Semester: III		
Transforms and Numerical Methods (Theory)		
Course Code:	**MVJ21MA31D (For EC, EE and IOT)**	**CIE Marks: 50**
Credits:	**L: T:P 3:2:0**	**SEE Marks: 50**
Hours:	**50L**	**SEE Duration: 3 Hrs.**
Course Learning Objectives: The students will be able to		
1	Solve the linear differential equations using Laplace transforms	
2	Apprehend and apply Fourier transform	
3	Realize and use of Z-Transforms	
4	Use of numerical methods to solve ordinary differential equation	
5	Use of statistical methods in curve fitting applications.	

UNIT-I	
Laplace Transforms: Definition, Transforms of elementary functions, Properties, Periodic function, Unit step function. **Inverse Laplace Transforms:** Inverse Laplace Transforms, Convolution theorem to find inverse Laplace transform. Solution of linear differential equations using Laplace transforms **Self-study:** Solution of simultaneous first order differential equations. **Applications:** Analysis of electrical and electronic circuits, used in Signal processing and in control systems. Video Links: https://youtu.be/NFuwtTT7VPM	**10 Hrs**
UNIT-II	
Fourier Transforms: Infinite Fourier transform, Infinite Fourier sine and cosine transforms, Inverse Fourier transforms, Inverse. Fourier sine and cosine transforms, Convolution theorem. **Self-study:** Complex form of Fourier series. **Applications:** Fourier transforms used in image Video Links: https://youtu.be/r18Gi8lSkfM	**10 Hrs**
UNIT-III	
Z-Transforms: Definition, standard Z-transforms, properties of Z- transforms-Shifting property, Reversal property, Multiplication by n, initial value and final value theorems. Inverse Z- transform, convolution theorem (proof and problems) Application of Z-transforms to solve difference equations. **Self-study:** Damping rule and problems on them. **Applications:** Fourier transforms used in image processing and Z-transforms in Digital signal processing. Video Links: https://youtu.be/spUNpyF58BY	**10 Hrs**
UNIT-IV	
Numerical solution of ordinary differential equations: Numerical solution of first order and first degree; Taylor's series method, modified Euler's method, Runge-Kutta method of fourth-order. Milne's and Quadratic Spline Method. **Self-study:** Adams Bash-Method. **Applications:** To solve initial value problems Video Links:https://youtu.be/pbYn3MEZyms	**10 Hrs**
UNIT-V	

Statistical Methods: Correlation and regression-Karl Pearson's coefficient of correlation-problems. Regression analysis- lines of regression –problems. **Curve Fitting:** Curve fitting by the method of least squares, fitting of linear, quadratic and geometric curve. **Self-study:** A study of rank correlation. **Applications:** Applications of Correlation in Signal Processing and application of regression analysis in business Video Links: https://youtu.be/jwTvCxasICc	**10 Hrs**

Course Outcomes: After completing the course, the students will be able to	
C201.1	Learn to solve linear differential equations using Laplace transforms
C201.2	Demonstrate Fourier Transform as a tool for solving Integral equations
C201.3	Learn to evaluate Z-transform to solve difference equations.
C201.4	Learn to solve algebraic, transcendental and ordinary differential equations numerically.
C201.5	Make use of the correlation and regression analysis to fit a suitable mathematical model for the statistical data

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

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.

Total marks: 50+50=100

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
C201.1	3	3	0	3	0	0	0	0	0	0	1	0
C201.2	3	3	0	3	0	0	0	0	0	0	0	1
C201.3	2	3	0	3	0	0	0	0	0	0	1	0
C201.4	3	3	0	3	0	0	0	0	0	0	0	0
C201.5	3	3	0	2	0	0	0	0	0	0	0	1

Semester: III		
Electric Circuit Analysis with Pspice (Theory)		
Course Code:	**MVJ21EE32**	**CIE Marks:50**
Credits:	**L:T:P: 3:2:0**	**SEE Marks: 50**
Hours:	**50L**	**SEE Duration: 3 Hrs**
Course Learning Objectives: The students will be able to		
1	Solve the electrical circuits using different analytical methods.	
2	Apply various network theorems to solve circuits.	
3	Analyze the series and parallel resonance in RLC circuits.	
4	Analyze transient response in series circuits.	
5	Analyze complex circuits using network topology and two-port networks.	

UNIT-I	
Basic circuit concepts: Ideal and Practical sources, Source Transformations, Loop and nodal analysis with linearly dependent and independent sources for DC circuits, Analysis of networks involving concepts of super node, Super mesh. **Laboratory Sessions/ Experimental learning**: Verification of Kirchhoff's Voltage law and current law using PSpice **Applications**: Analysis of electric circuits by reducing their complexity. **Video link**: https://nptel.ac.in/courses/108104139/	**10Hrs**
UNIT-II	
Network Theorems: Superposition Theorem, Thevenin's Theorem, Norton's theorems; Maximum power transfer theorem, Reciprocity Theorem, Millman's theorem. **Laboratory Sessions/ Experimental learning**: Verification of all network theorems using PSpice **Applications**: Analysis of complex electric circuits by reducing the complexity. **Video link**:http://www.digimat.in/nptel/courses/video/108105112/L20.html	**10Hrs**
UNIT-III	
Resonant Circuits: RLC Series and parallel resonance, the frequency response of series and parallel circuits, Q factor, Bandwidth. Application. **Laboratory Sessions/ Experimental learning**: Realization of Series/Parallel Resonance using Pspice. **Applications**: Network topology- to understand the networking concepts Resonant circuits- Oscillating circuit, Radio, and communication engineering **Video link**:https://nptel.ac.in/courses/108102097/	**10Hrs**
UNIT-IV	
Transient Analysis: Behaviour of circuit elements under switching condition and their representation, Evaluation of Initial and Final conditions in series RL, RC, and RLC circuits. **Laboratory Sessions/ Experimental learning**: Realization of the transient response of series/Parallel RL, RC circuits in Pspice. **Applications**: Stability Analysis of systems containing energy storage elements **Video link:** https://nptel.ac.in/courses/108102097/	**10Hrs**
UNIT-V	
Network topology: Graph of a network, Concept of tree and Co-tree, Incidence matrix, tie-set matrix, cut-set & cut set matrix, the concept of duality and dual networks.	**10Hrs**

Two port networks: Definition of Z, Y, ABCD parameters, Relationship between parameter sets. **Laboratory Sessions/ Experimental learning**: Virtual lab experiment – Three-phase power measurement for balanced/unbalanced star-connected load **Applications**: Model of voltage, current characteristics of complex electrical networks, Modeling of the transmission line. Videolink: • https://nptel.ac.in/courses/108104139	

Course Outcomes: After completing the course, the students will be able to	
C202.1	Solve the electrical circuits using different analytical methods.
C202.2	Apply various network theorems to solve circuits.
C202.3	Analyze the series and parallel resonance in RLC circuits.
C202.4	Analyze transient response in series circuits.
C202.5	Analyze complex circuits using network topology and two-port networks**.**

Reference Books	
1	"Network Analysis", M. E. Van Valkenburg/T.S. Rathore, Third ,2019, Pearson Education, 978-9353433123.
2	"Network analysis and Synthesis", D. Anand Kumar,2018,PHI Learning Pvt. Ltd.,ISBN-13978-9388028103
3	"Circuit theory analysis and synthesis",A Chakrabarti, 2018,Dhanpat Rai Publishing Co Pvt Ltd, ISBN: 9788177000009
4	"Engineering Circuit Analysis" Hayt, Kemmerly and Durbin**,**2005,Tata McGraw Hill Education,978-0070611054

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):
SEEfor 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.

Total marks: 50+50=100

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
C202.1	3	3	1	1	1	-	-	-	1	-	-	2
C202.2	3	3	1	2	1	-	-	-	1	-	-	2
C202.3	3	3	1	2	1	-	-	-	1	-	-	2
C202.4	3	3	1	2	1	-	-	-	1	-	-	2
C202.5	3	2	1	2	1	-	-	-	1	-	-	2

Semester: III		
DIGITAL ELECTRONICS		
Course Code:	**MVJ21EE33**	**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 Digital fundamentals, Boolean algebra, and its applications in digital systems	
2	Design of various combinational digital circuits using logic gates	
3	Design procedures for synchronous and asynchronous sequential circuits	
4	Design counters and registers for the given circuits.	
5	Explain the electronic circuits involved in the making of logic gates	

UNIT-I	
DIGITAL FUNDAMENTALS: Boolean theorems, Logic gates, Universal gates, Sum of products and product of sums, Min-terms and Max-terms, Karnaugh map Minimization **Laboratory Sessions/ Experimental learning**: Design and implementation of code converters using logic gates (i) BCD to excess-3 code and vice versa (ii) Binary to gray and vice-versa **Applications**: Traffic Signals **Video link**:https://nptel.ac.in/courses/108105113	**8 Hrs**
UNIT-II	
COMBINATIONAL CIRCUIT DESIGN: Design of Half and Full Adders, Half and Full Subtractors, Binary Parallel Adder – Carry look ahead Adder, BCD Adder, Multiplexer, Demultiplexer, Magnitude Comparator, Decoder, Encoder, Priority Encoder. **Laboratory Sessions/ Experimental learning: -** To realize half/full adder and half/full subtractor. Using X-OR and basic gates Using only nand gates. **Applications:** Microcontrollers for arithmetic subtraction **Video link:**https://www.youtube.com/watch?v=85XxQZqBNlg	**8 Hrs**
UNIT-III	
SYNCHRONOUS SEQUENTIAL CIRCUITS: Flip flops – SR, JK, T, D, Master/Slave FF – operation and excitation tables. Design – Moore/Mealy models, state minimization, state assignment, **Laboratory Sessions/ Experimental learning:** Truthtable verification of Flip-Flops: (i) JK Master Slave (ii) D- Type (iii) T- Type. **Applications:** Data Transfer,Counters **Video link:** 1. https://www.youtube.com/watch?v=EAhtV0H6z0Y 2.https://www.youtube.com/watch?v=j_NrUIwj1gc	**8 Hrs**
UNIT-IV	
Circuit implementation – Design of Counters- Ripple Counters, Ring Counters, Shift registers**,** Universal Shift Register. Application of shift registers. **Laboratory Sessions/ Experimental learning**: **Applications**: Realization of 3-bit counters as a sequential circuit and MOD – N counter design using 7476,7490,74193	**8 Hrs**

Video link:1.https://www.youtube.com/watch?v=Iecj9xmIfXM 2.https://www.youtube.com/watch?v=aGHpADG8Yo4	
UNIT-V	
MEMORY DEVICES AND DIGITAL INTEGRATED CIRCUITS: Basic memory structure – ROM -PROM – EPROM – EEPROM –EAPROM, RAM – Static and dynamic RAM – Programmable Logic Devices – Programmable Logic Array (PLA) – Programmable Array Logic (PAL) – Field Programmable Gate Arrays (FPGA. **Laboratory Sessions/ Experimental learning**:Design and testing of Monostable and Astable multivibrators using 555 timers. **Applications**: Video processor **Video link**: https://www.youtube.com/watch?v=2aRwFWhLk0o0	**8 Hrs**

Course Outcomes: After completing the course, the students will be able to	
C203.1	Solve different logic equations using K map and compare different logic families
C203.2	Develop combinational circuit for given circuits.
C203.3	Develop state diagrams for given clocked sequential circuits.
C203.4	Develop counters and registers of circuits.
C203.5	Explain the various semiconductor memories and related technology

Reference Books	
1.	Electronic Devices and Circuit Theory, Robert L Boylestad Louis Nashelsky, Pearson, 11thEdition, Pearson India, 2015.
2.	Electronic Devices and Circuits, S.Salivahanan & N.Suresh, McGraw Hill, 3rd Edition, 2013.
3.	Fundamentals of Logic design, Charles H Roth and Larry L Kinney,Cengage Learning,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):

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.

Total marks: 50+50=100

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
C203.1	2	2	2	1	2	-	-	-	-	-	-	-
C203.2	2	2	2	2	3	-	-	-	-	-	-	-
C203.3	2	2	2	2	3	-	-	-	-	-	-	-
C203.4	2	3	3	2	3	-	-	-	-	-	-	-
C203.5	2	2	3	2	3	-	-	-	-	-	-	-

ANALOG ELECTRONICS AND OPAMP WITH PSPICE (Theory and Practice)		
Course Code:	**MVJ21EE34**	**CIE Marks:50+50**
Credits:	**L: T: P: 3:0:2**	**SEE Marks: 50 +50**
Hours:	**40 L+ 26 P**	**SEE Duration: 03+03 Hours**
Course Learning Objectives: The students will be able to		
1	Understand the working of different diode circuits and characteristics of special diodes.	
2	Use transistors as multistage amplifiers and feedback amplifiers.	
3	Understand the basic operations of operational amplifier circuits.	
4	Discuss about various active filters.	
5	Discuss the specific applications of linear ICs.	

UNIT-I	
Diode circuits: Diode clipping and clamping circuits, Special Diodes Schottky diodes, Tunnel diode, Varactor diode characteristics and applications. **Multistage Amplifiers:** Cascade and cascode connections, direct coupled and RC Coupled multi-stage amplifiers. **Laboratory Sessions / Experimental learning:** Formation of different waveforms by using clipper and clamper circuits in PSpice. **Applications:** Analysis of composite picture signals **Videolink:**https://lake.videoken.com/nptel/category/698/search/clipping%20using%20diodes/video/tZE0-YcL0XM	**8Hrs**
UNIT-II	
Feedback amplifiers: Concepts of feedback – Classification of feedback amplifiers – General characteristics of Negative feedback amplifiers Effect of Feedback on Amplifier characteristics **Oscillators**: Principle of operation, Condition for Oscillations, analysis and derivation of frequency of oscillation of phase shift oscillator, working of crystal oscillator and LC Oscillators. **Laboratory Sessions/ Experimental learning:**Design and testing of BJT -RC phase shift oscillator for given frequency of oscillation in PSpice. **Applications:** Analysis of different pulse generations. **Video link: 1.** https://www.youtube.com/watch?v=0nXEUkFBd8A 2. https://www.youtube.com/watch?v=SVQutMsLKfQ	**8Hrs**
UNIT-III	
Operational Amplifiers: Introduction, Block diagram representation of a typical Op-amp, characteristics of an ideal and practical Op-amp, open loop and closed loop configuration of op-amp, differential amplifier, inverting & non –inverting amplifier, Op-amp with negative feedback. **General Linear Applications:** A.C. amplifier, summing, scaling & averaging amplifier. **Laboratory Sessions/ Experimental learning:** Analysis of inverting and non-inverting op-amp circuits using PSpice **Applications:** Analysis of audio mixer to add different signals with equal gains **Videolink:**https://lake.videoken.com/nptel/search/AC%20Amplifiers/video/J92DIPyPnzY	**8 Hrs**

UNIT-IV	
Active Filters: First & Second order high pass & low pass Butterworth filters. Band pass filters, all pass filters. **DC Voltage Regulators:** voltage regulator basics, voltage follower regulator, adjustable output regulator, LM317 Integrated circuits regulators. **Laboratory Sessions/ Experimental learning:**Design and realize an op – amp based first order Butterworth (a) low pass (b) high pass and (c)band pass filters for a given cut off frequency/frequencies to verify the frequency response Characteristic. **Applications:** Analysis of constant power supply **Videolink:**https://lake.videoken.com/nptel/search/ACTIVE%20FILTER/video/b37hZCpVnuc	**8 Hrs**
UNIT-V	
Signal Generators: Triangular / rectangular wave generator. **Comparators & Converters:** Basic comparator, zero crossing detector, Schmitt trigger circuit, voltage to current converter with grounded load, current to voltage converter and basics of voltage to frequency and frequency to voltage converters. **Laboratory Sessions/ Experimental learning:** Verify the operation of an op – amp as (a) voltage comparator circuit and (b) zero crossing detector. **Applications:** Generation of different signals **Video link:** https://www.youtube.com/watch?v=L5-a1y1wD8k	**8 Hrs**

LABORATORY EXPERIMENTS

1. Design of different clipping circuits.
2. Design of different clamping circuits.
3. Design and testing of BJT -RC phase shift oscillator for given frequency of oscillation.
4. Design and realize to analyze the frequency response of an op – amp amplifier under inverting and non - inverting configuration for a given gain.
5. Design and verify the operation of op – amp as an (a) adder (b) subtractor (c) integrator and (d) differentiator.
6. Design and realize Schmitt trigger circuit using an op – amp for desired upper trip point (UTP) and lower trip point (LTP).
7. Design and realize an op-amp based function generator to generate square and triangular waves of desired frequency.
8. Designing of Fixed voltage power supply (voltage regulator) using IC regulators 78 series and 79 series.

Along with mandatory experiments students are advised to complete two open ended experiments. The following are some suggestions for open ended experiments.

9. Design and Testing of Full wave – center tapped transformer type and Bridge type rectifier circuits with and without Capacitor filter. Determination of ripple factor, regulation, and efficiency.
10. Design and realize an op – amp based function generator to generate sine, square and triangular waves of desired frequency.

Course Outcomes: After completing the course, the students will be able to	
C204.1	Explain the working of different diode circuits and characteristics of special diodes.
C204.2	Explain the concept of multistage amplifiers and feedback amplifiers.
C204.3	Explain basic operations of operational amplifier circuits.
C204.4	Describe the working of various active filters.

C204.5	Discuss the specific applications of linear ICs.

Reference Books	
1	Electronic Devices and Circuit Theory, Robert L Boylestad Louis Nashelsky, Pearson, 11th Edition, 2015.
2	Electronic Devices and Circuits, S.Salivahanan & N.Suresh, McGraw Hill, 3rd Edition, 2013
3.	Operational Amplifiers and Linear ICs, David A. Bell Oxford 3rd Edition 2011
4.	Linear Integrated Circuits, S. Salivahanan, et al McGraw Hill 2nd Edition,2014

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

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

Laboratory- 50 Marks

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

Semester End Examination (SEE):

Total marks: 50+50=100

SEE for 50 marksare 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 subdivisions. 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**
C204.1	3	3	2	-	-	-	-	-	-	-	-	-
C204.2	3	2	1	-	-	-	-	-	-	-	-	1
C204.3	3	3	2	-	-	-	-	-	-	-	-	-
C204.4	3	3	1	1	2	-	-	-	-	-	-	1
C204.5	3	3	1	1	2	-	-	-	-	-	-	1

Electrical Machines-I (Theory and Practice)		
Course Code:	**MVJ21EE35**	**CIE Marks:50+50**
Credits:	**L:T:P:S: 3:0:2:Y**	**SEE Marks: 50 +50**
Hours:	**40 L+ 26 P**	**SEE Duration: 03+03 Hours**
Course Learning Objectives: The students will be able to		
1	Understand the concepts of transformers and suggest a suitable three phase transformer connection.	
2	Discuss the various methods for testing and parallel operation of a transformer.	
3	Explain the detailed working of three phase induction motor.	
4	Explain the performance characteristics of induction machines.	
5	Explain the starting and speed control of induction motor.	

UNIT-I	
Single phase Transformers: Operation of practical transformer under no-load and on-load with phasor diagrams. calculation of equivalent circuit parameters and predetermination of efficiency-commercial and all-day efficiency. Voltage regulation and its significance. **Three-phase Transformers:** Introduction, Constructional features of three-phase transformers (self-study) Transformer connection for three phase operation– star/star, delta/delta, star/delta, zigzag/star and V/V, comparative features. Phase conversion-Scott connection for three-phase to two-phase conversion. **Laboratory Sessions/ Experimental learning:** Plotting B-H curve/hysteresis loop of different core material specimen for comparative study. **Applications:** R&D in transformer core manufacture **Video link / Additional online information:** https://nptel.ac.in/content/storage2/courses/112108150/pdf/PPTs/MTS_16_m.pdf	**8 Hrs**
UNIT-II	
Testing of Transformers: Open circuit and short circuit tests, Polarity test, Sumpner's test, separation of hysteresis and eddy current losses **Parallel Operation of Transformers:** Necessity of Parallel operation, conditions for parallel operation– Single phase and three phase. Load sharing in case of similar and dissimilar transformers. **Auto transformers and tap changing transformers:** Introduction to autotransformer-copper economy, equivalent circuit, no load and on load tap changing transformers. Cooling of transformers. **Laboratory Sessions/ Experimental learning:** Computer simulation of plotting efficiency and regulation curves of a single-phase transformer using OC and SC test data. **Applications:** Countercheck for manufacturer's load test data **Video link / Additional online information**: https://nptel.ac.in/courses/108/105/108105017/	**8Hrs**
UNIT-III	
Three Phase Induction Motors: Review of concept and generation of rotating	**8Hrs**

magnetic field,Principle of operation, construction, classification and types; squirrel-cage, slip-ring (self-study). Slip, Torque equation, torque-slip characteristic covering motoring, generating, and braking regions of operation, Maximum torque, significance of slip. **Laboratory Sessions/ Experimental learning:** Assembling of poly-phase induction machines. **Applications**: Understanding the detailed analysis of poly-phase induction motors. **Web Link and Video Lectures:** https://www.youtube.com/watch?v=dZyO5gcWP-o https://youtu.be/leXNHZM-CZE	
UNIT-IV	
Performance of Three-Phase Induction Motor: Phasor diagram of induction motor on no-load and on load, equivalent circuit, losses, efficiency, No-load and blocked rotor tests. Performance of the motor from the circle diagram and equivalent circuit. Cogging and crawling. Induction motor working as induction generator**.** **Laboratory Sessions/ Experimental learning:** Brake test on slipring induction motor. **Applications:** Induction motor drives. **Web Link and Video Lectures:** https://www.youtube.com/watch?v=ze8LY4yq9Wk https://youtu.be/eMq9j0KY2Ak	**8Hrs**
UNIT-V	
Starting and Speed Control of Three-Phase Induction Motors: Need for starter. Direct on line, Star-Delta, and autotransformer starting. Rotor resistance starting. Speed control by voltage, frequency, and rotor resistance methods. **Single-Phase Induction Motor:** Double revolving field theory and principle of operation. Construction and operation of split-phase, capacitor start, capacitor run, and shaded pole motors. Comparison of single-phase motors and applications. **Laboratory Sessions/ Experimental learning:** Assembling of poly-phase induction machines. **Applications**: Understanding the detailed analysis of poly-phase induction motors. **Web Link and Video Lectures:** https://www.youtube.com/watch?v=dZyO5gcWP-o https://youtu.be/leXNHZM-CZE	**8Hrs**
LABORATORY EXPERIMENTS	
1. Open Circuit Characteristics of DC shunt generator. 2. Hopkinson's test on identical DC shunt machines. 3. Fields test on DC series machines. 4. Swinburne's test on a DC shunt motor and speed control of DC shunt motor. 5. Brake test on DC shunt motor. 6. O.C. & S.C. Tests on Single phase Transformer-Predetermination of efficiency and regulation. 7. Sumpner's test on identical single-phase transformers. 8. Scott Connection of two single phase transformers. **Along with mandatory experiments students are advised to complete two open ended**	

experiments. The following are some suggestions for open ended experiments.

9. Parallel operation of Single-phase Transformers.
10. Separation of core losses in a single-phase transformer.
11. Load test on DC compound generator.

Course Outcomes: After completing the course, the students will be able to	
C205.1	Understand the construction and operation of 1-phase, 3-Phase transformers.
C205.2	Analyze the performance of transformers by polarity test, Sumpner's Test, phase conversion, 3-phase connection, and parallel operation.
C205.3	Understand the working of three phase induction motors and applications.
C205.4	Analyze performance characteristics of induction machines.
C205.5	Understand the starting and speed control of induction motor.

Reference Books	
1.	Electric Machines, D. P. Kothari, et al, 4th Edition, 2011.
2.	Principals of Electrical Machines, V.K Mehta, Rohit Mehta, S Chand, 2nd edition, 2009
3.	Electric Machines, MulukuntlaS.Sarma,at el, Cengage, 1st Edition, 2009
4.	Electrical Technology, B.L Theraja, Volume2, S. Chand, 22nd 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 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.

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 marksare 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	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**
C205.1	3	3	-	1	2	-	-	-	-	-	-	1
C205.2	3	3	-	1	2	-	-	-	-	-	-	1
C205.3	3	3	-	1	2	-	-	-	-	-	-	1
C205.4	3	3	-	1	2	-	-	-		-	-	1
C205.5	3	3	-	1	2	-	-	-	-	-	-	1

Semester: III		
CONSTITUTION OF INDIA AND PROFESSIONAL ETHICS AND CYBER LAW (Theory)		
Course Code:	**MVJ21CPH36**	**CIE Marks: 50**
Credits:	**L:T:P: 1:0:0**	**SEE Marks: 50**
Hours:	**15L**	**SEE Duration: 2 Hrs.**
Course Learning Objectives: The students will be able to		
1	To know the fundamental political codes, structure, procedures, powers, and duties of Indian constitution, Indian government institutions, fundamental rights, directive principles and the duties of the citizens.	
2	To provide overall legal literacy to the young technograts to manage complex societal issues in the present scenario.	
3	To understand engineering ethics & their responsibilities, identify their individual roles and ethical responsibilities towards society**.**	

UNIT-I	
Introduction to Indian Constitution The Necessity of the Constitution, The Societies before and after the Constitution adoption. Introduction to the Indian Constitution, The Making of the Constitution, The role of the Constituent Assembly – Preamble and Salient features of the Constitution of India. Fundamental Rights and its Restriction and Limitations in different Complex Situations. Directive Principles of State Policy (DPSP) and its present relevance in our society with examples. Fundamental Duties and its Scope and Significance in Nation Building.	**3 Hrs**
UNIT-II	
Union Executive and State Executive Parliamentary System, Federal System, Centre-State Relations. Union Executive – President, Prime Minister, Union Cabinet, Parliament - LS and RS, Parliamentary Committees, Important Parliamentary Terminologies. Supreme Court of India, Judicial Reviews and Judicial Activism. State Executives – Governor, Chief Minister, State Cabinet, State Legislature, High Court and Subordinate Courts, Special Provisions (Article 370, 371, 371J) for some States.	**3 Hrs**
UNIT-III	
Elections, Amendments and Emergency Provisions Elections, Electoral Process, and Election Commission of India, Election Laws. Amendments - Methods in Constitutional Amendments (How and Why) and Important Constitutional Amendments. Amendments – 7,9,10,12,42,44,61,73,74,75,86, and 91,94,95,100,101,118 and some important Case Studies. Recent Amendments with explanation. Important Judgements with Explanation and its impact on society (from the list of Supreme Court Judgements). Emergency Provisions, types of Emergencies and it's consequences. **Constitutional Special Provisions:** Special Constitutional Provisions for SC & ST, OBC, Special Provision for Women, Children & Backward Classes.	**3 Hrs**
UNIT-IV	

Professional / Engineering Ethics Scope & Aims of Engineering & Professional Ethics - Business Ethics, Corporate Ethics, Personal Ethics. Engineering and Professionalism, Positive and Negative Faces of Engineering Ethics, Code of Ethics as defined in the website of Institution of Engineers (India) : Profession, Professionalism, Professional Responsibility. Clash of Ethics, Conflicts of Interest. **Responsibilities in Engineering** - Responsibilities in Engineering and Engineering Standards, the impediments to Responsibility. Trust and Reliability in Engineering, IPRs (Intellectual Property Rights), Risks, Safety and liability in Engineering	**3 Hrs**
UNIT-V	
Internet Laws, Cyber Crimes and Cyber Laws: Internet and Need for Cyber Laws, Modes of Regulation of Internet, Types of cyber terror capability, Net neutrality, Types of Cyber Crimes, India and cyber law, Cyber Crimes and the information Technology Act 2000, Internet Censorship, Cybercrimes and enforcement agencies.	**3 Hrs**

Course Outcomes: After completing the course, the students will be able to	
C206.1	Have constitutional knowledge and legal literacy
C206.2	Understand Engineering and Professional ethics and responsibilities of Engineers.
C206.3	Understand the cyber-crimes and cyber laws for cyber safety measure.

Reference Books	
1.	Durga Das Basu (DD Basu): "Introduction to the Constitution on India", (Students Edition.)Prentice –Hall EEE, 19th/20thEdn., (Latest Edition) or 2008.
2.	Shubham Singles, Charles E. Haries, and Et al : "Constitution of India and Professional Ethics" by Cengage Learning India Private Limited, Latest Edition – 2018.
3.	M.Govindarajan, S.Natarajan, V.S.Senthilkumar, "Engineering Ethics", Prentice – Hall of India Pvt. Ltd. New Delhi, 2004.
4.	M.V.Pylee, "An Introduction to Constitution of India", Vikas Publishing, 2002.

Semester: III		
Domestic Wiring (Theory and Practice)		
Course Code:	**MVJ21EEA37**	**CIE Marks:50**
Credits:	**L:T:P::1:0:2**	**SEE Marks: 50**
Hours:	**5L+10P**	**SEE Duration: 02 Hours**

Course Learning Objectives: The students will be able to	
1	Understand the working principles of different household domestic appliances.
2	Understand the various tools and equipments used for domestic wiring.
3	Acquire necessary knowledge on identifying parts of various electrical appliances.
4	Acquire necessary skills/hand on experience/ working knowledge on single-phase and three-phase connections, basics of electrical wiring.
5	Acquire the electrical connections layout diagrams for various lighting system.

