “Data Structures and Algorithmic Thinking with Python”,

	CareerMonk Publications.
3	Michael T. Goodrich, R. Tamassia and Michael H Goldwasser "Data structures and Algorithms in python",Wiley student edition, John Wiley and Sons.

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

Laboratory- 50 Marks

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

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

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

CO-PO Mapping

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

High-3, Medium-2, Low-1

Semester:V		
DATA STRUCTURES AND ALGORITHMS USING PYTHON Laboratory		
Course Code:	**MVJ22IOL44**	**CIE Marks:50**
Credits:	**L:T:P:0:0:2**	**SEE Marks: 50**
Hours:	**26P**	**SEE Duration: 03Hours**
Course Learning Objectives: The students will be able to		
1	Understand the fundamentals of data structures and their applications in logic building and project assessment.	
2	Understand the concept of linked lists and sorting techniques.	
3	Acquire the knowledge of algorithms of queues and stacks.	
4	Analyze the concepts of Binary trees.	
5	To Understand Graphs and its algorithms.	

Laboratory Sessions	
Sl No	**Experiment Name**
1	Write a Python program for implementing the following searching techniques. i. Linear Search ii. Binary Search
2	Write a Python program for implementing the following sorting techniques. i. Bubble Sort ii. Selection Sort iii. Insertion Sort
3	Write a Python program for implementing the following sorting techniques. i. Quick Sort ii. Merge Sort
4	Write a Python program to design and implement Linked List and its operations.
5	Write a Python program to design and implement Circular Linked List and its operations.
6	Write a Python program to i. Design and implement Stack and its operations using List. ii. Design and implement Queue and its operations using List.
7	Write a Python program for the following stack applications:

	i. Infix to postfix conversion ii. Tower of Hanoi
8	Write a Python program to implement the following: i. Create a Binary Search Tree ii. Tree Traversals: Inorder, Preorder, Postorder. iii. Determine the height of the tree. iv. Count the number of elements of tree.
9	Write a Python program to implement the following graph traversal algorithms: i. BFS ii. DFS

Course Outcomes: 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	Understand the concepts of Graphical algorithms.

CO-PO Mapping

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

High-3, Medium-2, Low-1

Semester: V		
Data Base Management System		
Course Code:	**MVJ21IO551**	**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	Develop a strong foundation in database concepts, technology, and practice.	
2	Apply SQL programming through a variety of database problems.	
3	Demonstrate the use of concurrency and transactions in database.	
4	Design and build database applications for real world problems.	
5.	Make use of the databases for various transactions.	

UNIT-I	
Introduction to Databases: Introduction; An example; characteristics of the database approach; actors on the scene; workers behind the scene; advantages of using the DBMS approach; A brief history of database Applications; when Not to use a DBMS. **Overview of Database Languages and Architectures:** Data Models, Schemas, and Instances. Three schema architecture and data independence, database languages, and interfaces, The Database System environment. **Modelling using Entities and Relationships:** Entity types, Entity sets, attributes, roles, and structural constraints, Weak entity types, ER diagrams, examples. **Laboratory Sessions/ Experimental learning:** Draw ER diagram for database applications (logical database design). **Applications:** Library Management system, Banking, Universities and colleges, credit card transactions, social media sites, Telecommunications, Finance, Military, online shopping, Human Resource Management, Manufacturing, Airline Reservation systems. **Video link / Additional online information (related to module if any):** • https://nptel.ac.in/courses/106106093/ • https://nptel.ac.in/courses/106105175/ • https://www.youtube.com/watch?v=WSNqcYqByFk	**08 Hrs**
UNIT-II	

Relational Model: Relational Model Concepts, Relational Model Constraints and relational database schemas, Update operations, dealing with constraint violations. **Relational Algebra:** Unary and Binary relational operations, additional relational operations (aggregate, grouping, etc.) Examples of Queries in relational algebra. **Mapping Conceptual Design into a Logical Design:** Relational Database Design using ER-to-Relational mapping. **SQL:** SQL data definition and data types, specifying constraints in SQL, retrieval queries in SQL, INSERT, DELETE, and UPDATE statements in SQL. **Laboratory Sessions/ Experimental learning:** programs to perform set operations, arithmetic operations, joins, selection, projection, create tables for real world db applications and insert values to it. **Applications:** RDBMS, enterprise level software solution (except light weight web applications) **Video link / Additional online information (related to module if any):** • https://nptel.ac.in/courses/106106093/ • https://nptel.ac.in/courses/106105175/ • https://www.youtube.com/watch?v=gGGHjYbQMvw • https://www.youtube.com/watch?v=nc1yivH1Yac https://www.youtube.com/watch?v=64szTfLNu3o	**08 Hrs**
UNIT-III	
SQL: Advances Queries: More complex SQL retrieval queries, Specifying constraints as assertions and action triggers, Views in SQL, Schema change statements in SQL. **Database Application Development:** Accessing databases from applications, An introduction to JDBC, JDBC classes and interfaces, SQLJ, Stored procedures, Embedded SQL**.** **Laboratory Sessions/ Experimental learning:** Mini-projects to develop connections between front end and backend(database) using JDBC. Write SQL queries for the given schema. **Applications:** Java Programming, In Server to reduce network traffic and to provide security (Stored procedure)	**08 Hrs**

Video link / Additional online information (related to module if any): • https://www.youtube.com/watch?v=64szTfLNu3o • https://www.digimat.in/nptel/courses/video/106105175/L11.html • https://www.youtube.com/watch?v=sjzlr0EsZL4 • https://nptel.ac.in/courses/106106093/ • https://nptel.ac.in/courses/106105175/	
UNIT-IV	
Normalization: Database Design Theory – Introduction to Normalization using Functional and Multivalued Dependencies: Informal design guidelines for relation schema, Functional Dependencies, Normal Forms based on Primary Keys, Second and Third Normal Forms, Boyce-Codd Normal Form, Multivalued Dependency and Fourth Normal Form, Join Dependencies and Fifth Normal Form. Dependency theory - functional dependencies, Armstrong's axioms for FD's, closure of a set of FD's, minimal covers. **Laboratory Sessions/ Experimental learning:** Draw schema diagram which satisfy all forms of normalization for all db real world application **Applications:** to optimize database design **Video link / Additional online information (related to module if any):** • https://nptel.ac.in/courses/106106093/ • https://nptel.ac.in/courses/106105175/ • https://www.youtube.com/watch?v=YD8dhOmuVnY	**08 Hrs**
UNIT-V	
Transaction Processing: Introduction to Transaction Processing, Transaction and System concepts, Desirable properties of Transactions, characterizing schedules based on recoverability, Characterizing schedules based on Serializability, Transaction support in SQL. **Concurrency Control in Databases:** Two-phase locking techniques for Concurrency control, Concurrency control based on Timestamp ordering. **File Organizations and Indexes:** Introduction, Hashing techniques, Indexing, Structures for Files. **Laboratory Sessions/ Experimental learning:** Develop banking and other financial applications.	**08 Hrs**

Applications: systems that manage sales order entry, airline reservations, payroll, employee records, manufacturing, and shipping. Operating system(deadlock) **Video link / Additional online information (related to module if any):** • https://nptel.ac.in/courses/106106093/ • https://nptel.ac.in/courses/106105175/ • https://www.youtube.com/watch?v=5ammL5KU4mo	

Course Outcomes: After completing the course, the students will be able to	
CO1	Identify, analyse and define database objects, enforce integrity constraints on a database using RDBMS.
CO2	Make use of Structured Query Language (SQL) for database manipulation.
CO3	Design and build simple database systems.
CO4	Apply the concepts of Normalization and design database which possess no anomalies.
CO5	Develop application to interact with databases.

Text Books:	
1	Fundamentals of Database Systems, Ramez Elmasri and Shamkant B. Navathe, 7th Edition, 2017, Pearson
2	Database management systems, Ramakrishnan, and Gehrke, 3rd Edition, 2014, McGraw Hill

Reference Books:	
1	Silberschatz Korth and Sudharshan, Database System Concepts, 6th Edition, McGrawHi 2013.
2	Database Principles Fundamentals of Design, Implementation and Management, Cengage Learning 2012.

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

Semester: V		
MEMS and NANO Technology		
Course Code:	**MVJ22IO552**	**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 overview of Microsystems and their applications.	
2	Study the working principles of Micro sensors and Micro Actuators.	
3	Acquire the knowledge of various Microsystems Fabrication Processes.	
4	Illustrate the Microsystems Design consideration.	
5	Know the basics of MEMS and its applications.	

UNIT 1	
Prerequisites: *Fundamentals of Physics (Mechanics, Optics, Electricity and magnetism),Fundamentals of Inorganic Chemistry* **MEMS Overview:** MEMS and Microsystems, Typical MEMS and Microsystems products: Micro gears, Micromotors, Microturbines & Micro-optical components, History of MEMS development, Intrinsic characteristics of MEMS, Application of Microsystems in various Industries. **Laboratory Sessions/ Experimental learning:** 1. An introduction to Comsol Multiphysics which is ideally suited for MEMS applications. **Applications:** Airbag Systems, Controlling automotive movement changes. **Video link / Additional online information :** 1. https://nptel.ac.in/courses/117/105/117105082/ 2. https://nptel.ac.in/courses/108/108/108108147/ **3.** http://www.nptelvideos.in/2012/12/mems-microsystems.html	**8Hrs.**
UNIT 2	
MEMS Sensors: Acoustic wave sensors, Biomedical & Biosensors, Chemical sensors, Optical sensors, Pressure sensor and thermal sensors, Piezo-resistive and Piezo-electric sensors.	**8Hrs.**

Laboratory Sessions/ Experimental learning: **1.** Case study of Blood Pressure Sensors **Applications:** Satellite launch vehicle, industries, automobile, medical, consumer applications **Video link / Additional online information:** 1. https://nptel.ac.in/courses/117/105/117105082/ 2. https://nptel.ac.in/courses/108/108/108108113/ **3.** https://nptel.ac.in/courses/108/108/108108147/	
UNIT 3	
Micro actuation: Actuation using thermal forces, Actuation using shape memory Alloys, Actuation using piezoelectric effect, Actuation using Electrostatic forces (Parallel plate, Torsion bar, Comb drive actuators), **MEMS with Micro actuators:** Microgrippers, Miniature Microphones, Micromotors, Micro actuators with mechanical inertia, Microfluidics. **Laboratory Sessions/ Experimental learning:** 1. Case studies on MEMS Microphone. **Applications:** Optical, RF and industrial applications. **Video link / Additional online information:** https://nptel.ac.in/courses/117/105/117105082/	**8Hrs.**
UNIT 4	
Nano Technology: Introduction to Nanotechnology, The nanoscale. Consequences of the nanoscale for technology and society. - Technologies for the Nanoscale, Top-down versus bottom-up assembly. Visualisation, manipulation and characterisation at the nanoscale, Proximal probe technologies. Self-assembly. **Applications:** Information technology, homeland security, medicine, transportation. **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=0MzIh7wkgMs&t=4s 2. https://www.youtube.com/watch?v=Z51R49OOqAA	**8Hrs.**
UNIT 5	
Nano Scale Manufacturing: Nanomanipulation, Nanolithography - An introduction to tribology and its industrial applications – Nanoscale Materials and Structure, Nanocomposites, Safety issues	**8Hrs.**

with nanoscale powders - Applications, Applications in energy, informatics, medicine, etc **Applications:** To measure blood pressure within the body, detect ions, to perform biological tests, displays, tunable Lasers, smart phones, mobile infrastructure, IoT and defense. **Video link / Additional online information:** 1. https://youtu.be/mpbpRtW8Flo?si=T505lzCpph5sz4v7 2. https://youtu.be/6yB5xg97Bjc?si=hMnULDNmoVAJzFvz	

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the technologies related to MEMS.
CO2	Gain knowledge of various Microsensors.
CO3	Understand actuators for MEMS applications.
CO4	Explore the students to the evolution of Nano technology
CO5	Knowledge about nano materials and various nano measurements techniques.

Text Books:	
1.	Tai-Ran Hsu, "MEMS and Micro systems: Design, Manufacture and Nanoscale Engineering", 2nd Ed, John Wiley & Sons, Inc. 2008.
2.	Chang Liu, "Foundation of MEMS", 2011, 2nd ed., Pearson Education India.
3.	Mark Ratner & Daniel Ratner , Nano Technology, Pearson Education,2003

Reference Books:	
1.	Rai Choudhury, "MEMS and MOEMS Technology and Applications", PHI Learning Private Limited, India, 2013.
2.	Marc Madou, "Fundamentals of Micro fabrication", CRC press, 1997.
3.	Beenaker and Van Houten, Quantum Transport in Semiconductor Nanostructures, in Solid State Physics v. 44, eds. Ehernreich and Turnbull, Academic Press, 1991.

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

High-3, Medium-2, Low-1

Semester: V		
Mobile Application Development		
Course Code:	**MVJ21IO553**	**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 mobile application development for Internet of Things (IoT) devices.	
2.	Develop programming applications for the different applications.	
3.	Interface the various hardware units in the devices.	
4.	Explain the wirless interfaces.	
5.	Understand the different applications.	

