Course Title	**Transforms, Fourier Series and Numerical Methods**	**Semester**	III
Course Code	MVJ20MEE31	**CIE**	50
Total No. of Contact Hours	40	**SEE**	50
No. of Contact Hours/week	4 L : T : P :: 2 : 2 : 0	**Total**	100
Credits	3	**Exam. Duration**	3 Hours

Course objective is to: This course will enable students to

- Solve the linear differential equations using Laplace transforms
- Apprehend and apply Fourier Series
- Realize and use of Fourier transforms and Z-Transforms
- Use of numerical methods to solve ordinary differential equation
- Use of statistical methods in curve fitting applications

Module-1	**L1, L2, L3**	**8Hrs.**

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

Applications: Analysis of electrical and electronic circuits, used in Signal processing and in control systems.

Video Link: https://youtu.be/NFuwtTT7VPM

Module-2	**L1, L2, L3**	**8Hrs.**

Fourier Series: Continuous and Discontinuous functions, Convergence and divergence of infinite series of positive terms, Periodic functions, Dirichlet's conditions, Fourier series of periodicfunctionsofperiod2πandarbitraryperiod.

Half Range Fourier Series: Half range Fourier sine series and cosine series of period and arbitrary period. Practical harmonic analysis

Applications: Fourier series solution to differential equation, Digital signal processing, spectrum analyzer.

Video Link: https://youtu.be/r18Gi8lSkfM

Module-3	**L1, L2, L3**	**8Hrs.**

Fourier Transforms: Infinite Fourier transform, Fourier Sine and Cosine transforms, Properties, Inverse Fourier transforms.

Z-Transforms: Definition, standard Z-transforms, damping rule, shifting rule, initial value and final value theorems. Inverse Z- transform, Application of Z-transforms to solve difference equations.

Applications: Fourier transforms used in image processing and Z-transforms in Digital signal processing.

Video Link: https://youtu.be/spUNpyF58BY

Module-4	**L1, L2, L3**	**8Hrs.**

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 Adams- Bashforth predictor and corrector method.

Applications: To solve initial value problems

Video Link: https://youtu.be/pbYn3MEZyms

Module-5	**L1, L2, L3**	**8Hrs.**

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.

Applications: Applications of Correlation in Signal Processing and application of regression analysis in business

Video Link: https://youtu.be/jwTvCxasICc

Course outcomes:

C201.1	Learn to solve linear differential equations using Laplacetransforms
C201.2	Learn to represent a periodic function in terms of sine and cosinefunctions.
C201.3	Evaluate Fourier transforms and use Z-transform to solve differenceequations.
C201.4	Learn to solve algebraic, transcendental and ordinary differential equationsnumerically.
C201.5	Make use of the correlation and regression analysis to fit a suitable mathematical model forthe statistical data

Text Books:

1	B.S. Grewal, "Higher Engineering Mathematics" Khanna Publishers, 44rd Edition, 2013.
2	Prof G.B.Gururajachar "Engineering Mathematics-IV , Academic Excellent series Publications, 2017-18

Reference Books:	
1	Ramana B. V., "Higher Engineering Mathematics", Tata Mc Graw-Hill, 2006.
2	Bali N. P. & Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, 8th Edition

CIE Assessment:

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

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

SEE Assessment:

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

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

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

CO-PO Mapping

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

High-3, Medium-2, Low-1

Course Title	Electric Circuit Analysis	Semester	III
Course Code	MVJ20EE32	CIE	50
Total No. of Contact Hours	50	SEE	50
No. of Contact Hours/week	5 L: T : P :: 3 : 1 : 1	Total	100
Credits	4	Exam. Duration	3 Hours

Course objective is to: This course will enable students to

- Solve the DC&AC circuits using mesh and node analysis and reduction of network using various techniques.
- Apply various network theorems to solve circuits.
- Solve first and second order differential equations to obtain steady state and transient response in series & parallel RLC circuits.
- Analyze the unbalanced three phase circuits
- Analyze the series and parallel resonance in RLC circuits.
- Obtain the two port network parameters**.**

Module-1	L1, L2, L3	10Hrs.

Basic circuit concepts: Ideal and Practical sources, Source Transformations, Loop and nodal analysis with linearly dependent and independent sources for DC and AC circuits, Analysis of networks involving concepts of super node, Super mesh.

Laboratory Sessions/ Experimental learning: Verification of Kirchhoff's Voltage law and current law - Virtual lab experiment

Applications: Analysis of electric circuits by reducing the complexity.

Video link: https://nptel.ac.in/courses/108104139/

Module-2	L1,L2,L3	10Hrs.

Network topology: Graph of a network, Concept of tree and Co-tree, Incidence matrix, tie-set, tie-set schedule, cut-set & cut-set schedule, Formulation and solution of equilibrium equations, concept of duality and dual networks.