UNIT-I	
Introduction to wiring a house: Flow of electricity, wiring cables and Wire gauges, Calculating Amps, Choosing cables, Connecting meter base to panel, Connecting the number of lamps in series and parallel circuits, Elements in main panel, identifying phase, neutral, and earthing in AC supply.	**3 Hrs**
UNIT-II	
Tools and Equipment used for domestic wiring: Insulated and Grounded tools, AC powered tools, Cordless tools, Specialised tools: Multimeters, Tung Tester, Manual and Digital Megger, Switches boxes,types of switches and dimmers.	**3 Hrs**
UNIT-III	
Grounding and Protection Methods of grounding, Choosing grounding materials, art of grounding, Fuses and circuit breaker selection and installation.	**3 Hrs**
UNIT-IV	
Room by Room Wiring Estimation and cost of wiring, Stocking Up, Outlet box selection, Planning Outlet box and switch location, Pulling cable in new construction, Draw, wire up & test different types of domestic wiring.	**3 Hrs**
UNIT-V	
Introduction to wiring fixtures Choosing the right box for wiring connection, Lighting, Ceiling Fan, Water heater, standby generators.	**3 Hrs**

Course Outcomes: After completing the course, the students will be able to	
C207.1	Understand basic concept of residential wiring
C207.2	Explain tools and equipment used for domestic wiring.
C207.3	Illustrate the grounding process of a residential building and identify different protection devices.
C207.4	Plan a residential wiring room by room.
C207.5	Illustrate a complete residential wiring

Reference Books	
1.	Practical guide to inspection, testing, and certification of electrical installations, Kitcher C., Routledge. Newnes; 3rd edition, 2009. ISBN: 0080969070
2.	Electric wiring: domestic, Scaddan, Brian, Routledge, 2003. ISBN 9780367023348
3.	Handbook of Repair & Maintenance of domestic electronics appliances,Shashi Bhushan Sinha,BPB Publications**,**2016, ISBN: 9788183335027.
4.	Wiring a house, Rex cauldwell, Taunton press, 5th edition, 2014, ISBN:162710674X

Semester: III		
Additional Mathematics-I (Common to all branches)		
Course Code:	**MVJ21MATDIP-1**	**CIE Marks:50**
Credits:	**L:T:P:S: 1:2:0:0**	**SEE Marks: 50**
Hours:	**40L**	**SEE Duration: 3 Hrs**
Course Learning Objectives: The students will be able to		
1	Familiarize the important and introductory concepts of Differential calculus	
2	Provide essential concepts integral calculus	
3	Gain knowledge of vector differentiation	
4	Learn basics of probability	
5	Ordinary differential equations of first orderand 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. **Video Link**: 1. http://nptel.ac.in/courses.php?disciplineID=111	**8 Hrs**
UNIT-II	
IntegralCalculus: 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. **Video Link**: 1. http://nptel.ac.in/courses.php?disciplineID=111	**8 Hrs**
UNIT-III	
Vector Differentiation: ScalarandVectorpointfunctions,Gradient,Divergence,Curl,SolenoidalandIrrotationalvectorfields. **Vector identities**- $div(\phi\vec{A})$, $curl(\phi\vec{A})$, $curl(grad(\phi))$, $div(curl\ \vec{A})$. **Video Link**: 1. http://nptel.ac.in/courses.php?disciplineID=111	**8Hrs**
UNIT-IV	
Probability: Basic terminology, Sample space and events. Axioms of probability. Conditional probability – illustrative examples. Bayes theorem-examples. **Video Link**: 1. http://nptel.ac.in/courses.php?disciplineID=111	**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. **Video Link**: 1. http://nptel.ac.in/courses.php?disciplineID=111	**8Hrs**

Course Outcomes: After completing the course, the students will be able to	
C208.1	Apply the knowledge of calculus to solve problems related to polar curves and its applications
C208.2	Applytheconceptofintegrationandvariablestoevaluatemultipleintegralsandtheirusagein computingthe areaandvolumes.
C208.3	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.
C208.4	UnderstandthebasicConceptsofProbability
C208.5	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.	G. B. Gururajachar, Calculus and Linear Algebra, Academic Excellent Series Publicatior 2018-19
3.	Chandrashekar K. S, Engineering Mathematics-I, Sudha Publications, 2010.

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

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

Semester End Examination (SEE):

Total marks: 50+50=100

SEE for 50 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**
C208.1	3	3	0	2	0	0	0	0	0	0	1	1
C208.2	3	3	0	2	0	0	0	0	0	0	1	1
C208.3	3	3	0	3	0	0	0	0	0	0	1	1
C208.4	2	2	0	3	0	0	0	0	0	0	1	1
C208.5	2	2	0	2	0	0	0	0	0	0	0	1

Semester: IV		
Probability Distribution, Optimization and Complex Variables (Theory)		
Course Code:	**MVJ21MA41D (Common to ECE, EEE and IOT)**	**CIE Marks: 50**
Credits:	**L: T:P: 2:2:0**	**SEE Marks: 100**
Hours:	**40L**	**SEE Duration: 3 Hrs.**

Course Learning Objectives: The students will be able to	
1	Apply discrete and continuous probability distributions in analyzing the probability models arising in engineering field.
2	Learn the mathematical formulation of linear programming problem
3	Learn the mathematical formulation of transportation problem.
4	Understand the concepts of Complex variables and transformation for solving Engineering Problems.
5	Learn the solutions of partial differential equations numerically

UNIT-I	
Probability Theory: Random variables (discrete and continuous), probability density function, cumulative density function. **Probability Distributions:** Binomial distribution, Poisson distribution. Normal distribution, Exponential distribution. Joint probability distributions. **Self-study:** Discrete and continuous probability problems **Applications:** Discrete and continuous probability distributions help in analyzing the probability models arising in engineering field. **Video Links:** https://youtu.be/cp7_ZF2kNi4	**8 Hrs**
UNIT-II	
Optimization: Linear Programming, mathematical formulation of linear programming problem (LPP), Types of solutions, Graphical Method, simplex method, big-M method, Dual – simplex method. **Self-study:** Two phase simplex method **Applications:** Applications of transportation Problems Video Links: https://youtu.be/WZIyL6pcItY	**8 Hrs**
UNIT-III	
The transportation problem: Initial Basic Feasible Solution (IBFS) by Least Cost Method, North West Corner Rule method, Vogel's Approximation Method, MODI method (Optimal Solution), Salesman problem, Assignment problem. **Self-Study Topic**: Matrix Minima Method Video Links: http://nptel.ac.in/courses.php?disciplineID=111	**8 Hrs**
UNIT-IV	
Complex Variables: Functions of complex variables, Analytic function, Cauchy-Riemann equations in Cartesian and polar coordinates, Construction of analytic function (Using Milne-Thomson method) Consequences of Cauchy-Riemann equations, Properties of analytic functions. Application to flow problems- complex potential, velocity potential, equipotential lines, stream functions, stream lines.	**8 Hrs**

Self-study: Unique Expression Method **Applications:** Application to flow problems Video Links: https://youtu.be/b5VUnapu-qs	
UNIT-V	
Numerical solutions of PDE – Classification of second order equations, finite difference approximation to derivatives, solution of heat equations, solution of wave equations and solution of Laplace equation. **Self-study:** Crank Nicolson method – problems. **Applications:** To solve boundary value problems Video Links:https://youtu.be/nNnnBMF03lI	**8 Hrs**

Course Outcomes: After completing the course, the students will be able to	
C209.1	Apply discrete and continuous probability distributions in analyzing the probability models arising in engineering field.
C209.2	Learn the mathematical formulation of linear programming problem
C209.3	Solve the applications of transport problems
C209.4	Use the concepts of analytic function and complex potentials to solve the problems arising in electromagnetic field theory
C209.5	Learn the numerical solutions of partial differential equations

Reference Books	
1.	B.S. Grewal, "Higher Engineering Mathematics" Khanna Publishers, 44th Edition, 2013.
2.	Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley-India publishers, 10thedition, 2014.
3.	Prof G.B.Gururajachar "Engineering Mathematics-III, Academic Excellent series Publications, 2016-17
4.	Bali N. P. & Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, 8th Edition

Continuous Internal Evaluation (CIE):
Theory for 50 Marks

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

Semester End Examination (SEE):

Total marks: 50+50=100

SEE for 50 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**
C209.1	3	3	0	3	0	0	0	0	0	0	1	1
C209.2	3	3	0	3	0	0	0	0	0	0	1	0
C209.3	3	2	0	2	0	0	0	0	0	0	0	0
C209.4	3	3	0	3	0	0	0	0	0	0	0	1
C209.5	3	3	0	3	0	0	0	0	0	0	1	0

Semester: IV		
Power System Engineering-I (Theory)		
Course Code	**MVJ21EE42**	**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 different types of power generating sources and structure.	
2	Illustrate the economic aspects of power generation and tariff methods.	
3	Evaluate the performances of transmission line and parameters calculations.	
4	Understand mechanical design of transmission lines.	
5	Examine A.C. and D.C. distribution systems.	

UNIT-I	
GENERATION OF ELECTRIC POWER: **Conventional generation Sources:** Layout of Hydro power station, block diagram of thermal power station and Nuclear Power Plant, brief description of components. Advantages and disadvantage of power plants. **Non-Conventional Sources:** Solar Power Generation: Role and Potential of Solar Energy Options, Principles of Solar Radiation, Flat Plate and Concentrating Solar Energy Collectors. Wind Power Generation: Role and potential of Wind Energy Option, Horizontal and Vertical Axis Wind Mills. Introduction to geothermal and ocean energy. **Laboratory Sessions/ Experimental learning:** Visit near any power station to get practical knowledge on working of power station. **Applications**: All industrial applications **Video link**: http://nptel.iitm.ac.inhttps://youtu.be/Yg6XsepGCKY	**8Hrs**
UNIT-II	
ECONOMICS ASPECTS OF POWER GENERATION: Introduction to load curve, load duration and integrated load duration, load demand, maximum demand, load factor, diversity factor, capacity factor, utilization and plant use factors. Base load and peak load plants. Cost of generation and their division into fixed and running cost, introduction to Tariff methods and numerical problems. Introduction to underground cables, types of cables. **Laboratory Sessions/ Experimental learning**: Load estimating using software **Applications:** Energy auditing of industry and other institutes. **Video links:** http://nptel.iitm.ac.in https://youtu.be/GRwJqD4StEU	**8Hrs**
UNIT-III	
INDUCTANCE & CAPACITANCE CALCULATIONS OF TRANSMISSION LINES Calculation of Line constants of single phase and three phase lines of symmetrical configuration. Classification of Transmission Lines -Short, Medium and Long line and their model representations, Nominal-T, Nominal-π and A, B, C, D Constants for	**8Hrs**

symmetrical networks, Numerical Problems. **Laboratory Sessions/ Experimental learning:** Calculation of inductance and capacitance of transmission line using MAT LAB -Simulink software. **Applications:** Design of transmission line for different voltages. Video link / Additional online information (related to module if any): http://nptel.iitm.ac.inhttps://youtu.be/lr1jgbR5ca8	
UNIT-IV	
PERFORMANCE OF FACTORS AFFECTING THE TRANSMISSION LINE: Skin and proximity effects, Ferranti effect, charging current, corona, Factors affecting corona, critical voltages and power loss. Introduction to overhead line insulators, types of insulators, string efficiency, calculation of string efficiency. Introduction to sag and tension calculations, effect of wind and ice on weight of conductor, numerical problems. **Laboratory Sessions/ Experimental learning:** Insulation test of materials for high voltage- HVE Lab **Applications:** Design of insulators for different voltage value. **Video link:** http://nptel.iitm.ac.inhttps://youtu.be/gd1nruo4_iA	**8Hrs**
UNIT-V	
A.C DISTRIBUTION SYSTEM Introduction, AC distribution, Single phase, 3-phase, 3 phase 4 wire system, bus bar arrangement, Selection of site for substation. Voltage Drop Calculations (Numerical Problems) in A.C. Distributors for the following cases: Power Factors referred to receiving end voltage. **D.C DISTRIBUTION SYSTEM**: Introduction to D.C distribution system, Comparison of DC vs. AC, and Under-Ground vs. Over- Head Distribution Systems. - Requirements and Design features of Distribution Systems. **Laboratory Sessions/ Experimental learning**: Visit near AC power distribution substation to get practical knowledge on working of power substation **Applications**: Domestic and industrial applications **Video link / Additional online information** (related to module if any): http://nptel.iitm.ac.inhttps://youtu.be/_iz8ZkjD7z8	**8Hrs**

Course Outcomes: After completing the course, the students will be able to	
C210.1	Discuss the operation of conventional generating stations and renewable sources of electrical power.
C210.2	Evaluate the economic aspects of power generation and tariff methods
C210.3	Discuss the performance of typical transmission and distribution system components.
C210.4	Determine the electrical circuit parameters of transmission lines
C210.5	Analyze A.C. and D.C. distribution systems for different loads.

Reference Books

1.	A Text Book on Power System Engineering, M.L.Soni, P.V.Gupta, U.S.Bhatnagar, A.Chakrabarthy, ,1999, Dhanpat Rai & Co Pvt. Ltd., ISBN: 978-8177000207.
2.	Power System Engineering, D P Kothari & I J Nagrath, Second Edition,2007, MC Graw Hill Education, ISBN: 9780070647916, 9780070647916
3.	Principles of Power system, V.K Mehta & Rohith Mehta, Revised Edition, 2010, S Chand, ISBN: 8121900964, 9788121900966
4.	Electrical Power Systems, C.L. Wadhwa,Fifth Edition,2009,New Age International, ISBN:9788122424683

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**
C210.1	2	1	2	2	2	-	2	-	-	-	-	-
C210.2	2	1	2	3	2	-	-	-	-	-	-	-
C210.3	2	1	2	1	2	-	-	-	-	-	-	-
C210.4	3	2	2	2	2	-	-	-	-	-	-	-
C210.5	2	2	2	1	2	-	-	-	-	-	-	-

Semester: IV		
OOPS with C++ for Electrical Engineering (Theory)		
Course Code:	**MVJ21EE43**	**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	Become familiar with OOPs concept	
2	Become familiar with C++ concepts, classes and usage	
3	Write effective C++ programs for big projects	
4	Become familiar with using and implementing C++ math libraries	
5	Learn how to program for embedded platforms	

UNIT-I	
INTRODUCTION TO OOP and C++: Procedure and Object-Oriented Programming, Basic Concepts and Benefits of OOP, Introduction to C++, C++ statements, Structure of C++ program, Compiling and Linking **Laboratory Sessions/ Experimental learning**: **Applications**: Applications Layer, Middleware, Firmware, Embedded Systems **Web Link and Video Lectures:** 1. C++ Tutorial for Beginners: Full Course, https://youtu.be/vLnPwxZdW4Y	**8Hrs**
UNIT-II	
Tokens, Expressions, Control Structure, Functions: Introduction, Keywords, Identifiers, Constants, Basic data types, User Defined data types, Derived data types, Variables, Operators, Expressions, Overloading, Control Structures, Details of functions, Overloading, Friend and Virtual Functions, Math Library functions **Laboratory Sessions/ Experimental learning:** Experimentation with simple C++ programs **Applications**: Applications Layer, Middleware, Firmware, Embedded Systems **Web Link and Video Lectures:** 1. C++ Tutorial for Beginners: Full Course, https://youtu.be/vLnPwxZdW4Y	**8Hrs**
UNIT-III	
Classes, Objects, Constructors, Destructors: Specifying, Member functions, Nesting, Private members, Arrays, Memory allocation, Static members, Friendly functions, Local classes, Details about constructors, Types, Dynamic initialization, Two dimensional arrays **Laboratory Sessions/ Experimental learning**: Experimentation for C++ programs on Classes and Objects **Applications**: Applications Layer, Middleware, Firmware, Embedded Systems **Web Link and Video Lectures:** **1.** C++ Tutorial for Beginners: Full Course, https://youtu.be/vLnPwxZdW4Y **2.** C++ Full Course for Beginners, https://youtu.be/GQp1zzTwrIg	**8Hrs**
UNIT-IV	
Operator Overloading, Type conversion, Inheritance, Extending Classes, Pointers, Virtual functions, Polymorphism, Console I/O operations, Working with Files. **Laboratory Sessions/ Experimental learning:** Experimentation for C++ programs on Operator Overloading, Virtual functions, Polymorphism, Console	**8Hrs**

I/O, File Operations **Applications**: GUI, Applications Layer, Middleware, Firmware, Embedded Systems, IoT **Web Link and Video Lectures:** **1.** C++ Tutorial for Beginners: Full Course, https://youtu.be/vLnPwxZdW4Y **2.** C++ Full Course for Beginners, https://youtu.be/GQp1zzTwrIg	
UNIT-V	
Applications to Electrical Engineering problems: Examples of Matrix operations, Writing Matrix Classes, Embedded C++ programming, C++ for solving electrical circuit problems **Laboratory Sessions/ Experimental learning:** Experimentation on Circuit and Power System Analysis, Embedded Systems **Applications**: Circuit Analysis, Power System Analysis, Embedded Systems, IoT **Web Link and Video Lectures:** **1.** C++ Tutorial for Beginners: Full Course, https://youtu.be/vLnPwxZdW4Y **2.** C++ Full Course for Beginners, https://youtu.be/GQp1zzTwrIg	**8Hrs**

Course Outcomes: After completing the course, the students will be able to	
C211.1	Become familiar with various concepts of OOP and C++
C211.2	Become well versed in C++ Programming on Desktop or Laptop
C211.3	Will be able to write C++ programs for GUI, Circuit analysis, Power System analysis
C211.4	Become familiar with C++ programming on Embedded platform and IoT
C211.5	Execute small to medium complexity C++ Projects

Reference Books	
1	E Balagurusamy "OBJECT ORIENTED PROGRAMMING WITH C++", The McGraw Hill Companies, 4th Edition
2	Stanley Lippman, C++ Primer", 5th Edition, Addison Wesley
3	Michael Barr, "Programming Embedded Systems in C & C++", O'Reilly Media, Inc.
4	Guido Buzzi Ferraris, "Scientific C++: Building Numerical Libraries the Object Oriented Way", Addison Wesley Longman

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**
C211.1	1	1	1	1	2	-	-	-	-	-	-	1
C211.2	2	2	2	2	1	-	-	-	-	-	-	1
C211.3	2	2	2	1	2	-	-	-	-	-	-	1
C211.4	3	2	2	1	2	-	-	-	-	-	-	1
C211.5	2	2	2	3	3	-	-	-	-	-	-	1

Electrical Machines-II (Theory and Practice)		
Course Code:	**MVJ21EE44**	**CIE Marks:50+50**
Credits:	**L:T:P: 3:0:2**	**SEE Marks: 50 +50**
Hours:	**40 L+ 26 P**	**SEE Duration: 03+03 Hours**

Course Learning Objectives: The students will be able to	
1	Understand the detailed working of synchronous motor.
2	Explain the concept of voltage regulation in alternator.
3	Explain the detailed working of permanent magnet synchronous motor.
4	Explain the construction and working of servo motor and BLDC motor.
5	Explain the construction and working of stepper motor and Linear Electric Machines.

UNIT-I	
Synchronous Motors: Theory of operation, principle of operation, construction of salient and non-salient pole machines, methods of starting, phasor diagram, excitation methods, synchronous condenser, mathematical analysis for power developed, hunting and its suppression. **Laboratory Sessions/ Experimental learning:** Open Circuit Test to calculate core loss and to draw open circuit curve for Three Phase Alternator **Application:** Power generation plant. **Web Link and Video Lectures:** https://youtu.be/59Jg5zEguVY https://youtu.be/nu8wtbxKCRM	**8Hrs**
UNIT-II	
Synchronous Generator: armature windings, coil span factor, distribution factor, chorded coils and EMF equation. **Voltage Regulation:** Significance, EMF, MMF and ZPF method. **Salient Pole Synchronous Machine:** Two reaction theory, slip test. **Synchronization:** Parallel operation of alternators -synchronization. **Laboratory Sessions/ Experimental learning:** Study the Synchronization of the alternator with infinite bus bar.(https://vp-dei.vlabs.ac.in/Dreamweaver/exp1.html) **Application:** Power Factor corrections. **Web Link and Video Lectures:** https://youtu.be/b24jORRoxEc https://youtu.be/edJFTap0zYw	**8Hrs**
UNIT-III	
Permanent Magnet Synchronous Motor (PMSM): Construction, Principle of Operation, EMF Equation of PMSM, Control of PMSM, Comparison of Conventional and PM Synchronous Motors, Applications of PMSM-Study of application of PMSM as traction motor for electric vehicles. **Laboratory Sessions/ Experimental learning**: MATLAB simulation of speed control of PMSM. **Applications:** Robotics, machine tools, actuators. **Video link**: https://nptel.ac.in/courses/108/102/108102156/	**8Hrs**
UNIT-IV	

Servo Motors: DC Servo Motors – Construction, Principle of Operation, AC Servo Motors – Construction & Working, Analysis of Two-phase AC Servo Motor, Torque speed characteristics. **Brushless D.C. Motors:** Principle of Operation, Types, Magnetic circuit analysis, EMF equation, Commutation, Motor characteristics and control, Torque/speed characteristics **Laboratory Sessions/ Experimental learning**: Speed torque characteristics of AC & DC servo motor. **Applications:** Robotics, Solar Tracking System, Metal Cutting Metal Forming Machines, Industrial robots, CNC machine tools. **Video link:** https://www.youtube.com/watch?v=UmHtWX2XYSM https://www.youtube.com/watch?v=EQzm51BK6UE&list=PLA5CA7D35114BA425&index=23	**8Hrs**
UNIT-V	
Stepper Motor: Introduction, Variable Reluctance Stepper Motor, Permanent Magnet Stepper Motor, Hybrid Stepper Motor, Windings in Stepper Motors, Characteristics of Stepper Motor, Open – loop Control of Stepper Motor, closed – loop Control of Stepper Motor, Microprocessor – Based Control of Stepper Motor, Applications of Stepper Motor. **Linear Electric Machines:** Linear Induction motor, DC Linear Motor, Linear Reluctance and Levitation Machines. **Laboratory Sessions/ Experimental learning**: Demonstration with an experiment, microprocessor-based control of stepper motor. **Applications:** 3D printing equipment, Textile machines, CNC milling machines, Welding equipment, overhead traveling cranes and beltless conveyors, , maglev (magnetic levitation) trains **Video link:** https://www.youtube.com/watch?v=UmHtWX2XYSM https://www.youtube.com/watch?v=Tp724MqrosA	**8Hrs**
LABORATORY EXPERIMENTS	
1. Load test on three phase Induction Motor. 2. Conduct suitable test to draw the equivalent circuit of single-phase induction motor. 3. Load test on a single-phase induction motor. 4. No-load & Blocked rotor test on three phase Induction motor. 5. Brake test on three phase Induction Motor. 6. Regulation of a three –phase alternator by synchronous impedance & m.m.f. methods. 7. Determination of Xd and Xq of a salient pole synchronous machine. 8. V and Inverted V curves of a three-phase synchronous motor. **Along with mandatory experiments students are advised to complete two open ended experiments. The following are some suggestions for open ended experiments.** 9. Efficiency of a three-phase alternator. 10. Speed control of 3 phase slip ring Induction motor- rotor Resistance control, stator voltage control. 11. Regulation of three-phase alternator by Z.P.F. method.	

Course Outcomes: After completing the course, the students will be able to	
C212.1	Determine the regulation of an alternator by various methods
C212.2	Describe the importance of Synchronization of Alternator and discuss V and inverted V curves.
C212.3	Explain the operation and control of permanent magnet synchronous motors.
C212.4	Explain Servo motors and brushless DC motors.
C212.5	Analyse the performance of stepper motors and linear electric machines.

Reference Books	
1	Electric Machines, D. P. Kothari, et al, 4th Edition, 2011.
2	Special Electrical Machines, E.G. Janardanan, PHI, 1 st Edition 2014.
3.	Brushless Permanent Magnet and Reluctance Motor Drives, T J E Miller, Clerendon Press, Oxford 1989.
4.	Electrical Technology, B.L Theraja, Volume2, S. Chand, 22nd 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 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.

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 marksare 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	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**
C212.1	3	2	-	-	-	-	-	-	3	-	-	1
C212.2	3	2	-	-	-	-	-	-	3	-	-	1
C212.3	3	2	-	-	-	-	-	-	3	-	-	1
C212.4	3	2	-	-	-	-	-	-	3	-	-	1
C212.5	3	2	-	-	-	-	-	-	3	-	-	1

Semester: IV		
MICROCONTROLLER AND ARM PROCESSOR		
Course Code:	**MVJ21EE45**	**CIE Marks:50+50**
Credits:	**L:T:P:S:3:0:2:Y**	**SEE Marks: 50+50**
Hours:	**40 L+ 26 P**	**SEE Duration: 03Hours**
Course Learning Objectives: The students will be able to		
1	Explain the working of different microcontrollers and internal organization of 8051.	
2	Understand the various instructions to write assembly language program for different applications.	
3	Understand C data types to develop 8051 timer, counter and serial port programs.	
4	Explain the various interrupts and interfacing of parallel peripheral devices to 8051.	
5	Understand the basics of ARM Embedded systems.	

UNIT-I	
8051 Microcontroller Basics: Review of numbering systems, Architecture and pin configuration of 8051, PSW and Flag Bits, 8051 Register Banks, Stack, Stack pointer, Program counter, Data pointer, Internal Memory Organization of 8051, Special Function Registers, Addressing Modes **Laboratory Sessions/ Experimental learning**: Conduct a review on different types of microcontrollers available in market. **Applications**: Selection of different microcontrollers for various applications/projects. **Video link**: https://youtube.videoken.com/embed/SUusup7FfJo	**8Hrs**
UNIT-II	
Assembly programming and instructions of 8051: Introduction to 8051 assembly programming, Assembling and running an 8051 program, Data types and Assembler directives, Arithmetic, logic instructions and programs, and program control instruction. **Laboratory Sessions/ Experimental learning**: 1. Simulate a program using Keil to find number of zeroes and ones in a given number. 2. Simulate a program to find whether a number is odd or even using Keil. **Applications**: Generating assembly language algorithms for various applications **Video link** : https://youtube.videoken.com/embed/oRPluYsxF28	**8Hrs**
UNIT-III	
8051 programming in C: Data types and time delay, I/O programming, Logic operations, TMOD and TCON, Timer Programming in mode 1and 2, Counter programming, SCON and SBUF, Serial port programming. **Laboratory Sessions/ Experimental learning**: Generate a Program for reading and manipulating port data. **Applications**: Generating baud rates and time delays for various embedded applications. **Video link** : • https://youtube.videoken.com/embed/2AVOxLPKjeA • https://youtube.videoken.com/embed/NhurqshD0HA	**8Hrs**
UNIT-IV	

8051 Interrupts: 8051 interrupts, Interrupt priority, Interrupt enable register. Interfacing: Stepper motor interfacing, DC motor interfacing, ADC 0808 interfacing to 8051, DAC interfacing, LCD and keyboard interfacing. **Laboratory Sessions/ Experimental learning**: Simulate a program using Keil to generate a square wave of frequency 100KHz on pin P2.3.Use timer 1 in mode 1. Take crystal frequency of 22MHz. **Applications**: Interfacing of external devices to microcontrollers. **Video link:** • https://youtube.videoken.com/embed/DpMxQzHhyyc • https://youtube.videoken.com/embed/MqhxeOi8R1Q	**8 Hrs**
UNIT-V	
ARM Embedded Systems: Microprocessors versus Microcontrollers, The RISC design philosophy, The ARM Design Philosophy, Embedded System Hardware, Embedded System Software, operating system. **ARM Processor Fundamentals:** Registers, Current Program Status Register, Pipeline. **Laboratory Sessions/ Experimental learning:** 1. Simulate a program using keil to toggle Led's connected to Port 1 continuously with some delay. 2. Develop any simple project using Microcontroller. 3. Virtual lab experiment: Interface DAC and LCD to 8051 **Video link:** ARM controllers for embedded applications. • https://nptel.ac.in/courses/106105193/ • https://nptel.ac.in/courses/117106111/	**8Hrs**
LABORATORY EXPERIMENTS	
1. Develop code for data movement and block exchange. 2. Find largest or smallest numbers in a series and sorting numbers in ascending / descending order. 3. Develop data conversion programs. 4. Develop counters using conditional statements and loop structure. 5. Perform 16-bit addition, subtraction, Multiplication and division. 6. Control the speed of a DC motor using PWM. 7. Rotate the Stepper motor in specified direction (clockwise or counter-clockwise). 8. Generate waveforms using DAC. **Along with mandatory experiments students are advised to complete two open ended experiments. The following are some suggestions for open ended experiments.** 9. Hardware implementation of a LCD control using 8051 microcontrollers. 10. Interface of Seven segment LED display with 8051 Microcontroller. 11. Interface an Elevator with 8051 Microcontroller.	

Course Outcomes: After completing the course, the students will be able to	
C213.1	Select microcontrollers for different applications and explain the functional units of 8051.
C213.2	Develop algorithm and formulate assembly language program for a given task.
C213.3	Develop program for timers and serial port using C.
C213.4	Design interfacing circuitry to interface various peripheral devices to microcontroller.
C213.5	Explain the basics of ARM Embedded systems.