UNIT-I	
IoT Product Conceptualization: IoT Product Development Lifecycle, IoT Product Conceptualizations IoT Programming Fundamentals: Getting Started, IoT Programming setup for LED flashing, Program to display message on screen, Program to read LDR level and display on screen, Android APK to perform read write operation, Particle android APK to control LED intensity, LED switching with HTML interface, Cloud based motion detection, Displaying temperature sensor data on terminal, Publishing sensor values on the cloud, Performing computation on sensor values. **Applications: Wearables, Smart Grids, Industrial IoT** **Video link / Additional online information (related to module if any):** https://youtu.be/BXDxYh1EV2w (nptel video)	**8 Hrs.**
UNIT-II	
IoT Programming Applications: Gas level detection using MQ2 sensor, Blink Android Application for controlling LED from mobile, Integration of Temperature and Gas Sensor with Blynk Mobile Application, Printing real-time Date and Time values on serial terminal, Display temperature value on serial terminal, Display temperature values on 16*2 LCD display Interfacing: Interfacing of Nokia 5110 display, display image on Nokia 5110, Particle Electron displaying battery charging level status, GPS tracking device interface to get coordinates. Applications: Sensor integration, Self-driven cars, smart home.	**8 Hrs.**

Video link / Additional online information (related to module if any): https://youtu.be/BXDxYh1EV2w (nptel video)	
UNIT-III	
IoT Product Hardware Development: Product realization, Connection diagram of IoT product, Engineering board development, Product board customization and optimization, Flowchart of IoT warehouse monitoring system, Wireless communication between the multiple kits, Particle cloud IDE. **Applications: Data acquisition, Communication systems, Data processing** **Video link / Additional online information (related to module if any):** https://youtu.be/BXDxYh1EV2w (nptel video)	**8 Hrs.**
UNIT-IV	
IoT Advance Wireless Interfaces: Bluetooth communication between master and slave module, Data visualization on ThingSpeak cloud using webhook services, Storing data into google excel sheet and sending the sheets to emails. Applications: Smart city, self-driven cars, Farming , Wearables **Video link / Additional online information:** https://youtu.be/BXDxYh1EV2w (nptel video)	**8 Hrs.**
UNIT-V	
IoT Production System: IoT Warehouse Monitoring System, IoT Product Packaging, Future of IoT Product Development. Applications: Asset tracking, Asset Management, Inventory Optimization Video link / Additional online information: https://youtu.be/BXDxYh1EV2w (nptel video)	**8 Hrs.**

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand fundamentals of IOT programming.
CO2	Analyse the various IoT programming applications.
CO3	Develops IoT applications using standardized hardware
CO4	Discuss concepts of IoT Advance Wireless Interfaces and IoT Production System.
CO5	Explain the various applications related to the production system.

Text Books:	
1.	IoT Product Development with Programming: Stepwise programming approach with Particle Development board Kindle Edition by Mahesh Jadhav and Tejas Sarang Patil.

Reference Books:	
1.	Kale, Vivek. Parallel Computing Architectures and APIs: IoT Big Data Stream Proces 1st edition, CRC Press, 2019.

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

High-3, Medium-2, Low-1

Semester: V		
FUZZY LOGIC AND NEURAL NETWORKS		
Course Code:	**MVJ22IO554**	**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	Make the students to understand about the concept of fuzzy set theory and fuzzy systems.	
2	Analyse the fuzzy system-based rules and fuzzy logic decision making.	
3	Understand the basics of Neural Networks and its architecture.	
4	Know about the single and multilayer feed forward networks.	
5	Provide the adequate knowledge about the Associative memory.	

UNIT-I	
Fuzzy Set Theory: Fuzzy versus Crisp, Crisp sets, Fuzzy Sets, Crisp Relations, Fuzzy Relations. **Fuzzy Systems:** Crisp Logic, Predicate Logic, Fuzzy Logic, Fuzzy Quantifiers, Fuzzy Interference, Fuzzy rule-based system, Defuzzification methods, Applications. **Laboratory Sessions/ Experimental learning:** 1. Implementation of Fuzzy operations. 2. Implementation of Fuzzy relations. **Applications:** Facial Pattern recognition, air conditioners, washing machines, vacuum cleaners, antiskid breaking systems. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/108/104/108104157/	**8Hrs.**
UNIT-II	
Fuzzy Rule- Based Systems: Natural Language, Linguistic Hedges, Rule-Based Systems, Canonical Rule Forms, Decomposition of Compound Rules, Likelihood and Truth Qualification, Aggregation of Fuzzy Rules, Graphical Techniques of Inference. **Fuzzy Decision Making :** Fuzzy Synthetic Evaluation, Fuzzy Ordering, Preference and consensus, Multi-objective Decision Making, Fuzzy Bayesian Decision	**8Hrs.**

Method, Decision Making under Fuzzy States and Fuzzy Actions. **Laboratory Sessions/ Experimental learning:** 1. Development of fuzzy membership functions and Fuzzy set properties 2. Implementation of Air Conditioning system using Fuzzy Logic Algorithm. 3. Implementation of Facial Pattern Recognition using Fuzzy Logic Algorithm. **Applications:** Facial Pattern recognition, air conditioners, washing machines, vacuum cleaners, antiskid breaking systems. **Video link / Additional online information:** 1. https://www.digimat.in/nptel/courses/video/117105084/L01.html 2. https://www.digimat.in/nptel/courses/video/127105006/L01.html	
UNIT-III	
Prerequisites: *Fundamentals of computing, Analysation, Mathematical calculations.* **Introduction to Neural Networks:** Basic concepts of Neural networks, Human Brain, Model of an Artificial Neuron, Artificial Neural network architectures, Characteristics of Artificial Neural Networks, Learning methods, Taxonomy of Neural Network Architectures, Early Neural Network Architectures, Rosenblatt's perceptron, ADALINE and MADALINE networks. **Laboratory Sessions/ Experimental learning:** 1. Implementation of Simple Neural Network in pattern recognition/matching. **Applications:** Speech recognition, character recognition, human face recognition **Video link / Additional online information:** 1. https://nptel.ac.in/courses/117/105/117105084/	**8Hrs.**
UNIT-IV	
Back Propagation Networks: Architecture**:** The perceptron model, the solution, Single Layer Artificial Neural Network, Model of multilayer Perceptron. **Back propagation Learning:** Input layer, Hidden layer, Output layer Computations, Error calculation, Training of neural network, Steepest Descent, Effect of learning rate, Adding of Momentum term, Back propagation algorithm. **Laboratory Sessions/ Experimental learning:** 1. Implementation of Perceptron Learning Algorithm for AND gate	**8Hrs.**

2. Application of Back Propagation technique in financial data. **Applications:** Voice Recognition, Financial forecasting **Video link / Additional online information:** 1. https://nptel.ac.in/courses/106/106/106106184/ 2. https://nptel.ac.in/courses/108/108/108108148/	
UNIT-V	
Associative Memory: Auto correlators, Hetero correlators, Wang et al's Multiple Encoding Strategy, Exponential BAM (Bidirectional Associative Memory), Associative memory for Real coded pattern pairs, Applications. **Laboratory Sessions/ Experimental learning:** 1. Development of auto associative network using outer product rule **Applications:** Used for parallel searches, speedup databases, page tables used by virtual memory in neural networks **Video link / Additional online information:** 1. https://nptel.ac.in/courses/117/105/117105084/	**8Hrs.**

Course Outcomes: After completing the course, the students will be able to	
CO1	Acquire the comprehensive knowledge of fuzzy set theory and fuzzy logic systems.
CO2	Apply the concepts of Fuzzy rule-based system and fuzzy decision making in real time applications.
CO3	Analyze the organization of the Brain, Biological and Artificial Neuron Models.
CO4	Design Perceptron Model, Single layer Artificial Neural Network, Back propagation network architecture, Model for Multilayer Perceptron.
CO5	Illustrate the concepts of associative memory in neural networks.

Text Books:	
1.	Rajasekharan and Rai, "Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications" by – PHI Publication.
2.	Timothy. J. Ross, "Fuzzy logic with engineering applications", McGraw Hill International Edition, 1997.
3.	James A Freeman and Davis Skapura, "Neural Networks", Pearson Education, 2002.

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

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

Semester End Examination (SEE):

Total marks: 50+50=100

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

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

High-3, Medium-2, Low-1

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

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

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

building', and Venture Activities.	

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

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand Entrepreneurial Skillset and Mindset
CO2	Understand and analyze industry problems and Enhance customer personas based on market/other feedback
CO3	Understand and develop MVPs
CO4	Understand and apply Business models and Business planning.
CO5	Develop a go-to-market strategy and build a Persuasive sales pitch

Suggested Learning Resources:

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

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

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

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

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

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

Books

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

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

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

Semester End Examination (SEE):

Total marks: 50+50=100

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

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

High-3, Medium-2, Low-1

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	Explain the overview of the research methodology and explain the technique. of defining a research problem and explain the basic ethics in research.	
2	Develop a suitable outline for research studies through various sources of information from literature review and data collection.	
3	Develop an understanding of the results and on analysis of the work carried.	
4	Demonstrate enhanced Scientific writing skills.	
5	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. **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.	**8 Hrs**
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	**8 Hrs**

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.	
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. **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.	**8 Hrs**

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

High-3, Medium-2, Low-1

Semester: VI		
Industrial Internet Of Things		
Course Code:	**MVJ22IO61**	**CIE Marks:50**
Credits:	**L:T:P: 3:0:2**	**SEE Marks: 50**
Hours:	**40 L+ 26 P**	**SEE Duration: 03 Hours**

Course Learning Objectives: The students will be able to

1	Understand the various modes of communications with Internet.
2	Define the basic issues, policy, and challenges on the Internet
3	Infer to get an idea of some of the application areas where Internet of Things can be applied.
4	Understand the cloud and internet environment
5	Understand the various modes of communications with Internet.

UNIT 1

Prerequisites : Basic Knowledge about C or C++ **Introduction to IoT:** Definition – Foundations – Challenges and Issues - Identification - Security. Components in internet of things: Control Units – Sensors – Communication modules –Power Sources – Communication Technologies – RFID – Bluetooth – Zigbee – Wifi – Rflinks –Mobile Internet – Wired Communication-IoT Platform Overview-Raspberry pi-Arduino boards. * **Laboratory Sessions/ Experimental learning:** Comparative study of Oracle, IBM and Cisco Architectures of IoT **Applications:** Sensors in IoT. **Video link / Additional online information (related to module if any):** 1. http://www.theinternetofthings.eu/what-is-the-internet-of-things. 2. https://www.educba.com/applications-of-sensors/ * Programming Assignments are Mandatory.	**8Hrs.**

UNIT 2	
IoT Protocols: Protocol Standardization for IoT-M2M and WSN Protocols-SCADA and RFID Protocols-Issues with IoT Standardization-Protocols-IEEE 802.15.4-BACNet Protocol-Zigbee Architecture - Network layer – APS Layer – Security. * **Laboratory Sessions/ Experimental learning:** Implement an IoT architecture to design an application of your own. **Applications:** IoT Protocol Applications **Video link / Additional online information (related to module if any):** https://inductiveautomation.com/resources/article/what-is-scada https://iotbytes.wordpress.com/application-protocols-for-iot/ https://data-flair.training/blogs/iot-protocols/ https://www.avsystem.com/blog/iot-protocols-and-standards/ * Programming Assignments are Mandatory.	**8 Hrs.**
UNIT 3	
Resource Management in the Internet of Things: Clustering - Software Agents - Data Synchronization - Clustering Principles in an Internet of Things Architecture - The Role of Context - Design Guidelines - Software Agents for Object – Data Synchronization- Types of Network Architectures - Fundamental Concepts of Agility and Autonomy-Enabling Autonomy and Agility by the Internet of Things - The Evolution from the RFID-based EPC Network to an Agent based Internet of Things- Agents for the Behavior of Objects.* **Laboratory Sessions/ Experimental learning:** 1. Weather monitoring using Blynk/ThingSpeak 2. Design a people counter using Node MCU 3. Christmas light show with Arduino **Applications:** RFID Applications **Video link / Additional online information (related to module if any):** RFID Applications:	**8 Hrs.**

1. https://www.digiteum.com/rfid-technology-internet-of-things 2. https://www.uio.no/studier/emner/matnat/ifi/INF5910CPS/h10/undervisningsmateriale/RFID-IoT.pdf * Programming Assignments are Mandatory.	
UNIT 4	
Case Study and IoT Application Development: IoT applications in home- infrastructures security- Industries- IoT electronic equipment's. Use of Big Data and Visualization in IoT Industry 4.0 concepts - Sensors and sensor Node –Interfacing using Raspberry Pi/Arduino- Web Enabled Constrained Devices. * **Laboratory Sessions/ Experimental learning:** Interfacing using Raspberry Pi/Arduino **Applications:** Elements in group **Video link / Additional online information (related to module if any):** 1. https://www.simform.com/home-automation-using-internet-of-things/ 2. https://iot5.net/iot-applications/smart-home-iot-applications/ 3. https://maker.pro/raspberry-pi/tutorial/how-to-connect-and-interface-raspberry-pi-with-arduino# * Programming Assignments are Mandatory.	**8 Hrs.**
UNIT 5	
Web of Things: Web of Things versus Internet of Things-Architecture Standardization for WoT-Platform Middleware for WoT- WoT Portals and Business Intelligence-Cloud of Things: Grid/SOA and Cloud Computing-Cloud Standards –Cloud of Things Architecture-Open Source e-Health sensor platform. **Laboratory Sessions/ Experimental learning:** Web Application Development **Applications:** Multiple IoT domains, Including Smart Home, Industrial, Smart City, Retail, and Health applications **Video link / Additional online information (related to module if any):**	**8 Hrs.**

1. https://www.water-io.com/iot-vs-wot

2. https://www.talend.com/resources/iot-cloud-architecture/

* Programming Assignments are Mandatory.

LABORATORY EXPERIMENTS

1. Write a program for interface Arduino Uno with DHT Sensor to print Humidity and Temperature.
2. Write a program for interface Arduino Uno with Smoke Sensor to print digital and analog output.
3. Write a program for interface Arduino Uno with LM-35 Sensor for analog output result.
4. Write a program for interface Arduino Uno with LDR (Light Dependent Resistor) Sensor.
5. Write a program for interface Arduino Uno with Magnetic Sensor.
6. Write a program for sending the data of Serial communication between Gateway and Arduino.
7. Write a program for establishing Wifi IOT module with Arduino uno.
8. Write a program for Communication between gateways to an end node.
9. Write a program for Send data on Thing speak with end node and display those data on LCD.