Resonant Circuits: Series and parallel resonance, frequency response of series and parallel circuits, Q factor, Bandwidth. Application.

Laboratory Sessions/ Experimental learning: Virtual lab experiment – Series/Parallel Resonance

Applications: Network topology- to understand the networking concepts

Resonant circuits- Oscillating circuit, Radio and communication engineering

Video link :https://nptel.ac.in/courses/108102097/

Module-3	L1,L2,L3	10Hrs.

Network Theorems: Superposition, Thevenin's and Norton's theorems; Maximum power transfer theorem, Reciprocity and Millman's theorem. **Laboratory Sessions/ Experimental learning**: Verification of all network theorems using Virtual lab. **Applications**: Analysis of complex electric circuits by reducing the complexity. **Video link**:http://www.digimat.in/nptel/courses/video/108105112/L20.html		
Module-4	**L1,L2,L3**	**10Hrs.**
Transient Analysis: Behaviour of circuit elements under switching condition and their representation, Evaluation of Initial and Final conditions in RL, RC and RLC circuits. **Laboratory Sessions/ Experimental learning**: Virtual Lab experiment on series/Parallel RL,RC circuits **Applications**: Stability Analysis of systems containing energy storage elements **Video link:** https://nptel.ac.in/courses/108102097/		
Module-5	**L1,L2,L3**	**10Hrs.**
Two port networks: Definition of Z, Y, ABCD parameters, Relationship between parameter sets. **Three-phase circuits**: Analysis of unbalanced star and delta connected loads, Neutral shift. **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 transmission line. Video link: https://nptel.ac.in/courses/108102097/		
Course outcomes:		
C202.1	Analyse DC and AC circuits using mesh and node analysis.	
C202.2	Analyse series and parallel resonance circuits.	
C202.3	Apply network theorems to solve the circuits.	
C202.4	Apply analytical techniques to analyze transient behavior of networks.	
C202.5	Solve two port networks to obtain various parameters.	
Text Books:		
1	Hayt, Kemmerly and Durbin "Engineering Circuit Analysis" TMH 6th 2002	
2	M E Van Valkenburg "Network Analysis" Ed 3. PHI. 2002	
Reference Books:		
1	J David Irwin et al" Engineering Circuit Analysis" Wiley India 10th Edition	
2	D. Anand Kumar "Network analysis and Synthesis", PHI Learning, 2019.	
CIE Assessment:		

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

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

SEE Assessment:

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

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

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

CO-PO Mapping

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

High-3, Medium-2, Low-1

Course Title	Analog & Digital Electronics	Semester	III
Course Code	MVJ20EE33	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4 L: T : P : : 2: 1 : 1	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to: This course will enable students to

- Understand the working of different diode and transistor circuits
- Use transistors as multistage amplifiers, feedback amplifiers and power amplifiers.
- Understand the working of oscillators and conversion of signals.
- Solve different logic equations using Kmap.
- Understand various flip flop applications and implement sequential logic circuits.

Module-1	L1,L2,L3	08Hrs.

Diode circuits: Diode clipping and clamping circuits, Special Diodes Schottky diodes, Tunnel diode, Varactor diode characteristics and applications.

Transistor analysis using h parameter model CE, CB, CC amplifiers comparison.

Laboratory Sessions/ Experimental learning: Static Transistor characteristics for CE, CB and CC modes and determination of h parameters.

Applications: Analysis of composite picture signals

Video link:

https://lake.videoken.com/nptel/category/698/search/clipping%20using%20diodes/video/tZE0-YcL0XM

Module-2	L1, L2, L3	08Hrs.

Multistage Amplifiers and Power Amplifiers: Direct coupled and RC Coupled multi-stage amplifiers, Darlington circuits analysis and design, Effect of Boot straping. Differential Amplifiers, Power amplifiers - Analysis of Class A, Class B & Class C amplifier.

Feedback Amplifiers: Concepts of feedback – Classification of feedback amplifiers – General characteristics of Negative feedback amplifiers – Effect of Feedback on Amplifier characteristics – Voltage series, Voltage shunt, Current series and Current shunt Feedback configurations – Simple problems

Laboratory Sessions/ Experimental learning: Determination of gain, input and output impedance ofBJT Darlington emitter follower with and without bootstrapping.

Applications: Analysis and design of amplifier circuit for different applications

Video link:

https://lake.videoken.com/nptel/category/698/search/power%20Amplifiers/video/WFUDeyOEdt

Module-3	L1, L2, L3	08Hrs.

Oscillators: Condition for Oscillations, RC type Oscillators-RC phase shift and Wien-bridge Oscillators, LC type Oscillators –LC Oscillators, Hartley and Colpitts

A/D and D/A Converters: Binary weighted and R-2R ladder type DAC, DAC parameters; Flash type, counter ramp type, tracking, single slop and dual slope type ADC, Successive Approximation ADC.