Reference Books	
1	Embedded Systems: Architecture, Programming and Design by Rajkamal , Tata McGraw-Hill, 7th Edition, 2006.
2	The 8051 Microcontroller Architecture Programming &Applications by Kenneth J. Ayala, Penram International, 1996.
3	8051 Microcontroller and Embedded Systems– using assembly and C by Muhammad Ali Mazidi, Janice Gillespie Mazidi, Rollin D. McKinlay, Pearson Education, 2nd Edition.
4	ARM Systems Developers Guide by Andrew.N. Sloss, Elsevier Publications, 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.

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 marksare 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**
C213.1	3	3	2	2	1	-	-	-	3	-	-	3
C213.2	3	3	3	3	3	-	-	-	-	-	-	3
C213.3	3	3	3	3	3	-	-	-	-	-	-	3
C213.4	3	3	3	3	3	-	-	-	-	-	-	3
C213.5	3	3	3	3	3	-	-	-	-	-	-	3

Semester: IV		
Digital Logic Design Using Integrated Circuits (Theory and Practice)		
Course Code:	**MVJ21EEA47**	**CIE Marks:50**
Credits: L: T:P:	**1:0:2**	**SEE Marks: 50**
Hours:	**5L+10P**	**SEE Duration: 02 Hours**

Course Learning Objectives: The students will be able to	
1	Understanding of Basic Logic gates using IC's.
2	Design of various combinational digital circuits using logic gates.
3	Design of Binary to gray code and BCD to EX-3 code converters.
4	Design and testing of various counters to count the data in a continuous loop.
5	Design MOD-N Counters for interfacing to digital displays.

UNIT-I	
Introduction: Study of basic logic gates using Integrated circuits, Simplification, realization of Boolean expressions using logic Gates/Universal gates.	**3 Hrs**
UNIT-II	
Adder and Subtractor: Realization of half/full adder using logic gates, Realization of half/full Subtractor using logic gates.	**3 Hrs**
UNIT-III	
Converters: Realization of Binary to Gray code converter, Realization of Gray code converters to Binary, BCD to Ex-3 code conversion and Ex-3 code to BCD conversion.	**3 Hrs**
UNIT-IV	
Counters: Design and testing of ring counter, Design and testing of Johnson counter,	**3 Hrs**
Module-V	
MOD-N Counters: Realization of 3-bit counters as a sequential circuit using 7476, Design of mod N counter using 7490	**3 Hrs**

Course Outcomes: After completing the course, the students will be able to	
215.1	Understand basic concept of Basic Logic gates and Truth Tables.
215.2	Design of Half/full adder/subtractor.
215.3	Design various code converters for sending signals.
215.4	Design Ring and Johnson counters to count the data in a continuous loop.
215.5	Design of 3-bit counters for interfacing to digital displays.

Reference Books

1.	Fundamentals of Digital Circuits, A Anand Kumar, 4th Edition, PHI Publishers, 2016.
2.	A Textbook of Digital Electronics, Dr. R. S. Sedha, S Chand & Co Ltd, 3rd Edition, 2017.

Semester: IV		
SummerInternship-I		
Course Code:	**MVJ21INT48**	**CIE Marks:50**
Credits: L: T:P:	**0:0:4**	**SEE Marks: 50**
Hours:		**SEE Duration:**

Course Learning Objectives: The students will be able to	
1	To get the field exposure and experience
2	To apply the theoretical concept in field application
3	To prepare the comparison statement of difference activities

Internship: This shall be carried out by students in industry set-up related to the construction/ materials testing laboratories/research organizations/project management consulting firms/QS and QA organizations/ planning and design offices/Professional organizations and other avenues related to the civil engineering domain in consultation and approval of internship guide/HOD /internship committees of the institutions.	**3 Hrs**

Course Outcomes: After completing the course, the students will be able to	
216.1	Develop skills to work in a team to achieve common goal.
216.2	Develop skills of self-learning, evaluate their learning and take appropriate actions to improve it.
216.3	Prepare them for life-long learning to face the challenges and support the technological changes to meet the societal needs.
216.4	Develop skills of project management and finance.
216.5	Understand work ethics and culture of industry.

Scheme of Evaluation

Evaluation of the field training/industrial internship shall be conducted during VIII semester bu internal and external examiners for 100 marks. The external examiner shall be from the industry, where the student carried out the field training/Industrial internship. In case of non-availability of external examiner, the concerned head of the department shall appoint an external examiner from the near by college or a senior faculty member from outside the department in consultation with respective BOE and approved by Principal. The field training/industrial internship carries two credits. A student has to get a minimum of 40% marks for a pass. If a student fails to complete the same, then the field training/Industrial internship has to be repeated in its entirety.

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
216.1	2	2	2	3	3	2	1	1	2	1	1	2
216.2	2	2	2	3	3	2	1	1	2	1	2	2
216.3	2	2	2	3	3	2	1	1	2	1	2	2
216.4	2	2	2	3	3	2	1	1	2	1	2	2
216.5	2	2	2	3	3	2	1	1	2	1	2	2

Semester: IV		
Additional Mathematics-II (Common to all branches)		
Course Code:	**MVJ21MATDIP-II**	**CIE Marks:50**
Credits:	**L:T:P:S: 1:2:0:0**	**SEE Marks: 50**
Hours:	**40L**	**SEE Duration: 3 Hrs**

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

UNIT-I	
LinearAlgebra: Introduction - Rank of matrix by elementary row operations - Echelon form. Consistency of system of linear equations - Gauss elimination method. Eigen values and eigen vectors of a square matrix. Diagonalization of a square matrix of order two. **Self study**: Application of Cayley-Hamilton theorem (without proof) to compute the inverse of a matrix-Examples. **Video Link**: 1. http://nptel.ac.in/courses.php?disciplineID=111	**8Hrs**
UNIT-II	
Differentialcalculus: Indeterminate forms: L-Hospital rule (without proof), Total derivatives, and Composite functions. Maxima and minima for a function of two variables. **BetaandGammafunctions:**BetaandGamma functions,RelationbetweenBetaandGamma function-simpleproblems. **Self study**: Curve tracing. **Video Link**: 1. http://nptel.ac.in/courses.php?disciplineID=111	**8Hrs**
UNIT-III	
Analyticalsolidgeometry: 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 indifferentforms and problems. **Video Link**: 1. http://nptel.ac.in/courses.php?disciplineID=111	**8Hrs**
UNIT-IV	
Differential Equations of higher order: Linear differential equations of second and higher order equations with constant coefficients. Inverse Differential operator, Operators methods for finding particular integrals, and Euler –Cauchy equation. **Self study**: Method of variation of parameters	**8Hrs**

Video Link: 1. http://nptel.ac.in/courses.php?disciplineID=111	
UNIT-V	
Partial differential equation: Introduction- Classification of partial differential equations, formation of partial differential equations. Method of elimination of arbitrary constants and functions. Solutions of non-homogeneous partial differential equations by direct integration. Solution of Lagrange's linear PDE. **Self study:** One dimensional heat and wave equations and solutions by the method of separable of variable **Video Link**: 1. http://nptel.ac.in/courses.php?disciplineID=111	**8Hrs**

Course Outcomes: After completing the course, the students will be able to	
C217.1	Make use of matrix theory for solving system of linear equations and compute eigenvalues and eigenvectors required for matrix diagonalization process.
C217.2	Learn the notion of partial differentiation to calculate rates of change of multivariate functions and solve problems related to composite functions and Jacobians.
C217.3	Understand the Three-Dimensional geometry basic, Equation of line in space-differentforms, Angle between two line and studying the shortest distance .
C217.4	Demonstrate various physical models through higher order differential equations and solve such linear ordinary differential equations.
C217.5	Constructavarietyofpartial differentialequations andsolutionbyexactmethods.

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

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

Semester End Examination (SEE):

Total marks: 50+50=100

SEE for 50 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**
C217.1	3	3	0	2	0	0	0	0	0	0	1	1
C217.2	3	3	0	2	0	0	0	0	0	0	1	1
C217.3	3	3	0	3	0	0	0	0	0	0	0	1
C217.4	2	2	0	3	0	0	0	0	0	0	1	1
C217.5	2	2	0	2	0	0	0	0	0	0	0	1

Semester: V		
Technical Management for Electrical Industries (Theory)		
Course Code:	**MVJ21EE51**	**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	Introduce the field of management, the task of the manager, the importance of planning and types of planning, staff recruitment, and the selection process.	
2	Understand the staff recruitment and selection process and explain the need for coordination between the manager and staff.	
3	Explain the social responsibility of business, and the role, and importance of the entrepreneur in economic development.	
4	Discuss the importance of Small-Scale Industries and the related terms and problems involved	
5	Explain the project feasibility study and project appraisal and discuss project financing.	

UNIT-I	
Management: Definition, Importance – Nature and Characteristics of Management, Management Functions, Roles of Manager, Levels of Management, Managerial Skills, Management &Administration, Management as a Science, Art & Profession**.** **Planning:** Nature, Importance and Purpose of Planning, Types of Plans, Steps in Planning, Decision Making – Meaning, Types of Decisions- Steps in Decision Making. **Laboratory Sessions/ Experimental learning:** Case study on decision making process in a corporate. **Applications**: Planning in engineering field. **Web Link and Video Lectures:** 1.https://nptel.ac.in/courses/110/105/110105146/ 2.https://nptel.ac.in/courses/122/108/122108038/	**08 Hrs**
UNIT-II	
Organizing and Staffing: Meaning, Nature and Characteristics of Organization – Process of Organization, Principles of Organization, Departmentalization, Committees –meaning, Types of Committees, Centralization Vs Decentralization of Authority and Responsibility, Span of Control, Nature and Importance of Staffing, Process of Selection and Recruitment. **Directing and Controlling:** Meaning and Nature of Directing-Leadership Styles, Communication – Meaning and Importance, Coordination- Meaning and Importance, Techniques of Coordination, controlling – Meaning and Steps in Controlling. **Laboratory Sessions/ Experimental learning:** Case study of steel plant departmentalization.	**08 Hrs**

Applications: Effective communication in a corporate. **Web Link and Video Lectures:** 1.https://nptel.ac.in/content/storage2/courses/122106031/slides/3_2s.pdf 2.https://www.slideshare.net/100005130728571/27-nature-of-directing	
UNIT-III	
Social Responsibilities of Business: Meaning of Social Responsibility, Social Responsibilities of Business towards Different Groups, Social Audit, Business Ethics and Corporate Governance. **Entrepreneurship**: Definition of Entrepreneur, Importance of Entrepreneurship, Characteristics of successful Entrepreneur, Classification of Entrepreneurs, Intrapreneur – An Emerging Class, Comparison between Entrepreneur and Intrapreneur, Myths of Entrepreneurship, Problems faced by Entrepreneurs and capacity building for Entrepreneurship. **Laboratory Sessions/ Experimental learning:** Case study of a startup. **Application:** Social auditing in electrical industry **Web Link and Video Lectures:** 1.https://nptel.ac.in/courses/110/106/110106141/ 2.https://nptel.ac.in/courses/127/105/127105007/	**08 Hrs**
UNIT-IV	
Modern Small Business Enterprises: Role of Small-Scale Industries, Concepts and definitions of SSI Enterprises, Government policy and development of the Small-Scale sector in India, Sickness in SSI sector, Problems faced by Small Scale Industries, Impact of Globalization on SSI, Impact of WTO/GATT on SSIs. **Institutional Support for Business Enterprises:** Introduction, Policies and Schemes of Central–Level Institutions, State-Level Institutions. **Laboratory Sessions/ Experimental learning**: Case study on the growth of small-scale industries. **Application:** Setting up and functioning of Small-Scale Industries **Web Link and Video Lectures:** 1. https://www.slideshare.net/syedmubarak15/institutional-support-for-business-enterprises 2. https://www.wto.org/english/docs_e/legal_e/gatt47_01_e.htm	**08 Hrs**
UNIT-V	
Electrical Project Management Process: Meaning of Project Management, Electrical project management process, Project Objectives and Characteristics; Project Life Cycle, Generating an Investment Project Proposal, Project Report-Need and Significance of Report, Contents, Formulation, Project Analysis-Market, Technical, Financial, Economic, Ecological, Project Evaluation and Selection, Project Financing, Project Implementation Phase, Prerequisites for Successful Project Implementation. **New Control Techniques:** PERT and CPM, Steps involved in developing the network, Uses and Limitations of PERT and CPM**.** **Laboratory Sessions/ Experimental learning: Preparation of detailed project**	**08 Hrs**

report (DPR). **Application:** Preparation of reports for specific project. **Web Link and Video Lectures:** 1.**https://www.projectmanager.com/project-scheduling** 2.https://kissflow.com/project/basics-of-project-scheduling/	

Course Outcomes: After completing the course, the students will be able to	
C301.1	Understand the concept of management
C301.2	Understand the staffing process
C301.3	Explain the social responsibilities of business towards different groups
C301.4	Explain the role of small-scale industries
C301.5	Interpret the project objectives

Reference Books	
3.	"Entrepreneurship Development and Small Business Enterprises", Poornima M.Charanthimath, , 2nd Edition,2014,Pearson.
4.	"Principles of Management", Tripathy PC & Reddy PN Tata McGraw Hill, 1999.
3.	"Fundamentals of Management", Stephen A. Robbins & David A. Decenzo & Mary Coulter, , , 7th Edition, 2011, Pearson Education.
4.	"Management", Stephen P. Robbins & Mary Coulter,., 10th Edition, 2009, Prentice Hall (India) 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 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 subdivisions. 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**
C301.1	-	2	-	1	-	-		3	3	3	3	3
C301.2	-	1	-	3	-	-		3	3	3	3	3
C301.3	-	2	-	2	-	3		3	3	2	3	3
C301.4	-	2	-	2	-	2		3	3	3	3	3
C301.5	-	2	-	2	-	2		3	3	3	3	3

Semester: V		
Smart Sensor Systems		
Course Code:	**MVJ21EE52**	**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 working of different sensors.
2	Study the conceptual approach of various smart sensors
3	Explain different operations of sensors with microcontrollers
4	Discuss about different type of wireless sensing
5	Explain different applications of smart sensors.

UNIT-I	
Basics of Sensors: Introduction- Sensor Vs Transducer, Definition for several kinds of sensors-Sensors, Smart sensors, Integrated smart sensors, Smart sensor systems, Nature of sensors, Sensor technology migration path, General sensing system, Sensor Output Characteristics, Various sensing technologies-capacitive, piezo electric, Hall effect, Digital output sensors. **Laboratory Sessions/ Experimental learning:** Voltage and Current Detection Circuitry **Applications:** Temperature Control of Transformer. **Video link:** 1. https://archive.nptel.ac.in/courses/108/108/108108147/	**8Hrs**
UNIT-II	
Smart Sensors: Smart Sensors, Components of Smart Sensors, General Architecture of Smart Sensors, Evolution of Smart Sensors, Advantages, Application area of Smart Sensors **Smart Sensor types:** Smart temperature sensor, Smart wind sensor and Smart Hall sensor, Calibration of smart sensors. **Laboratory Sessions/ Experimental learning:** Simulate the performance of a chemical sensor in virtual lab. **Applications:** Monitoring & Control Mechanisms **Video link:** https://youtu.be/oRydUfgMdgA	**8Hrs**
UNIT-III	
Sensor with Microcontroller: Introduction, Amplification and Signal Conditioning, Integrated Signal Conditioning, Digital Conversion-A/D converters and performance of A/D converters, MCU Control, MCUs for Sensor Interface, Techniques and Systems Considerations- Linearization and PWM control, Sensor	**8Hrs**

Integration. **Laboratory Sessions/ Experimental learning:** Control of Water flow and Level detection Circuitry. **Applications:** Temperature control of furnaces. **Video link:**https://youtu.be/WiKdofvx270	
UNIT-IV	
Wireless Sensing: Wireless Data and Communications-RF spectrum and Spread spectrum, Wireless Sensing Networks-Zigbee, Zigbee-Like wireless, 6LoWPAN and Z wave. Industrial Wireless Sensing Networks, RF Sensing-Surface Acoustic Wave Devices, RADAR, LIDAR, Global positioning system, Remote Emission System, Remote Keyless Entry, RF ID. **Laboratory Sessions/ Experimental learning:** **Applications:** Health monitoring **Video link:**https://youtu.be/5ZFfqhdf0QI	**8Hrs**
UNIT-V	
Smart Applications and System Requirements: Automated consumer products-Smart Car, Smart Home, Smart Domestic Appliances, Smart Toys. **The next phase of sensing systems: F**uture sensing requirements-sensing in automobiles, sensing in smart phones, sensing in health care systems, Cloud sensing and trusted sensing **Laboratory Sessions/ Experimental learning:** Smart home **Applications:** Smart Dustbin **Video link:**https://youtu.be/2ZEdKhIMz_8	**8Hrs**

Course Outcomes: After completing the course, the students will be able to	
C302.1	Explain the working of different sensors.
C302.2	Explain the conceptual approach of various smart sensors
C302.3	Discuss different operations of sensors with microcontrollers
C302.4	Explain about different type of wireless sensing
C302.5	Discuss different applications of smart sensors.

Reference Books	
5.	Frank, Randy, "Understanding smart sensors", Artech House integrated microsystems series, 3rd Edition, 2013.
6.	Gerard Meijer, Michiel Pertijs, Kofi Makinwa,"Smart Sensor SystemsEmerging Technologies and Applications",Wiley (2014)

3	Alan S Morris, Reza Langari, Measurement and Instrumentation: Theory and Application,Academic Press, Elsevier, 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 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 subdivisions. 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**
C302.1	3	2	2	2	2	1	1	-	1	2	-	2
C302.2	3	3	3	2	3	2	2	-	2	3	2	3
C302.3	3	3	3	2	3	2	2	-	2	3	2	3
C302.4	3	3	3	2	3	2	2	-	2	3	2	3
C302.5	3	3	3	3	3	3	3	-	3	3	3	3

Semester:V		
ControlSystem Engineering With MATLAB (Theory and Practice)		
Course Code:	**MVJ21EE53**	**CIE Marks:50+50**
Credits:	**L: T:P: 2:2:2**	**SEE Marks: 50 +50**
Hours:	**40 L+ 26 P**	**SEE Duration: 03+03 Hours**
Course Learning Objectives: The students will be able to		
1	Obtain mathematical modeling of control systems.	
2	Obtain transfer function of systems using various techniques and discuss time response of the systems.	
3	Determine the stability of LTI systems in time domain	
4	Determine the stability of LTI systems in frequency domain and discuss different controllers used in control systems.	
5	Explain different compensators used in control systems	

UNIT-I	
Introduction: Open loop and closed loop systems – Examples, Control system components. Transfer function of physical systems: Mechanical systems - Translational and Rotational systems, Electrical network, Transfer function of DC servomotor, AC servomotor. **Laboratory Sessions/ Experimental learning**: Obtain the transfer function of Servomotor by using MATLAB. **Applications**: Modeling of Physical systems helps in Mathematical analysis. **Video link**: https://nptel.ac.in/courses/108101037	**8Hrs**
UNIT-II	
Block diagram - Reduction techniques. Signal flow graphs – Mason's gain formula, Construction of block diagram from signal flow graph, Construction of signal flow graph from block diagram. **Laboratory Sessions/ Experimental learning**: Experiment to obtain the time response of RLC circuit and determine the time domain specification. **Applications**: Performance analysis of second order system in time domain. **Video link**:https://nptel.ac.in/courses/108106098	**8Hrs**
UNIT-III	
Time domain Analysis: Standard Test signals –Time response of first and second order system, Time domain specifications, Type of systems, Steady state error constants, generalized error coefficients. **Laboratory Sessions/ Experimental learning**: Obtain the root locus for the given open loop transfer function and analyze the stability using MATLAB software. **Applications**: Stability Analysis of a given system **Video link**:https://nptel.ac.in/courses/108102044	**8Hrs**

UNIT-IV	
Stability Analysis: Concept of stability, Effect of location of poles on stability, R H criterion, applications of RH criterion with limitations. **Root locus technique**: Introduction to root locus concepts, Construction rules, Analysis of stability by root locus plot. **Laboratory Sessions/ Experimental learning**: Write a MATLAB program to obtain the Bode plot and analyze the stability of the system in frequency domain. **Applications**: Performance analysis of second order system in frequency domain **Video link:** http://www.ni.com/tutorial/6450/en/	**8Hrs**
UNIT-V	
Frequency Domain Analysis: Frequency domain specification, Bode plots, GM and PM, Relative stability. **Basic Control Actions and Controller:** Introduction, elements of industrial automatic controller, classification of controllers, P, I, D, PI, PD, and PID controllers (only block diagram). **Introduction to compensators**: Introduction, types of compensators, transfer function of lead, Lag, Lag-Lead Compensators. **Laboratory Sessions/ Experimental learning**: Simulation of compensator by using MATLAB. **Applications**: Analysis of system for accuracy and stability improvement. **Video link:**https://www.digimat.in/nptel/courses/video/108107115/L01.html	**8Hrs**

LABORATORY EXPERIMENTS

1. Speed torque characteristics of (i) AC servo motor (ii) DC servo motor.
2. Synchro pair characteristics
3. Determine frequency response of a second order system.
4. Frequency response of a passive RC lead compensating network for the given specifications.
5. Frequency response of a passive RC lag compensating network for the given specifications.
6. Frequency response characteristics of the lag – lead compensating network for the given specifications.
7. (a) Simulate a typical second order system and determine step response and evaluate time response specifications.

(b)Evaluate the effect of adding poles and zeros on time response of second ordersystem.

8. Study a second order system and verify the effect of (a) P, (b) PI, (c) PD and (d) PID controller on the step response.

Along with mandatory experiments students are advised to complete two open ended experiments. The following are some suggestions for open ended experiments.

9. Determine the stability of system using root locus plot in MATLAB.
10. Determination of specific cake and medium resistance using Plate and frame filter press.
11. Simulate a D.C. Position control system and obtain its step response.
12. Simulate a DC Servomotor and study its stability.

Course Outcomes: After completing the course, the students will be able to	
C303.1	Obtain the mathematical model of physical systems.

C303.2	Obtain transfer function of systems using various techniques and discuss time response of the systems
C303.3	Determine the stability of LTI systems in time domain
C303.4	Determine the stability of LTI systems in frequency domain and differentiate the various controllers used in control systems
C303.5	Explain different compensators used in control systems.

Reference Books	
1	"Control Systems Engineering", I. J. Nagrath, M. Gopal, 7th Edition, New Delhi, 2017.New Age International Publishers.
2	"Modern Control Engineering", Ogata K; 5th edition2013Pearson
3	"Automatic Control Systems (with MATLAB programs)" S. Hasan Saeed, KATSON Books, 8th Edition, New Delhi, 2016.
4	"Control systems", A. Anand Kumar, 2nd edition, PHI, 2018.

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 marksare executed by means of an examination.

The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the entire syllabus. Part – B

Students have to answer five questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have a maximum of three subdivisions. Each unit will have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

Semester End Examination (SEE):

Total marks: 50+50=100

SEE for 50 marksare 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 subdivisions. 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**
C303.1	3	3	1	2	2	-	-	-	3	2	-	3
C303.2	3	3	1	3	2	-	-	-	3	2	-	3
C303.3	3	3	1	3	2	-	-	-	3	2	-	3
C303.4	3	3	2	3	2	-	-	-	3	2	-	3
C303.5	3	3	2	3	2	-	-	-	3	2	-	3

Power Electronics with MATLAB (Theory and Practice)		
Course Code:	**MVJ21EE54**	**CIE Marks:50+50**
Credits:	**L: T:P:S:2:2:2: Y**	**SEE Marks: 50 +50**
Hours:	**40 L+ 26 P**	**SEE Duration: 03+03 Hours**
Course Learning Objectives: The students will be able to		
1	Understand the working of power diodes and power transistor.	
2	Understand the operation, characteristics, and performance parameters of thyristor.	
3	Explain the working of controlled rectifier for different loads.	
4	Explain the working of AC voltage controller for different loads.	
5	Design chopper and pulse width modulated inverter for different applications.	

UNIT-I	
Introduction: Power electronic systems, Application of power electronics, Advantage and disadvantage of power electronics, Types of power electronic converter. **Power Transistors:** Introduction, Power MOSFETs (Enhancement and depletion type): Steady State Characteristics, Switching Characteristics, Gate Drive, IGBT (Construction and Working), Gan, Isolation of Gate Drives. **Laboratory Sessions/ Experimental learning**: Build a circuit for controlling a load by using MOSFET/IGBT in MATLAB. **Applications:** Mobile charging unit, switch mode power supply, induction heating, and traction motor control. **Web Link and Video Lectures:** 1. https://gansystems.com/design-center/application-notes/ 2. https://youtu.be/Z2CORFayCv0 3. https://youtu.be/tNp39_L_HtU	**8Hrs**
UNIT-II	
Thyristors: Introduction, Static Characteristics, switching characteristics, turn on methods, Two-Transistor Model, Bidirectional Triode Thyristors, Protection Circuits. **Laboratory Sessions/ Experimental learning:** Realize the static characteristics of SCR in MATLAB. **Application**s: AC voltage stabilizers, light dimmer, AC power control with solid relay. **Web Link and Video Lectures:** 1. https://youtu.be/no1hld5JcCw 2. https://www.electrical4u.com/thyristor-silicon-controlled-rectifier-scr/	**8Hrs**
UNIT-III	
Controlled Rectifiers: Introduction, Performance Parameters, Single-Phase half wave Converters with R and RL load, Single-Phase Full wave Bridge Converters	**8Hrs**

with R, RL and RLE load (continuous current conduction operation only), Single phase symmetrical semi converter, Single-Phase Dual Converters, Three-Phase Full wave Converters with R and RL Load. **Laboratory Sessions/ Experimental learning:** Simulation of single phase and three phase full wave rectifier for R, RL and RLE load in MATLAB **Applications:** Paper mills, textile mills using DC motor drives and DC motor control in steel mills, AC fed traction system using a DC traction motor, High voltage DC transmission, UPS. **Web Link and Video Lectures:** 1. https://youtu.be/EpTKSp9611I 2. https://youtu.be/OuyyVgkzKT8 3. https://youtu.be/Q5Yw4Z_Oydc	
UNIT-IV	
AC Voltage Controllers: Introduction, Single phase half-wave controller with R and RL load, Single-Phase Full-Wave Controllers with R and RL Loads, Three-Phase Full-Wave Controllers with R load. **Cycloconverters:** **Laboratory Sessions/ Experimental learning:** MATLAB simulation of AC voltage controller**.** **Applications:** Adjustable speed drives, Light dimming, industrial heating **Web Link and Video Lectures:** https://youtu.be/6NCml4kY9Jo	**8Hrs**
UNIT-V	
DC-DC Converters: Introduction, Buck, Boost, Buck Boost regulator, Applications. **DC-AC converters: Introduction, principle of operation single phase bridge inverters with RL Load, three phase bridge inverters, Current source inverters, PWM techniques -SPWM technique.** **Laboratory Sessions/ Experimental learning: Build a circuit to step up PV output voltage in MATLAB** **Applications: Two stage solar power conversion, Solar PV integration to grid.** **Web Link and Video Lectures:** 1. https://www.youtube.com/watch?v=rfChSvb8FX0 2. https://www.youtube.com/watch?v=Q7cTuZIH8IA 3. https://www.electrical4u.com/boost-converter-step-up-chopper/ 4. https://www.youtube.com/watch?v=QnUhjnbZ0T8 5. https://www.youtube.com/watch?v=zNfbbPobtus	**8Hrs**
LABORATORY EXPERIMENTS	
1. Static Characteristics of SCR 2. Static Characteristics of MOSFET and IGBT 3. Single phase controlled full wave rectifier with R load, R –L load, R-L-E load with and without freewheeling diode. 4. AC voltage controller with R and RL loads.	

5. Speed control of universal motor using ac voltage regulator.
6. Speed control of DC motor using single semi converter.
7. Speed control of a separately excited D.C. Motor using chopper.
8. Single phase MOSFET/IGBT based PWM inverter.

Along with mandatory experiments students are advised to complete two open ended experiments. The following are some suggestions for open ended experiments.

1. Speed control of stepper motor
2. Study of charging and discharging of capacitor in snubber circuit.
3. SCR digital triggering circuit for a single-phase controlled rectifier and ac voltage regulator.

Course Outcomes: After completing the course, the students will be able to	
C304.1	Explain types of power diodes and power transistors
C304.2	Explain the operation, characteristics, and performance parameters of thyristor.
C304.3	Explain steady state, switching characteristics and gate control requirements of controlled rectifiers
C304.4	Discuss the principle of operation of AC voltage controllers.
C304.5	Design DC – DC and DC –AC converters for different application.

Reference Books	
1.	Power Electronics: Circuits Devices and Applications Mohammad H Rashid, Pearson 4th Edition, 2014.
2.	Power Electronics, Dr. P S Bimbhra, Khanna Publishers, 7th Edition, 2022.
3.	Power Electronics: Converters, Applications and Design Ned Mohan et al Wiley 3rd Edition, 2014
4.	Power Electronics Daniel W Hart McGraw Hill 1st Edition, 2011

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

CIE is executed by way of quizzes (Q), tests (T) and self-study. 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.

Laboratory- 50 Marks

The laboratory session is held every week as per the timetable and the performance of the student is evaluated in every session. The average of the marks over number of weeks is considered for 30 marks. At the end of the semester a test is conducted for 10 marks. The

students are encouraged to implement additional innovative experiments in the lab and are awarded 10 marks. Total marks for the laboratory is 50.