Course outcomes:	
CO1	Identify the components of IoT.
CO2	Analyze various protocols of IoT.
CO3	Design portable IoT using appropriate boards
CO4	Develop schemes for the applications of IOT in real time scenarios.
CO5	Designing various programs to interface sensors with Arduino and understanding the communication

Text Books:	
1.	Honbo Zhou, “The Internet of Things in the Cloud: A Middleware Perspective” -CRC Press-2012.
2.	Dieter Uckelmann, Mark Harrison, “Architecting the Internet of Things”, Springer2011.
Reference Books:	
1.	Arshdeep Bahga, Vijay Madisetti, “Internet of Things (A Hands-On-Approach)”, VPT, 2014.
2.	Olivier Hersent, David Boswarthick, Omar Elloumi, “The Internet of Things – Key applications and Protocols”, Wiley, 2012.
3.	Luigi Atzori, Antonio Lera, Giacomo Morabito, “The Internet of Things: A Survey”, Journal on Networks, Elsevier Publications, October 2010.

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of three quizzes are conducted along with tests. 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 and assignment are added to get marks out of 100 and report CIE for 50 marks.

Laboratory- 50 Marks

The laboratory session is held every week as per the timetable and the performance of the student is evaluated in every session. The average of the marks over number of weeks is considered for 30 marks. At the end of the semester a test is conducted for 10 marks. The students are 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**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**
CO2	**3**	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**
CO3	**3**	**3**	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**3**
CO4	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**2**	**2**	**2**	**-**	**3**
CO5	**3**	**3**	**3**	**3**	**-**	**-**	**2**	**2**	**3**	**2**	**-**	**3**

High-3, Medium-2, Low-1

Semester: VI		
Microcontroller and Embedded Systems		
Course Code:	**MVJ22IO62**	**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 fundamental operating concepts of microprocessors and microcontrollers.
2	Understand the basic architecture of various microprocessors and micro controllers
3	Knowledge with a solid theoretical basis as well as comprehensive professional understanding of Arduino.
4	Understand the concepts of solid theoretical basis Raspberry Pi.
5	Demonstrate the use of different controllers in IoT applications.

UNIT I	
Microprocessors: 8085-architecture, operation, pin configuration and functions, bus organization, control signal generation for external operations- fetch, IO/M, read/write, machine cycles and bus timings. Addressing mode, instruction set, Overview/concept of peripheral interfacing devices-8251, 8253, 8255 and 8279.	8Hrs.
UNIT 2	
Microcontrollers: 8051-architecture, operation, pin configuration and functions, memory organization, register, I/O ports, addressing modes, instruction sets, instruction classification. Assembly language programming, Interrupts in 8051. Timer/Counter programming for time delay generation and waveform generation. Interfacing with ADC, DAC, LEDs and seven segment display.	8Hrs.
UNIT 3	
Arduino: Introduction to the Arduino, creating an Arduino programming Environment, Arduino IDE, creating an Arduino program, Arduino Libraries, Analog and Digital Interfacing, Adding	8Hrs.

Interrupts, communicating with devices and sensors	
UNIT 4	
Raspberry Pi: Introduction to the Raspberry Pi, basic functionality of the Raspberry Pi board and its processor, setting and configuring the board, programming on Raspberry Pi, python programming environment, python expressions, general purpose IO pins, Protocol pins, RPi, GPIO library, communicating with devices and sensors.	8Hrs.
UNIT 5	
IoT application using Arduino and Raspberry Pi: Arduino- Playing tones and a melody, alphanumeric LCD display, speed and direction control, temperature and humidity sensor interfacing. Raspberry Pi -controlling LED, interfacing an LED and Switch, Interfacing a Light Sensor (LDR), camera interfacing etc.	8Hrs.

Course Outcomes: After completing the course, the students will be able to	
CO1	Distinguish various types of processor architectures
CO2	Describe architecture, memory organization of 8085 and 8051
CO3	Create sketches, libraries and Arduino development environment
CO4	Design Raspberry Pi hardware and implement program.
CO5	Develop interfacing between different sensors and Arduino / Raspberry Pi for IoT Applications

Text Books:	
1.	"8085 Microprocessors Architecture Application and Programming", Ramesh S. Goankar, Penram International, 5th Edition.
2.	"The 8051 Microcontroller", Kenneth J. Ayala, Cangage learning, 3rd Edition
3	"Arduino Cookbook", Michael Margolis, O'Reilly Media, Inc., 1st Edition

Reference Books:	
1.	"Arduino for beginners: Essential Skills Every Maker Needs", John Baichtal, Person Education, Inc., 1st Edition
2.	"Raspberry Pi User Guide", Eben Upton and Gareth Halfacree, August 2016, 4th Edition, John Wiley & Sons
3	"Programming with Raspberry Pi: Getting Started with Python", Simon Monk, January 2012, McGraw Hill Professional.

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

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

Semester End Examination (SEE):

Total marks: 50+50=100

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

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

High-3, Medium-2, Low-1

Semester: VI		
Application of IoT in Robotics		
Course Code:	**MVJ22IO631**	**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 basics of Internet of Things (IoT), and its execution using multiple robotic sensors	
2	Understand Internet of Robotic Things (IoRT) and its various implementations in industry and automation	
3	Design and Implement IoT and Robotics application in autonomous driving and health care	
4.	Understand the basic concepts of Autonomous Vehicles	
5.	Understand the basic introduction of Industrial IoT Architecture.	

UNIT I	
Introduction to IoT and Vision systems: Machine Vision, optoelectronic sensors, 3D & 2D machine vision technologies, robot navigation, control schemes, motion controllers, intelligent algorithms, and vision systems. **Video link / Additional online information :** **https://www.youtube.com/watch?v=WUYAjxnwjU4&list=PLE7VH8RC_N3bpVn-e8QzOAHziEgmjQ2qE**	**8Hrs.**
UNIT 2	
Robotic Sensors: Optical sensors and actuators; Mechanical sensors and actuators; Acoustic sensors and actuators; Performance characteristics of sensors and actuators. **Video link / Additional online information:** 1. **https://www.youtube.com/watch?v=nE1C4ghfvac&list=PLgMDNELGJ1CbufZjqWa8uoSlQWKqVwPN7**	**8Hrs.**
UNIT 3	
Internet of Robotic Things : Communication architecture for IoRT; Decentralized and automated IoT infrastructure using Blockchain; IoRT Platforms Architecture, IoRT applications. **Applications:**	**8Hrs.**

Video link / Additional online information: **1. https://www.youtube.com/watch?v=lRm9GiGoZKg&list=PLLy_2iUCG87AjAXKbNMiKJZ2T9vvGpMB0**	
UNIT 4	
Autonomous Vehicle Systems: Introduction to Autonomous Driving; Perception in Autonomous Driving; Robot Operating System (ROS) Overview - Client Systems for Autonomous Driving - Decision planning and control in autonomous vehicle systems - Cloud Platform for Autonomous Driving. **Video link / Additional online information :** **1. https://www.youtube.com/watch?v=iTnbD180VMg**	**8Hrs.**
UNIT 5	
Industrial Internet of Things : IIoT Architecture; IIoT Applications and Challenges; IIoT Standards and Frameworks; IIoT security concerns **Video link / Additional online information:** **1.** https://www.youtube.com/watch?v=hvaBonZMRQ&list=PLWbMIWDTOauBvP0ZxvoIshg55WPMF37UI	**8Hrs.**

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand IoT ecosystem in robotic paradigm
CO2	Analyze IoT infrastructure and develop IoRT applications
CO3	Apply IoT in robotics over different platforms
CO4	Implement Cloud robotics in automations
CO5	Implement automated applications using multiple robotic sensors for IIoT.

Text Books:	
1.	Vermesan, Ovidiu, and Joël Bacquet, eds., "Cognitive Hyperconnected Digital Transformation: Internet of Things Intelligence Evolution", 1st edition, River Publishers, 2017.

Reference Books:	
1.	A.K.Gupta, S.K.Arora, and J.Riescher, "Industrial Automation and Robotics", 1 st edition, Mercury Learning and Information LLC,2017
2.	A.K Dubey, A.Kumar, and S.R Kumar., AI and IoT-based Intelligent Automation in Robotics, 1st edition. Wiley, 2020

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

High-3, Medium-2, Low-1

Semester: VI		
MACHINE LEARNING		
Course Code:	**MVJ22IO632**	**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 algorithm. Use an appropriate data set for building the decision tree and apply this	**8Hrs.**

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.	**8Hrs.**

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:** 1. https://nptel.ac.in/courses/106106139	

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

High-3, Medium-2, Low-1

Semester: VI		
Industrial and Medical IoT		
Course Code:	**MVJ22IO633**	**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	Develop knowledge in Industrial Internet of Things (IIoT) fundamentals.
2	Gain conceptual understanding of networking and wireless communication protocols used in IIoT deployments
3	Understand the various Internet of Things (IoT) Protocols like COAP, MQTT.
4	Enables healthcare professionals to be more watchful and connect with the patients proactively.
5	Gain knowledge in Low power and wireless connectivity to other devices and the cloud

UNIT 1	
***Prerequisites**: IOT, Medical Electronics* **Industrial IOT Introduction:** Introduction to IOT, what is IIOT? IOT Vs. IIOT, History of IIOT, Components of IIOT - Sensors, Interface, Networks, Key terms – IOT Platform, Interfaces, API, clouds, Data Management Analytics, Mining &Manipulation; Role of IIOT in Manufacturing Processes Use of IIOT in plant maintenance practices, Sustainability through Business excellence tools Challenges & Benefits in implementing IIOT **Laboratory Sessions/ Experimental learning:** **1.** Long-Distance Serial Link Between Two Arduino Devices **2.** IoT on the MATLAB Platform **Applications:** Automated and remote equipment management and monitoring, Pinpoint inventories **Video link / Additional online information :** **1.** http://www.nitttrc.edu.in/nptel/courses/video/106105195/L32.html **2.** https://www.henryharvin.com/blog/iot-courses-online/	8Hrs.

UNIT 2	
IIoT Architecture: IOT components; Various Architectures of IOT and IIOT, Advantages & disadvantages, Industrial Internet - Reference Architecture; IIOT System components: Sensors, Gateways, Routers, Modem, Cloud brokers, servers, and its integration, WSN, WSN network design for IOT **Laboratory Sessions/ Experimental learning:** 1. Experiment on Gate way as a service deployment in IoT Toolkit 2. Design of mixer **Applications:** Internet gateways: , Edge or fog computing, Cloud or data center **Video link / Additional online information:** **1.** https://onlinecourses.nptel.ac.in/noc20_cs66/preview **2.** https://www.youtube.com/watch?v=-RHYCpsn8TA **3.** https://www.youtube.com/watch?v=xsZ9YhVy-7g	8Hrs.
UNIT 3	
IoMT Introduction; What are IoMT and its working? Tracking assets and resources, Internet of things in hospitals, collection and integration of clinical data, Major benefits of IoT in healthcare, Disadvantages of IoT in healthcare **Laboratory Sessions/ Experimental learning:** **1.** Experiment on HTTP-to-CoAP semantic mapping Proxy in IoT Toolkit. **Applications:** Activity Trackers During Cancer Treatment, Heart Monitors with Reporting, Medical Alert Systems **Video link / Additional online information:** **1.** https://www.youtube.com/watch?v=uDzRyrA1Z5Q **2.** https://www.youtube.com/watch?v=9lNB7DK1-oo	8Hrs.
UNIT 4	
Healthcare Technologies: Home Monitoring System for Aged Care, Smart Medicinal Packages for Medication Adherence, Smart Drug Delivery System for Automated Drug Dispensation, Connected Rural Healthcare Consultation, Population and Environment Monitoring of Infectious Diseases	8Hrs.

Laboratory Sessions/ Experimental learning: **1.** Experiment on Gate way as a health care service deployment in IoT Toolkit. **Applications:** Remote patient monitoring, Glucose monitoring, Ingestible Sensors, Trackable Inhaler, Wearables to Fight Depression, Connected Contact Lenses **Video link / Additional online information:** 1. http://nitttrc.edu.in/nptel/courses/video/106105166/L58.html 2. https://www.youtube.com/watch?v=UvQFH5RGOnU 3. https://www.youtube.com/watch?v=_qO9nETG7QU 4. https://onlinecourses.nptel.ac.in/noc22_cs53/preview	
UNIT 5	
Application Design & Case Study: Wireless Patient Monitor system, Wearable Fitness & Activity Monitor Application Design: Design of IOT based pulse oximeter, Reliability of IoT-Aware BPNM Healthcare process **Laboratory Sessions/ Experimental learning:** 1. Speed Control of motors using PWM with python programming. 2. Create Wireless network of sensors using Zigbee. **Applications:** leap fitness step counter, Strava, Pacer Pedometer **Video link / Additional online information :** 1. https://nevonprojects.com/wireless-patient-health-monitor/ 2. https://www.youtube.com/watch?v=mlTuag3fPA0 https://nptel.ac.in/courses/106105160	8Hrs.
Course Outcomes: After completing the course, the students will be able to	

CO1	Knowledge of the basic introduction of Industrial IOT and Medical IOT
CO2	Distinguishing the technical and industrial requirement procedures for IIOT applications
CO3	Describe various applications using IIOT architectures
CO4	Study about Internet of Medical Things (IoMT) and its applications in Healthcare industry
CO5	Design various applications using IoT in Healthcare Technologies.

Text Books:	
1.	Veneri, Giacomo, and Antonio Capasso- Hands-on Industrial Internet of Things: Creat Powerful Industrial IoT Infrastructure Using Industry 4.0, 1stEd., Packt Publishing Ltd, 2018.
2.	D. Jude Hemanth and J. Anitha George A. Tsihrintzis- Internet of Medical Things Ren Healthcare Systems and Applications, covered by Scopus

Reference Books:	
1.	Alasdair Gilchrist- Industry 4.0: The Industrial Internet of Things, 1st Ed., Apress, 2017
2.	Reis, Catarina I., and Marisa da Silva Maximiano, eds.- Internet of Things and advanced application in Healthcare, 1st Ed., IGI Global, 2016.