Semester End Examination (SEE):

Total marks: 50+50=100

SEE for 50 marksare 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 subdivisions. 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**
C304.1	3	1	1	1	2	3	-	-	3	2	-	3
C304.2	3	1	1	1	2	3	-	-	3	2	-	3
C304.3	3	3	2	1	2	3	-	-	3	2	-	3
C304.4	3	3	2	3	3	3	-	-	3	2	-	3
C304.5	3	3	2	3	3	3	-	-	3	2	-	3

Semester: V		
Introduction to IoT (Theory)		
Course Code:	**MVJ21EE551**	**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 architecture of Internet of Things	
2	Analyze different analog and digital sensors and actuators	
3	Understand Wireless Sensor/Actuator Network Technologies	
4	Understand different IoT messaging protocols	
5	Apply the IoT concepts to the real-world applications	

UNIT-I	
BASIC IoT ARCHITECTURE: Different layers of IoT system, Things, Data Acquisition and Gateways, Edge Analytic Systems, Data Centers and Cloud Storage **Laboratory Sessions/ Experimental learning**: NA **Applications**: All IoT Applications **Web Link and Video Lectures:** 1.https://youtu.be/xsZ9YhVy-7g	**8Hrs**
UNIT-II	
SENSORS AND ACTUATORS: Introduction to Sensors and Actuators. Analog and Digital Sensors. Sensors based on Serial Communication. Relays, Solenoids. **Laboratory Sessions/ Experimental learning:** Use basic sensors and actuators with microcontrollers. **Applications**: All IoT Applications **Web Link and Video Lectures:** 1. https://archive.nptel.ac.in/content//storage2/108/108/108108179/MP4/mod04lec26.mp4 2. https://archive.nptel.ac.in/content//storage2/108/108/108108179/MP4/mod04lec28.mp4	**8Hrs**
UNIT-III	
WIRELESS TECHNOLOGIES: RFID, Zigbee, ZWave, NB-IoT, LORA, BLE, Wi-Fi (General Block Diagram Approach). **Laboratory Sessions/ Experimental learning**: Wireless Sensor Network using Zigbee. **Applications**: All IoT Applications **Web Link and Video Lectures:**	**8Hrs**

3. https://archive.nptel.ac.in/content//storage2/108/108/108108179/MP4/mod02lec08.mp4 4. https://archive.nptel.ac.in/content//storage2/108/108/108108179/MP4/mod07lec39.mp4	
UNIT-IV	
IoT MESSAGING PROTOCOLS: HTTP, MQTT, CoAP, Websockets (General Outlines) **Laboratory Sessions/ Experimental learning:** Messaging using HTTP and MQTT **Applications**: All IoT Applications **Web Link and Video Lectures:** 1. https://archive.nptel.ac.in/content//storage2/108/108/108108179/MP4/mod06lec33.mp4 2. https://archive.nptel.ac.in/content//storage2/108/108/108108179/MP4/mod06lec34.mp4	**8Hrs**
UNIT-V	
IoT APPLICATIONS:Smart Homes: Security and Safety. **Smart Energy:** Smart Meters, Automatic Meter Reading (AMR), Smart grid, **Smart Cities:** Smart Vehicles, Smart Lighting, Smart Parking. **Laboratory Sessions/ Experimental learning:** Smart Lighting system **Web Link and Video Lectures:** 1. https://archive.nptel.ac.in/content//storage2/106/105/106105166/MP4/mod10lec46.mp4 2. https://archive.nptel.ac.in/content//storage2/106/105/106105166/MP4/mod11lec51.mp4	**8Hrs**

Course Outcomes: After completing the course, the students will be able to	
C305.1.1	Understand the architecture of IoT and cloud storage
C305.1.2	Analyze various types of sensors and actuators
C305.1.3	Understand various types of Wireless Network Technologies
C305.1.4	Understand how to send and receive messages using IoT messaging protocols
C305.1.5	Apply the knowledge of the concept of IoT Technologies to Electrical Engineering Applications

Reference Books	
1.	Introduction to IoT, S. Misra, A. Mukherjee, and A. Roy, Cambridge University Press; First edition, 2022.
2.	IoT for Beginners, Vibha Soni, BPB Publishers, 1st Edition, 2021.
3.	Recipes to Begin, Expand, and Enhance Your Projects, 2nd Edition,Michael Margolis,Arduino Cookbook and O"Reilly Media,2011.
4.	Architecting the Internet of Things,Dieter Uckelmann, Mark Harrison, Michahelles and Florian (Eds), Springer,2011.

5.	"From Machine-to-Machine to the Internet of Things – Introduction to a New Age of Intelligence",Jan Ho¨ ller, VlasiosTsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand. David Boyle and Elsevier, 2014.
6.	"From Machine-to-Machine to the Internet of Things – Introduction to a New Age of Intelligence",Jan Ho¨ ller, VlasiosTsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand. David Boyle and Elsevier, 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 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**
C305.1.1	3	3	1	1	1	-	-	-	-	-	-	1
C305.1.2	3	3	2	2	3	-	-	-	-	-	-	1
C305.1.3	3	3	3	3	3	-	-	-	-	-	-	1
C305.1.4	3	3	3	3	3	-	-	-	-	-	-	1
C305.1.5	3	3	3	3	3	-	-	-	-	-	-	1

Semester: V		
Micro Grid (Theory)		
Course Code:	**MVJ21EE552**	**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	Illustrate the basic concepts and types of microgrids.
2	Design modern control technologies for microgrids in Islanded mode.
3	Understand grid energy management systems.
4	Analyse the power quality impacts in grid integration.
5	Study concept of Microgrid protection schemes and configurations.

UNIT-I	
Introduction to Microgrid: Microgrid Configurations – CERTS Microgrid Test Bed– DC Microgrid- HFAC Microgrid –LFAC Microgrid –Hybrid DC- and AC-Coupled Microgrid. **Laboratory Sessions/ Experimental learning:**Using Simscape Power Systems to Simulate Microgrids - Microgrid Development and Analysis **Application:** Ride- Through capability for energy storage. **Web Link and Video Lectures:** https://youtu.be/AIEAGqfXFxk	**8Hrs**
UNIT-II	
Power Electronics in Microgrid: Grid Connected Mode – Islanded mode – Battery Charging mode – Brick Busses Software Framework- Multi Function grid Connected inverters. **Laboratory Sessions/ Experimental learning:**Modeling and simulation of Micro Grid Connected Solar PV System Using Matlab Simulink. **Application:**HIL Real-Time Simulation for Testing of Microgrids and Power Electronics Systems. **Web Link and Video Lectures:** https://youtu.be/xdC6S5auGn8	**8Hrs**
UNIT-III	
Microgrid Energy Management Systems: Load Sharing and Power Management Strategy – Standalone– Grid connected – energy storage – VoltageControl and Active Power Management. **Laboratory Sessions/ Experimental learning**: Design and Simulation of Small-Scale Micro Grid Using MATLAB Simulink. **Application**: Micro Grid Energy Management Using Model Predictive Control Approach. **Web Link and Video Lectures:** https://youtu.be/u1cmXLeHxic	**8Hrs**
UNIT-IV	
Power Quality Enhancement: Compensators and controllers for power quality	**8Hrs**

issues – Power Quality Improvement technologies – Impact of DG integration on Power Quality. **Laboratory Sessions/ Experimental learning:** Power Quality Enhancement in Residential Smart Grids Through Power Factor Correction Stages. **Application:**Micro Grid Energy Management Using Model Predictive Control Approach. **Web Link and Video Lectures:** https://youtu.be/93CcJk8IcsY	
UNIT-V	
Protection in Microgrid: Device Discrimination-Islanding detection, Effect on Feeder Reclosure, Protection for an Islanded Microgrid having IIDG Units-Adaptive relaying scheme. **Laboratory Sessions/ Experimental learning:** Adaptive Protection Scheme for Islanded Mode of Operation using MATLAB Simulink. **Application**: Artificial intelligence-based protection of microgrids **Web Link and Video Lectures:** https://youtu.be/93CcJk8IcsY	**8Hrs**

Course Outcomes: After completing the course, the students will be able to	
C305.2.1	Understand the concepts of microgrids, and networked microgrids.
C305.2.2	Design power converter for grid coordinations.
C305.2.3	Understand the operation of microgrid system power sharing and control
C305.2.4	Analyze power quality issues, control and grid integration system of micro grid
C305.2.5	Design active fault management system for microgrids

Reference Books	
7.	Power Electronic Converters for Microgrid, Suleiman M,Sharkh, Mohammad A.Abu-Sara Georgios I. Orfanoudakis, Babar Hussain, First Edition, 2014, Wiley-IEEE Press, ISBN: 978-0-470-82403-0
8.	Microgrid: Stability Analysis and Control, Ritwi K Majumder, First Edition, 2010, VDM Publishing 2010, ISBN : 978-3639247695.
3.	Microgrids and Active Distribution Networks, S.Chowhury, S.P.Chowdury and Peter Crossley, First Edition, 2011, IET renewable Energy series 6, ISBN978-1-84919-014-5
4.	Optimum Design of Renewable Energy Systems: Microgrid and Nature Grid Methods, Shin'ya Obara, First Edition, 2014, AEEGT Book Series, ISBN: 978-1466657960.

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 subdivisions. 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**
C305.2.1	2	2	**2**	1	2	2	1	-	-	**2**	-	**2**
C305.2.2	2	3	**2**	1	1	2	1	-	-	**2**	-	**2**
C305.2.3	2	3	**2**	1	1	2	1	-	-	**2**	-	**2**
C305.2.4	2	3	**2**	1	2	2	1	-	-	**2**	-	**2**
C305.2.5	2	2	**2**	1	2	2	1	-	-	**2**	-	**2**

Semester: V		
Embedded Systems		
Course Code:	**MVJ21EE553**	**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 concepts of embedded system design such as ROM variants, RAM.	
2	Learn the technological aspects of embedded system such as signal conditioning, Sample &Hold.	
3	Understand the design trade-offs.	
4	Explain the software aspects of embedded system.	
5	Understand the subsystem interfacing.	

UNIT-I	
Concept of Embedded System Design: Components, classification, skills required. Embedded Microcontroller cores: Architecture of 6808 and 6811, Embedded Memories ROM variants, RAM. **Laboratory Sessions/ Experimental learning**: Assembly Language Program for addition of 8-bit numbers stored in an array. **Applications**:Digital electronics. **Video link**: https://nptel.ac.in/courses/106/105/106105193/	**8Hrs**
UNIT-II	
Technological Aspects of Embedded System: Applications of embedded system: Examples of Embedded systems SOC for bar code scanner. Interfacing between analog and digital blocks, Signal conditioning, digital signal processing, DAC & ADC interfacing, Sample & hold, Multiplexer interface Internal ADC interfacing (excluding 6805 & 6812). **Laboratory Sessions/ Experimental learning**: 1. Interfacing of 8-bit ADC 0809 with 8051 Microcontroller. 2. Interfacing of 8-bit DAC 0800 with 8051 Microcontroller and Waveform generation using DAC. **Applications**: Telecommunications. **Video link**: https://nptel.ac.in/courses/108/102/108102169/	**8Hrs**
UNIT-III	
Design Trade Offs Due to Process Incompatibility, Thermal Considerations: Data Acquisition System and Signal conditioning using DSP. Issues in embedded system design. Design challenge, design technology, trade-offs. Thermal considerations. **Laboratory Sessions/ Experimental learning:** 1.Temperature control interfacing with 8051 microcontrollers. 2.Implementation of Digital FIR filters on 8051 microcontrollers.	**8Hrs**

Applications: Computer networks **Video link:** https://nptel.ac.in/courses/106/103/106103182/	
UNIT-IV	
Software aspects of Embedded Systems: Real time programming Languages, operating systems. Programming concepts and embedded programming in C. Round Robin, Round Robin with interrupts, function queue-scheduling architecture. **Laboratory Sessions/ Experimental learning:** Implementation of Hopfield network in C to recognize a simple ASCII character. **Applications**: Systems with artificial intelligence and robotics. **Video link:**https://nptel.ac.in/noc/courses/noc20/SEM2/noc20-ee98/	**8Hrs**
UNIT-V	
Subsystem interfacing: With external systems user interfacing, Serial I/O devices, Parallel portInterfaces: Input switches, Keyboards and Memory interfacing. **Laboratory Sessions/ Experimental learning:** 1. Implementation of Serial Communication by using 8051 serial ports. 2. Simple test program using Arm 9 mini 2440 kit (Interfacing LED with ARM 9 mini-2440 kit). **Applications:** Militarydefence systems. **Video link:** https	**8Hrs**

Course Outcomes: After completing the course, the students will be able to	
C305.3.1	Identify the Embedded system components.
C305.3.2	Apply technological aspects to various interfacing with devices.
C305.3.3	Elaborate various design trade-offs.
C305.3.4	Apply software aspects and programming concepts to the design of Embedded System.
C305.3.5	Explain how to interface subsystems with external systems.

Reference Books	
1.	” Introduction to Embedded Systems”,Shibu K V, Second Edition,2017, McGraw Hill Education India Private Limited,9789339219680 .
2.	“Embedded System, Architecture, Programming and Design Operational Amplifiers”,Raj Kamal, , 2nd Edition, 2008,McGraw Hill Education, 9780070667648
3.	Embedded Microcomputer systems: Real time interfacing Valvano, 2nd edition, 2011, J.W Cengage Learning India Private Limited,978-111142625.
4.	Embedded System Design: A Unified Hardware / Software Introduction, Wiley, Student edition, 2006,978-8126508372.

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**
C305.3.1	2	1	2	1	2	-	-	-	-	-	-	3
C305.3.2	2	1	2	2	2	-	-	-	-	-	-	3
C305.3.3	2	2	2	1	1	-	-	-	-	-	-	3
C305.3.4	2	3	3	2	3	-	-	-	-	-	-	2
C305.3.5	2	2	2	2	3	-	-	-	-	-	-	3

Semester: V		
Solar PV Technologies (Theory)		
Course Code:	**MVJ21EE554**	**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 knowledge on world energy scenario and PN junction diode	
2	Understand the design of a solar cell.	
3	Explain different emerging solar cell technologies	
4	Explain balance of solar PV systems.	
5	Explain various photovoltaic systems and their lifecycle costing.	

UNIT-I	
Introduction to Solar Photovoltaic energy source: Need for sustainable energy, solar PV as a renewable energy source, current status of renewable energy sources in India. **Introduction to Solar Cell:** Introduction to PN junction equilibrium condition, non-equilibriumcondition, PN junction under illumination. **Applications:** Help in better understanding of the solar cell **Video Link:** https://www.youtube.com/watch?v=bdnHTkrKWfc	**8Hrs**
UNIT-II	
Solar Cell Design: Upper limits of cell parameters, losses in solar cells, solar cell design, design for high I_{sc}, design for high V_{oc}, design for high FF, analytical techniques **Applications:** Analyse and design a cell for various requirements **Video Link:**https://www.youtube.com/watch?v=KlHdlVrVj8o	**8Hrs**
UNIT-III	
Solar Cell Technologies: Production of Si, Si wafer based solar cell technology, thin film solar cell technologies, emerging solar cell technologies and concepts. **Applications:** Selection of appropriate solar panel for different applications. **Video Link:** https://www.youtube.com/watch?v=9LGLbcjXxqI https://www.youtube.com/watch?v=8uGZMyjFugg	**8Hrs**
UNIT-IV	
Solar Photovoltaic: Solar radiation, solar photovoltaic modules, balance of solar PV systems. **Applications:** Helps in better understanding of solar PV systems **Video Link:** https://www.youtube.com/watch?v=1yvaZZJ5IMc	**8Hrs**
UNIT-V	

Photovoltaic System Design and Applications: Introduction to solar PV systems, standalone PV systems configurations, design methodology of PV systems, wire sizing in PV systems, hybrid PV systems, grid connected PV systems, lifecycle costing. **Applications:** Installation of solar PV systems **Video Link:** https://www.youtube.com/watch?v=jZs37m3IXJU https://www.youtube.com/watch?v=mi2BzuEbj9o&t=1275s	**8Hrs**

Course Outcomes: After completing the course, the students will be able to	
C305.4.1	Acquire knowledge on world energy scenario and PN junction diode
C305.4.2	Understand the design of a solar cell.
C305.4.3	Explain different emerging solar cell technologies
C305.4.4	Explain balance of solar PV systems.
C305.4.5	Explain various photovoltaic systems and their lifecycle costing.

Reference Books	
1.	Solar Photovoltaics: Fundamentals, Technologies and Applications, Chetan Singh Solanki, 3rd Edition, PHI Learning PVT Ltd., 2015.
2.	Renewable Energy: Theory & Practice, Rathore N.S., Kurchania A.K., Panwar N.L. , First edition,2006, Himanshu Publications, New Delhi.
3.	Solar Photo-voltaic Products, Derrick, Francis and Bookalders, Second edition,1991, ITDG Publishing, UK.

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 subdivisions. 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**
C305.4.1	**3**	**3**	**3**	**3**	**-**	**2**	**2**	**-**	**-**	**1**	**-**	**-**
C305.4.2	**3**	**3**	**3**	**3**	**2**	**3**	**2**	**-**	**-**	**1**	**-**	**-**
C305.4.3	**3**	**3**	**3**	**3**	**2**	**3**	**2**	**-**	**-**	**1**	**-**	**-**
C305.4.4	**3**	**3**	**3**	**3**	**2**	**3**	**2**	**-**	**-**	**1**	**-**	**-**
C305.4.5	**3**	**3**	**3**	**1**	**-**	**3**	**2**	**-**	**-**	**1**	**-**	**-**

Semester: V		
Environmental Studies		
Course Code:	**MVJ21ENV56**	**CIE Marks: 50**
Credits:	**L: T:P: 1:0:0**	**SEE Marks: 50**
Hours:	**15 L**	**SEE Duration: 2 Hrs.**
Course Learning Objectives: The students will be able to		
1	Relate interdisciplinary approach to complex environmental problems using basic tools of the natural and social sciences including geo-systems, biology, chemistry, economics, political science, and international processes	
2	Study drinking water quality standards and to illustrate qualitative analysis of water.	
3	Critically evaluate the science and policy ramifications of diverse energy portfolios on air and water quality, climate, weapons proliferation, and societal stability.	

UNIT-I	
Introduction to environmental studies, Multidisciplinary nature of environmental studies; Scope and importance; Concept of sustainability and sustainable development. **Ecosystems (Structure and Function):** Forest, Desert, Rivers, Ocean **Biodiversity:** Types, Hot spots; Threats and Conservation of biodiversity, Deforestation**.** **Video link:**https://nptel.ac.in/courses/127/106/127106004/	**3Hrs**
UNIT-II	
AdvancesinEnergySystems(Merits,Demerits,GlobalStatusandApplications):Hydrogen,Solar,Tidal andWind. **Natural Resource Management (Concept and case-study):** Disaster Management, Sustainable Mining and Carbon Trading. **Video link:** https://nptel.ac.in/courses/121/106/121106014/	**3Hrs**
UNIT-III	
Environmental Pollution: SurfaceandGroundWaterPollution,Noisepollution, SoilPollutionand Air Pollution. **Waste Management & Public Health Aspects:** Bio-medical Waste, Solid waste, Hazardous waste, and E-waste. **Video link:** • https://nptel.ac.in/courses/122/106/122106030/ • https://nptel.ac.in/courses/105/103/105103205/ • https://nptel.ac.in/courses/120/108/120108005/ • https://nptel.ac.in/courses/105/105/105105160/	**3Hrs**

UNIT-IV	
Global Environmental Concerns (Concept, policies, and case-studies): Global Warming, ClimateChange, AcidRain, OzoneDepletion and Fluorideproblemindrinkingwater. **Video link:** • https://nptel.ac.in/courses/122/106/122106030/ • https://nptel.ac.in/courses/120108004/ • https://onlinecourses.nptel.ac.in/noc19_ge23/preview	**3Hrs**
UNIT-V	
Latest Developments in Environmental Pollution Mitigation Tools (Concept and Applications): G.I.S. & Remote Sensing, Environment Impact Assessment, Environmental Management Systems. **Video link:** • https://nptel.ac.in/courses/105/102/105102015/ • https://nptel.ac.in/courses/120/108/120108004/	**3Hrs**

Course Outcomes: After completing the course, the students will be able to	
C306.1	Describe the principles of ecology and environmental issues that apply to air, land, and water issues on a global scale.
C306.2	Develop critical thinking and/or observation skills and apply them to the analysis of a problem or question related to the environment.
C306.3	Demonstrate ecology knowledge of a complex relationship between biotic and Abiotic components.
C306.4	Apply their ecological knowledge to illustrate and graph a problem
C306.5	Describe the realities that managers face when dealing with complex issues.

Reference Books	
1.	Principals of Environmental Science and Engineering, Raman Siva kumar, Cengage learning, Singapur, 2nd Edition, 2005.
2.	Environmental Science – working with the Earth G.Tyler Miller Jr. Thomson Brooks /Cole, 11th Edition, 2006
3.	Textbook of Environmental and Ecology, Pratiba Singh, Anoop Singh & Piyush Malaviya , ACME Learning Pvt. Ltd. New Delhi, 1st Edition.

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

CIE for 50 marks,executed by way of tests (T) and assignments. A minimum of three quizzes are conducted along with tests. Test portion is evaluated for 40 marks and assignment is evaluated for 10 marks. The three tests are conducted for 40 marks each and the average of all the tests are calculated for 40. The marks for the assignments are 10 (2 assignments for 5

marks each). The marks obtained in test and assignment are added and report CIE for 50 marks.

Semester End Examination (SEE):

SEE for 50 marks,executed by means of an examination. The Question paper contains objective type questions for 100 marks covering the entire syllabus having same complexity in terms of COs and Bloom's taxonomy level.

Total marks: 50+50=100

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
C306.1	3	3	3	1	–	2	2	1	1	–	2	1
C306.2	3	3	2	1	–	1	2	–	1	1	2	1
C306.3	3	3	2	1	–	2	2	–	1	1	2	1
C306.4	3	3	2	2	–	2	2	–	1	1	2	1

Semester: V		
Research Methodology and IPR		
Course Code:	**MVJ21RMI57**	**CIE Marks:50**
Credits:	**L: T:P:S: 1:2:0:0**	**SEE Marks: 50**
Hours:	**30**	**SEE Duration: 3 Hrs**
Course Learning Objectives: The students will be able to		
1	To give an overview of the research methodology and explain the technique of defining a research problem and explainthe basic ethics in research.	
2	To develop a suitable outline for research studies through various sources of information from literature review and data collection.	
3	To develop an understanding of the results and on analysis of the work carried.	
4	To Demonstrate enhanced Scientific writing skills.	
5	To Develop an Understanding on Various Intellectual Property Rights and importance of filing patents.	

UNIT-I	
Research Methodology: Introduction, Meaning of Research, Objectives of Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Research Process, Criteria of Good Research, Defining the Research Problem: Research Problem, Selecting the Problem, Necessity of Defining the Problem. **Ethics in Engineering Research:** Ethics in Engineering Research Practice, Types of Research Misconduct, Ethical Issues Related to Authorship.	**6 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.	**6 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, Basic Principles of Experimental Designs, Important Experimental Designs.	**6 Hrs**

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, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports.	**6 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.	**6 Hrs**

Course Outcomes: After completing the course, the students will be able to	
C307.1	formulate the research problem and follow research ethics.
C307.2	carryto carrying out a Literature survey for the topic identified
C307.3	Analyse the research and interpret the outcomes of the research.
C307.4	Enhance their technical writing skills
C307.5	Understand the importance of Patenting, Licensing and technology transfer.

Textbooks	
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
C307.1	3	2	-	1	2	2	-	-	1	1	1	2
C307.2	3	2	3	2	2	2	-	1	1	1	-	1
C307.3	1	2	3	3	2	2	-	1	1	1	-	1
C307.4	1	2	3	3	3	2	-	1	1	-	1	2

High-3, Medium-2, Low-1

Semester: V		
Universal Human Values (Theory)		
Course Code:	**MVJ21UHV58**	**CIE Marks: 50**
Credits:	**L: T:P: 2:0:0**	**SEE Marks: 50**
Hours:	**30 L**	**SEE Duration: 02 Hrs.**
Course Learning Objectives: The students will be able to		
1	Appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.	
2	Facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.	
3	Highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature.	

UNIT-I	
Introduction to Value Education: Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education), Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Happiness and Prosperity – Current Scenario, Method to Fulfill the Basic Human Aspirations. **Practical Sessions**: (1) Sharing about Oneself (2) Exploring Human Consciousness (3) Exploring Natural Acceptance. Video link: • https://www.youtube.com/watch?v=85XCw8SU084 • https://www.youtube.com/watch?v=E1STJoXCXUU&list=PLWDeKF97v9SP_Kt6j qzA3p Z3yA7g_OAQz • https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw	**6 Hrs**
UNIT-II	
Harmony in the Human Being: Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Programme to ensure self-regulation and Health. **Practical Sessions**: (4) Exploring the difference of Needs of Self and Body (5) Exploring Sources of Imagination in the Self (6) Exploring Harmony of Self with the Body Video link: • https://www.youtube.com/watch?v=GpuZo495F24 • https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw	**6 Hrs**
UNIT-III	
Harmony in the Family and Society: Harmony in the Family – the Basic Unit of Human Interaction, 'Trust' – the Foundational Value in Relationship, 'Respect' – as the Right	**6 Hrs**

Evaluation, Other Feelings, Justice in Human-to-Human Relationship, Understanding Harmony in the Society,Vision for the Universal Human Order. **Practical Sessions**: (7) Exploring the Feeling of Trust (8) Exploring the Feeling of Respect (9) Exploring Systems to fulfill Human Goal Video link: • https://www.youtube.com/watch?v=F2KVW4WNnS • https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw	
UNIT-IV	
Harmony in the Nature/Existence: Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfillment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels, The Holistic Perception of Harmony in Existence. **Practical Sessions**: (10) Exploring the Four Orders of Nature (11) Exploring Co-existence in Existence. Video link: • https://www.youtube.com/watch?v=1HR-QB2mCF0 • https://www.youtube.com/watch?v=lfN8q0xUSpw • https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw	**6 Hrs**
UNIT-V	
Implications of the Holistic Understanding – a Look at Professional Ethics: Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics, Holistic Technologies, Production Systems and Management Models-Typical Case Studies, Strategies for Transition towards Value-based Life and Profession **Practical Sessions**: (12) Exploring Ethical Human Conduct (13) Exploring Humanistic Models in Education (14) Exploring Steps of Transition towards Universal Human Order Video link: • https://www.youtube.com/watch?v=BikdYub6RY0 • https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw	**6 Hrs**

Course Outcomes: After completing the course, the students will be able to	
C308.1	Explore themselves, get comfortable with each other and with the teacher
C308.2	Enlist their desires and the desires are not vague.
C308.3	Restate that the natural acceptance (intention) is always for living in harmony, only competence is lacking
C308.4	Differentiate between the characteristics and activities of different orders and study the mutual fulfillment among them
C308.5	Present sustainable solutions to the problems in society and nature

Reference Books	
7.	AICTE SIP UHV-I Teaching Material, https://fdp-si.aicte india.org/ AicteSipUHV _download.php
8.	A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1

3.	Teachers' Manual for A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2
4.	Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010

Continuous Internal Evaluation (CIE):

CIE for 50 marks 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):

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.

Total marks: 50+50=100

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
C308.1	-	1	-	-	-	2	2	3	2	1	2	1
C308.2	-	1	-	-	-	2	2	3	2	1	2	1
C308.3	-	1	-	-	-	2	2	3	2	1	2	1
C308.4	-	1	-	-	-	2	2	3	2	1	2	1
C308.5	-	1	-	-	-	2	2	3	2	1	2	1

Semester: VI		
Electric Vehicle and Battery Management System (Theory)		
Course Code:	**MVJ21EE61**	**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 needs and types of electric vehicles.	
2	Understand upcoming technology of hybrid electric vehicles.	
3	Explain the types and operation of electrochemical batteries.	
4	Analyze battery management systems for EV.	
5	Ability to analyze different power converter topologies used for EVs application.	