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: VI		
CRYPTOGRAPHY & NETWORK SECURITY		
Course Code:	**MVJ22IO634**	**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	State 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, Secure Network Communication **Laboratory Sessions/ Experimental learning:** 1. Breaking the Shift Cipher **Video link / Additional online information :** 1. https://nptel.ac.in/courses/117103063/ 2. https://nptel.ac.in/courses/117107095/ 3. http://nptelvideos.com/video.php?id=2441	**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	**8Hrs.**

operation, Evaluation Criteria for Advanced Encryption standard, The AES Cipher. **Laboratory Sessions/ Experimental learning:** 1. Breaking the Mono-alphabetic Substitution Cipher **Applications:** Wireless securities, processor security, file encryption. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/117106087/ 2. https://www.youtube.com/watch?v=ANHTfY9feZg 3. https://nptel.ac.in/courses/108102095/	
UNIT 3	
Public Key Cryptography: Principles of public key Cryptosystem, The RSA algorithms, Key management, Diffie – Hellman key exchange, PRNG. **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. Diffie-Hellman Key Establishment **Applications:** Random number generator, permutation generator **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=m4sjTt7rhow 2. https://nptel.ac.in/courses/117101106/ 3. https://nptel.ac.in/courses/108108114/	**8Hrs.**
UNIT 4	
Intruders, Intrusion Detection, Password Management, Malicious software programs – Viruses and related Threats, Virus Countermeasures **Firewall:** Need of firewalls, Firewall Characteristics, Types of Firewalls,Design Principles, Trusted Systems **Laboratory Sessions/ Experimental learning:** 1. Digital Signatures Scheme 2. Cryptographic Hash Functions and Applications (HMAC) **Applications:** Cyber-attacks, Cybercrime, Cyber security. **Video link / Additional online information :**	**8Hrs.**

1. https://nptel.ac.in/courses/108105113/ 2. https://nptel.ac.in/courses/117106086/	
UNIT 5	
Transport Level Security: Web Security Considerations, Secure Sockets Layer, Transport Layer Security, HTTPS, Secure Shell (SSH) **IP Security:** IP Security Overview, IP Security Policy, ESP, Combining Security Associations. **Laboratory Sessions/ Experimental learning:** 1. Program for SSL operation. **Applications:**Encryption , message authentication and integrity, and replay attack protection **Video link / Additional online information:** https://nptel.ac.in/courses/117102052/	**8Hrs.**

Course Outcomes: After completing the course, the students will be able to	
CO1	Analyse the importance of security attacks, service mechanism, basic network security model and its applications.
CO2	Design and develop simple cryptography algorithms and Explain basic structure of DES and AES
CO3	Apply the concepts of Primes, Testing, Factorization, Chinese remainder theorem and RSA Cryptosystem.
CO4	Illustrate the concept public key cryptography & apply digital signatures in email. Processing and Explain usages of email-security, IP security and web security.
CO5	Describe different techniques used in key exchange protocols.

Text Books:	
1.	Cryptography and Network Security- Behrouz A Forouzan, DebdeepMukhopadhyay,Mc-GrawHill, 3rd Edition, 2015
2.	Cryptography and Network Security- William Stallings, Pearson Education, 7th Edition.

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

High-3, Medium-2, Low-1

Semester: VI		
Real Time Operating Systems		
Course Code:	**MVJ22IO641**	**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	Acquire knowledge about concepts related to OS for Embedded Systems.	
2	Gain knowledge about different types of scheduling algorithms suitable for embedded real time systems.	
3	Iintroduce the principles of Inter process communication and multitasking applications.	
4	Explain the architecture of Linux Kernel and RTOS applications to Linux.	
5	Discuss Real-Time Programming in Linux and µC linux	

Module-1	
Prerequisites: *Basic Concepts of Operating systems and basics of task management and task scheduling.* **Real Time Systems:** Introduction, issues in real time computing, Structure of a real time system, task classes, performance measures for real time systems, task assignment and scheduling algorithms, mode changes, Fault tolerant scheduling, Real Time Models. **Laboratory Sessions/ Experimental learning:** 1. Create an application that creates two tasks that wait on a timer whilst the main task loops. 2. Create an application that creates tasks and scheduling tasks. **Applications:** Kiel RTOS for ARM (Keil RTX - ARM) **Video link / Additional online information:** 1. https://nptel.ac.in/courses/106/105/106105036/	**8Hrs.**
Module-2	
µC/OS- II RTOS Concepts: Foreground/Background process, Resources, Tasks, Multitasking, Priorities, Schedulers, Kernel, Exclusion, Inter task communication,	**8Hrs.**

Interrupts, Clock ticks, µC/OS- II Kernel structure , µC/OS- II Initialisation, Starting µC/OS-II. **Laboratory Sessions/ Experimental learning:** 1. Write an Keil RTOS code that demonstrates the multitasking priority. 2. Write an Keil RTOS code that assigns priority and sets the time slice period to illustrate time slicing. **Applications:** 1. Email Spam and Malware Filtering 2. File Managers and Resource management systems **Video link / Additional online information:** **1.** https://nptel.ac.in/courses/106/106/106106198/ **2.** http://www.nptelvideos.in/2012/11/real-time-systems.html	
Module-3	**8Hrs.**
µ**C/OS- II RTOS Functions:** Task Management, Time management, Semaphore management, Mutual exclusion semaphore, Event Management, Message management, Memory management, porting µC/OS- II – comparison and study of various RTOS like QNX- VX Works-Psos. **Laboratory Sessions/ Experimental learning:** **1.** Write an Keil RTOS code to manage tasks to handle semaphore to overcome mutual exclusion. **2.** Demonstrate Porting of µC/OS- II in Embedded processor. **Applications:** Traffic light controller system **Video link / Additional online information:** 1. https://nptel.ac.in/courses/106/105/106105215/ https://nptel.ac.in/courses/106/105/106105172/	
Module-4	**8Hrs.**
Embedded Linux: Embedded Linux, Features - Embedded Linux Distributions -Architecture of Embedded Linux - Linux Kernel Architecture – User Space -Root File System - Linux Start-Up Sequence - GNU Cross Platform Tool chain -Porting Traditional RTOS Applications to Linux.	

Laboratory Sessions/ Experimental learning: 1. Write an application that display two different messages in LCD display in two lines. **Applications:** Smart Mobile Phone operating system development process demonstration. **Video link / Additional online information:** **1.** http://1.https//nptel.ac.in/courses/11706087/ **2.** https://nptel.ac.in/courses/106/106/106106198/	
Module-5	**8Hrs.**
Real time Linux: Linux and Real-Time, Real-Time Programming in Linux, Hard Real-Time Linux - Building and Debugging, Building the Kernel, Integrated Development Environment, Kernel Debuggers, Embedded Drivers, Boardsupport packages, Introduction to µC linux. **Laboratory Sessions/ Experimental learning:** 1. Creating and UART driver for USB bus. **Applications:** Demonstration of ABS system in automobiles **Video link / Additional online information:** 1. https://nptel.ac.in/courses/117102059/ **2.** http://www.nptelvideos.in/2012/11/real-time-systems.html	

Course outcomes:	
CO1	Summarize fundamental principles for programming of real time systems with time and resource limitations.
CO2	Develop RTOS based embedded real time applications.
CO3	Analyze the functions of real time operating systems .
CO4	Utilize RTOS software tool chain for Embedded Applications.
CO5	Develop real time kernals and Embedded Drivers.
Text Books:	
1.	Krishna C.M., Kang G. Shin, “Real Time Systems”, Tata McGraw-Hill Edition, 2010.
2.	Philip A.Laplante, “Real Time Systems Design and Analysis-An Engineers Handbook”, II Edition-IEEE Press, IEEE Computer Society Press, 2001.

Reference Books:	
1.	Jean J Labrosse, “MicroC/OS-II The Real Time Kernel” II Edition, CMP Books, 2002.
2.	P.Raghavan, Amol Lad, Sriram Neelakandan, “Embedded Linux System Design and Development”,Auerbach Publications, Taylor& Francis Group, 2006.
3.	Christopher Hallinan, “Embedded Linux Primer, A Practical, Real-World Approach”, II Edition PearsonEducation, Inc., 2011.

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

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

Semester End Examination (SEE):

Total marks: 50+50=100

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

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

High-3, Medium-2, Low-1

Semester: VI		
Sensor Technology		
Course Code:	**MVJ22IO642**	**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.	

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

Laboratory Sessions/ Experimental learning: 1. Strain measurement with Bridge circuit **Applications:** Patient monitoring in medical applications, Manufacturing and industrial equipment and motorsport applications. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/108/105/108105064/ 2. https://nptel.ac.in/courses/108/106/108106165/	
Module-3	**8Hrs.**
Reactance Variation and Electromagnetic Sensors: Capacitive sensors: Variable capacitor and Differential capacitor**,** Inductive sensors:Variable reluctance sensors, Eddy current sensors, Linear Variable Differential Transformers (LVDTs), Electromagnetic sensors: Sensors based on Faraday's Law and Hall effect sensors. **Laboratory Sessions/ Experimental learning:** 1. Develop a displacement measurement system with inductive sensors (LVDT) **Applications:** Smart phones, Industrial automation, Communication, automobile and aerospace. **Video link / Additional online information:** https://nptel.ac.in/courses/108/105/108105064/	
Module-4	**8Hrs.**
Self-Generating sensors: Thermoelectric sensors, Piezoelectric sensors, Pyroelectric sensors, Photovoltaic sensors, Electrochemical sensors, Proximity sensors. **Laboratory Sessions/ Experimental learning:** 1. Develop a sensor system for force measurement using piezoelectric sensors **Applications:** Temperature controlled devices: refrigeration and air conditioning, Alarm clocks, Medical devices, PIN pads, photonics and pharmaceutical compositions, Robotics. **Video link / Additional online information:** https://nptel.ac.in/courses/108/105/108105064/	
Module-5	**8Hrs.**
Digital sensors: Position encoders,Resonant sensors: SAW sensors, Vibrating wire strain gages, Vibrating cylinder sensors, Digital flow meters **Other sensing methods:** Charge-Coupled sensors – Fundamentals & types of CCD, Fiber-	

Optic sensors, Ultrasonic-based sensors, Gyroscope sensors, optical sensors, IR sensors. **Laboratory Sessions/ Experimental learning:** 1. Measure strain, temperature and pressure using LabVIEW. **Applications:** Industries, digital cameras, photocopiers. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/108/105/108105064/ 2. https://nptel.ac.in/courses/112/103/112103174/	

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

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

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

Semester End Examination (SEE):

Total marks: 50+50=100

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

CO-PO Mapping

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

High-3, Medium-2, Low-1

Semester: VI

Robotics and Automation		
Course Code:	**MVJ22IO643**	**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	Explain the history, concept development and key components of robotics technologies.	
2	Knowledge about the concept of interfacing actuators and other components	
3	Understand basic mathematics manipulations of spatial coordinate representation and transformation.	
4	Learn basic robot forward and inverse kinematic problems	
5	Analyze basic robotic dynamics, path planning and control problems	

Module-1	
Basic concepts in robotics: Definition, anatomy of robot, basic structure of robot, Specifications and Classification of robot, Safety Measures in robotics, Industrial Applications of Robots. Drives for robots: Electric, hydraulic and pneumatic. Sensors: Internal-External, Contact-noncontact, position, velocity, force, torque, proximity and range. **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.**
Module-2	
Robot drivers, Sensors and Vision : Vision Introduction to techniques, Image acquisition and processing, Different types of grippers- Mechanical, Magnetics ,vacuum, Adhesive, Gripper force Analysis & Gripper Design , overview of actuators, Power and torque, Acceleration and velocity Specifications and characteristics of Stepper motors, AC motors, DC motors and servomotors.	**8Hrs.**

Laboratory Sessions/ Experimental learning: 1. Interface motors using various Motor drivers. **Applications:** Industrial application, agriculture robots, surgical robots **Video link / Additional online information:** 1. https://nptel.ac.in/courses/112/105/112105249/ 2. https://nptel.ac.in/courses/112/101/112101098/	
Module-3	
Robot Kinematics and Dynamics: Direct and inverse kinematics for industrial robots for position and orientation, Redundancy, Manipulator, direct and inverse velocity. Lagrangian formulation, Link inertia tensor and manipulator inertia tensor, Newton –Eller formulation for RP and RP manipulators, Trajectory planning. **Laboratory Sessions/ Experimental learning:** 1. Interface servo motors to form gripper. **Applications:** Pick and Place, Excavators, 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.**
Module-4	
Robot Kinematics: Dynamics and Programming methods, Robot language classification, Robot language structure, KINEMATICS AND PATH PLANNING: Solution of inverse kinematics problem – multiple solution jacobian work envelop, hill climbing techniques, robot programming languages elements and its functions. Simple programs on Sensing distance and direction, Line Following Algorithms, Feedback Systems. **Laboratory Sessions/ Experimental learning:** 1. Design algorithm for Maze solving robot. **Applications:** Defence, Survillience, Autonomous Vehicle. **Video link / Additional online information:**	**8Hrs.**

1. https://nptel.ac.in/courses/112/105/112105249/ 2. https://nptel.ac.in/courses/112/101/112101098/	
Module-5	
Developing and building a robot, Models of flexible links and joints, Robotic arm, Components and structure, Types of joints and workspace, Design models for mechanic arms and lifting systems Multiple robots, machine interface, robots in manufacturing and non- manufacturing applications, robot cell design, selection of robot. Laboratory Sessions/ Experimental learning: 1. Robots in material handling and assembly. Human Robot Interaction **Applications:** Humanoid, Robotic Arms. **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	Implement basic mathematics manipulations of spatial coordinate representation and Transformation.
CO4	Solve basic robot forward and inverse kinematic problems
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 McGraw HilL
Reference Books:	

1.	Robert J. Schilling , Fundamentals of Robotics- Analysis and Control, Prentics Hall India.
2.	Robotics Technology and Flexible Automation by S.R.Deb, S. Deb, Tata McGraw Hill.
3.	Robot Motion and Control (Recent Developments) by M.Thoma& M. Morari.

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

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

Semester End Examination (SEE):

Total marks: 50+50=100

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

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

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

High-3, Medium-2, Low-1

Semester: VI		
Introduction to Industrial IOT		
Course Code:	**MVJ22IO644**	**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 impart basic concepts of IIoT and its implementation	
2	To Understand potential gains of IIoT business incentives and models	
3	To understand the working of IIoT through case studies	
4	To understand the technical issues required to build an IIoT network	
5	To provide business and technology participants with the information required in deploying and delivering an IIoT network.	

Module-1	
Introduction to the Industrial Internet: Basic introduction, What Is the Industrial Internet?, The Power of 1%, Key IIoT Technologies, Why Industrial Internet and Why Now?, Catalysts and Precursors of the IIoT, Innovation and the IIoT, Intelligent Devices, Key Opportunities and Benefits, The Digital and Human Workforce Industrial Internet Use-Cases: Healthcare, Oil and Gas Industry, Smart Office, Logistics and the Industrial Internet, IOT Innovations in Retail. **Video link:** http://www.nitttrc.edu.in/nptel/courses/video/106105195/lec6.pdf https://www.academia.edu/38736167/The_Industrial_Internet_of_Things_Industry_4_0 https://nptel.ac.in/courses/106105195	**8Hrs.**
Module-2	
IIoT Reference Architecture: Introduction, The IIC Industrial Internet Reference, Architecture, Industrial Internet Architecture Framework (IIAF), Industrial Internet Viewpoints, The Business Viewpoint, The Usage Viewpoint, The Functional Viewpoint, Implementation Viewpoint, The Three-Tier Topology, Connectivity, Key System Characteristics, Data Management, Advanced Data	**8Hrs.**

Analytics. **Video link:** http://www.nitttrc.edu.in/nptel/courses/video/106105195/lec6.pdf https://www.academia.edu/38736167/The_Industrial_Internet_of_Things_Industry_4_0 https://nptel.ac.in/courses/106105195	
Module-3	**8Hrs.**
Designing Industrial Internet Systems: Introduction, The Concept of the IIoT, The Proximity Network, WSN Edge Node, WSN Network Protocols, Legacy Industrial Protocols, Modern Communication Protocols, Wireless Communication Technologies, Gateways. **Video link:** http://www.nitttrc.edu.in/nptel/courses/video/106105195/lec6.pdf https://www.academia.edu/38736167/The_Industrial_Internet_of_Things_Industry_4_0 https://nptel.ac.in/courses/106105195	
Module-4	**8Hrs.**
Introducing Industry 4.0: Introduction, Defining Industry 4.0, Why Industry 4.0 and Why Now?, Four Main Characteristics of Industry 4.0, The Value Chain, Industry 4.0 Design Principles, Building Blocks of Industry 4.0, Industry 4.0 Reference Architecture. **Video link:** http://www.nitttrc.edu.in/nptel/courses/video/106105195/lec6.pdf https://www.academia.edu/38736167/The_Industrial_Internet_of_Things_Industry_4_0 https://nptel.ac.in/courses/106105195	
Module-5	**8Hrs.**
Smart Factories: Introducing the Smart Factory, Smart Factories in Action, Why Smart Manufacturing Is Important, Winners and Losers?, Real-World Smart Factories, Industry 4.0: The Way Forward. Video link: http://www.nitttrc.edu.in/nptel/courses/video/106105195/lec6.pdf https://www.academia.edu/38736167/The_Industrial_Internet_of_Things_Industry_4_0 https://nptel.ac.in/courses/106105195	

Course outcomes:	
CO1	Define IIoT and Industry 4.0, and list the uses of IIoT
CO2	Describe the IIoT architecture
CO3	Discuss the concepts used to design and implement IIoT.
CO4	Explain the need of Industry 4.0 and design principles.
CO5	Discuss the development of smart factories based in IIoT and Industry 4.0 protocols

Text Books:	
1.	"Industry 4.0: The Industrial Internet Of Things" by Alasdair Gilchrist, Apress Publications, 2016

Reference Books:	
1.	"Introduction to Industrial Internet of Things and Industry 4.0" by Sudip Misra, Chandana Roy, Anandarup Mukherjee, CRC Press, 2020

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

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

Semester End Examination (SEE):

Total marks: 50+50=100

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

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

High-3, Medium-2, Low-1

PROJECT PHASE – I		
Course Code:	**MVJ22IOP65**	**CIE Marks:50**
Credits:	**L:T:P: 0:0:4**	**SEE Marks: 50**
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.	

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

Scheme of Evaluation:

Internal Marks: The Internal marks (50 marks) evaluation shall be based on Phase wise completion of the project work, Project report, Presentation and Demonstration of the actual/model/prototype of the project.

CO-PO Mapping

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

High-3, Medium-2, Low-1

Semester: VI		
Microcontroller and Embedded Systems Laboratory		
Course Code:	**MVJ22IOL66**	**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	Experiment the basic programs using the microcontroller	
2	Developing different logical solutions for different programs using microcontrollers	
3	Apply the basics of programming language in interfacing with the hardware kits.	

LABORATORY EXPERIMENTS
PART A
Conduct the following experiments by writing program using ARM7TDMI/LPC2148 using an evaluation board/simulator and the required software tool. 1. Write a program to multiply two 16 bit binary numbers. 2. Write a program to find the sum of first 10 integer numbers. 3. Write a program to find factorial of a number. 4. Write a program to add an array of 16 bit numbers and store the 32 bit result in internal RAM 5. Write a program to find the square of a number (1 to 10) using look-up table. 6. Write a program to find the largest/smallest number in an array of 32 numbers . 7. Write a program to arrange a series of 32 bit numbers in ascending/descending order. 8. Write a program to count the number of ones and zeros in two consecutive memory locations
PART B
Conduct the following experiments on an ARM7TDMI/LPC2148 evaluation board using evaluation version of Embedded 'C' & Keil Uvision-4 tool/compiler. 9. Display “Hello World” message using Internal UART. 10. Interface and Control a DC Motor. 11. Interface a Stepper motor and rotate it in clockwise and anti-clockwise direction.

12. Determine Digital output for a given Analog input using Internal ADC of ARM controller.

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

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

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

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

Course outcomes:

CO1	Distinguish various types of processor architectures
CO2	Describe architecture, memory organization of 8085 and 8051
CO3	Create sketches, libraries and Arduino development environment
CO4	Design Raspberry Pi hardware and implement program.
CO5	Develop interfacing between dif erent sensors and Arduino / Raspberry Pi

CO-PO Mapping

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

High-3, Medium-2, Low-1

B.E, VII Semester, Industrial Internet of Things

Semester: VII		
Big Data Analytics		
Course Code:	**MVJ22IO71**	**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 Big Data Platform and its Use cases	
2	Provide an overview of Apache Hadoop	
3	Provide HDFS Concepts and Interfacing with HDFS and Understand Map Reduce Jobs	
4	Provide hands on Hadoop Eco System	
5	Explain different approaches for text analysis and big data	

Module-1	**8Hrs.**
Introduction To Big Data : Types of Digital Data, Introduction to Big Data, Analysing Data with Unix tools, The Big Data Foundation, Big Data Computing Platforms (or Computing Platforms That Handle the Big Data Analytics Tsunami), Big Data Computation, More on Big Data Storage, Big Data Computational Limitations, Big Data Emerging Technologies. **Video link** : https://www.digimat.in/nptel/courses/video/106104189/L01.html	
Module-2	**8Hrs.**
Basics of Hadoop: Hadoop Architecture, The Design of HDFS, HDFS Concepts, Command Line Interface, Hadoop file system interfaces, Data flow, Data Ingest with Flume and Scoop and Hadoop archives, Hadoop I/O: Compression, Serialization, Avro and File-Based Data structures. Anatomy of File Write and Read, NameNode, Secondary NameNode, and DataNode, Hadoop MapReduce paradigm, Map and Reduce tasks, Job, Task trackers - Cluster Setup – SSH & Hadoop Configuration – HDFS Administering –Monitoring & Maintenance. Analysing Data with Hadoop, Hadoop Streaming, IBM Big Data Strategy, Introduction to Infosphere BigInsights and Big Sheets. **Video link :** https://www.digimat.in/nptel/courses/video/106104189/L04.html	
Module-3	**8Hrs.**
Map Reduce: Anatomy of a Map Reduce Job Run, Failures, Job Scheduling, Shuffle and Sort, Task Execution, Map Reduce Types and Formats, Map Reduce Features. **Hadoop Ecosystem And Yarn**: Hadoop ecosystem components - SPARK, FLUME, Hadoop	

2.0 New Features- NameNode High Availability, HDFS Federation, MRv2, YARN. **Video link** : https://www.digimat.in/nptel/courses/video/106104189/L04.html	
Module-4	**8Hrs.**
Pig: Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User Defined Functions, Data Processing operators. **Hive:** Hive Shell, Hive Services, Hive Metastore, Comparison with Traditional Databases, HiveQL, Tables, Querying Data and User Defined Functions. **Zookeeper** - how it helps in monitoring a cluster, HBase uses Zookeeper and how to Build Applications with Zookeeper. **Video link** : https://www.digimat.in/nptel/courses/video/106104189/L06.html	
Module-5	**8Hrs.**
Understanding Text Analytics and big Data: Exploring Unstructured data, Understanding Text Analytics, Analysis and extraction techniques, Putting the results together with structured data, putting big data to use, Text analytics tools for Big Data. **Customized approaches for Analysis of Big Data**: Different approaches to big data Analysis, custom and semi-custom applications for big data analysis. **Video link:** **https://www.youtube.com/watch?v=qr_awo5vz0g**	

List of Experiments
1. Installation of Hadoop and basic commands execution on Hadoop. 2. Implementation of wordcount program using MapReduce. 3. Implementation of max avg of student marks using MapReduce programs. 4. Implement MapReduce program to find the max temperature. 5. Implementation of matrix multiplication using map reduce program. 6. Implement MapReduce program to find the max. Fuel consumed by the vehicles in the city. 7. Implement MapReduce program to find the average of city MPG just for electric cars for the given data sets 8. Implement the MapReduce program to find Even and odd numbers. 9. Implement the MapReduce program to find the list of prime numbers in the given data sets. 10. Implement MapReduce program to find the total and Average salary of the employees.

Course outcomes:	
CO1	Describe big data and use cases from selected business domains
CO2	Install, configure, and run Hadoop and HDFS
CO3	Perform map-reduce analytics using Hadoop
CO4	Use Hadoop related tools such as HBase, Pig, and Hive for big data Analytics
CO5	Understand different Applications of big data approaches through various programs in Hadoop platform.
Text Books:	
1.	Big Data Analytics" , Seema Acharya, Subhasini Chellappan, Wiley 2015
2.	Understanding Big data: Analytics for Enterprise Class Hadoop and Streaming Data,Chris Eaton, Dirk deroos et al., 1 st edition, Tata McGraw Hill, 2015, ISBN 13: 978-9339221270

Reference Books:	
1.	Tom White “Hadoop: The Definitive Guide” Third Edit on, O’reily Media, 2012.
2.	Big data for dummies, Judith Hurwitz, Alan Nugent,Fern Halper, Marcia Kaufman, Wiley Publications, 1st edition, 2013, ISBN: 978-1-118-50422-2
3.	Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses, Michael Minelli ,Michele Chambers , Ambiga Dhiraj

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

High-3, Medium-2, Low-1

Semester: VII		
Artificial Intelligence		
Course Code:	**MVJ22IO72**	**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	Describe the basic principles, techniques, and applications of Artificial Intelligence	
2	Analyze and explain different AI learning methods.	
3	Compare and contrast different AI techniques available.	
4	Understanding the minimax algorithm.	
5	Apply the concept of NLP algorithms	

UNIT 1	
INTRODUCTION: What Is AI? The Foundations of Artificial Intelligence ,The History of Artificial Intelligence, The State of the Art . Intelligent Agents : Agents and Environments ,Good Behaviour: The Concept of Rationality ,The Nature of Environments, The Structure of Agents. Knowledge Representation Issues, Using Predicate Logic, Representing knowledge using Rules. **Experimental Learning:** Implementation of Relational and Inheritable Knowledge **Video Links** • https://www.youtube.com/watch?v=GHpchgLoDvI&t=59s	8 Hrs.
UNIT 2	
The natural Language of Artificial Intelligence: Introduction, Converting English to Prolog Facts and Rules, Goals, Prolog Terminology, Variables, Control Structures, Arithmetic operators, Matching in Prolog, Backtracking, Cuts, Recursion, Lists, Dynamic databases, Input/Output and Streams **Using Predicate Logic:** Representing simple facts in logic, representing instance and ISA relationships, Computable Functions and Predicates, Resolution, Natural Deduction. **Experimental Learning:** Implementing programs in PROLOG to solve problems of Predicate Logic **Video Links:** • https://www.youtube.com/watch?v=pzUBrJLIESU • https://www.youtube.com/watch?v=2juspgYR7as • https://www.youtube.com/watch?v=h9jLWM2lFr0 • https://www.youtube.com/watch?v=-v1K9AnkAeM	8 Hrs.
UNIT 3	
Heuristic search techniques: Generate and test, Hill Climbing, Best First Search, Problem	8 Hrs.

Reduction, Constraint Satisfaction, Means-ends Analysis. **Weak Slot- and- Filler Structures:** Semantic Nets,Frames. **Strong slot-and Filler Structures-** Conceptual Dependency, Scripts. **Experimental Learning**: Program to implement Best first Search, A*, AO* algorithm **Video Links:** • https://www.youtube.com/watch?v=ieZr_TpRwnQ • https://www.youtube.com/watch?v=lCrHYT_EhDs	
UNIT 4	
Game Playing : Overview, Minimax Search Procedure, Adding alpha beta cut off, Additional Refinements, Iterative Deepening, References on Specific games. **Learning:** What is learning?, Forms of learning, Rote learning, learning by taking advice, Learning in problem solving, Induction leaning, Explanation based learning, Discovery, Analogy, Formal learning Theory, Neural Network Learning. **Experimental Learning** : Real time problem solving using Game Playing **Video Links**: • https://www.youtube.com/watch?v=_i-lZcbWkps • https://www.youtube.com/watch?v=l-hh51ncgDI	8 Hrs.
UNIT 5	
Natural Language Processing: Syntactic Processing, Semantic Analysis, Discourse and Pragmatic processing, Statistical Natural language processing and Spell checking. **Genetic Algorithms**: A peek into the biological world, Genetic Algorithms (GAs), Significance of genetic operators, termination parameters, niching and speciation, evolving neural network, theoretical grounding. **Experimental Learning**: Program to implement spell checking problem **Video Links**: • https://www.youtube.com/watch?v=zG8AJhVy5NY • https://www.youtube.com/watch?v=Z_8MpZeMdD4	8 Hrs.