UNIT-I	
Introduction to Electric Vehicles: Introduction, conventional vehicles, and Electric vehicles, vehicle fundamentals, Types, performance, and configuration of EVs, Traction motor characteristics. **Hybrid Electric Vehicles:** Energy consumption concept of Hybrid Electric Drive Trains, Architecture of Hybrid Electric Drive Trains, Series Hybrid Electric Drive Trains, Parallel Hybrid Electric Drive Trains. **Laboratory Sessions/ Experimental learning**: Case study on different EVs **Applications**: Electric vehicles **Video link:** https://youtu.be/T5P9b0_Fv6w	**8Hrs**
UNIT-II	
Design of Electric and Hybrid Electric Vehicles: **Series Hybrid Electric Drive Train Design:** Operating patterns, control strategies, Sizing of major components, power rating of traction motor, power rating of engine/generator, design of PPS **Parallel Hybrid Electric Drive Train Design:** Control strategies of parallel hybrid drive train, design of engine power capacity, design of electric motor drive capacity, transmission design, energy storage design. **Laboratory Sessions/ Experimental learning:** Case study on different energy management strategies. **Applications:** Electric vehicles **Video link:** https://nptel.ac.in/courses/108/102/108102121/	**8Hrs**
UNIT-III	
Energy storage: Introduction to energy storage requirements in Electric vehicles, Types of energy storage. **Introduction to Batteries:** Battery Parameters, Battery Specifications, Types of Batteries, Construction and working of Lead acid batteries and Lithium-ion batteries. Efficiency of batteries; Selection of battery for EVs & HEVs, Traction	**8Hrs**

Battery Pack design. **Laboratory Sessions/ Experimental learning:** **1.**MATLAB Simulation of battery pack design. 2. Conduct experiments to understand the chemical process of different electro chemical batteries **Application:** Design of battery packs, Select batteries for EVs. **Web Link and Video Lectures:1.** https://youtu.be/DSoHQupqC30 2.https://youtu.be/WBbefOjmiEQ	
UNIT-IV	
Battery Management System: Definition, basic functions of battery management system, topology of BMS, development process of BMS, Functional blocks: Power Module, Battery, DC/DC Converter, load, communication channel, Battery Pack Safety, Battery Standards & Tests, IoT based BMS. **Laboratory Sessions/ Experimental learning:** MATLAB simulation of BMS. **Application:** Design of battery management systems for EVs. **Web Link and Video Lectures:** https://youtu.be/G8g1WI1L2YY	**8Hrs**
UNIT-V	
Power Electronic Converter for Battery Charging: Charging methods for battery, Termination methods, charging from grid, The Z-converter, Isolated bidirectional DC-DC converter. E-mobility Indian Roadmap Perspective. Policy: EVs in infrastructure system, integration of EVs in smart grid, social dimensions of EVs. Laboratory Sessions/ Experimental learning: Modeling of Electric Vehicles using MATLAB & Simulink. **Applications:** Electric vehicles **Video link:** https://youtu.be/yCjtiCFTFbk	**8Hrs**

Course Outcomes: After completing the course, the students will be able to	
C309.1	Explain needs and typesof EVs.
C309.2	Discuss the construction and working of batteries.
C309.3	Explain different energy storage devices for EVs.
C309.4	Model and analyze battery management system for EVs
C309.5	Design converters for battery charging topologies.

Reference Books	
1.	Larminie, James, and John Lowry, "Electric Vehicle Technology Explained" John Wiley and Sons, 2012
2.	Modern Electric, Hybrid Electric, andFuel Cell Vehicles: Fundamentals, Theory, and Design, M. Ehsani, Y. Gao, S.Gay and Ali Emadi, 2005, CRC Press, ISBN 0-8493-3154-4
3.	Electric and Hybrid Vehicles: Design Fundamentals, Iqbal Husain CRC Press, 2003, ISBN: 9780367693930.
4.	Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles, Sheldon S. Williamson, 2013, Springer, ISBN: 978-1-4614-7710-5

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**
C309.1	2	2	-	**-**	2	2	**3**	-	**2**	**2**	-	**3**
C309.2	2	3	-	**-**	1	2	**3**	-	**2**	**2**	-	**3**
C309.3	2	3	-	-	1	2	**3**	-	**2**	**2**	-	**3**
C309.4	2	3	**2**	**3**	2	2	**3**	-	**2**	**2**	-	**3**
C309.5	2	2	3	**3**	2	2	**3**	-	**2**	**2**	-	**3**

Semester: VI		
Power System Engineering -II **(Theory and Practice)**		
Course Code:	**MVJ21EE62**	**CIE Marks:50+50**
Credits:	**L: T:P: 2:2:2**	**SEE Marks: 50 +50**
Hours:	**40L+ 26 P**	**SEE Duration: 03+03 Hours**
Course Learning Objectives: The students will be able to		
1	Represent a power system element including generation, transmission lines, and transformers	
2	Understand per unit quantities, bus admittance matrix analysis for large systems, and compute of load flow solution using numerical iterative techniques	
3	Compute short circuit faults calculation occurring in power systems for symmetrical faults	
4	Deals with short circuit analysis of power system for steady and transient state	
5	Analysis of power system stability under transient state conditions for multi-machine stability	

UNIT-I	
Per Unit Representation and Topology: Per-Unit representation of Power system elements - Per-Unit equivalent reactance network of a three phase Power System. Graph Theory: Definitions, Formation of element node incidence and Bus Incidence Matrices, Y bus formation by Direct and Singular Transformation Methods, Numerical Problems. **Laboratory Sessions/ Experimental learning**: Preparation of graph for a simple power system. **Applications**: Analysis of power system by reducing the complexity. **Video link:** https://freevideolectures.com/course/4337/nptel-electrical-distribution-system-analysis/24	**10Hrs**
UNIT-II	
Power flow analysis: Bus classification, Introduction to load flow studies, necessity of load flow analysis, significance of slack bus,operating constraints, data required for load flow analysis, Formulation of Power Flow problems, Power flow solution using Gauss Seidel method and Newton Raphson method, numerical. **Laboratory Sessions/ Experimental learning**: Write a MATLAB program to solve any simple equation using iterative methods. **Applications:** Power system planning and operation **Video link:** https://archive.nptel.ac.in/courses/108/105/108105067/	**10Hrs**
UNIT-III	
Symmetrical components and sequence impedance: Introduction to symmetrical components, resolution of unbalanced phasor into symmetrical components, phase voltage in terms symmetrical components and symmetrical components in terms of phase voltage, numerical, relation between sequence components of phase and line voltages in star connected system, relation between sequence components of phase and line currents in delta connected	**10Hrs**

system, effect of neutral in the system, **Sequence Impedance**: Sequence impedance of a symmetrical and an unsymmetrical circuit, sequence impedance and networks of three phase transformer. **Laboratory Sessions/ Experimental learning**: Evaluation of sequence components of phase currents and voltages for any fault in a simple bus system using MATLAB programming. **Applications**: Selection of appropriate protective devices based on fault condition. **Video link:** https://archive.nptel.ac.in/courses/108/105/108105067/	
UNIT-IV	
Unsymmetrical fault analysis Introduction to unsymmetrical faults, fault calculations of synchronous generator, Analysis of LG fault on an unloaded generator, Analysis of LL fault on an unloaded generator, Analysis of LLG fault on an unloaded generator, Analysis of three phase fault on an unloaded generator,numericals, series type of fault. **Laboratory Sessions/ Experimental learning**: Evaluation of sequence components of phase currents and voltages for an LG, LL & LLG fault in a simple bus system using MATLAB programming. **Applications:** To determine the nature of the relaying system needed, critical clearing time of circuit breakers, voltage level, and transfer capability between systems. **Video link:https://nptel.ac.in/courses/108106026**	**10Hrs**
UNIT-V	
Power System Stability analysis Elementary concepts of steady state, Dynamic and transient stabilities, derivation of swing equation, power angle curve and determination of steady-state stability, determination of transient stability by Equal area criterion, application of equal are criterion, Critical clearing angle calculation, numerical problems for the solution of swing equation, methods to improve stability. **Laboratory Sessions/ Experimental learning**: Determination of Power Angle curves using MATLAB. **Applications:** To determine the dynamic and transient stability of the system by using different methods. **Video link: https://nptel.ac.in/courses/108101039**	**10Hrs**
LABORATORY EXPERIMENTS	
1. Y Bus Formation for Power Systems with and without Mutual Coupling, by Singular Transformation and Inspection Method. 2. Formation of Z Bus (without mutual coupling) using Z-Bus Building Algorithm. 3. ABCD parameters: i) Formation for symmetric T configuration ii) Verification of AD-BC=1 4. ABCD parameters: i) Formation for symmetric configuration ii) Verification of AD-BC=1 5. Develop a Simulink model for a single area load frequency problem and simulate the same. 6. Load flow analysis of transmission system using gauss Seidal method by MATLAB	

programming.

7. Economic load dispatch strategies using Mi-Power package.
8. Power angle plot for salient and non-salient synchronous machine.

Along with mandatory experiments students are advised to complete two open ended experiments. The following are some suggestions for open ended experiments.

9. Load flow analysis using Gauss seidel and newton Rapson methods Using Mi-Power package.
10. Short Circuit Studies using Mi-Power package.
11. Load flow analysis of transmission system using newton Rapson method by MATLAB programming.

Course Outcomes: After completing the course, the students will be able to	
C310.1	Prepare per unit reactance diagram and formulate network matrices and models for solving load flow problems.
C310.2	Perform steady state power flow analysis of power systems using numerical iterative techniques
C310.3	Analyze fault calculation for various faults and the impact of them on system performances.
C310.4	Analyze steady state and transient stability of power system under pre and postfault conditions.
C310.5	Analyze the power system stability concepts.

Reference Books	
1.	Modern Power System, D. P. Kothari, 4th Edition ,2011, Tata McGraw Hill, ISBN: 0071077758.
2.	Power System Analysis Operation and Control, Abhijit Chakrabarti and Sunita Halder, 3rd Edition, 2010, PHI Learning Pvt. Ltd., ISBN:8120340159.
3.	Power System Analysis and Stability,by S.N. Sivanandam , S.N. Deepa , J. Rizwana ,2014, Vikas Publishing House; First Edition January 2014),**ISBN-10 :** 9325974134
4.	Power System Analysis, Hadi Sadat, 1st Edition, 2002, Tata McGraw Hill, ISBN: 0071281843

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.

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 marksare 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 subdivisions. 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**
C310.1	3	3	3	3	2	-	-	-	1	2	2	1
C310.2	3	3	3	3	3	-	-	-	1	3	3	3
C310.3	3	3	3	3	3	-	-	-	1	3	2	2
C310.4	3	3	2	3	3	-	-	-	1	3	2	1
C310.5	3	3	2	3	3	-	-	-	1	3	2	1

Semester: VI		
Signals And Digital Signal Processing		
Course Code:	**MVJ21EE63**	**CIE Marks: 50**
Credits:	**L:T:P:S:2:2:2:Y**	**SEE Marks: 50**
Hours:	**40L+26P**	**SEE Duration: 3 Hrs.**
Course Learning Objectives: The students will be able to		
1	Explain basic operations on signals and properties of systems.	
2	Apply discrete Fourier representation to periodic signals.	
3	Compute Z – transform and DFT for a given time domain signal.	
4	Design IIR filter by applying appropriate transformation techniques.	
5	Design FIR filter by applying appropriate transformation techniques.	

UNIT-I	
Signals Introduction: Definitions of signals and a system, Classification of signals, Basic operations on signals, Elementary signals viewed as interconnections of operations. Relation between the elementary signals, specific systems, Properties of systems. **Laboratory Sessions/ Experimental learning**: Verification of Sampling Theorem both in time and frequency domains by using MATLAB. **Applications**:Speech recognition. **Video link**:https://www.youtube.com/watch?v=879pXoml0XI	**10Hrs**
UNIT-II	
Time domain Representation for LTI system: Convolution for discrete signals, impulse response, properties, solution of difference equations for discrete signals, block diagram representation system. **Laboratory Sessions/ Experimental learning**:Evaluate impulse response of a system using MATLAB. **Applications**:Digital Speedometer. **Video link**:https://www.youtube.com/watch?v=U8riFeiiu3s	**10Hrs**
UNIT-III	
Z Transform: Introduction Z-transform, Properties of ROC, Properties of Z-transform only derivations. Basic elements of digital signal processing, Advantages of digital signal processing over analog signal processing. **Discrete Fourier Transform:** Properties of DFT, DFT as a linear transformation, circular convolution, Use of DFT in linear filtering. **Laboratory Sessions/ Experimental learning:**Computation of N point DFT and to plot the magnitude and phase spectrum. **Applications**: Image processing. **Video link: 1.**https://www.youtube.com/watch?v=gkC7cXa8ewk 2.https://www.youtube.com/watch?v=6spPyJH6dkQ	**10Hrs**
UNIT-IV	

Design of IIR Filters from Analog Filters: IIR Filter design by impulse invariance. Characteristics of analog filters -Butterworth and Chebyshev. **Laboratory Sessions/ Experimental learning:** Design and implementation of IIR filters to meet given specification (Low pass, high pass, band pass and band reject filters) by using MATLAB. **Application:** High-speed telecommunication. **Video Link:** **1.** https://www.youtube.com/watch?v=3QWvi8EC_DI **2.** https://youtu.be/ryfaCpTHVtQ	**10Hrs**
UNIT-V	
Design of FIR Filters: Introduction to filters, Design of linear phase FIR Filters using rectangular, Hamming and Hanning windows, FIR filter design by frequency sampling method. **Laboratory Sessions/ Experimental learning:** Design and implementation of FIR filters to meet given specification (Low pass, high pass, band pass and band reject filters) using frequency sampling technique in MATLAB **Application:** Radio Astronomy. **VideoLink:** **1.** https://www.youtube.com/watch?v=nsK7mmRSTDY 2.https://www.youtube.com/watch?v=Xl5bJgOkCGU	**10Hrs**
LABORATORY EXPERIMENTS	
1.Computation of N – point DFT and to plot the magnitude and phase spectrum. 2Verification of Sampling Theorem both in time and frequency domains 2.Evaluation of impulse response of a system 3.Linear and circular convolution by DFT and IDFT method. 4.Solution of a given difference equation. 5.Calculation of DFT and IDFT by FFT 6.Design and implementation of IIR filters to meet given specification (Low pass, high pass, band pass and band reject filters) 7.Design and implementation of FIR filters to meet given specification (Low pass, high pass, band pass and band reject filters) using different window functions 8.Design and implementation of FIR filters to meet given specification (Low pass, high pass, band pass and band reject filters) using frequency sampling technique. 10.Realization of IIR and FIR filters **Along with mandatory experiments students are advised to complete two open ended experiments. The following are some suggestions for open ended experiments.** 1. To perform circular convolution of given sequences using (a) the convolution summation formula (b) the matrix method and (c) Linear convolution from circular convolution with zero padding. **2.** Computation of N – point DFT and to plot the magnitude and phase spectrum	

Course Outcomes: After completing the course, the students will be able to	
C311.1	Explain the generation of signals, behavior of system and the basic operations that can be performed on signals and properties of systems.
C311.2	Apply convolution in both continuous and discrete domain for the analysis of systems given impulse response of a system.
C311.3	Introduction to Z transform. Perform Fourier analysis for discrete time, linear time invariant systems.
C311.4	Design FIR filters by use of window function and frequency sampling method.
C311.5	Develop a digital IIR filter by direct, cascade, parallel, and ladder methods of realization.

Reference Books	
1.	"Signals and Systems", Simon Haykin, Barry Van Veen, John Wiley & Sons,Wiley,2nd edition 2002,978-8126512652
2.	"Digital Signal Processing –Principles, Algorithms, and Applications",Jhon G. Proakis, Dimitris G. Manolakis, Pearson, 4th Edition, 2007,978-013187374.
3.	"Digital Signal Processing",A .Nagoor Kani, McGraw Hill Education; 2nd edition, 2017,978-0070086654.
4.	"Signals and Systems",Oppenheim, Willsky and Nawab, Phi Learning, 2nd Edition, 1997, 9332550239.

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**
C311.1	3	2	2	2	2	1	-	1	1	3	3	2
C311.2	3	2	2	2	2	1	-	1	1	3	3	2
C311.3	3	2	2	2	2	-	-	1	2	3	3	3
C311.4	3	2	2	2	2	-	-	1	2	3	3	3
C311.5	3	2	2	2	2	-	-	1	2	3	3	3

Semester VI		
Non-Conventional Energy Sources (Theory)		
Course Code:	**MVJ21EE641**	**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 energy resources and availability of renewable energy.	
2	Examine types of solar collectors, their configurations, solar cell system, their characteristics, and their applications.	
3	Discuss generation of energy from hydrogen, wind, and geothermal system.	
4	Discuss production of energy from biomass, biogas and tidal.	
5	Discuss sea wave energy and OTEC.	

UNIT-I	
Renewable Energy sources: Causes of Energy Scarcity, Solution to Energy Scarcity, Factors Affecting Energy Resource Development, Energy Resources and Classification, Renewable Energy – Worldwide Renewable Energy Availability, Renewable Energy in India. Energy from Sun: Sun- earth Geometric Relationship, Layer of the Sun, Earth – Sun Angles and their Relationships, Solar Energy Reaching the Earth's Surface, Solar Thermal Energy Applications. **Laboratory Sessions/ Experimental learning:** Survey and data collection of different renewable energy sources available. **Applications:** Get awareness about available RES.	**8Hrs**

Web Link and Video Lectures: https://youtu.be/e0nkkKDjY50	
UNIT-II	
Solar Thermal Energy Collectors: Types of Solar Collectors, Configurations of Certain Practical Solar Thermal Collectors, Material Aspects of Solar Collectors, Concentrating Collectors, Parabolic Dish –Solar Collector Systems into Building Services, Solar Water Heating Systems, Passive Solar Water Heating Systems, Applications of Solar Water Heating Systems, Active Solar Space Cooling, Solar Air Heating, Solar Dryers, Crop Drying, Space Cooling, Solar Cookers, Solar Pond. Solar Cells: Components of Solar Cell System, Elements of Silicon Solar Cell, Solar Cell materials, Practical Solar Cells, I – V Characteristics of Solar Cells, Efficiency of Solar Cells, Photovoltaic Panels, Applications of Solar Cell Systems. **Laboratory Sessions/ Experimental learning:** Design of solar torch **Applications:** solar thermal applications for water and room heating. **Web Link and Video Lectures**: https://youtu.be/Dd20RQNBwGY	**8Hrs**
UNIT-III	
Hydrogen Energy: Benefits of Hydrogen Energy, Hydrogen Production Technologies, Hydrogen Energy Storage, Use of Hydrogen Energy, Advantages and Disadvantages of Hydrogen Energy, Problems Associated with Hydrogen Energy. **Wind Energy:** Windmills, Wind Turbines, Wind Resources, Wind Turbine Site Selection. **Geothermal Energy**: Geothermal Systems, Classifications, Geothermal Resource Utilization, Resource Exploration, Geothermal Based Electric Power Generation, Associated Problems, environmental Effects **Solid waste and Agricultural Refuse**: Waste is Wealth, Key Issues, Waste Recovery Management Scheme, Advantages and Disadvantages of Waste Recycling, Sources and Types of Waste, Recycling of Plastics. **Laboratory Sessions/ Experimental learning:** Visit a nearby Wind mill. **Applications**: Extract power from wind and geothermal energy. **Web Link and Video Lectures**: https://youtu.be/3JXWrKzlkZQ	**8Hrs**
UNIT-IV	
Biomass Energy: Biomass Production, Energy Plantation, Biomass Gasification, Theory of Gasification, Gasifier and their Classifications, Chemistry of Reaction Process in Gasification, Updraft, Downdraft and Cross-draft Gasifiers, Fluidized Bed Gasification, Use of Biomass Gasifier, Gasifier Biomass Feed Characteristics, Applications of Biomass Gasifier, Cooling and Cleaning of Gasifiers. Biogas Energy: Introduction, Biogas and its Composition, Anaerobic Digestion, Biogas Production, Benefits of Biogas, Factors Affecting the Selection of a Particular Model of a Biogas Plant, Biogas Plant Feeds and their Characteristics. **Tidal Energy:** Introduction, Tidal Energy Resource, Tidal Energy Availability, Tidal Power Generation in India, Leading Country in Tidal Power Plant	**8Hrs**

Installation, Energy Availability in Tides, Tidal Power Basin, Turbines for Tidal Power, Advantages and Disadvantages of Tidal Power, Problems Faced in Exploiting Tidal Energy. **Laboratory Sessions/ Experimental learning:** Visit a biogas plant nearby. **Applications**: Produce bio-fuel for cooking. **Web Link and Video Lectures**: https://youtu.be/_OQtT4yhhWc	
UNIT-V	
Sea Wave Energy: Introduction, Motion in the sea Waves, Power Associated with Sea Waves, Wave Energy Availability, Devices for Harnessing Wave Energy, Advantages and Disadvantages of Wave Power. **Ocean Thermal Energy**: Introduction, Principles of Ocean Thermal Energy Conversion (OTEC), Ocean Thermal Energy Conversion Sea plants, Basic Rankine Cycle and its Working, Closed Cycle, Open Cycle and Hybrid Cycle, Carnot Cycle, Application of OTEC in Addition to Produce Electricity, Advantages, Disadvantages and Benefits of OTEC. **Laboratory Sessions/ Experimental learning:** Visit near RES plant and get practical knowledge on working of OTEC. **Applications:** Power generation **Web Link and Video Lectures**: https://youtu.be/_iz8ZkjD7z8	**8Hrs**

Course Outcomes: After completing the course, the students will be able to	
C312.1.1	Understand energy resources and availability of renewable energy
C312.1.2	Examine types of solar collectors, their configurations, solar cell system, its characteristics and their applications
C312.1.3	Discuss generation of energy from hydrogen, wind and geothermal system
C312.1.4	Discuss production of energy from biomass, biogas and tidal.
C312.1.5	Discuss sea wave energy and OTEC.

Reference Books	
1.	Nonconventional Energy Resources ShobhNath Singh Pearson 1 st Edition, 2015.
2.	Nonconventional Energy Resources B.H. Khan McGraw Hill 3 rd edition.
3.	Renewable Energy; Power for a sustainable Future Godfrey Boyle Oxford 3rd Edition, 2012.
4.	Renewable Energy Sources: Their Impact on global Warming and Pollution Tasneem Abbasi S.A. Abbasi PHI.

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 subdivisions. 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**
C312.1.1	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**
C312.1.2	**3**	**3**	**3**	**2**	**-**	**-**	**1**	**-**	**-**	**2**	**2**	**3**
C312.1.3	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**2**	**2**	**2**	**1**	**3**
C312.1.4	**3**	**3**	**3**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**3**
C312.1.5	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**

Semester: VI		
Carbon Capture and Storage (Theory)		
Course Code:	**MVJ21EE642**	**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 atmospheric impact of carbon and power generation fundamentals.	
2	Explain different carbon absorption techniques from various power generation plants.	
3	Detail various carbon adsorption and separation techniques.	
4	Discuss the distillation process of carbon and geological storage.	
5	Detail the carbon sequestration and transportation systems.	

UNIT-I	
Introduction: The carbon cycle, Mitigating growth of the atmospheric carbon inventory, The process of technology innovation. **Overview of carbon capture and storage:** Carbon capture, Carbon storage. **Power generation fundamentals:** Physical and chemical fundamentals, Fossil-fueled power plant, Combined cycle power generation, Future developments in power-generation technology. **Web Link and Video Lectures:** 1. https://www.digimat.in/nptel/courses/video/102105088/L49.html 2. https://www.youtube.com/watch?v=OKMANIFoJLc	**8Hrs**
UNIT-II	
Carbon capture from power generation: Introduction, Pre combustion capture, Post combustion capture, Oxyfuel combustion capture, Chemical looping capture systems, Capture-ready and retrofit power plant, Approaches to zero-emission power generation. **Carbon capture from industrial processes:** Cement production, Steel production, Oil refining, Natural gas processing. **Absorption capture systems:** Chemical and physical fundamentals, Absorption applications in post combustion capture. **Web Link and Video Lectures:** 1. https://nptel.ac.in/courses/108/101/108101039/ 2. https://www.youtube.com/watch?v=2Gj3dLK06ho	**8Hrs**
UNIT-III	
Adsorption capture systems: Physical and chemical fundamentals, Adsorption process applications, **Membrane separation systems**: Physical and chemical fundamentals, Membrane configuration and preparation and module construction, Membrane applications in pre-combustion capture, Membrane and molecular sieve applications in oxyfuel combustion, Membrane applications in postcombustion CO2 separation, Membrane	**8Hrs**

applications in natural gas processing. **Web Link and Video Lectures:** 1. https://nptel.ac.in/courses/108/101/108101039/ 2. https://www.youtube.com/watch?v=2Gj3dLK06ho	
UNIT-IV	
Cryogenic and distillation systems: Physical Fundamentals, Distillation column configuration and operation, Cryogenic oxygen production for oxyfuel combustion, Ryan–Holmes process for CO2 –CH4 separation. **Mineral carbonation:** Physical and chemical fundamentals, Current state of technology development, Demonstration and deployment outlook. **Geological storage:** Introduction, Geological and engineering fundamentals, Enhanced oil recovery, Saline aquifer storage. **Web Link and Video Lectures:** 1. https://nptel.ac.in/courses/108/101/108101039/ 2. https://www.youtube.com/watch?v=2Gj3dLK06ho	**8Hrs**
UNIT-V	
Ocean storage: Introduction, Physical, chemical, and biological fundamentals, Direct CO2 injection, Chemical sequestration, Biological sequestration. **Storage in terrestrial ecosystems:** Introduction, Terrestrial carbon storage options. **Other sequestration and use options:** Enhanced industrial usage, Algal biofuel production. **Carbon dioxide transportation:** Pipeline transportation, Marine transportation. **Web Link and Video Lectures:** 1. https://nptel.ac.in/courses/108/101/108101039/ 2. https://www.youtube.com/watch?v=2Gj3dLK06ho	**8Hrs**

Course Outcomes: After completing the course, the students will be able to	
C312.2.1	Discuss the impacts of climate change and the measures that can be taken to reduce emissions.
C312.2.2	Discuss carbon capture and carbon storage.
C312.2.3	Explain the fundamentals of power generation.
C312.2.4	Explain methods of carbon capture from power generation and industrial processes.
C312.2.5	Explain different carbon storage methods: storage in coal seams, depleted gas reservoirs and saline formations.

Reference Books	
3.	Carbon Capture and Storage, Stephen A. Rackley, 2017, 2nd Edition**,** Butterworth-Heinemann- Elsevier**,** ISBN: 9780128120422.
4.	Introduction to Carbon Capture and Sequestration, Berend Smit, Jeffrey R Reimer, Curtis M Oldenburg, Ian C Bourg, 2014, 1st Edition, Imperial College Press, London, ISBN: 978-1-78326-327-1.

3.	Palladium Membrane Technology for Hydrogen Production, Carbon Capture and Other Applications Principles, Energy Production and Other Applications, Doukelis, A., Panopoulos, K., Koumanakos, A., Kakaras, E, 2015, 1st Edition, Woodhead Publishing, ISBN: 9781782422419.
4.	Carbon Capture and Storage Physical, Chemical, and BiologicalMethods, Rao Y. Surampalli, Tian C. Zhang, R. D. Tyagi, Ravi Naidu, B. R. Gurjar, C. S. P. Ojha, Song Yan , Satinder K. Brar, Anushuya Ramakrishnan, C. M. Kao, 2015, 1st Edition, American Society of Civil Engineers, ISBN 978-0-7844-7891-2.

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 subdivisions. 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**
C312.2.1	3	3	3	2	3	3	3	3	2	2	2	2
C312.2.2	3	3	3	2	3	3	3	3	2	2	2	2
C312.2.3	3	3	3	2	3	3	3	3	2	2	2	2
C312.2.4	3	3	3	2	3	3	3	3	2	2	2	2
C312.2.5	3	3	3	2	3	3	3	3	2	2	2	2

Semester: VI		
Introduction To Smart Cities (Theory)		
Course Code:	**MVJ21EE643**	**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 concept of a smart city and associated challenges.	
2	Understand the latest technologies used in intelligent building.	
3	Explain the process of planning and drafting a plan for a smart city.	
4	Enumerate the importance of the different smart systems.	
5	Explain the importance of water and waste management schemes.	

UNIT-I	
INTRODUCTION TO SMART CITIES: Introduction to city planning, Concept, objectives of smart cities, history of smart city world and India, Key trends in smart cities developments. Need to develop smart city, Challenges of managing in India and world. **Laboratory Sessions/ Experimental learning**: Visiting cities and finding challenges faced by them. **Applications**: Smart infrastructure can be developed for various applications such as air monitoring, traffic control and smart waste management. **Web Link and Video Lectures**: **1. https://nptel.ac.in/courses/124107158** **https://www.open.edu/openlearn/mod/oucontent/view.php?id=67877#**	**8Hrs**
UNIT-II	
SMART CITIES PLANNING AND DEVELOPMENT: Understanding smart cities, dimension of smart cities, global standards and performance benchmarks, practical codes, smart city planning and development, financing smart cities development, governance of smart cities. **Lab oratory Sessions/ Experimental learning**: Following start procedures and codes for planning smart cities. **Applications:** More effective, data-driven decision-making can be done, safer communities can be constructed. **Web Link and Video Lectures::** https://www.youtube.com/watch?v=Cp0ezwt1c7s	**8Hrs**
UNIT-III	
PROJECT MANAGEMENT IN SMART CITIES: Phases, Stages of project and work break down Structure, Project organization structure, Planning, Scheduling and CPM, Project cost analysis, resource allocation &leveling, Line of balancing technique, Project monitoring and control, Project risk management. **Laboratory Sessions/ Experimental learning:** Performing project cost analysis by	**8Hrs**

different techniques **Applications:** Improved infra structure buildings can be built. Increase work force engagement can be done. **Web Link and Video Lectures:** https://learning.tcsionhub.in/courses/industry-honour-certification/project-management-in	
UNIT-IV	
GREEN BUILDING IN SMART CITIES Introduction to green buildings, Rating system, Energy saving system, Smart material associated with smart building. Technology involved in different construction of smart building. Model preparation on smart city. Case study on smart city. **Laboratory Sessions/ Experimental learning:** Conducting a case study on smart city development and infrastructure. **Applications:** Reduce the environment footprints, enhance the street light control and energy infrastructure **Web Link and Video Lectures:** **https://archive.nptel.ac.in/courses/105/102/105102195/**	**8Hrs**
UNIT-V	
MANAGEMENT OF WATER RESOURCES AND RELATED INFRASTRUCTURE Storage and conveyance system of water, sustainable water and sanitation, sewerage system, flood management, conservation system. **Laboratory Sessions/ Experimental learning**: Conducting a case study on how water and sanitation management in performed in smart city **Applications**: water management, waste management and public safety. **Web Link and Video Lectures**: **https://www.digimat.in/nptel/courses/video/105101215/L41.html**	**8Hrs**

Course Outcomes: After completing the course, the students will be able to	
C312.3.1	Acquaire knowledge on smart cities planning and development
C312.3.2	Develop work break down structure, scheduling, and project management of smart cities
C312.3.3	Work out the most energy-efficient technique
C312.3.4	Acquire knowledge on green buildings in smart cities to save energy and public safety
C312.3.5	Develop water and waste management procedure to build a smart city

Reference Books	
1.	Introduction of smart cities,P.P. Anil kumar, First edition, 2019, Pearson India,ISBN: 9353439574.
2.	Insights into inclusive growth, employment and wellbeing in India, Arup Mitra,First

	Edition,2013, Springer New Delhi, ISBN: 978-81-322-0655-2.
3.	A city for all: valuing differences and working with diversity, Jo Beall, Second Edition, 1997, Zed books limited, London, ISBN: 1-85649-477-2 .
4.	Inclusive and sustainable urban planning: a guide for municipalities, UN-Habitat, Third Edition,2007, Urban Development Planning, United Nations Human Settlements Programme, ISBN: 978- 92-1-132024-4.