LABORATORY SESSIONS:

1. Implement and Demonstrate Depth First Search Algorithm on Water Jug Problem
2. Implement and Demonstrate Best First Search Algorithm on any AI problem
3. Implement AO* Search algorithm.
4. Solve 8-Queens Problem with suitable assumptions
5. Implementation of TSP using heuristic approach
6. Implementation of the problem-solving strategies: either using Forward Chaining or Backward Chaining
7. Implement resolution principle on FOPL related problems
8. Implement any Game and demonstrate the Game playing strategies
9. Illustrate and Demonstrate the working model and principle of Find-S algorithm. Program: For a given set of training data examples stored in a .CSV file, implement and demonstrate the Find-S algorithm to output a description of the set of all hypotheses consistent with the training examples.
10. Demonstrate the working model and principle of candidate elimination algorithm. Program: For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.
11. To construct the Decision tree using the training data sets under supervised learning concept. Program: Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
12. To understand the working principle of Artificial Neural network with feed forward and feed backward principle. Program: Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.
13. Demonstrate the text classifier using Naïve bayes classifier algorithm. Program: Write a program to implement the naive Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.

Any 12 experiments to be conducted

Course Outcomes:

CO1	Identify AI based problems and understand Intelligent agents
CO2	Apply predicate logic and heuristic techniques to solve AI problems.
CO3	Understand the different representation of knowledge.
CO4	Understand the concepts of learning and Natural Language Processing.
CO5	Understand Genetic Algorithms and solve AI problems by developing programs and understanding the applications.

Text Books	
1.	Artificial Intelligence: A Modern Approach, Stuart Rusell, Peter Norving, Pearson Education 2nd Edition.
2.	E. Rich , K. Knight & S. B. Nair - Artificial Intelligence, 3/e, McGraw Hill.
3.	Dan W. Patterson, Introduction to Artificial Intelligence and Expert Systems – Prentice Hal of India.
Reference Books	
1	G. Luger, "Artificial Intelligence: Structures and Strategies for complex problem Solving", Fourth Edition, Pearson Education, 2002.
2	N.P. Padhy "Artificial Intelligence and Intelligent Systems" , Oxford University Press-2015

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

High-3, Medium-2, Low-1

Semester: VII		
Real Time Operating Systems		
Course Code:	**MVJ22IO73**	**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	Acquire knowledge about concepts related to OS for Embedded Systems.	
2	Gain knowledge about different types of scheduling algorithms suitable for embedded real time systems.	
3	Introduce the principles of Inter process communication and multitasking applications.	
4	Explain the architecture of Linux Kernel and RTOS applications to Linux.	
5	Discuss Real-Time Programming in Linux and µC linux	

Module-1	
Prerequisites: *Basic Concepts of Operating systems and basics of task management and task scheduling.* **Real Time Systems:** Introduction, issues in real time computing, Structure of a real time system, task classes, performance measures for real time systems, task assignment and scheduling algorithms, mode changes, Fault tolerant scheduling, Real Time Models.	**8Hrs.**

Laboratory Sessions/ Experimental learning: 1. Create an application that creates two tasks that wait on a timer whilst the main task loops. 2. Create an application that creates tasks and scheduling tasks. **Applications:** Kiel RTOS for ARM (Keil RTX - ARM) **Video link / Additional online information:** 1. https://nptel.ac.in/courses/106/105/106105036/	
Module-2	**8Hrs.**
µC/OS- II RTOS Concepts: Foreground/Background process, Resources, Tasks, Multitasking, Priorities, Schedulers, Kernel, Exclusion, Inter task communication, Interrupts, Clock ticks, µC/OS- II Kernel structure , µC/OS- II Initialisation, Starting µC/OS- II. **Laboratory Sessions/ Experimental learning:** 1. Write an Keil RTOS code that demonstrates the multitasking priority. 2. Write an Keil RTOS code that assigns priority and sets the time slice period to illustrate time slicing. **Applications:** 1. Email Spam and Malware Filtering 2. File Managers and Resource management systems **Video link / Additional online information:** **1.** https://nptel.ac.in/courses/106/106/106106198/ **2.** http://www.nptelvideos.in/2012/11/real-time-systems.html	
Module-3	**8Hrs.**
µC/OS- II RTOS Functions: Task Management, Time management, Semaphore management, Mutual exclusion semaphore, Event Management, Message management, Memory management, porting µC/OS- II – comparison and study of various RTOS like QNX- VX Works-Psos. **Laboratory Sessions/ Experimental learning:** **1.** Write an Keil RTOS code to manage tasks to handle semaphore to overcome mutual exclusion.	

2. Demonstrate Porting of µC/OS- II in Embedded processor. **Applications:** Traffic light controller system **Video link / Additional online information:** 1. https://nptel.ac.in/courses/106/105/106105215/ 2. https://nptel.ac.in/courses/106/105/106105172/	
Module-4	**8Hrs.**
Embedded Linux: Embedded Linux, Features - Embedded Linux Distributions -Architecture of Embedded Linux - Linux Kernel Architecture – User Space -Root File System - Linux Start-Up Sequence - GNU Cross Platform Tool chain -Porting Traditional RTOS Applications to Linux. **Laboratory Sessions/ Experimental learning:** 1. Write an application that display two different messages in LCD display in two lines. **Applications:** Smart Mobile Phone operating system development process demonstration. **Video link / Additional online information:** 1. http://1.https//nptel.ac.in/courses/11706087/ 2. https://nptel.ac.in/courses/106/106/106106198/	
Module-5	**8Hrs.**
Real time Linux: Linux and Real-Time, Real-Time Programming in Linux, Hard Real-Time Linux - Building and Debugging, Building the Kernel, Integrated Development Environment, Kernel Debuggers, Embedded Drivers, Boardsupport packages, Introduction to µC linux. **Laboratory Sessions/ Experimental learning:** 1. Creating and UART driver for USB bus. **Applications:** Demonstration of ABS system in automobiles **Video link / Additional online information:** 1. https://nptel.ac.in/courses/117102059/ 2. http://www.nptelvideos.in/2012/11/real-time-systems.html 3. https://www.youtube.com/watch?v=HlU5cYqGLZE	

Course outcomes:	
CO1	Summarize fundamental principles for programming of real time systems with time and

	resource limitations.
CO2	Develop RTOS based embedded real time applications.
CO3	Analyze the functions of real time operating systems .
CO4	Utilize RTOS software tool chain for Embedded Applications.
CO5	Develop real time kernals and Embedded Drivers.
Text Books:	
1.	Krishna C.M., Kang G. Shin, “Real Time Systems”, Tata McGraw-Hill Edition, 2010.
2.	Philip A.Laplante, “Real Time Systems Design and Analysis-An Engineers Handbook”, II Edition-IEEE Press, IEEE Computer Society Press, 2001.
Reference Books:	
1.	Jean J Labrosse, “MicroC/OS-II The Real Time Kernel” II Edition, CMP Books, 2002.
2.	P.Raghavan, Amol Lad, Sriram Neelakandan, “Embedded Linux System Design and Development”,Auerbach Publications, Taylor& Francis Group, 2006.
3.	Christopher Hallinan, “Embedded Linux Primer, A Practical, Real-World Approach”, II Edition PearsonEducation, Inc., 2011.

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

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

Semester End Examination (SEE):

Total marks: 50+50=100

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

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

High-3, Medium-2, Low-1

Professional Elective Course:

Semester: VII		
Privacy and security in IoT		
Course Code:	**MVJ22IO741**	**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	Make use of the student to understand the concept of mobile computing terminology and basics	
2	Understand the wireless protocols.	
3	Understand various routing mechanisms.	
4	Illustrate the privacy issues in IoT.	
5	Demonstrate the various applications and different case studies.	

UNIT 1	
Introduction to IoT: Physical Design of IoT, Logical design of IoT, IoT Enabling Technology and Applications. IoT Physical Device and Endpoints, Tools of IoT **Video link / Additional online information** • http://youtu.be/E4h4Z3g-eLM (NPTEL VIDEO)	**8Hrs.**
UNIT 2	
M2M to IoT Introduction, Difference between IoT and M2M, Some Definitions, M2M Value Chains, IoT Value Chains, networking in IoT **Video link / Additional online information (related to module if any):** http://youtu.be/E4h4Z3g-eLM (NPTEL VIDEO)	**8Hrs.**
UNIT 3	
Internet of Things (IoT) Architecture: Introduction, State of the art, Architecture Reference Model-Developing Internet of Thing: IoT Platform design methodology, Case Study Illustrating IoT Design. IoT Physical Servers and Cloud Offering, Data Analytics for IoT. **Video link / Additional online information** http://youtu.be/E4h4Z3g-eLM	**8Hrs.**
UNIT 4	
Need of Internet of Things (IoT) Security: Requirement and Basic Properties, Main	**8Hrs.**

Challenges, Confidentiality, Integrity, Availability, NonRepudiation Security Classification & Access Control: Data classification (Public and Private), Privacy issues in IoT, IoT Authentication and Authorization, IoT Data Integrity **Video link / Additional online information** http://youtu.be/E4h4Z3g-eLM	
UNIT 5	
Internet of Things Privacy, Security and Governance: Introduction, Overview of Governance, Privacy and Security Issues, Contribution from FP7 Projects, Security, Case Study 1: Smart Home, Case Study 2: Smart Grid Network, Case Study 4: Wearable Computing & BYOD, Case Study 5: Mobile HealthCare **Video link:** http://youtu.be/E4h4Z3g-eLM	**8Hrs.**

Course Outcomes: After completing the course, the students will be able to	
CO1	Interpret GSM architecture and its services.
CO2	Analyse the various wireless application protocols and its different concepts for various mobile applications.
CO3	Explain the representation of mobile network layer protocols and its functionalities.
CO4	Understand, analyse & develop any existing or new models of mobile environments for 3G networks.
CO5	Understand, evaluate, and create the platforms, protocols, and related concepts along with along with mobile in mobile environment.

Text Books:	
1.	Vijay Madisetti and Arshdeep Bahga, “Internet of Things (A Hands-on-Approach)”, 1st Edition, VPT, 2014.
2.	Francis daCosta, “Rethinking the Internet of Things: A Scalable Approach to Connecting Everything”, 1st Edition, Apress Publications, 2013.

Reference Books:	
1.	Cuno Pfister, Getting Started with the Internet of Things, O"Reilly Media, 2011, ISBN: 978-1-4493- 9357-1
2.	"Practical Internet of Things Security" ,Drew Van Duren,2016.

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

High-3, Medium-2, Low-1

Semester: VII		
DESIGN OF SMART CITIES		
Course Code:	**MVJ22EC742**	**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	Acquire specific scripting knowledge to develop interactive applications.	
2	Understand the basics of android application development.	
3	Apply the programming skills in developing application pertaining to Industrial, medical,	
4	Realize the importance of energy in IoT applications.	
5	Develop case studies for different applications with modern solutions.	

UNIT 1	
Smart City Introduction: Introduction, Smart City, Complexities of Smart Cities, Urban Network, Sensor Network, Role of Urban Networks, Trends in Urban Development, Community Resource Sensing. **Applications:** Philosophy and project management, Phases and Stages of Project, Work Breakdown Structure **Video link / Additional online information :** 1. https://www.youtube.com/watch?v=tKJZxsEeVzk 2. https://www.youtube.com/watch?v=lmRkYi6WAhE	**8Hrs.**
UNIT 2	
Urban Planning Urban Planning, Databases, Principles of Urban Planning, Data Organization, Role of Planning in Smart Cities, Case Studies. **Applications:** Project Organization Structure, Planning, Scheduling. **Video link / Additional online information:** **1.** https://www.youtube.com/watch?v=q_XmlG3CwNk **2.** https://www.youtube.com/watch?v=2F0Bdfb1GqY	**8Hrs.**
UNIT 3	
Energy Sustainability in Smart Cities: Energy, Decision Making, Energy as a catalyst for Sustainable Transformation, Cohesion and efficiency of smart cities.	**8Hrs.**

Applications: Internet of Vehicle (IoV) Importance **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=j_5GldeUpRg 2. https://www.youtube.com/watch?v=BJSiN9FH5UU 3. https://www.youtube.com/watch?v=g8JgdzbOYUA	
UNIT 4	
Security, Privacy and Ethics in Smart Cities Security challenges in Internet of Things, Security threats in IoT, IoT related safety measures for a safer smart city. **Applications:** Structural concept, Specific applications, Structural health monitoring-Process control and stabilization **Video link / Additional online information :** 1. https://www.youtube.com/watch?v=ye0RGdlxGX0 2. https://www.youtube.com/watch?v=92c4xj5N2mk	**8Hrs.**
UNIT 5	
Smart Cities Planning and Development : City Planning, Understanding Smart Cities, Dimensions of Smart Cities, Global standards and performance benchmark of smart cities, Financing smart cities development, Governance of smart cities. **Applications:** Perspectives on Intelligent Transport Systems (ITS), ITS Highway safety perspective, Environmental aspects of ITS. **Video link / Additional online information:** **1.** https://www.youtube.com/watch?v=i8LhbDJf2WU **2.** https://www.youtube.com/watch?v=IYZA06kRktw	**8Hrs.**

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

CO1	Design dynamic systems to process user & sensor data
CO2	Design on a profound level to implement hardware & software for wireless sensor networks in day to day life
CO3	Implement secured application using android Software Development Kit
CO4	Solve the need for smart systems in a distributed environment.
CO5	Understand the Internet of Things (IoT) architecture and building blocks for various domains

Reference Books:	
1.	Fadi Al-Turjman, Intelligence in IoT-enabled Smart Cities,1st edition, CRC Press ,2019.
2.	Giacomo Veneri, and Antonio Capasso , Hands-on Industrial Internet of Things: Create a powerful industrial IoT infrastructure using Industry 4.0 , 1 st edition, Packt Publishing,2018

Reference Books:	
1.	John Dean, Web Programming with HTML5, CSS and JavaScript, 1 st edition, Jones and Bartlett Publishers Inc.,. 2018
2.	Subhas Chandra Mukhopadhyay, Smart Sensing Technology for Agriculture and Environmental Monitoring, 1 st edition, Springer, 2012
3.	Mashrur A. Chowdhury, and Adel Sadek, Fundamentals of Intelligent Transportation Systems Planning, Artech House, Inc., 2003.