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 subdivisions. 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**
C312.3.1	2	2	2	2	2	1	2	-	-	1	1	-
C312.3.2	2	1	2	3	2	1	-	-	-	1	2	-
C312.3.3	2	1	2	1	2	1	-	-	-	-	1	-
C312.3.4	3	2	2	2	2	1	-	-	-	-	1	-
C312.3.5	2	2	2	1	2	1	-	-	-	-	2	-

Semester: VI		
Smart Sensors and Systems for Industrial Applications		
Course Code:	**MVJ21EE644**	**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 different types of sensors and smart sensors.
2	Learn the principles and operations of active sensors.
3	Understand the concepts of smart sensors.
4	Study the conceptual approach of various Passive Sensors.
5	Learn the fundamentals of signal conditioning, data acquisition and communication systemsused in mechatronics system development.

UNIT-I	
Introduction to Smart Sensor: Introduction, definition of sensors, smart sensors, integrated smart sensors and integrated smart sensor systems, Classification of sensors, Third and fourth industrial revolution, Smart Sensors applications for Automated homes and vehicles. Laboratory Sessions/ Experimental learning: Automated system using smart sensors. Applications: Automation Video link: 1. https://archive.nptel.ac.in/courses/108/108/108108147/ 2. https://youtu.be/n1XcDq-Ynv0 **3.** https://youtu.be/fhp61CepgUg	**8Hrs**
UNIT-II	
Motion, Proximity and Ranging Sensors: Motion Sensors, Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive, LVDT – RVDT – Synchro – Microsyn, Accelerometer – GPS, Bluetooth, Range Sensors – RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR). **Laboratory Sessions/ Experimental learning:** Measuring analog variations in physical variables by using appropriate resistive sensors in an RC-circuit and measuring the time to charge/discharge the capacitor **Applications:**Smart systems essentials for physical measurements Video link: 1. https://onlinecourses.nptel.ac.in/noc22_ee36/preview 2.https://youtu.be/sIBHVsoRgLs 3. https://nptel.ac.in/courses/112108092	**8Hrs**
UNIT-III	
Force, Magnetic and Heading Sensors: Strain Gage, Load Cell, Magnetic Sensors –types, principle, requirement, and advantages: Magneto resistive – Hall Effect – Current sensor Heading Sensors – Compass, Gyroscope, Inclinometers. **Laboratory Sessions/ Experimental learning:** Display the distance the object is placed from the sensor using Arduino. **Applications:** Integrated smart system design	**8Hrs**

Video link: 1. https://nptel.ac.in/courses/112104251 2. https://archive.nptel.ac.in/courses/112/107/112107298/	
UNIT-IV	
Smart Sensors: Optical sensors based on photon detection- introduction, Photon absorption in silicon- detection limit- photon detectors with gain, physical chemosensory-physical chemosensing-energy domains, Thermal sensors- heat transfer mechanisms, different temperature sensing elements. **Laboratory Sessions/ Experimental learning**: To display the temperature in a room by using thermal sensor. **Applications:** Smart Sensors **Video link:** 1.https://archive.nptel.ac.in/courses/115/107/115107122/ 2. https://www.youtube.com/watch?v=oRydUfgMdgA	**8Hrs**
UNIT-V	
Signal Conditioning and DAQ Systems: Amplification – Filtering – Sample and Hold circuits – Data Acquisition: Single channel and multi-channel data acquisition – Data logging - applications - Automobile, Aerospace, Home appliances, Manufacturing, Environmental monitoring. **Laboratory Sessions/ Experimental learning:** Interfacing Data Acquisition system hardware with computer. **Applications:** LabVIEW programming techniques. **Video link:** 1. https://nptel.ac.in/courses/108105062 2. https://youtu.be/I_9Pwyxhe40	**8Hrs**

Course Outcomes: After completing the course, the students will be able to	
C312.4.1	Expertise in various types for sensors and smart sensors.
C312.4.2	Acquire knowledge on different sensors and transducers.
C312.4.3	Apply the various smart sensors in the Automotive and Mechatronics applications.
C312.4.4	Study the basic principles of various smart sensors
C312.4.5	Implement the DAQ systems with different sensors for real time applications

Reference Books	
1.	"Measurement Systems – Applications and Design", Ernest O Doebelin, Tata McGraw-Hill, 2009.
2.	"A Course in Mechanical Measurements and Instrumentation and Control", Sawney A K and Puneet Sawney, 12th edition, Dhanpat Rai & Co, New Delhi, 2013.
3.	"Sensors and Transducers", Patranabis D, 2nd Edition, PHI, New Delhi, 2010.
4	"Instrumentation for Engineers and Scientists", John Turner and Martyn Hill, Oxford Science Publications, 1999.

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 subdivisions. 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**
C312.4.1	3	2	2	2	2	1	1	-	1	2	-	2
C312.4.2	3	3	3	2	3	2	2	-	2	3	2	3
C312.4.3	3	3	3	2	3	2	2	-	2	3	2	3
C312.4.4	3	3	3	2	3	2	2	-	2	3	2	3
C312.4.5	3	3	3	3	3	3	3	-	3	3	3	3

ABILITY ENHANCEMENT COURSE Troubleshooting and Diagnosis of Electrical Appliances			
Course Code	**MVJ21EEA66**	**CIE Marks**	**50**
Credits	**L: T: P:0:0: 2**	**SEE Marks**	**50**
Hours	**15**	**SEE Duration**	**3 hours**

Course Learning Objectives: The students will be able to	
1	Acquire knowledge about function and use of various electrical tools, equipment's, and accessories.
2	Acquire knowledge aboutrepair and installation of electric tube light.
3	Acquireknowledge about **repair** and maintenance of ceiling fan.
4	Enable the students to carry out repair and maintenanceof electric iron box.
5	Enable the students to carry out repair and maintenanceof water heater.

UNIT-I	
D.C. Power supply – Assembly and Applications: Introduction &application of power supply. Identification of different parts. Testing & fault finding.	**3Hrs**
UNIT-II	
Repair and Installation of Electric tube light: Introduction of lighting appliances, Circuit diagram offluorescent tube with electronic choke& starter. Introduction of CFL lamp, LEDlamp.Testing & fault finding.	**3Hrs**
UNIT-III	
Repair and Maintenance of Ceiling Fan: Construction, Identification of various parts, electrical diagram,maintenance of fan (overhauling), repair of some commonproblems like low speed, fan not starting, fan rotating in reverse direction.	**3Hrs**
UNIT-IV	
Repair and Maintenance of Electric Iron box: Introduction, construction & working principle, Dismantling & procedure, Testing & Fault finding, Common Faults & remedies of electric iron.	**3Hrs**
UNIT-V	
Repair and Maintenance of Water Heater:introduction, construction & working principle, Dismantling &procedure, Testing & Fault finding, Common Faults & remedies of Water Heaters.	**3Hrs**

Course Outcomes: After completing the course, the students will be able to	
C314.1	Acquire knowledge about function and use of various electrical tools, equipment's,

	and accessories.
C314.2	Acquire knowledge aboutrepair and installation of electric tube light.
C314.3	Acquireknowledge about **repair** and maintenance of ceiling fan.
C314.4	Enable the students to carry out repair and maintenanceof electric iron box.
C314.5	Enable the students to carry out repair and maintenanceof water heater.

Reference Books	
1.	Troubleshooting and Repairing Major Appliances, Eric Kleinert, 3rd Edition
2.	Study of Electrical Appliances and devices - K.B.Bhatia
3.	Electrical Appliances: The Complete Guide to the Maintenance and Repair of Domestic Electrical Appliancesby Graham Dixon
4.	Troubleshooting and Maintenance of Electronic Equipment's, Lalak., 2 Edition.
5.	How to repair small Appliances - Jack Darr
6.	Maintenance of Domestic Appliances - R. B. Lal

Semester: VI		
Mini Project		
Course Code:	MVJ21EEMP67	**CIE Marks: 50**
Credits:	**L: T: P: 0:0:4**	**SEE Marks: 50**
Hours:	**40L**	**SEE Duration: 3 Hrs.**

Course Learning Objectives: The students will be able to	
1	Support independent learning and innovative attitude.
2	Guide to select and utilize adequate information from varied resources upholding ethics.
3	Guide to organize the work in the appropriate manner and present information (acknowledging the sources) clearly.
4	Develop interactive, communication, organization, time management, and presentation skills.
5	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.

Mini Project: Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary Mini- project can beassigned to an individual student or to a group having not more than 4 students.

Course Outcomes: After completing the course, the students will be able to	
C315.1	Describe the project and be able to defend it. Develop critical thinking and problem-solving skills.
C315.2	Learn to use modern tools and techniques. Communicate effectively and present ideas clearly and coherently both in written and oral forms.
C315.3	Develop skills to work in a team to achieve a common goal. Develop skills in project management and finance.
C315.4	Develop skills of self-learning, evaluate their learning and take appropriate actions to improve it.
C315.5	Prepare them for life-long learning to face the challenges and support the technological changes to meet societal needs.

Scheme of Evaluation:

Continuous Internal Evaluation: The CIE (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**
C315.1	3	2	2	2	2	1	1	-	1	2	-	2
C315.2	3	3	3	2	3	2	2	-	2	3	2	3
C315.3	3	3	3	2	3	2	2	-	2	3	2	3
C315.4	3	3	3	2	3	2	2	-	2	3	2	3
C315.5	3	3	3	3	3	3	3	-	3	3	3	3

Semester: IV		
SummerInternship-II		
Course Code:	**MVJ21INT68**	**CIE Marks:50**
Credits: L: T:P:	**0:0:4**	**SEE Marks: 50**
Hours:		**SEE Duration:**

Course Learning Objectives: The students will be able to	
1	To get the field exposure and experience
2	To apply the theoretical concept in field application
3	To prepare the comparison statement of difference activities

Internship: This shall be carried out by students in industry set-up related to the construction/ materials testing laboratories/research organizations/project management consulting firms/QS and QA organizations/ planning and design offices/Professional organizations and other avenues related to the civil engineering domain in consultation and approval of internship guide/HOD /internship committees of the institutions.	**3 Hrs**

Course Outcomes: After completing the course, the students will be able to	
316.1	Develop skills to work in a team to achieve common goal.
316.2	Develop skills of self-learning, evaluate their learning and take appropriate actions to improve it.
316.3	Prepare them for life-long learning to face the challenges and support the technological changes to meet the societal needs.
316.4	Develop skills of project management and finance.
316.5	Understand work ethics and culture of industry.

Scheme of Evaluation

Evaluation of the field training/industrial internship shall be conducted during VIII semester bu internal and external examiners for 100 marks. The external examiner shall be from the industry, where the student carried out the field training/Industrial internship. In case of non-availability of external examiner, the concerned head of the department shall appoint an external examiner from the near by college or a senior faculty member from outside the department in consultation with respective BOE and approved by Principal. The field training/industrial internship carries two credits. A student has to get a minimum of 40% marks for a pass. If a student fails to complete the same, then the field training/Industrial internship has to be repeated in its entirety.

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
316.1	2	2	2	3	3	2	1	1	2	1	1	2
316.2	2	2	2	3	3	2	1	1	2	1	2	2
316.3	2	2	2	3	3	2	1	1	2	1	2	2
316.4	2	2	2	3	3	2	1	1	2	1	2	2
316.5	2	2	2	3	3	2	1	1	2	1	2	2

Semester: VII		
Switchgear and Protection (Theory and Practice)		
Course Code:	**MVJ21EE71**	**CIE Marks:50+50**
Credits:	**L:T:P: 3:0:2**	**SEE Marks: 50 +50**
Hours:	**40 L+ 26 P**	**SEE Duration: 03+03 Hours**
Course Learning Objectives: The students will be able to		
1	Discuss performance of protective relays, components of protection scheme and relay terminology.	
2	Explain Overcurrent protection using electromagnetic relays and Overcurrent protective schemes.	
3	Explain construction, operating principles of various distance relays for distance protection.	
4	Discuss construction, operating principles of static and numerical relays for Numerical protection.	
5	Explain the principle of circuit interruption and different types of circuit breakers	

UNIT-I	
Protective Relays: Introduction, Need for power system protection, evolution of protective relays, zones of protection, primary and backup protection, essential qualities of protection, classification of protective relays and schemes, basic relay terminology. **Operating Principles and Relay Construction:** Electromagnetic relays, thermal relays, static relays. **Laboratory Sessions/ Experimental learning:** Field visit to show placing and operation of relays in substation. **Applications**: Selection of relays for protection of system components. **Web Link and Video Lectures:** 3. https://nptel.ac.in/courses/108/101/108101039/ 4. https://youtu.be/NEXWcOgqZOI	**10Hrs**
UNIT-II	
Over-Current Protection: Time-current characteristics, current setting, over current protective schemes, directional relay,Protection of parallel feeders, protection of ring mains, Phase fault and earth fault protection, Combined earth fault and phase fault protective scheme. **Distance Protection**: Impedance relay, reactance relay, MHO relay, Effect of arc resistance, Effect of power swings, effect of line length and source impedance on the performance of distance relays, selection of distance relays. **Laboratory Sessions/ Experimental learning:** Design of protection system for distribution system. **Applications:** Protection of transmission line and selection of distance relays. **Web Link and Video Lectures:**	**10Hrs**

3. https://nptel.ac.in/courses/108/101/108101039/ 4. https://youtu.be/XdE149Hk_h0	
UNIT-III	
Differential protection–Introduction, differential relays, differential protection scheme, Wire Pilot protection (Transley scheme), Carrier current protection. **AC Machines and Bus Zone Protection:** Protection of Generators, Protection of transformers, Protection of induction motors, Protection of Bus zone protection **Laboratory Sessions/ Experimental learning:** Study the gas actuated Buchholz relay for oil filled transformer (virtual lab). **Application:** Protection of machines from internal and external faults. **Web Link and Video Lectures:** **1.** https://nptel.ac.in/courses/108/101/108101039/ **2.** https://youtu.be/ZXyq-xxRLnQ	**10Hrs**
UNIT-IV	
Numerical Protection Static Relays: Amplitude and Phase comparators, Static amplitude comparator, static over current relays, static directional relay, and static distance relays. **Microprocessor Based Relays:** Over current relays, directional relays, distance relays. **Laboratory Sessions/ Experimental learning:** Industrial visit **Application:** Numerical protection is used in smart grid. **Web Link and Video Lectures:** 1. https://nptel.ac.in/courses/108/101/108101039/ 2. https://youtu.be/NEXWcOgqZOI	**10Hrs**
UNIT-V	
FUSES: Introduction, fuse characteristics, types of fuses, application of HRC fuses, discrimination **Circuit Breakers:** Introduction, arcing in circuit breakers, arc interruption theories, re-striking and recovery voltage, resistance switching, current chopping, interruption of capacitive current, oil circuit breaker, air blast Circuit breakers, SF6 circuit breaker, operating mechanism, selection of circuit breakers, ratings of circuit breakers, testing of circuit breakers. **Laboratory Sessions/ Experimental learning:** **1.** Circuit Breaker Status Indication from field input(virtual lab) **2.** Substation Visit **Application:** MCB & Fuses are used for protection of all electrical machines. **Web Link and Video Lectures:** **1. https://nptel.ac.in/courses/108/101/108101039/** **2. https://youtu.be/JRv2RVyYMtM**	**10Hrs**
LABORATORY EXPERIMENTS	

12. IDMT non-directional characteristics and calculation of error in operating time for Over current Relay (Electro mechanical type).
13. Operating characteristics of Over voltage & Under voltage Relay (Electro mechanical type)
14. Operating characteristics of Microprocessor – based (numeric) Over / Under voltage Relay.
15. Operating Characteristics of Microprocessor Based (Numeric) Over Current Relay.
16. Motor protection scheme Studies.
17. Spark over characteristics of air insulation subjected to High Voltage AC – with Spark over voltage corrected to STP.
18. Breakdown strength of transformer oil using oil test kit.
19. Generator Protection Scheme

Along with mandatory experiments students are advised to complete two open ended experiments. The following are some suggestions for open ended experiments.

20. Field mapping using electrolytic tank for capacitor model
21. Generation of standard lightning impulse voltage.
22. Spark over characteristics of air insulation subjected to High Voltage DC.

Course Outcomes: After completing the course, the students will be able to	
C401.1	Compare and contrast electromagnetic, static and microprocessor-based relays
C401.2	Select relay settings of over current and distance relays.
C401.3	Analyze different protective schemes for bus-bars, generators, induction motors and transformers
C401.4	Apply technology to protect power system components.
C401.5	Analyze quenching mechanisms used in air, oil and vacuum circuit breakers

Reference Books	
9.	Power System Protection and Switchgear, Badriram and D.N. Vishwakarma, 2ND Edition, TMH 2011.
10.	Fundamentals of Switchgear and Protection, J B Gupta, Technical Publications, 1st Edition, 2001.
3.	Fundamentals of Power system protection, Y.G.Paithankar and S.R.Bhide,2nd Edition, PHI private limited,NewDelhi,2010
4.	Switch Gear and Protection, Sunil S Rao, Khanna Publication, 1999

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 marksare 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**
C401.1	3	3	2	2	3	1	2	1	2	3	1	2
C401.2	3	3	2	2	3	1	2	1	2	3	1	2
C401.3	3	3	2	2	3	1	2	1	2	3	1	2
C401.4	3	3	2	2	3	1	2	1	2	3	1	2
C401.5	3	3	2	2	3	1	2	1	2	3	1	2

Semester: VII		
IOT Applications for EEE (Theory)		
Course Code:	**MVJ21EE721**	**CIE Marks:50+50**
Credits:	**L:T:P: 3:0:0**	**SEE Marks: 50 +50**
Hours:	**40 L**	**SEE Duration: 03+03 Hours**
Course Learning Objectives: The students will be able to		
1	Understand the basic architecture of Internet of Things.	
2	Understand IoT Concepts applicable to Smart Home Appliances.	
3	Understand IoT Concepts applicable to Smart Metering Systems.	
4	Understand IoT Concepts applicable to Smart Grid Systems.	
5	Understand IoT Concepts applicable to SCADA Systems.	

UNIT-I	
BASIC IoT ARCHITECTURE: Different layers of IoT system, Things, Data Acquisition and Gateways, Edge Analytic Systems, Data Centres and Cloud Storage **Laboratory Sessions/ Experimental learning**: Read Sensors and send data to Cloud storage **Applications**: IoT Applications **Web Link and Video Lectures:** https://youtu.be/xsZ9YhVy-7g	**8Hrs**
UNIT-II	
SMART HOME APPLIANCES: Introduction, Definition, Benefits. Block Diagram of Smart Appliance. Case studies: Microwave Oven, Refrigerator, Washing Machine, Air Conditioner, etc **Laboratory Sessions/ Experimental learning**: Remote Control of bulbs, appliances through Web **Applications**: All Home Electrical Appliances **Web Link and Video Lectures:** https://www.silabs.com/applications/smart-home/appliances	**8Hrs**
UNIT-III	
SMART METERING: Introduction, Smart Metering Infrastructure, Classification of Smart Metering Communication Systems, Smart Meter: Benefits, Issues, Standards, Deployment **Laboratory Sessions/ Experimental learning:** Accessing Smart Meter reading through Web **Applications**: Smart Meters in Homes, Buildings, etc **Web Link and Video Lectures:** https://www.slideshare.net/satabdyjena/smart-meteringsystem	**8Hrs**
UNIT-IV	
SMART GRID SYSTEM: Need for Smart Grid, Architecture and Block diagram. Working principle, Characteristics and advantages. Essential technologies: Two way integrated communication, Smart Appliances, Smart Power Meters, Smart Sub	**8Hrs**

Stations, Phasor Measurement Unit. **Laboratory Sessions/ Experimental learning:** Remote reading of energy consumption for home devices **Applications**: Generating station, Transmission, Substations, Consumers **Web Link and Video Lectures:** 1. https://www.tutorialspoint.com/what-is-a-smart-grid-and-how-does-it-work 2. https://circuitdigest.com/article/smart-grid-the-electrical-grid-of-the-future	
UNIT-V	
IoT BASED SCADA SYSTEMS: Benefits of IoT based SCADA System, System Architecture. Implementation of different SCADA systems. Data communication, protocols, and media usage. Substation automation, smart transmission and distribution. Distribution automation, distribution management system and energy management systems. **Laboratory Sessions/ Experimental learning:** Prototype model for IoT based SCADA System **Applications**: Generating station, transmission, sub station **Web Link and Video Lectures:** 1. https://youtu.be/6MxWt4gWuKM(IoT Based SCADA System) 2. https://youtu.be/JiNY6S7vwSc (SCADA and IoT for Beginners) 3. https://www.biz4intellia.com/blog/8-benefits-of-adopting-internet-of-things-(IoT)-in-scada-system/	**8Hrs**

Course Outcomes: After completing the course, the students will be able to	
C402.1.1	Apply IoT concepts for Home Appliances, Smart Metering, Grid and SCADA systems
C402.1.2	Apply IoT concepts for a wide range of IoT applications
C402.1.3	Perform Use Case and Requirement Analysis for Smart Electrical Systems
C402.1.4	Design Smart Electrical Systems based on IoT
C402.1.5	Implement simple IoT applications for Electrical Systems

Reference Books	
1	Smart Metering Technologies. Inderpreet Kaur. BoD – Books on Demand, 2021
2	Smart Grid: Fundamentals of Design and Analysis. James O Momoh. Wiley-IEEE Press; 1st edition (March 2012)
3	Power System SCADA and Smart Grids. Mini S Thomas and John Douglas McDonald. CRC Press, 1st Edition
4	Wiley Online library, Chapter 17: SCADA FUNDAMENTALS AND APPLICATIONS IN THE IoT, Rich Hunzinger

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**
C402.1.1	3	3	1	3	1	-	-	-	-	-	-	1
C402.1.2	3	3	1	3	1	-	-	-	-	-	-	1
C402.1.3	3	3	2	3	2	-	-	-	-	-	-	1
C402.1.4	3	3	3	3	3	-	-	-	-	-	-	1
C402.1.5	3	3	1	3	1	-	-	-	-	-	-	1

Semester: VII		
SMART GRID		
Course Code:	**MVJ21EE722**	**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 concepts and introduction of Smart Grid
2	Understand the monitoring techniques in transmission and distribution systems
3	Employ the knowledge on different smart meters and advanced metering infrastructure.
4	Develop the solution for various power quality management issues in Smart Grid.
5	Implement the high-performance computing systems for Smart Grid applications.

UNIT-I	
Introductionto Smart Grid: Evolution of Electric Grid, Concept, Definitions and Need for Smart Grid, Smart grid drivers, functions, opportunities, challenges and benefits, Difference between conventional & Smart Grid, National and International Initiatives in Smart Grid. **Laboratory Sessions/ Experimental learning:Case Studies and Test beds for the Smart Grid.** **Applications:** Hybridizing Optimization Techniques and Applications to the Smart Grid, Computational Challenges. **Web Link and Video Lectures**: 1. https://nptel.ac.in/courses/108107113 2. https://youtu.be/ksbTExNURzU	**8Hrs**
UNIT-II	
Smart Grid Technologies: Technology Drivers, Smart energy resources, Smart substations, Substation Automation, Feeder Automation, Transmission systems: EMS, Wide area monitoring, Protection and control, Distribution systems: DMS, Fault Detection, Isolation and service restoration, Outage management,Plugin Hybrid Electric Vehicles(PHEV). **Laboratory Sessions/ Experimental learning:** Attack Detection using DC state estimation. **Applications:** Smart Grid Decision Support and operational technology **Web Link and Video Lectures**: 1. https://onlinecourses.nptel.ac.in/noc21_ee68/preview 2. https://youtu.be/uFpOU7up-fM	**8Hrs**
UNIT-III	
Smart Meters and Advanced Metering Infrastructure: Introduction to Smart Meters, Advanced Metering infrastructure (AMI) drivers and benefits, AMI protocols, standards and initiatives, AMI needs in the smart grid, Phasor Measurement Unit (PMU), Intelligent Electronic Devices(IED) & their application for monitoring & protection. **Laboratory Sessions/ Experimental learning:** Design of virtual PMU in MATLAB. **Applications:** Monitoring, control and automation in Smart Grids	**8Hrs**

Web Link and Video Lectures : **1..**https://www.energy.gov/sites/prod/files/2016/12/f34/AMI%20Summary%20Report_09-26-16.pdf 2. https://www.youtube.com/watch?v=2O3LznQQKTE	
UNIT-IV	
Power Quality Management in Smart Grid: Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, smart services for network operations and electricity markets: overview of the smart services, metering services and data communication and information management. Laboratory Sessions/ Experimental learning: MATLAB Implementation of Unified Power Quality Conditioner (UPQC) for Power Quality Improvement. **Applications:** Power system stability in Smart Grids **Video Link:** 1.https://onlinecourses.nptel.ac.in/noc21_ee103/preview 2. https://youtu.be/EzZS_Uk1c_o	**8Hrs**
UNIT-V	
High Performance Computing for Smart Grid Applications: Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN), Broad band over Power line (BPL), IP based Protocols, smart grid cyber security and cyber-Securityand possible operation for improving methodology for other users. **Laboratory Sessions/ Experimental learning:** Data capturing from PMU using HIL-PMU setup using C-37 protocol **Applications:** Communication technologies for Smart Grids **Web Link and Video Lectures** : 1. https://nptel.ac.in/courses/106108055 2. https://youtu.be/bkLVuNfiCVs	**8Hrs**

Course Outcomes: After completing the course, the students will be able to	
C402.2.1	Understanding on the concepts of Smart Grid and its present developments.
C402.2.2	Study about different Smart Grid technologies
C402.2.3	Acquire knowledge about different smart meters and advanced metering infrastructure.
C402.2.4	Enrich knowledge on power quality management in Smart Grids.
C402.2.5	Develop more understanding on LAN, WAN and Cloud Computing for Smart Grid applications.