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

High-3, Medium-2, Low-1

Semester: VII		
SOFTWARE ENGINEERING		
Course Code:	**MVJ22EC743**	**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 principles, concepts, methods, and techniques of the software engineering approach to producing quality software (particularly for large, complex systems).	
2	Develop skills in the design and implementation of efficient software systems across disciplines.	
3	Familiarize engineering practices and standards used in developing software products and components.	
4	Knowledge on various software testing, maintenance methods.	
5	Develop the quality assured products.	

UNIT-I	
INTRODUCTION TO SOFTWARE ENGINEERING: The Evolving nature of software engineering, Changing nature of software engineering, Software engineering Layers, The Software Processes, Software Myths. **PROCESS MODELS:** A Generic Process Model, Waterfall Model, Incremental Process Models, Evolutionary Process Models, Spiral Model, the Unified Process, Personal and Team Process Models, the Capability Maturity Model Integration (CMMI), Triple modular redundancy. **Laboratory Sessions/ Experimental learning:** To write the SRS for the given real time application using report writing tools. **Applications:** In Software development process. **Video link / Additional online information:** https://nptel.ac.in/courses/106105182/	**8 Hrs**
UNIT-II	
REQUIREMENTS ENGINEERING: Functional and Non-Functional Requirements, The Software requirements Document, Requirements Specification, requirements Engineering, Requirements Elicitation and Analysis, Requirement Validation, Requirement Management, System Modelling: Context Models, Interaction	**8 Hrs**

Models, Structural Models, Behavioural Model, Model-Driven Engineering. **DESIGN CONCEPTS:** The Design Process, Design Concepts, The Design Models, Architectural Design: Software Architecture, Architectural Genres, Architectural Styles. **Applications:** In Software development process. **Video link / Additional online information:** https://www.coursera.org/lecture/client-needs-and-software-requirements/3-2-4-use-cases-bZNCr	
UNIT-III	
DESIGN AND IMPLEMENTATION: The Object-Oriented Design with UML, Design Patterns, Implementation Issues, Open-Source Development. User Interface Design: The Golden Rules, User Interface Analysis and Design, Interface Analysis, Interface Design Steps, Design Evaluation. **SOFTWARE TESTING STRATEGIES:** A Strategic approach to Software Testing, Strategic Issues, Test Strategies for Conventional Software, Validation Testing, System Testing, The Art of Debugging, White-Box Testing, Black Box Testing. **Laboratory Sessions/ Experimental learning:** Using Selenium IDE write a test suite containing minimum 4 test cases. **Applications:** In Software development process. **Video link / Additional online information:** https://www.youtube.com/watch?v=T3q6QcCQZQg	**8 Hrs**
UNIT-IV	
PRODUCT METRICS: A Framework for Product Metrics, Metrics for the Requirements Model, Metrics for Design Model, Metrics for Source Code, Metrics for Testing. **PROCESS AND PROJECT METRICES:** Metrics in the Process and Project Domains, Software Measurements, Metrics for Software Quality, Risk Management: Risk verses Proactive Risk Strategies, Software Risks, Risk Identification, Risk Projection, Risk Refinements, Risk Mitigation Monitoring and Management (RMMM), The RMMM Plan. **Laboratory Sessions/ Experimental learning:** Create a project using MS projects	**8 Hrs**

for any real time scenario. **Applications:** In Software development process. **Video link / Additional online information:** https://youtu.be/tIZ1dg4pxCE	
UNIT-V	
QUALITY MANAGEMENT: Quality Concepts, Software Quality, Software Quality Dilemma, Achieving Software Quality, Review Techniques, Reviews: A Formal spectrum, Informal Reviews, Formal Technical Reviews, **SOFTWARE QUALITY ASSURANCE:** Background Issues, Elements of Software Quality Assurance, Tasks, Goals and Metrics, Software Reliability, the ISO 9000 Quality Standards. **Laboratory Sessions/ Experimental learning:** Estimation of test coverage metrics using manual test metrics. **Applications:** In Software development process. **Video link / Additional online information:** https://nptel.ac.in/courses/110105039/	**8 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand various Process Models.
CO2	Investigate various requirements engineering and apply design concepts.
CO3	Identify numerous Software Testing Strategies.
CO4	Evaluate Process and Project Metrices.
CO5	Illustrate Quality Management and Software Quality Assurance Concepts

Reference Books	
1.	Roger S. Pressman (2011), Software Engineering, A Practitioner's approach, 7 th edition, McGraw Hill International Edition, New Delhi
2.	Sommerville (2001), Software Engineering, 9 th edition, Pearson education, India
3.	K. K. Agarval, Yogesh Singh (2007), Software Engineering, 3rd edition, New Age International Publishers, India.
4.	Lames F. Peters, Witold Pedrycz(2000), Software Engineering an Engineering approach, John Wiely & Sons, New Delhi, India

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: VII		
Cloud Computing and IoT Analytics		
Course Code:	**MVJ22IO744**	**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 fundamental ideas behind Cloud Computing, the evolution of the paradigm, its applicability, benefits, as well as current and future challenges.	
2	Knowledge about the introduction of the basic ideas and principles in data center design, cloud management techniques and cloud software deployment considerations.	
3	Explain the different CPU, memory and I/O virtualization techniques that serve in offering software, computation, and storage services on the cloud; Software Defined Networks (SDN) and Software Defined Storage (SDS)	
4	Understand cloud storage technologies and relevant distributed file systems, NoSQL databases and object storage.	
5	Differentiate the variety of programming models and develop working experience in several of them.	

UNIT 1	
Introduction to Cloud Computing: Cloud Computing in a Nutshell, Roots of Cloud Computing, Layers and Types of Clouds, Desired Features of a Cloud, Cloud Infrastructure Management, Infrastructure as a Service Providers, Platform as a Service Providers, Challenges and Risks, Broad Approaches to Migrating into the Cloud, The Seven-Step Model of Migration into a Cloud. Introduction to big data analytics, using MapReduce/Hadoop for analyzing unstructured data, Hadoop ecosystem of tools. **Applications:** Microsoft Azure, Amazon Web Services **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=PW-V-72MJNY	**8Hrs.**
UNIT 2	
'Integration as a Service' Paradigm for the Cloud Era: An Introduction, The Onset of Knowledge Era, The Evolution of SaaS , The Challenges of SaaS	**8Hrs.**

Paradigm, Approaching the SaaS Integration Enigma, New Integration Scenarios, The Integration Methodologies, SaaS Integration Products and Platforms , SaaS Integration Services, Businesses-to-Business Integration (B2Bi) Services, A Framework of Sensor- Cloud Integration, SaaS Integration Appliances, Issues for Enterprise Applications on the Cloud, Transition Challenges, Enterprise Cloud Technology and Market Evolution, Business Drivers Toward a Marketplace for Enterprise Cloud Computing, The Cloud Supply Chain **Laboratory Sessions/ Experimental learning:** 1. Installation and Configuration of Hadoop. **Applications:** PAAS (Facebook, Google App Engine) **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=ifZh5SJAujA	
UNIT 3	
Virtual Machines Provisioning and Migration Services: Introduction and Inspiration- Background and Related Work-Virtual Machines Provisioning and Manageability- Virtual Machine Migration Services- VM Provisioning and Migration in Action– Provisioning in the Cloud Context- The Anatomy of Cloud Infrastructures-Distributed Management of Virtual Infrastructures - Scheduling Techniques for Advance Reservation of Capacity- Capacity Management to meet SLA Commitments- RVWS Design and Cluster as a Service: The Logical Design **Laboratory Sessions/ Experimental learning:** Implementation of Para-Virtualization using VM Ware‘s Workstation/ Oracle‘s Virtual Box and Guest O.S **Applications:** Hardware Virtualization, Operating system Virtualization, Server Virtualization, Storage Virtualization **Video link / Additional online information:** https://www.youtube.com/watch?v=7m3f-P-WWbg	**8Hrs.**
UNIT 4	
Platform and Software as a Service**:**Technologies and Tools for Cloud Computing- Aneka Cloud	**8Hrs.**

Platform- Aneka Resource Provisioning Service- Hybrid Cloud Implementation - Comet Cloud Architecture- Autonomic Behavior of Comet Cloud- Overview of Comet Cloud-based Applications- Implementation and Evaluation- Workflow Management Systems and Clouds- Architecture of Workflow Management Systems - Utilizing Clouds for Workflow Execution- Case Study: Evolutionary Multi objective Optimizations- Visionary thoughts for Practitioners **Laboratory Sessions/ Experimental learning:** Create an application (Ex: Word Count) using Hadoop Map/Reduce. **Applications:** Schedule book **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=3KJjKY8k9Lk	
UNIT 5	
MapReduce Programming Model and Implementations**:** MapReduce Programming Model- Major MapReduce Implementations for the Cloud- The Basic Principles of Cloud Computing-A Model for Federated Cloud Computing- Traditional Approaches to SLO Management- Types of SLA- Life Cycle of SLA- SLA Management in Cloud- Automated Policy-based Management- The Current State of Data Security in the Cloud-Data Privacy and Security Issues-Producer Consumer Relationship-Cloud Service Life Cycle **Laboratory Sessions/ Experimental learning:** Create your resume in a neat format using google and zoho cloud Programs on PaaS **Applications:** Network Storage, Google Apps and Microsoft office online **Video link / Additional online information:** **https://www.youtube.com/watch?v=uj2Sb7b_Do0**	**8Hrs.**

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

CO1	Recall the recent history of cloud computing, illustrating its motivation and evolution.
CO2	List some of the enabling technologies in cloud computing and discuss their significance
CO3	Articulate the economic benefits as well as issues/risks of the cloud paradigm for businesses as well as cloud providers
CO4	Define SLAs and SLOs and illustrate their importance in Cloud Computing.
CO5	List some of the common cloud providers and their associated cloud stacks and recall popular cloud use case scenarios.

Text Books:	
1.	Cloud Computing, Principles and Paradigms, Rajkumar Buyya, James Broberg, Wiley Publication

Reference Books:	
1.	Dan C Marinescu: Cloud Computing Theory and Practice. Elsevier (MK) 2013.

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

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

Semester End Examination (SEE):

Total marks: 50+50=100

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

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

High-3, Medium-2, Low-1

Open Elective Course

Semester: VII		
Soft Computing Techniques		
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:		
1	Learn soft computing techniques and their applications.	
2	To introduce the concepts of fuzzy sets and fuzzy logic	
3	To make students familiar with neural networks	
4	Analyze various neural network architectures	
5	Apply soft computing techniques to solve problems	

UNIT-I	
Introduction to Soft Computing – Neural networks, Fuzzy logic, Genetic algorithms, Hybrid systems and its applications, Fundamental concept of ANN, Evolution basic Model of ANN, Terminologies used in ANN, MP model, Hebb model. **Laboratory Session:** Finding weight matrix and bias of HebbNet to classify two dimensional input patterns in MATLAB. **Applications:** Social Media,Marketing and sales**.** **Project:** Stock Price Detection using Neural networks**.** **Video Link**: https://nptel.ac.in/courses/106/105/106105173/	**8 Hrs**
UNIT-II	
Perception Network: Adaptive linear neuron, Multiple adaptive linear neurons, Back propagation Network (Theory, Architecture for training, learning factors, testing and applications of all the above NN models). **Laboratory Session:** Generation of XOR function using back propagation algorithm in MATLAB **Applications:** Personal Assistants,Healthcare**.** **Project:** Autism Prediction using ANN**.** **Video Link**: https://www.youtube.com/watch?v=xbYgKoG4x2g	**8 Hrs**
UNIT-III	
Introduction to Classical sets and Fuzzy sets: Classical relations and fuzzy relations, Membership functions – Fuzzy rules and Fuzzy Reasoning, Fuzzy Interference Systems,	**8 Hrs**

Fuzzy Expert Systems, Fuzzy Decision Making. **Laboratory Session:** Implementation of Fuzzy Inference System in MATLAB. **Applications:** Altitude control of spacecraft**.** **Project:** Rainfall prediction using fuzzy logic**.** **Video Link:** https://nptel.ac.in/courses/108/104/108104157/	
UNIT-IV	
Defuzzification: Fuzzy decision making and applications. **Laboratory Session:** Using fuzzy toolbox to model tips value in MATLAB **Project:** Prediction of product quality using fuzzy logic**.** **Applications:** Intelligent Highway systems**.** **Video Link:** https://nptel.ac.in/courses/127/105/127105006/	**8 Hrs**
UNIT-V	
Genetic Algorithms: Introduction, Basic operations, Traditional algorithms, Simple GA General genetic algorithms, The Schema theorem, Genetic programming, applications. **Laboratory Session:** Finding weight matrix of Hetero-Associative neural net for mapping of vectors in MATLAB. **Applications:** Control of hypervelocity interceptor **Project:** Multisensor activity detection for elderly people based on Genetic Algorithms. **Video Link:** https://www.youtube.com/watch?v=Z_8MpZeMdD4	**8 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Implement machine learning through neural networks
CO2	Understand Artificial neural networks and its applications
CO3	Develop a Fuzzy expert system
CO4	Model Neuro Fuzzy system for clustering and classification
CO5	Design Genetic Algorithm to solve the optimization problem

Text Books:	
1	S.N.Sivanandam & S.N.Deepa "Principles of Soft Computing" Wiley India Pvt. Ltd., 2007
2	J.S.R.Jang, C.T.Sun and E.Mizutani, "Neuro-Fuzzy and Soft Computing", PHI,2004, Pearson Education 2004.

Reference Books:	
1	N. K. Sinha and M. M. Gupta, Soft Computing & Intelligent Systems: Theory & Applications-Academic Press /Elsevier. 2009
2	R. Eberhart and Y. Shi, Computational Intelligence: Concepts to Implementation, Morgan Kaufman/Elsevier, 200

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

Semester: VII		
Medical Electronics		
Course Code:	**MVJ22IO752**	**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 physiological parameters such as electrical, non-electrical and the recording methods.	
2	Learn the methods used for recording and measuring the biological signals.	
3	Illustrate the various Medical Imaging devices used in the hospitals.	
4	Explain the telemetry systems and know the safety aspects required in medical equipment.	
5.	Understand the various Therapeutic Devices and know about recent trends in medical system.	

UNIT 1	
Prerequisites: Basics of Transducer **Fundamentals of Physiology and Transducer:** Types of Bioelectric Potentials: Introduction to different types of bioelectric potentials, Action and resting potentials, Propagation of action potentials. Biological Systems: Nervous system and its fundamentals, Basic components of a biomedical system, Cardiovascular systems, Respiratory systems **Electrodes and Transducers in Medical systems:** Different type of electrodes, sensors used in biomedicine. Physiological signals and transducers, Piezoelectric Transducers, ultrasonic transducers, Temperature measurement, Fibre optic temperature sensors. Selection criteria for transducer and electrodes. **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/ 2. https://www.youtube.com/watch?v=QiwxdcckPGc 3. https://www.youtube.com/watch?v=LOjK2wB_qcg&feature=youtu.be	**8Hrs.**

UNIT 2	
Electrical and Non-Electrical Parameter Measurement: **Electro Physiological Measurement:** Biological amplifiers, ECG, EEG, EMG, PCG, typical waveforms and signal characteristics **Non Electrical Parameter Measurement:** Measurement of blood pressure, Ultra sound blood flow meter, Blood flow cardiac output, Heart rate, heart sound, measurement of gas volume, flow rate of CO2 and O2 in exhaust air, pH of blood **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/ 2. https://www.youtube.com/watch?v=7cvgDIdtw8M 3. https://www.youtube.com/watch?v=mK6sPBbChqc	**8Hrs.**
UNIT 3	
Amplifiers used in Medical Electronics: Amplifiers, preamplifiers, differential amplifiers, chopper amplifiers, Isolation amplifier **Medical Imaging:** X-ray machine, Computer tomography, Magnetic resonance imaging system, Positron emission tomography and endoscopy. **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:** 1. https://www.youtube.com/watch?v=N0Dwh3avx9A 2. https://www.youtube.com/watch?v=5_k6GVMwQ8	**8Hrs.**
UNIT 4	
Telemetry: Introduction to telemetry systems, Different types of biotelemetry systems, Retinal Imaging, Imaging application in Biometric systems. **Safety in Medical Environment:** Electrical safety in medical environment, shock hazards, leakage current, Instruments for checking safety parameters of biomedical equipment	**8Hrs.**

Laboratory Sessions/ Experimental learning: 1. Practical applications of telemetry in medical systems. **Applications:**In the branch of Ophthalmology **Video link / Additional online information :** 1. https://www.youtube.com/watch?v=0UPoSdBFD48 2. https://www.youtube.com/watch?v=8SPHA_1tTw4	
UNIT 5	
Assisting and Therapeutic Devices: Cardiac pacemakers, Defibrillators, Ventilators, Surgical diathermy, Heart lung machine, Laser in surgery and medicine. **Recent Trends in medical System:** Insulin Pumps, Radio pill, Endo microscopy, Brain machine interface, Lab on a chip, ICCU patient monitoring system, Wearable Antennas. **Robotic Devices:** Nano Robots, Robotic surgery, Orthopedic prostheses fixation. **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:** 1. https://www.youtube.com/watch?v=SMXBR_YFocs 2. https://www.youtube.com/watch?v=qUD865w2Drw 3. https://www.youtube.com/watch?v=KAvQsRL-jeo	**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	Demonstrate the electronic systems and analyse their applicability
CO4	Analyse requirement of electronic devices and systems.
CO5	Design a simple prototype for a certain application.

Text Books:	
1.	R.S. Khandpur, “Hand book of Bio Medical Instrumentation” (2nd edition)- ISBN-13: 9789339205430.
2.	Mandeep Singh, “Introduction to Biomedical Instrumentation”, ISBN-13: 9788120350236

Reference Books:	
1.	S.K. Guha, “Principles of Medical Electronics and biomedical Instrumentation” - ISBN-13: 978-8173712579.
2.	J.G.Webster(Wiley India), “Medical instrumentation Application and Design”, ISBN-13: 978-0471676003.
3	Joseph D. Bronzino, “The Biomedical Engineering Handbook”, Third Edition, CRC Press-2006.
4	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

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

Semester: VII		
IoT and Wireless Sensor Networks		
Course Code:	**MVJ22IO753**	**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 Cloud computing and design principles of IoT	
4	Understand the architecture and design principles of WSNs.	
5.	Provide knowledge about MAC and routing protocols 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:** 1. Comparative study of Oracle, IBM and Cisco Architectures of IoT **Applications:** Smart Cities, Home Automation System **Video link / Additional online information :** 1. https://nptel.ac.in/courses/106/105/106105166/ 2. https://www.analyticsvidhya.com/blog/2016/08/10-youtube-videos-explaining-the-real-world-applications-of-internet-of-things-iot/	**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.	**8Hrs.**

Laboratory Sessions/ Experimental learning: 1. Implement an IoT architecture to design an application of your own. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/108/108/108108147/ 2.https://onlinecourses.nptel.ac.in/noc20_cs69/unit?unit=17&lesson=18	
UNIT 3	
Data Collection, Storage and Computing using a Cloud Platform: Introduction, Cloud computing paradigm for data collection, storage and computing, Cloud service models, IoT Cloud - based data collection, storage and computing services using Nimbits, The Hierarchy of Edge, Fog, and Cloud. Prototyping and Designing Software for IoT Applications: Introduction, Prototyping Embedded device software, Programming Embedded Device, Arduino Platform using IDE, Reading data from sensors and devices, Devices, Gateways, Internet and Web/Cloud services software development. Laboratory Sessions/ Experimental learning: 1. Weather monitoring using Blynk/ThingSpeak through cloud 2. Design a people counter using Node MCU 3. 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/ 2. https://onlinecourses.swayam2.ac.in/aic20_sp04/preview	**8Hrs.**
UNIT 4	
Overview of Wireless Sensor Networks: Challenges for Wireless Sensor Networks, Enabling Technologies for Wireless Sensor Networks. Architectures: Single-Node Architecture, Hardware Components, Energy Consumption of Sensor Nodes, Operating Systems and Execution Environments, Network Architecture, Sensor Network Scenarios, Optimization Goals and Figures of Merit, Design principles for WSNs, Service interfaces of WSNs Gateway Concepts. Laboratory Sessions/ Experimental learning:	**8Hrs.**

1. 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/	
UNIT 5	
Communication Protocols: Physical Layer and Transceiver Design Considerations, MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols and Wakeup Concepts - S-MAC, The Mediation Device Protocol, Wakeup Radio Concepts, Contention based protocols(CSMA,PAMAS), Schedule based protocols (LEACH) Address and Name Management in WSNs, Assignment of MAC Addresses, Routing Protocols- Energy-Efficient Routing, Geographic Routing, Hierarchical networks by clustering. 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/	**8Hrs.**

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.	Raj Kamal,"Internet of Things-Architecture and design principles", McGraw Hill Education.

Reference Books:	
1.	Holger Karl & Andreas Willig, "Protocols And Architectures for Wireless Sensor Networks" , John Wiley, 2005.
2.	Kazem Sohraby, Daniel Minoli, & Taieb Znati, "Wireless Sensor NetworksTechnology, Protocols, And Applications", John Wiley, 2007.
3	Arshdeep Bahga and Vijay Madisetti, 'Internet of Things – A Hands on Approach', Orient Blackswan Private Limited - New Delhi; First edition (2015), ISBN-10: 8173719543, ISBN-13: 978-8173719547

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

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Semester End Examination (SEE):

Total marks: 50+50=100

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

High-3, Medium-2, Low-1

Semester: VII		
Industrial and Medical IoT		
Course Code:	**MVJ22IO754**	**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	Develop knowledge in Industrial Internet of Things (IIoT) fundamentals.
2	Gain conceptual understanding of networking and wireless communication protocols used in IIoT deployments
3	Understand the various Internet of Things (IoT) Protocols like COAP, MQTT.
4	Enables healthcare professionals to be more watchful and connect with the patients proactively.
5	Gain knowledge in Low power and wireless connectivity to other devices and the cloud

UNIT 1	
***Prerequisites**: IOT, Medical Electronics* **Industrial IOT Introduction:** Introduction to IOT, what is IIOT? IOT Vs. IIOT, History of IIOT, Components of IIOT - Sensors, Interface, Networks, Key terms – IOT Platform, Interfaces, API, clouds, Data Management Analytics, Mining &Manipulation; Role of IIOT in Manufacturing Processes Use of IIOT in plant maintenance practices, Sustainability through Business excellence tools Challenges & Benefits in implementing IIOT **Laboratory Sessions/ Experimental learning:** **1.** Long-Distance Serial Link Between Two Arduino Devices **2.** IoT on the MATLAB Platform **Applications:** Automated and remote equipment management and monitoring, Pinpoint inventories **Video link / Additional online information :** **1.** http://www.nitttrc.edu.in/nptel/courses/video/106105195/L32.html **2.** https://www.henryharvin.com/blog/iot-courses-online/	8Hrs.

UNIT 2	
IIoT Architecture: IOT components; Various Architectures of IOT and IIOT, Advantages & disadvantages, Industrial Internet - Reference Architecture; IIOT System components: Sensors, Gateways, Routers, Modem, Cloud brokers, servers, and its integration, WSN, WSN network design for IOT **Laboratory Sessions/ Experimental learning:** 1. Experiment on Gate way as a service deployment in IoT Toolkit 2. Design of mixer **Applications:** Internet gateways: , Edge or fog computing, Cloud or data center **Video link / Additional online information:** **1.** https://onlinecourses.nptel.ac.in/noc20_cs66/preview **2.** https://www.youtube.com/watch?v=-RHYCpsn8TA **3.** https://www.youtube.com/watch?v=xsZ9YhVy-7g	8Hrs.
UNIT 3	
IoMT Introduction; What are IoMT and its working? Tracking assets and resources, Internet of things in hospitals, collection and integration of clinical data, Major benefits of IoT in healthcare, Disadvantages of IoT in healthcare **Laboratory Sessions/ Experimental learning:** **1.** Experiment on HTTP-to-CoAP semantic mapping Proxy in IoT Toolkit. **Applications:** Activity Trackers During Cancer Treatment, Heart Monitors with Reporting, Medical Alert Systems **Video link / Additional online information:** **1.** https://www.youtube.com/watch?v=uDzRyrA1Z5Q **2.** https://www.youtube.com/watch?v=9lNB7DK1-oo	8Hrs.
UNIT 4	
Healthcare Technologies: Home Monitoring System for Aged Care, Smart Medicinal Packages for Medication Adherence, Smart Drug Delivery System for Automated Drug Dispensation, Connected Rural Healthcare Consultation, Population and Environment Monitoring of Infectious Diseases	8Hrs.

Laboratory Sessions/ Experimental learning: **1.** Experiment on Gate way as a health care service deployment in IoT Toolkit. **Applications:** Remote patient monitoring, Glucose monitoring, Ingestible Sensors, Trackable Inhaler, Wearables to Fight Depression, Connected Contact Lenses **Video link / Additional online information:** 1. http://nitttrc.edu.in/nptel/courses/video/106105166/L58.html 2. https://www.youtube.com/watch?v=UvQFH5RGOnU 3. https://www.youtube.com/watch?v=_qO9nETG7QU 4. https://onlinecourses.nptel.ac.in/noc22_cs53/preview	
UNIT 5	
Application Design & Case Study: Wireless Patient Monitor system, Wearable Fitness & Activity Monitor Application Design: Design of IOT based pulse oximeter, Reliability of IoT-Aware BPNM Healthcare process **Laboratory Sessions/ Experimental learning:** 1. Speed Control of motors using PWM with python programming. 2. Create Wireless network of sensors using Zigbee. **Applications:** leap fitness step counter, Strava, Pacer Pedometer **Video link / Additional online information :** 1. https://nevonprojects.com/wireless-patient-health-monitor/ 2. https://www.youtube.com/watch?v=mlTuag3fPA0	8Hrs.

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

CO1	Knowledge of the basic introduction of Industrial IOT and Medical IOT
CO2	Distinguishing the technical and industrial requirement procedures for IIOT applications
CO3	Describe various applications using IIOT architectures
CO4	Study about Internet of Medical Things (IoMT) and its applications in Healthcare industry
CO5	Design various applications using IoT in Healthcare Technologies.

Text Books:	
1.	Veneri, Giacomo, and Antonio Capasso- Hands-on Industrial Internet of Things: Creat Powerful Industrial IoT Infrastructure Using Industry 4.0, 1stEd., Packt Publishing Ltd, 2018.
2.	D. Jude Hemanth and J. Anitha George A. Tsihrintzis- Internet of Medical Things Ren Healthcare Systems and Applications, covered by Scopus

Reference Books:	
1.	Alasdair Gilchrist- Industry 4.0: The Industrial Internet of Things, 1st Ed., Apress, 2017
2.	Reis, Catarina I., and Marisa da Silva Maximiano, eds.- Internet of Things and advanced application in Healthcare, 1st Ed., IGI Global, 2016.

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

VII SEMESTER		
PROJECT PHASE – II		
Course Code:	**MVJ22IOP76**	**CIE Marks:100**
Credits:	**L:T:P:0:0:12**	**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
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