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**
C402.2.1	3	2	-	-	-	-	2	2	-	-	-	2
C402.2.2	3	2	2	3	2	2	3	2	2		-	2
C402.2.3	3	2	3	3	3	3	3	2	2	2	2	2
C402.2.4	3	2	3	3	3	3	3	2	3	3	2	3
C402.2.5	3	2	3	3	3	3	3	2	3	3	2	3

Semester: VII		
SYSTEM ON CHIP		
Course Code:	**MVJ21EE723**	**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 components of system, hardware and software	
2	Know the basic concepts of processor architecture and instructions	
3	Describe external and internal memory of SOC	
4	Get knowledge of bus models of SOC	
5	Understand SOC customization and reconfiguration technologies	

UNIT-I	
Introduction to the System Approach: System Architecture, Components of the system, Hardware & Software, Processor Architectures, Memory and Addressing. System level interconnection. **Laboratory Sessions/ Experimental learning**: Write-up on Microprocessors, 8086 Functional block diagram, Pin diagram and description. **Applications**: Understand different microprocessor architectures (ARM, Intel etc) **Video link**: https://www.youtube.com/watch?v=3KLOXUYGo9s	**8Hrs**
UNIT-II	
Processors: Introduction, Processor Selection for SOC, Basic concepts in Processor Architecture, Basic concepts in Processor Micro Architecture, Basic elements in Instruction handling. Buffers: minimizing Pipeline Delays, Branches, More Robust Processors, and Vector Processors. **Laboratory Sessions/ Experimental learning**: Design and develop an assembly language program to search a key element "X" in a list of 'n' 16-bit numbers. Adopt Binary search algorithm in your program for searching. **Applications**: Consumer device, Networking, and communication. **Video link**: https://nptel.ac.in/courses/108/107/108107029/	**8Hrs**
UNIT-III	
Memory Design for SOC: Overview of SOC external memory, Internal Memory, Size, Scratchpads and Cache memory, Cache Organization, Cache data, Write Policies, Strategies for line replacement at miss time, Types of Cache, Split – I, and D – Caches, Multilevel Caches, Virtual to real translation, SOC Memory System, Models of Simple Processor – memory interaction. **Laboratory Sessions/ Experimental learning**: Design and develop an assembly program to sort a given set of 'n' 16-bit numbers in ascending order. Adopt Bubble Sort algorithm to sort given elements. **Applications**: Biomedical devices, Media processors, GPS controllers. **Video link**: https://nptel.ac.in/courses/108/107/108107029/	**8Hrs**
UNIT-IV	

Interconnect Customization and Configuration: Interconnect Architectures, Bus: Basic Architectures, SOC Standard Buses, Analytic Bus Models, Using the Bus model, Effects of Bus transactions and contention time. **Laboratory Sessions/ Experimental learning**: Develop an assembly language program to reverse a given string and verify whether it is a palindrome or not. Display the appropriate message. **Applications**: ASICs, PC-on-a-chip etc. **Video link**: https://nptel.ac.in/courses/108/107/108107029/	**8Hrs**
UNIT-V	
SOC Customization: An overview, Customizing Instruction Processor, Reconfiguration Technologies, Mapping design onto Reconfigurable devices, Instance- Specific design, Customizable Soft Processor, Reconfiguration - overhead analysis and trade-off analysis on reconfigurable Parallelism. **Application Studies / Case Studies**: SOC Design approach, AES algorithms, Design and evaluation, Image compression – JPEG compression. **Laboratory Sessions/ Experimental learning**: To write and simulate ARM assembly language programs for data transfer, arithmetic, and logical operations (Demonstrate with the help of a suitable program). **Applications**: Image processing, AI, and ML. **Video link**: https://nptel.ac.in/courses/108/107/108107029/	**8Hrs**

Course Outcomes: After completing the course, the students will be able to	
402.3.1	Memorize the system architecture, components of system hardware and software
402.3.2	Know the basic concepts of processor architecture and instructions and delays
402.3.3	Describe external and internal memory of SOC and organization
402.3.4	Explain bus architectures and models of SOC
402.3.5	Apply the knowledge of SOC design in real time applications

Reference Books	
1.	Design of System on a Chip: Devices and Components – Ricardo Reis,Springe, 1st Ed., 2004, 978-1-4419-5454-1.
2.	Co-Verification of Hardware and Software for ARM System on Chip Design (Embedded Technology) – Jason Andrews – Newness, BK and CDROM,9780080476902.
3.	System on Chip Verification – Methodologies and Techniques –Prakash Rashinkar, Peter Paterson and Leena Singh L, , Kluwer Academic Publishers,2001,978-0792372790.
4.	Engineering the Complex SOC: Fast,Flexible design with configurable processors,C.Rowen Prentice Hall, 2004,978-0131455375.

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 subdivisions. 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	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**
402.3.1	2	2	2	1	2	-	-	-	-	-	-	-
402.3.2	2	2	2	2	3	-	-	-	-	-	-	-
402.3.3	2	2	2	2	3	-	-	-	-	-	-	-
402.3.4	2	3	3	2	3	-	-	-	-	-	-	-
402.3.5	2	2	3	2	3	-	-	-	-	-	-	-

OPERATION AND MAINTENANCE OF SOLAR ENERGY SYSTEMS (Theory)		
Course Code:	**MVJ21EE724**	**CIE Marks: 50**
Credits:	**L:T:P: 3:0:0**	**SEE Marks: 50**
Hours:	**40L**	**SEE Duration: 3 Hrs.**
Course Learning Objectives: The students will be able to		
1	Discuss basics of solar resource data, PV technology, buying the PV modules, and connecting the modules to form arrays.	
2	Discuss inverters, system components, cabling used to connect the components, and mounting methods of the PV system.	
3	Explain site assessment, the design process of the grid-connected system, and its sizing.	
4	Explain installation, commissioning, operation, and maintenance of PV systems.	
5	Explain the types of financial incentives available, the calculation of payback time.	

UNIT-I	
Solar Resource and Radiation: Solar resources, quantifying solar radiation, the effect of the Earth's atmosphere on solar radiation, Sun geometry, Geometry for installing solar arrays. **PV Industry and Technology:** Semiconductor devices, Mainstream technologies, Monocrystalline silicon, Multi crystalline/polycrystalline silicon, thin film solar cells, Contacts, Buying solar modules, Standards, Certifications, Warranties, Emerging technologies, Dye-sensitized solar cells, Sliver cells, Heterojunction with intrinsic thin layer (HIT) photovoltaic cells, III-V Semiconductors, Solar concentrators. **PV Cells, Modules and Arrays:** Characteristics of PV cells, Graphic representations of PV cell performance, Connecting PV cells to create a module, Specification sheets, creating a string of modules, Creating an array, Photovoltaic array performance, Irradiance, Temperature, Shading. **Laboratory Sessions/ Experimental learning:** To inspect solar panels and make a report about the type of panel, ratings, cost, etc. **Applications:** Identification of solar panels for different SPV applications. **Web Link and Video Lectures**: • https://www.youtube.com/watch?v=pOx-rtIECuo • https://www.youtube.com/watch?v=pOx-rtIECuo • https://www.youtube.com/watch?v=RyzJlsxzG4A	**8Hrs**
UNIT-II	
Inverters and Other System Components: Introduction, Inverters, Battery inverters, Grid interactive inverters, Transformers, Mainstream inverter technologies, String inverters, Multi-string inverter, Central inverter, Modular inverters, Inverter protection systems, Self-protection, Grid protection, Balance of system equipment: System equipment excluding the PV array and inverter, Cabling, PV combiner box, Module junction box, Circuit breakers and fuses ,PV main disconnects/isolators, Lightning and surge protection, System monitoring,	**8Hrs**

Metering, Net metering, Gross metering. **Mounting Systems:** Roof mounting systems, pitched roof mounts, Pitched roof mounts for tiled roofs, Pitched roof mounts for metal roofs, Rack mounts, Direct mounts, Building-integrated systems, Ground mounting systems, Ground rack mounts, Pole mounts, Sun-tracking systems, Wind loading, Lightning protection. **Laboratory Sessions/ Experimental learning:** To build a cardboard model to demonstrate an SPV and grid connected PV system along with BOS equipment. **Applications:** Installation of PV systems. **Web Link and Video Lectures**: • https://www.youtube.com/watch?v=oPTyem9dmEI • https://www.youtube.com/watch?v=oPTyem9dmEI	
UNIT-III	
Site Assessment: Location of the PV array, Roof specifications, Is the site shade-free, Solar Pathfinder, SolmetricSuneye, HORIcatcher, iPhone apps, Software packages, Available area, Portrait installation, Landscape installation, Energy efficiency initiatives, Health, safety and environment (HSE) risks, Local environment, Locating balance of system equipment, Site plan. **Designing Grid-connected PV Systems:** Design brief, Existing system evaluation, choosing system components, Modules, Mounting structure, Inverters, Cabling, Voltage sizing, Current sizing, Monitoring, System protection, Over-current protection, Fault-current protection, Lightning and surge protection, Grounding/earthing, Mechanical protection, Array protection, Subarray protection, Extra low voltage (ELV) segmentation. **Sizing a PV System:** Introduction, Matching voltage specifications, Calculating maximum voltage, Calculating minimum voltage, Calculating the minimum number of modules in a string, Calculating the maximum voltage, Calculating the maximum number of modules in a string, Calculating the minimum voltage, Calculating the minimum number of modules in a string, Matching current specifications, Matching modules to the inverter's power rating, Losses in utility-interactive PV systems, Temperature of the PV module, Dirt and soiling, Manufacturer'stolerance, Shading, Orientation and module tilt angle, Voltage drop, Inverter efficiency,Calculating system yield. **Laboratory Sessions/ Experimental learning:** A case study of any grid connected PV system. **Applications**: Choosing a site for PV installation, designing solar PV systems for grid connected operation. **Web Link and Video Lectures**: • https://www.youtube.com/watch?v=mi2BzuEbj9o • https://www.youtube.com/watch?v=2PeyBWy5NF8	**8Hrs**
UNIT-IV	
Installing Grid-connected PV Systems: PV array installation, DC wiring, Cabling routes, and required lengths, Cable sizing, PV combiner box, System grounding/earthing, Inverter installation, Installation checklist, Interconnection	**8Hrs**

with the utility grid, Required information for installation, and Safety. **System Commissioning:** Introduction, Final inspection of system installation, Testing, Commissioning, System documentation. **System Operation and Maintenance:** System maintenance, PV array maintenance, Inverter maintenance, System integrity, Troubleshooting, Identifying the problem, Troubleshooting PV arrays, troubleshooting underperforming systems, Troubleshooting inverters, and Other common problems. **Laboratory Sessions/ Experimental learning:** A case study on commissioning, operation, and maintenance of the solar system. **Applications**: Operation and maintenance of the solar system. **Web Link and Video Lectures:** https://www.youtube.com/watch?v=bTiHbAzKZGw	
UNIT-V	
Marketing and Economics of Grid-connected PV Systems: Introduction, PV system costing, Valuing a PV system, Simple payback, and financial incentives, Simple payback, Feed-in tariffs, Rebates, Tax incentives, Loans, Renewable portfolio standards and renewable energy certificates, Marketing, Insurance **Laboratory Sessions/ Experimental learning:** A case study on the economic aspect of grid integrated solar system. **Web Link and Video Lectures:** https://www.youtube.com/watch?v=CQCtkFXQqMI	**8Hrs**

Course Outcomes: After completing the course, the students will be able to	
C402.4.1	Discuss basics of solar resource data, PV technology, buying the PV modules, and connecting the modules to form arrays.
C402.4.2	Discuss inverters, system components, cabling used to connect the components, and mounting methods of the PV system.
C402.4.3	Explain site assessment, the design process of the grid-connected system, and its sizing.
C402.4.4	Explain installation, commissioning, operation, and maintenance of PV systems.
C402.4.5	Explain the types of financial incentives available, the calculation of payback time.

Reference Books	
1.	Grid-connected Solar Electric Systems, The Earthscan Expert Handbook for Planning, Design and Installation Geoff Stapleton and Susan Neill Earthscan 1st Edition, 2012

Continuous Internal Evaluation (CIE):
Theory for 50 Marks

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

Semester End Examination (SEE):
Total marks: 50+50=100

SEE for 50 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 subdivisions. 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**
C402.4.1	3	2	2	1	-	-	-	-	-	-	-	3
C402.4.2	3	2	2	1	-	-	-	-	-	-	-	3
C402.4.3	3	2	2	1	-	-	-	-	-	-	-	3
C402.4.4	3	2	2	1	-	-	-	-	-	-	-	3
C402.4.5	3	2	2	1	-	-	-	-	-	-	-	3

Semester: VII		
Power System Operation and Control		
Course Code:	**MVJ21EE731**	**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 significance of power system operation and control.	
2	Understand the basics of load frequency control and automatic generation control.	
3	Understand the basics of speed governing system, various methods to control frequency.	
4	Understand the reactive power-voltage interaction and to learn the control actions to be implemented for maintaining the voltage profile against varying system load.	
5	Understand the reliability and contingency analysis, state estimation and related issues.	

UNIT-I	
Economic operation of power system: Statement of economic dispatch problem - input and output characteristics of thermal plant - incremental cost curve - optimal generation allocation with line losses neglected and including the effect of transmission line losses-statement of unit commitment (UC) problem - constraints on UC problem - solution of UC problem using priority list method. **Experimental learning:** Solving unit commitment problem using software. **Applications:** Solving unit commitment problems **Web Link and Video Lectures:** • https://nptel.ac.in/content/storage2/courses/108107028/module1/lecture1/lecture1.pdf https://www.power-technology.com/features/feature-the-top-10-biggest-thermal-power-plants-in-india/	**8Hrs**
UNIT-II	
Automatic Generation Control (AGC): Introduction-Schematic diagram of load frequency and excitation voltage regulators of turbo generators-Modeling of Turbine: First Order Turbine Model- Block Diagram Representation of Steam Turbines and Approximate Linear Models- Modeling of Governor: Mathematical Modeling of Speed Governing System – Derivation of Small Signal Transfer Function – Block Diagram. **Experimental learning:** Modelling the turbine first order model using MATLAB **Applications:** designing of turbines and machines for power plant **Web Link and Video Lectures:** • https://nptel.ac.in/content/storage2/courses/108107028/module1/lecture1/lecture1.pdf • https://archive.nptel.ac.in/courses/108/105/108105133/	**8Hrs**
UNIT-III	
Load –Frequency Control: Necessity of Keeping Frequency Constant. Definitions of Control Area – Single AreaControl – Block Diagram Representation of an Isolated	**8Hrs**

Power System – Steady StateAnalysis – Dynamic Response – Uncontrolled Case. Load Frequency Control of 2-AreaSystem – Uncontrolled Case and Controlled Case, Tie-Line Bias Control. **Experimental learning: Single and** Two area LFC control modelling in MATLAB. **Applications:** Frequency control in power plants **Web Link and Video Lectures:** • https://jntua.ac.in/gate-online-classes/registration/downloads/material/a159041328312.pdf • https://www.allumiax.com/blog/top-5-advantages-of-parallel-operation-of-generators-or-alternators	
UNIT-IV	
Reactive power and Voltage control: Generation and absorption of reactive power, basics of reactive power control- Automatic Voltage Regulator (AVR)-Reactive Power Compensation in TransmissionSystems – Advantages and Disadvantages of Different Types of CompensatingEquipment for Transmission Systems; Load Compensation – Specifications of LoadCompensator- Shunt andSeries Compensation. **Experimental learning:** Design of Simulink model for AVR **Applications**: Reactive power control in transmission and distribution systems. **Web Link and Video Lectures:** • https://www.electricalindia.in/reactive-power-management-voltage-control-to-avoid-blackouts/ • https://electrical-engineering-portal.com/how-reactive-power-is-helpful-to-maintain-a-system-healthy	**8Hrs**
UNIT-V	
Power System Security analysis: Introduction-Factors affecting power system security- Contingency Analysis-Linear Sensitivity Factors-AC power flow methods-Contingency Selection and Ranking.Challenges to Electricity Pricing –Construction of Forward Price Curves – Short-time Price Forecasting. **Experimental learning:** Visiting substation equipped with SCADA devices. **Applications:** Automation. **Web Link and Video Lectures:** • https://www.inductiveautomation.com/resources/article/what-is-scada • https://www.youtube.com/watch?v=nlFM1q9QPJw	**8Hrs**

Course Outcomes: After completing the course, the students will be able to	
C403.1.1	Describe the day-to-day operation of electric power system.
C403.1.2	Understand the reactive power-voltage interaction and load frequency control

	and modelling turbine and generators.
C403.1.3	Acquire knowledge on real power-frequency interaction in single area system.
C403.1.4	Describe the significance of power system operation and control for reactive power compensation.
C403.1.5	Explain security, contingency analysis, state estimation of power systems.

Reference Books	
11.	Kundur P., 'Power System Stability and Control, McGraw Hill Education Pvt. Ltd., New Delhi, 10th reprint, 2010.
12.	Allen. J. Wood and Bruce F. Wollen berg, 'Power Generation, Operation and Control', John Wiley & Sons, Inc., 2016.
3.	Kothari D.P. and Nagrath I.J., 'Power System Engineering', Tata McGraw-Hill Education, Second Edition, 2008.
4.	Hadi Saadat, 'Power System Analysis', McGraw Hill Education Pvt. Ltd., New Delhi, 21st reprint, 2010.

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

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

Semester End Examination (SEE):

Total marks: 50+50=100

SEE for 50 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
C403.1.1	3	3	-	3	-	-	-	-	-	-	2	1
C403.1.2	3	3	-	3	-	-	-	-	-	-	3	1
C403.1.3	3	3	-	3	-	-	-	-	-	-	2	1
C403.1.4	3	3	-	3	-	-	-	-	-	-	3	1
C403.1.5	3	3	-	3	-	-	-	-	-	-	2	1

Semester: VII		
Power Quality and FACTS (Theory)		
Course Code:	**MVJ21EE732**	**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 power quality related terms and Illustrate power quality issues.	
2	Analyze overvoltage and transients in power systems.	
3	Understand various power quality monitoring and compensation techniques.	
4	Explain the basic concepts and requirements of FACTS.	
5	Discuss Voltage Source Converter based (FACTS) Controllers	

UNIT-I	
Introduction To Power Quality: Terms and definitions & Sources – Overloading, under voltage, over voltage - Concepts of transients - short duration variations such as interruption - long duration variation such as sustained interruption - Sags and swells - Voltage sag - Voltage swell - Voltage imbalance – Voltage fluctuations - Power frequency variations. **Voltage sags:** Sources of Sags and Interruptions, Estimating Voltage Sag Performance, Fundamental Principles of Protection **Laboratory Sessions/ Experimental learning**: Study of effect of nonlinear loads on power quality by using MATLAB simulation **Applications**: Identification and classification of power quality issues. **Video link:** https://nptel.ac.in/courses/108/107/108107157 https://nptel.ac.in/content/storage2/108/107/108107157/MP4/mod02lec06.mp4	**8Hrs**
UNIT-II	
Harmonics: sources from commercial and industrial loads – Locating harmonic sources –Harmonics Vs transients. Effect of harmonics – Harmonic distortion – Voltage and current distortions – Harmonic indices – Inter harmonics – Infraction harmonics,Principles for compensating Harmonics. **Over Voltages**: Sources of over voltages - Capacitor switching – lightning - ferro resonance. Mitigation of voltage swells - surge arresters - low pass filters - power conditioners. Lightning protection – shielding - line arresters - protection of transformers and cables. **Laboratory Sessions/ Experimental learning**: Simulation for generation of transients. **Applications**: Selection of equipment rating. **Video link:** https://www.youtube.com/watch?v=FiGjNyX6h8c https://nptel.ac.in/content/storage2/108/107/108107157/MP4/mod02lec07.mp4	**8Hrs**
UNIT-III	

Power Quality Monitoring: Monitoring considerations - Monitoring and diagnostic techniques for various power quality problems – Power Quality measurement equipment - Assessment of Power Quality Measurement Data, Application of intelligent Systems- Power Quality Monitoring Standards. **Laboratory Sessions/ Experimental learning:** Design of active shunt compensator for harmonics compensation **Applications:** Active filters **Video link:** https://www.youtube.com/watch?v=FiGjNyX6h8c	**8Hrs**
UNIT-IV	
Thyristor-based Flexible AC Transmission Controllers (FACTS): Description and Characteristics of Thyristor-based FACTS devices: Static VARCompensator (SVC), Thyristor Controlled Series Capacitor (TCSC),configurations/modes of operation, harmonics, and control of SVC and TCSC,applications of SVC's. **Laboratory Sessions/ Experimental learning:** Design a control scheme for UPFC in SIMULINK. **Applications**: Voltage control and power flow control of multiple line. Power flow control between the lines. **Video link:** https://nptel.ac.in/courses/108/107/108107114/ https://nptel.ac.in/courses/108/107/108107114/	**8Hrs**
UNIT-V	
Voltage Source Converter based (FACTS) Controllers: Fundamentals of Voltage Source Converters (VSC) for FACTs, STATCOM: Principle of operation and applications, Dynamic voltage restorer (DVR): Operation and applications, Unified Power Flow Controller (UPFC): Principle of Operation and control. **Laboratory Sessions/ Experimental learning:** Design a TCR for reactive power compensation in SIMULINK. **Applications**: Reactive power compensation in the long transmission lines. **Video link** :https://nptel.ac.in/courses/108/107/108107114/	**8Hrs**

Course Outcomes: After completing the course, the students will be able to	
C403.2.1	Understand power quality related terms and Illustrate power quality issues.
C403.2.2	Analyze overvoltage and transients in power systems.
C403.2.3	Understand various power quality monitoring and compensation techniques.
C403.2.4	Explain the basic concepts and requirements of FACTS.
C403.2.5	Discuss Voltage Source Converter based (FACTS) Controllers.

Reference Books	
1.	"Electric Power Quality", Dugan, Roger C, Santoso, Surya, McGranaghan, Mark F Beaty, H. Wayne McGraw-Hill professional publication 2003.
2.	"Power Quality in Power Systems and Electrical Machines", Mohammad A.S Masoum, Ewald F.Fuchs, Academic Press, Elsevier, 2015.
3.	"Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems", N.G. Hingorani, L. Gyugyi, IEEE Press, N.Y., 2000.
4.	"Thyristor-based FACTS controllers for Electrical Transmission Systems", R. Mohan Mathur, R K Verma, Wiley IEEE Press.

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**
C403.2.1	3	3	-	1	1	-	-	-	-	-	-	2
C403.2.2	3	3	-	2	1	-	-	-	-	-	-	2
C403.2.3	3	3	-	2	1	-	-	-	-	-	-	2
C403.2.4	3	3	-	2	1	-	-	-	-	-	-	2
C403.2.5	3	2	-	2	1	-	-	-	-	-	-	2

Semester VII		
Electric Drives and Control (Theory)		
Course Code:	**MVJ21EE733**	**CIE Marks:100**
Credits:	**L:T:P:3:0:0**	**SEE Marks: 100**
Hours:	**40L**	**SEE Duration: 3 Hrs.**
Course Learning Objectives: The students will be able to		
1	Understand the fundamental concepts and dynamic conditions of electric drives.	
2	Study the various speed control strategies of DC motor control.	
3	Develop solid state control of induction motor drive.	
4	Classify the synchronous motor drive with relevant control techniques.	
5	Incorporate the industrial applications in drive motor control.	

UNIT-I	
Introduction: Introduction to Electric Drives – Need of electric drives, basic parts, types of drives, Selection of drives, Heating and cooling of electric drives, classes of duties, Speed - Torque characteristics of various types of loads and drive motors Multi quadrant operation, **Laboratory Sessions/ Experimental learning:** Speed- Torque characteristics of drive motor **Applications:** Analysis on dynamics of drive motors **Video link**: 1. https://archive.nptel.ac.in/courses/108/104/108104140/ 2. https://youtu.be/QaLGo0R0SYU	**8Hrs**
UNIT-II	
Control of DC Drives: Ward - Leonard control scheme- Chopper controlled DC motor drives- Four quadrant chopper circuit – DC motor drive using half controlled and fully controlled single phase and three phase rectifiers, continuous conduction modes of operation, 4-quadrant operation using dual converter- Braking of DC drives. Analysis of Closed Loop Control of DC Motor. **Laboratory Sessions/ Experimental learning:** Simulation of closed loop control of converter fed DC motor. **Applications:** Solid state speed control of DC motors. Video link: 1. https://youtu.be/aW7JYwrzTJI 2. https://youtu.be/D0yHlNbf5-w 3. https://youtu.be/5qzUm3PvWXA	**8Hrs**
UNIT-III	
Induction Motor Drive: Stator voltage controller fed closed loop control of induction motor, Four quadrant closed loop control, open loop VFVS fed IM, Cycloconverter fed IM, closed loop control of VSI & CSI fed IM drives, Closed loop control of static rotor resistance control- Slip power recovery scheme- Vector control strategies- Braking of induction motor. **Laboratory Sessions/ Experimental learning:** Speed control of slip ring induction motor. **Applications:** Solid state speed control of three phase induction motor. **Video link:** 1.https://nptel.ac.in/courses/108104140	**8Hrs**

2. https://youtu.be/LXdB0_pbIWA 3. https://youtu.be/Wf5sFR68cBI	
UNIT-IV	
Speed control of 3 phase Synchronous Motors: - True synchronous and self controlled modes of operations. Synchronous motor drive with voltage source inverter, load commutated thyristor inverter and Cycloconverter - Power factor control –Permanent Magnet AC (PMAC) motor drives. **Laboratory Sessions/ Experimental learning**: Simulation of Synchronous Motor Drives using MATLAB. **Applications:** Speed Control of Synchronous Motors **Video link:** 1.https://youtu.be/lp5U1ez1_w8 2. https://youtu.be/b24jORRoxEc 3. https://youtu.be/oGoDbEHkc0Y	**8Hrs**
UNIT-V	
Digital Control and Drive Applications: Microprocessor/Microcontroller and PLC based control of drives- Solar and battery powered Drives- Drive circuits for stepper motors. **Industrial Drives:** The drive selection, Steel rolling mills, Paper mills, Lifts and Cranes. **Laboratory Sessions/ Experimental learning:** Speed control of stepper motors. **Applications:** Measurement of energy conservation in electrical drives. **Video link:** 1. https://youtu.be/OQdoPDB-iYk 2. https://onlinecourses.nptel.ac.in/noc21_ee112/preview 3. https://youtu.be/8XrhTxJCaq8	**8Hrs**

Course Outcomes: After completing the course, the students will be able to	
C403.3.1	Discuss the basic components of the drive system from automation perspective.
C403.3.2	Analyze the various converter and chopper fed DC drive with appropriate control.
C403.3.3	Explain the various speed control methodologies for induction motor drive.
C403.3.4	Examine the synchronous motor control strategies with pertinent techniques.
C403.3.5	Apply digital control techniques on industrial drive applications.

Reference Books	
1.	Fundamentals of Electrical Drives, Gopal K Dubey, Narosa Publishing House,2014.
2.	Electric Drives (Concepts and Applications), Vedam Subrahmaniam, , Tata McGraw-Hill, 2010
3.	A First Course on Electric Drives, Pillar S.K , Wiley Eastern Limited,2012
4.	Programmable Logic Controllers principles & Applications, John Webb, PHI, 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):

SEEfor 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.

Total marks: 50+50=100

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
C403.3.1	**3**	**3**	**3**	**3**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**3**
C403.3.2	**3**	**3**	**3**	**3**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**3**
C403.3.3	**3**	**3**	**3**	**3**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**3**
C403.3.4	**3**	**3**	**3**	**3**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**3**
C403.3.5	**3**	**3**	**3**	**3**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**3**

Semester: VII		
PLC and SCADA (Theory)		
Course Code:	**MVJ22EE734**	**CIE Marks:50**
Credits:	**L:T:P: 3:0:0**	**SEE Marks: 50**
Hours:	**40L**	**SEE Duration: 3 Hrs**
Course Learning Objectives: The students will be able to		
1	Discuss architecture of industrial automation system and draw block diagram of industrial automation & control system.	
2	Describe the basic and application of PLC for automation.	
3	Discuss the fundamentals of PLC Wiring Diagram and Ladder Logic Program**.**	
4	Discuss different program control instruction in PLC	
5	Discuss the fundamentals of SCADA and HMI.	

UNIT-I	
Programmable Logic Controllers: Introduction, Parts of a PLC, Principles of Operation, Modifying the Operation, PLCs versus Computers, PLC Size and Application. **PLC Hardware Components:** The I/O Section, Discrete I/O Modules, Analog I/O Modules, Special I/O Modules, I/O Specifications, The Central Processing Unit (CPU), Memory Design, Memory Types. **Basics of PLC Programming:** Processor Memory Organization, Program Scan, PLC Programming Languages, Relay-Type Instructions, Instruction Addressing, Branch Instructions, Internal Relay Instructions, Programming Examine If Closed and Examine If Open Instructions, Modes of Operation. **Laboratory Sessions/ Experimental learning:** Study hardware and software used in PLC **Applications:** Industrial and commercial applications. **Video Link:** https://nptel.ac.in/courses/108/105/108105088/	**8Hrs**
UNIT-II	
Developing Fundamental PLC Wiring Diagrams and Ladder Logic Programs: Electromagnetic ControlRelays, Contactors, Motor Starters, Manually Operated Switches, Mechanically Operated Switches, Sensors,Output Control Devices, Seal-In Circuits, Latching Relays, Converting Relay Schematics into PLC LadderPrograms,Writinga LadderLogicProgramDirectlyfroma Narrative Description. **Laboratory Sessions/ Experimental learning:** Implementation Logic Gates and verification of truth table in virtual lab or Logix Pro 500. **Applications:** Industrial and commercial applications **Video Link:**http://www.digimat.in/nptel/courses/video/108105088/L31.html	**8Hrs**
UNIT-III	
Programming Timers and counters: Timer Instructions, On/offDelay Timer Instruction, Retentive Timer, Cascading Timers,Programming Counter Instructions, Up-Counter, Down-Counter, Cascading Counters, Incremental	**8Hrs**

Encoder, Combining Counter and Timer Functions for different applications. **Laboratory Sessions/ Experimental learning:** Implementation of On-Delay Timer and Off-Delay Timer in Virtual lab. **Application:** Counter and timer applications **Video Link:** https://www.youtube.com/watch?v=qD1WGwe0AQ0	
UNIT-IV	
Program Control Instructions: Master Control Reset Instruction, Jump Instruction, Subroutine Functions, Immediate Input and Immediate Output Instructions, Forcing External I/O Addresses, Safety Circuitry, Selectable Timed Interrupt, Fault Routine, Temporary End Instruction, Suspend Instruction. **Laboratory Sessions/ Experimental learning:** Implementation of arithmetic instruction using Virtual lab **Application:** Conveyor belt control in industries. **Video Link:**https://www.youtube.com/watch?v=grr-3XhBSuY	**8Hrs**
UNIT-V	
SCADA Fundamentals: Introduction, Open system: Need and advantages, building blocks of SCADA systems, Remote terminal unit (RTU), Evolution of RTUs, Components of RTU, and human-machine interface (HMI) subsystem, Power supplies, Advanced RTU functionalities, Intelligent electronic devices (IEDs), SCADA communication systems. **Laboratory Sessions/ Experimental learning:** Study of key concepts within SCADA systems **Application:** Temperature control using PLC and SCADA **Video Link:**https://youtu.be/X0U8-4ZPcro	**8Hrs**

Course Outcomes: After completing the course, the students will be able to	
C403.4.1	Explain the architecture of industrial automation system and draw a block diagram of industrial automation & control system
C403.4.2	Explain basic concepts and Application of PLC to process control industries.
C403.4.3	Develop the fundamental PLC Wiring Diagrams and Ladder Logic Programsfor different applications.
C403.4.4	Develop the ladder diagram using different program control instructions.
C403.4.5	Explain the fundamentals of SCADA and HMI.

Textbooks/ Reference Books	
1.	Programmable Logic controllers, Frank D Petruzella, The McGraw Hill ,4th edition.
2.	Introduction Programmable Logic Controllers, Gary Dunning, Cengage 3rd Edition, 2006.
3.	Process Control Instrumentation Technology By. C.D. Johnson, PHI
4.	Industrial Instrumentation and Control By. S.K. Singh the McGraw Hill Companies

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 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):

SEEfor 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.

Total marks: 50+50=100

CO-PO Mapping													**PSO**	
CO/PO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**
C403.4.1	3	2	-	2	-	-	-	-	-	-	-	3	-	-
C403.4.2	3	2	2	2	2	-	-	-	-	-	-	3	-	-
C403.4.3	3	3	3	2	2	-	-	-	-	-	-	3	-	-
C403.4.4	3	2	2	2	1	-	-	-	-	-	-	2	-	-
C403.4.5	3	2	-	2	-	-	-	-	-	-	-	2	-	-

IOT based Smart Appliances (Theory)		
Course Code:	**MVJ21EE741**	**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	Assess the genesis and impact of IoT applications, architectures in real world.	
2	Illustrate diverse methods of deploying smart objects and connect them to network.	
3	Compare different Application protocols for IoT.	
4	Infer the role of Data Analytics and Security in IoT.	
5	Identify sensor technologies for sensing real world entities and understand the role of IoT in various domains of Industry.	

UNIT-I	
What is IoT, Genesis of IoT, IoT and Digitization, IoT Impact, Convergence of IT and IoT, IoT Challenges, IoT Network Architecture and Design, Drivers Behind New Network Architectures, Comparing IoT Architectures, A Simplified IoT Architecture, The Core IoT Functional Stack, IoT Data Management and Compute Stack. **Laboratory Sessions/ Experimental learning**: Case study on different types of architectures. **Applications**: IoT based sensors and its applications **Video link:** 1. https://youtu.be/WUYAjxnwjU4 2.https://youtu.be/BXDxYh1EV2w	**8Hrs**
UNIT-II	
Smart Objects: The "Things" in IoT, Sensors, Actuators, and Smart Objects, Sensor Networks, Connecting Smart Objects, Communications Criteria, IoT Access Technologies. **Laboratory Sessions/ Experimental learning**: Design a model of IoT based temperature monitor **Applications**: Electric actuators, Thermal or magnetic actuators. **Video link**: 1. https://youtu.be/z3VEZPwl5gA 2. https://youtu.be/SXz0XR68dwE	**8Hrs**
UNIT-III	
IP as the IoT Network Layer, The Business Case for IP, The need for Optimization, Optimizing IP for IoT, Profiles and Compliances, Application Protocols for IoT, The Transport Layer, IoT Application Transport Methods. **Laboratory Sessions/ Experimental learning**: IoT based traffic light control for emergency vehicles. **Applications**: Vehicle tracking system, Traffic management	**8Hrs**

Video link : 1. https://youtu.be/IfzGf4kI2a8 2. https://youtu.be/nyUZn93Lr-o	
UNIT-IV	
Data and Analytics for IoT, An Introduction to Data Analytics for IoT, Machine Learning, Big Data Analytics Tools and Technology, Edge Streaming Analytics, Network Analytics, Securing IoT, A Brief History of OT Security, Common Challenges in OT Security, How IT and OT Security Practices and Systems Vary, Formal Risk Analysis Structures: OCTAVE and FAIR, The Phased Application of Security in an Operational Environment **Laboratory Sessions/ Experimental learning**: Design a system to control the direction and speed of DC motor **Applications**: Real time monitoring in healthcare systems. **Video link:** 1. https://youtu.be/5meTtLGc2j8 2.https://youtu.be/qko-f1VDhCM	**8Hrs**
UNIT-V	
IoT Physical Devices and Endpoints - Arduino UNO: Introduction to Arduino, Arduino 10 Hours UNO, Installing the Software, Fundamentals of Arduino Programming. **IoT Physical Devices and Endpoints – Raspberry Pi:** Introduction to Raspberry Pi, About the Raspberry Pi Board: Hardware Layout, Operating Systems on Raspberry Pi, Configuring Raspberry Pi, Programming Raspberry Pi with Python, Wireless Temperature Monitoring System Using Pi, DS18B20 Temperature Sensor, Connecting Raspberry Pi via SSH, Accessing Temperature from DS18B20 sensors, Remote access to Raspberry Pi, Smart and Connected Cities, An IoT Strategy for Smarter Cities, Smart City IoT Architecture, **Laboratory Sessions/ Experimental learning:** Controlling IoT LED using Raspberry Pi **Applications:** Raspberry Pi IoT Garden, An Industrial IoT controller **Video link:** 1. https://youtu.be/s2AKMERnBhQ	**8Hrs**

Course Outcomes: After completing the course, the students will be able to	
C404.1.1	Interpret the impact and challenges posed by IoT networks leading to new architectural models.
C404.1.2	Compare and contrast the deployment of smart objects and the technologies to connect them to network.
C404.1.3	Appraise the role of IoT protocols for efficient network communication.
C404.1.4	Elaborate the need for Data Analytics and Security in IoT.

C404.1.5	Illustrate different sensor technologies for sensing real world entities and identify the applications of IoT in Industry.

Reference Books	
1.	IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things, David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, 1st Edition, Pearson Education (Cisco Press Indian Reprint). (ISBN: 978-9386873743)
2.	Internet of Things, Srinivasa K G, CENGAGE Leaning India, 2017
3.	Internet of Things (A Hands -onApproach), Vijay Madisetti and ArshdeepBahga, 1st Edition, VPT, 2014. (ISBN: 978-8173719547)

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):

SEEfor 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.

Total marks: 50+50=100

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
C404.1.1	**3**	**3**	**3**	**3**	**3**	**2**		**-**	**-**	**-**	**-**	**3**
C404.1.2	**3**	**3**	**3**	**3**	**3**	**2**		**-**	**-**	**-**	**-**	**3**
C404.1.3	**3**	**3**	**3**	**3**	**3**	**2**		**-**	**-**	**-**	**-**	**3**
C404.1.4	**3**	**3**	**3**	**3**	**3**	**2**		**-**	**-**	**-**	**-**	**3**
C404.1.5	**3**	**3**	**3**	**3**	**3**	**2**		**-**	**-**	**-**	**-**	**3**

DISASTER MANAGEMENT (Theory)		
Course Code:	**MVJ21EE742**	**CIE Marks: 50**
Credits:	**L:T:P: 3:0:0**	**SEE Marks: 50**
Hours:	**40L**	**SEE Duration: 3 Hrs.**
Course Learning Objectives: The students will be able to		
1	Discuss disaster management, its planning, occurrence of cyclones and their hazard potential.	
2	Discuss the role of IMD, cyclone warning system in India and cyclone disaster management plan.	
3	Discuss the role of different institutions, defence, and other services in natural disaster management.	
4	Discuss the role of Central Water Commission in river water sharing, Draught, its assessment, and drought management plan.	
5	Discuss reasons for the occurrence of earthquake, Tsunamis, and thunderstorms.	

UNIT-I	
Disaster Management Plan (DMP): - General introduction. **Cyclones and their Hazard Potential:** Classification of Low-Pressure Systems, Movement of Cyclones in Indian Seas, Storm Surges. Hazard Potential of Cyclonic Storms, Cyclone Prediction and Dissemination of Warnings, Dissemination of Cyclone Warnings. **Case study:** A study on Hazard Risks and Vulnerabilities in Regions Requiring Special Attention. **Applications: R**educe vulnerability to hazards & cope with disaster. **Web Link and Video Lectures:** • https://www.youtube.com/watch?v=TB97oX7ANGo • https://nptel.ac.in/courses/105104183	**8Hrs**
UNIT-II	
India Meteorological Department and Cyclone Warnings in India: Cyclone Warnings through INSAT, Port Warnings with Day and Night hoisting Signals. **Cyclones Disaster Management – Plan:** Hazard Potentials Associated with Cyclones, Vulnerability Reduction, Early Warning. **Action Plan for Cyclone Disaster Management.** **Case study:** A study on cyclones and its impact on India. **Applications:** helps removing people and property from a threatened location by facilitating timely and effective rescue, relief, and rehabilitation. **Web Link and Video Lectures:**	**8Hrs**

• https://nptel.ac.in/courses/105104183 • https://archive.nptel.ac.in/courses/105/104/105104183/	
UNIT-III	
Role of Different Institutions in Natural Disaster Management: Role of Zilla Parishad, Role of PRA Groups in Disaster Management, Role of NGOs, Self Help Groups in Disaster Management, Role of Red Cross in Disaster Management. **The Role of Defence and other Services in Disaster Management:** Role of Air Force in DisasterManagement, Role of Medical and Health Department in Cyclone disaster management, National Disaster Response Force (NDRF), Role of Remote Sensing in Disaster Management, Role of Broadcast, Educational Media in disaster management. **Case study:** Role of NGOs during Covid 19 pandemic. **Applications:** helps to provide effective rescue, relief, and rehabilitation. **Web Link and Video Lectures:** • https://www.youtube.com/watch?v=F6expVc06PI • https://egyankosh.ac.in/bitstream/123456789/25512/1/Unit-3.pdf	**8Hrs**
UNIT-IV	
Floods: Definition of Flood, Role of Central Water Commission, Flood Warning Signals and Precautionary Actions, Water Purification Technologies in Flood Affected Areas. **Drought:** Drought Management Plan, Drought Assessment, Drought Parameters, Role of Banking, Insurance, Microfinance in drought mitigation, Drought Monitoring, Drought Research Unit (IMD), Rainwater harvesting. **Case study:** A study on impact of floods and drought on India. **Applications:** helps to provide effective rescue, relief, and rehabilitation. **Web Link and Video Lectures:** • https://nptel.ac.in/courses/105104183 • https://archive.nptel.ac.in/courses/105/104/105104183/	**8Hrs**
UNIT-V	
Earthquakes: Plate Tectonics, Seismicity of India, Earthquake Forecast and disaster management, Tsunamis, Landslides and Avalanches, Volcanoes. **Hazards associated with Convective Clouds:** Lightning, Some Effects of Electric Shock, Favours and Frowning's of Thunderstorms, Hailstorms, Tornadoes, Waterspouts, Dust-Devils, Nowcasting, Summer Thunderstorms over India, Cold Waves and Heat Waves in India. **Case study:** Case study on Gorkha Earthquake **Applications:** helps removing people and property from a threatened location by facilitating timely and effective rescue, relief, and rehabilitation. **Web Link and Video Lectures:**	**8Hrs**

• https://archive.nptel.ac.in/courses/105/104/105104183/ • https://nptel.ac.in/courses/105104183 • https://nptel.ac.in/courses/105104183	

Course Outcomes: After completing the course, the students will be able to	
C404.2.1	Discuss disaster management plan, cyclones, and their hazard potential.
C404.2.2	Understand the role of IMD and cyclone prediction and cyclone warning system in India.
C404.2.3	Understand the role of different institutions defense and other services in natural disaster management.
C404.2.4	Understand the role of Central Water Commission in river water sharing, Draught, its assessment, and draught management plan.
C404.2.5	Understand occurrence of earthquake, Tsunamis, and thunderstorms.

Reference Books	
1.	''Earth and Atmospheric Disaster Management Natural and Man-made'' Navale Pandharinath, C. K. Rajan, BS Publications 2009
2.	''National Disaster Management Plan'' by National Disaster Management Authority Revised Edition - November, 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 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
C404.2.1	3	3	1	1	1	-	-	-	1	-	-	2
C404.2.2	3	3	1	2	1	-	-	-	1	-	-	2
C404.2.3	3	3	1	2	1	-	-	-	1	-	-	2
C404.2.4	3	3	1	2	1	-	-	-	1	-	-	2
C404.2.5	3	2	1	2	1	-	-	-	1	-	-	2

Semester: VII		
Introduction to Electric Vehicles (Theory)		
Course Code:	**MVJ21EE743**	**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 laws and vehicle mechanics.	
2	Understand working of Electric Vehicles and recent trends.	
3	Analyze different energy storage systems used in electric vehicles.	
4	Develop the electric propulsion unit and its control for application of electric vehicles	
5	Develop and design major components of Electric and Hybrid Electric Vehicles	

UNIT-I	
Vehicle Mechanics: Roadway Fundamentals, Laws of Motion, Vehicle Kinetics, Dynamics of Vehicle Motion, Propulsion Power, Force-Velocity Characteristics, Maximum Gradability, Velocity and Acceleration, Constant FTR, Level Road, Velocity Profile, Distance Traversed, Tractive Power, Energy Required, Non-constant FTR, General Acceleration, Propulsion Systems. **Laboratory Sessions/ Experimental learning:** Simulation of an EV **Applications**: Designing an Electric Vehicle **Web Link and Video Lectures:** https://www.youtube.com/watch?v=LZ82iANWBL0	**8Hrs**
UNIT-II	
Electric and Hybrid Electric Vehicles: Configuration of Electric Vehicles, Performance of Electric Vehicles, Traction motor characteristics, Tractive effort and Transmission requirement, Vehicle performance, Tractive effort in normal driving. **Concept of Hybrid Electric Drive Trains**, Architecture of Hybrid Electric Drive Trains, Series Hybrid Electric Drive Trains, Parallel hybrid electric drive trains **Laboratory Sessions/ Experimental learning:** Industrial Visit **Applications:** Selection of appropriate motors for Electric vehicles **Web Link and Video Lectures:** https://www.youtube.com/watch?v=q6BYr5-fq5U	**8Hrs**
UNIT-III	
Energy storage for EV and HEV: Energy storage requirements, Battery parameters, Types of Batteries, Fuel Cell basic principle and operation, Types of Fuel Cells, PEMFC and its operation, Supercapacitors **Laboratory Sessions/ Experimental learning:** **Application:** Selection of the most efficient energy storage system for an EV. **Web Link and Video Lectures:**	**8Hrs**

1. https://www.youtube.com/watch?v=IgxY_Xz4OMA 2. https://www.youtube.com/watch?v=y0Pa35ftnOI	
UNIT-IV	
Electric Propulsion: EV consideration, DC motor drives and speed control, Induction motor drives, Permanent Magnet Motor Drives, Switch Reluctance Motor Drive for Electric Vehicles, Configuration and control of Drives. **Laboratory Sessions/ Experimental learning:** Simulation of an EV drive with MATLAB/SIMULINK **Application:** Electric Vehicles **Web Link and Video Lectures:** **1.** https://www.youtube.com/watch?v=9JFSJmD3m1E **2.** https://www.youtube.com/watch?v=OhiZH7geedQ	**8Hrs**
UNIT-V	
Design of Electric and Hybrid Electric Vehicles: **Series Hybrid Electric Drive Train Design**: Operating patterns, control strategies, Sizing of major components, power rating of traction motor, power rating of engine/generator. **Design of Parallel Hybrid Electric Drive Train Design**: Control strategies of parallel hybrid drive train, design of engine power capacity, design of electric motor drive capacity, transmission design. **Laboratory Sessions/ Experimental learning: :** Develop an electric propulsion unit and its control for application in electric vehicles **Application**: Design of power transmission system in an electric vehicle **Web Link and Video Lectures:** 1. **https://www.youtube.com/watch?v=zzpOtJA-Rqw** 2. **https://www.youtube.com/watch?v=GgtesA-8tKs**	**8Hrs**

Course Outcomes: After completing the course, the students will be able to	
C404.3.1	Explain the roadway fundamentals, laws of motion, vehicle mechanics and propulsion system design.
C404.3.2	Explain the working of electric vehicles and hybrid electric vehicles in recent trends.
C404.3.3	Model batteries, Fuel cells, PEMFC and super capacitors
C404.3.4	Develop the electric propulsion unit and its control for application of electric vehicles.
C404.3.5	Develop and design major components of Electric and Hybrid Electric Vehicles

Reference Books	
1.	Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design, M. Ehsani, Y. Gao, S.Gay and Ali Emadi,1 Edition,2005, CRC Press, ISBN:.978-0849331541.

2.	Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles, Sheldon S. Williamson, 1 Edition, 2013, Springer, ISBN:**1493955233**
3.	Modern Electric Vehicle Technology, C.C. Chan and K.T. Chau,4 Edition,2001,Oxford University press, ISBN: 9780198504160
4.	Electric and Hybrid Vehicles: Design Fundamentals, Iqbal Husain, 1 Edition,2003, CRC Press,ISBN: **084931466.**

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**
C404.3.1	2	3	1	1	-	-	-	-	-	-	-	-
C404.3.2	2	3	1	2	-	-	-	-	-	-	-	-
C404.3.3	2	3	1	2	-	-	-	-	-	-	-	-
C404.3.4	2	3	1	2	-	-	-	-	-	-	-	-
C404.3.5	2	3	1	3	-	-	-	-	-	-	-	-

Semester: VII		
AIRCRAFT POWER SYSTEM (Theory)		
Course Code:	**MVJ21EE744**	**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 electrical and electronics components of aircraft system.	
2	Explain electrical machines and power units in aircraft system.	
3	Explain power distribution in aircraft systems.	
4	Explain different controls, transducers and lighting used in aircraft system.	
5	Explain the fuel management and engine system in aircraft.	

UNIT-I	
Electrical and Electronic fundamentals for aircraft systems: Electrostatics and Capacitors, Direct Current, Current, Voltage and Resistance, Power and Energy, Electromagnetism, and Inductors, Alternating Current and Transformers, Safety, Semiconductor Theory, Diodes, Transistors, Integrated Circuits. **Digital fundamentals for aircraft systems:** Logic Gates, Combinational Logic Systems, Monostable and Bistable Devices, Encoders and Decoders, Multiplexers, Bus Systems and Computers **Applications**: Concepts can be used to understand basics of power components of any aircraft system. **Web Link and Video Lectures:** 1. https://www.youtube.com/watch?v=BzBhHKLQO3k **2.** https://www.youtube.com/watch?v=d5sXmNplQHw	**8Hrs**
UNIT-II	
Generators and motors: Working Principle, AC Generators, 3 Phase Generation and Distribution, AC Motors, Practical Aircraft Generating Systems. **Power supplies:** Regulators, External Power, Inverters, Transformer Rectifier Units, Auxiliary Power Unit, Emergency Power. **Applications**: Concepts can be used to understand the different power sources available for aircraft system. **Web Link and Video Lectures:** 1. https://www.youtube.com/watch?v=b0qaO_1mmOw **2.** https://www.youtube.com/watch?v=ObHw148t6ss	**8Hrs**
UNIT-III	

Wiring and Circuit Protection: Overview, Construction and Materials, Specifications, Shielding/ Screening, Circuit Protection. **Distribution of Power Supplies:** Single Engine/General Aviation, Twin Engine General Aviation Aircraft, Large Aircraft Systems, Split Bus System, Parallel Bus System, Battery Charging, Control and Protection, Load Shedding **Laboratory Sessions/ Experimental learning:** Wiring of aircraft model. **Applications**: Power Distribution in Aircraft. **Web Link and Video Lectures:** **1.** https://www.youtube.com/watch?v=DTe8mrw7pko **2.** https://www.youtube.com/watch?v=5uaebpWwz0A	**8Hrs**
UNIT-IV	
Lights: Lighting Technologies, Flight Compartment Lights, Passenger Cabin Lights, Exterior Lights. **Controls and Transducers:** Switches, Relays and Contactors, Variable Resistors, Linear Displacement Transducers, Fluid Pressure Transducers, Temperature Transducers, Strain Transducers, Rotary Position Transducers, electronic flight instrument system **Applications**: Concept can be used to design lighting **Web Link and Video Lectures:** 1. https://www.youtube.com/watch?v=3WxhYtkADKs **2.** https://www.youtube.com/watch?v=WhQ8Ai4fa_Q **3.** https://www.youtube.com/watch?v=FSl8iIpeHEk	**8Hrs**
UNIT-V	
Engine system: Starting and Ignition, Indicating Systems Overview, Primary Indicating Systems, Secondary Indicating Systems, Electronic Indicating Systems. **Fuel Management:** introduction, storage overview, Fuel Quantity Measurement and Indication, Fuel Feed and Distribution, Fuel Transfer. **Web Link and Video Lectures:** **1.** https://www.youtube.com/watch?v=gIdXLMVP6VU **2.** https://www.youtube.com/watch?v=R0_Hn3WeOCI	**8Hrs**

Course Outcomes: After completing the course, the students will be able to	
C404.4.1	Understand the electrical and electronic components of the aircraft system.
C404.4.2	Understand the electrical and electronic components of the aircraft system.
C404.4.3	Describe power distribution in aircraft systems.

C404.4.4	Explain different controls, transducers, and lighting used in aircraft systems.
C404.4.5	Explain the fuel management and engine system in aircraft.

Reference Books	
1.	Aircraft electrical and Electronics systems, Mike Tooley and David Wyatt, Elsevier Book Aid International
2.	Aircraft Electrical System by EHJ Pallett, 3rd edition Pearson
3.	Aircraft Electricity and Electronics by Thomas K Eismin, Sixth edition MC. Graw Hill

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

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

Semester End Examination (SEE):

Total marks: 50+50=100

SEE for 50 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**
C404.4.1	3	1	-	-	-	1	-	-	-	-	2	2
C404.4.2	3	1	-	-	-	1	-	-	-	-	2	2
C404.4.3	3	2	-	-	-	1	-	-	-	-	2	2
C404.4.4	3	2	-	-	-	1	-	-	-	-	2	2
C404.4.5	3	2	-	-	-	1	-	-	-	-	2	2

Semester: VII		
PROJECT PHASE – I		
Course Code:	**MVJ221EEP75**	**CIE Marks: 50**
Credits:	**L:T:P: 0:0:4**	**SEE Marks: 50**
Hours:		**SEE Duration:**

Course Learning Objectives: The students will be able to	
1	Develop interactive, communication, organization, time management, and presentation skills.
2	Impart flexibility and adaptability.
3	Inspire independent and team working.
4	Expand intellectual capacity, credibility, judgment, intuition.
5	Adhere to punctuality, setting and meeting deadlines.
6	Instill responsibilities to oneself and others.
7	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 - 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 theproject report as per the norms avoiding plagiarism.

Course Outcomes: After completing the course, the students will be able to	
405.1	Describe the project and be able to defend it. Develop critical thinking and problem-solving skills.
405.2	Learn to use modern tools and techniques. Communicate effectively and to present ideas clearly and coherently both in written and oral forms.
405.3	Develop skills to work in a team to achieve common goal. Develop skills of project management and finance.
405.4	Develop skills of self-learning, evaluate their learning and take appropriate actions to improve it.
405.5	Prepare them for life-long learning to face the challenges and support the technological changes to meet the societal needs.

Scheme of Evaluation:

Continuous Internal Evaluation: The CIE (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**
405.1	2	2	2	3	3	2	1	1	2	1	1	2
405.2	2	2	2	3	3	2	1	1	2	1	2	2
405.3	2	2	2	3	3	2	1	1	2	1	2	2
405.4	2	2	2	3	3	2	1	1	2	1	2	2
405.5	2	2	2	3	3	2	1	1	2	1	2	2

High-3, Medium-2, Low-1

Semester: VIII		
PROJECT PHASE – II		
Course Code:	**MVJ21EE81**	**CIE Marks: 50**
Credits:	**L:T:P: 0:0:20**	**SEE Marks: 50**
Hours:		**SEE Duration:**
Course Learning Objectives: The students will be able to		
1	Develop interactive, communication, organization, time management, and presentation skills.	
2	Impart flexibility and adaptability.	
3	Inspire independent and team working.	
4	Expand intellectual capacity, credibility, judgment, intuition.	
5	Adhere to punctuality, setting and meeting deadlines.	
6	Instill responsibilities to oneself and others.	
7	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 - 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 theproject report as per the norms avoiding plagiarism.

Course Outcomes: After completing the course, the students will be able to	
407.1	Describe the project and be able to defend it. Develop critical thinking and problem-solving skills.
407.2	Learn to use modern tools and techniques. Communicate effectively and to present ideas clearly and coherently both in written and oral forms.
407.3	Develop skills to work in a team to achieve common goal. Develop skills of project management and finance.
407.4	Develop skills of self-learning, evaluate their learning and take appropriate actions to improve it.
407.5	Prepare them for life-long learning to face the challenges and support the technological changes to meet the societal needs.

Scheme of Evaluation:

Continuous Internal Evaluation: The CIE (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**
407.1	2	2	2	3	3	2	1	1	2	1	1	2
407.2	2	2	2	3	3	2	1	1	2	1	2	2
407.3	2	2	2	3	3	2	1	1	2	1	2	2
407.4	2	2	2	3	3	2	1	1	2	1	2	2
407.5	2	2	2	3	3	2	1	1	2	1	2	2

High-3, Medium-2, Low-1

Semester: VIII		
Research/Industrial Internship		
Course Code:	**MVJ21INT82**	**CIE Marks: 50**
Credits:	**L:T:P: 0:0:10**	**SEE Marks: 50**
Hours:		**SEE Duration:**

Course Learning Objectives: The students will be able to	
1	To get the field exposure and experience
2	To apply the theoretical concept in field application
3	To prepare the comparison statement of difference activities

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

Course Outcomes: After completing the course, the students will be able to	
408.1	Develop skills to work in a team to achieve common goal.
408.2	Develop skills of self-learning, evaluate their learning and take appropriate actions to improve it.
408.3	Prepare them for life-long learning to face the challenges and support the technological changes to meet the societal needs.
408.4	Develop skills of project management and finance.
408.5	Understand work ethics and culture of industry.

Scheme of Evaluation:

Evaluation of the field training/industrial internship shall be conducted during VIII semester bu internal and external examiners for 100 marks. The external examiner shall be from the industry, where the student carried out the field training/Industrial internship. In case of non-availability of external examiner, the concerned head of the department shall appoint an external examiner from the near by college or a senior faculty member from outside the department in consultation with respective BOE and approved by Principal. The field training/industrial internship carries two credits. A student has to get a minimum of 40% marks for a pass. If a student fails to complete the same, then the field training/Industrial internship has to be repeated in its entirety.

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
408.1	2	2	2	3	3	2	1	1	2	1	1	2
408.2	2	2	2	3	3	2	1	1	2	1	2	2
408.3	2	2	2	3	3	2	1	1	2	1	2	2
408.4	2	2	2	3	3	2	1	1	2	1	2	2
408.5	2	2	2	3	3	2	1	1	2	1	2	2

High-3, Medium-2, Low-1

Semester: VIII		
Seminar		
Course Code:	**MVJ21EES83**	**CIE Marks: 50**
Credits:	**L:T:P: 0:0:2**	**SEE Marks: 50**
Hours:		**SEE Duration:**
Course Learning Objectives: The students will be able to		
1	To inculcate self-learning, face audience confidently, enhance communication skill, involve in group discussion and present and exchange ideas.	

Seminar: Each student, under the guidance of a faculty, is required to choose, preferably, a recent topic of his/her interest relevant to the course of specialization. Carryout literature survey; organize the Course topics in a systematic order.

- Conduct literature survey in the domain area to find appropriate topic.
- Prepare the synopsis report with own sentences in a standard format.
- Learn to use MS word, MS power point, MS equation and Drawing tools or any such facilities in the preparation of report and presentation.
- Present the seminar topic orally and/or through power point slides.
- Communicate effectively to answer the queries and involve in debate/discussion.

The participants shall take part in discussion to foster friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident.

Course Outcomes: After completing the course, the students will be able to	
409.1	Develop knowledge in the field of Civil Engineering and other disciplines through independent learning and collaborative study.
409.2	Identify and discuss the current, real-time issues and challenges in engineering & technology. Develop written and oral communication skills.
409.3	Explore concepts in larger diverse social and academic contexts.
409.4	Apply principles of ethics and respect in interaction with others.
409.5	Develop the skills to enable life-long learning.

Scheme of Evaluation:

Evaluation of the field training/industrial internship shall be conducted during VIII semester bu internal and external examiners for 100 marks. The external examiner shall be from the industry, where the student carried out the field training/Industrial internship. In case of non-availability of external examiner, the concerned head of the department shall appoint an external examiner from the near by college or a senior faculty member from outside the department in consultation with respective BOE and approved by Principal. The field training/industrial internship carries two credits. A student has to get a minimum of 40% marks for a pass. If a student fails to complete the same, then the field training/Industrial internship has to be repeated in its entirety.

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
409.1	2	2	2	3	3	2	1	1	2	1	1	2
409.2	2	2	2	3	3	2	1	1	2	1	2	2
409.3	2	2	2	3	3	2	1	1	2	1	2	2
409.4	2	2	2	3	3	2	1	1	2	1	2	2
409.5	2	2	2	3	3	2	1	1	2	1	2	2

High-3, Medium-2, Low-1