Laboratory Sessions/ Experimental learning: Analysis of Wien-bridge Oscillators and LC oscillator

Applications: Analysis of different pulse generations.

Video link :https://lake.videoken.com/nptel/category/698/search/a%2Fd%20and%

Module-4	L1,L2,L3	08Hrs.

Principles of Combinational Logic: Definition of combinational logic, representation of logic functions-SOP and POS forms, Karnaugh maps-3,4,5 variables with don't care condition, Look ahead carry, Binary comparators

Digital Logic Families: Comparison of RTL, DTL, TTL, ECL and MOS families -operation, characteristics of digital logic family.

Laboratory Sessions/ Experimental learning: Analysis of Wien-bridge Oscillators and LC oscillator

Applications: Analysis of different pulse generations.

Video link:
https://lake.videoken.com/nptel/category/698/search/a%2Fd%20and%20d%2Fa%20converters/video/3

Module-5	L1,L2,L3	08Hrs.

Flip-Flops Applications: Triggering of Flip-flops: Master Slave Flip-Flops, Edge Triggered Flip Flops, Characteristic Equations, Conversion of flip-flops, Shift Registers, Ripple Counters, Synchronous Counters, Design of a synchronous mod-n counter using clocked T, JK, D and SRflip-flops.

Sequential Circuit Design: Mealy and Moore models, State machine notation, Synchronous Sequential circuit analysis, Construction of state diagrams, counter design.

Laboratory Sessions/ Experimental learning: Simplification, realization of Boolean expressions using logic gates/Universal gates.

Applications: Analysis of switching device used in different relays.

Video link: https://lake.videoken.com/nptel/category/698/search/Karnaugh%20maps/video/BzN3nFV-vTQ

Course outcomes:

C203.1	Interpret the characteristics of different transistor configurations and special diodes.
C203.2	Develop multistage and feedback amplifiers and power amplifiers using transistors.

C203.3	Explain different oscillator circuits and signals conversion techniques.
C203.4	Solve different logic equations using K map and compare different logic families.
C203.5	Develop state diagrams for given clocked sequential circuits.

Text Books:

1	Electronic Devices and Circuit Theory, Robert L Boylestad Louis Nashelsky, Pearson, 11th Edition, 2015.
2	M. Morris Mano, Digital Design, 4th Edition, Pearson Prentice Hall, 2008

Reference Books:

1	Electronic Devices and Circuits, S.Salivahanan&N.Suresh, McGraw Hill, 3rd Edition, 2013
2	Charles H Roth and Larry L Kinney, Fundamentals of Logic design, Cengage Learning,2019.

CIE Assessment:

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

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

SEE Assessment:

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

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

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

CO-PO Mapping

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

Course Title	Power System Engineering	Semester	III
Course Code	MVJ20EE34	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4 L: T : P :: 2 : 1 : 1	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to: This course will enable students to

- Understand the different types of power generating stations.
- Examine A.C. and D.C. distribution systems.
- Understand and compare overhead line insulators and Insulated cables.
- Illustrate the economic aspects of power generation and tariff methods.
- Evaluate the transmission line parameters calculations
- Understand the concept of corona

Module-1	L1,L2	8Hrs

GENERATION OF ELECTRIC POWER

Conventional Sources (Qualitative): Hydro station, Steam Power Plant, Nuclear Power Plant and Gas Turbine Plant.

Non-Conventional Sources (Qualitative): wind Energy and Solar Energy, Introduction of other Non-ConventionalSources (Ocean Energy, Tidal Energy, Wave 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 / Additional online information (related to module if any):

http://nptel.iitm.ac.inhttps://youtu.be/Yg6XsepGCKY

Module-2	L1,L2,L3	8Hrs

ECONOMICS OF GENERATION

Introduction, definitions of connected load, maximum demand, demand factor, load factor, diversity factor, Load duration curve, number and size of generator units. Base load and peak load plants. Cost of electrical energy-fixed cost, running cost, Tariff on charge to customer.

Laboratory Sessions/ Experimental learning: Load estimating using software

Applications: Energy auditing

Video link / Additional online information (related to module if any):

http://nptel.iitm.ac.inhttps://youtu.be/GRwJqD4StEU

Module-3	L1,L2,L3	8Hrs

OVERHEAD LINE INSULATORS & INSULATED CABLES

Introduction, types of insulators, Potential distribution over a string of suspension insulators, Methods of equalizing the potential.

Introduction, insulation, insulating materials, Extra high voltage cables, insulation resistance of a cable, Capacitance of a single core and three core cables, Overhead lines versus underground cables, types of cables

Laboratory Sessions/ Experimental learning: Insulation test of materials for high voltage- HVE Lab

Applications: Design of insulators and cables

Video link / Additional online information (related to module if any):

http://nptel.iitm.ac.inhttps://youtu.be/gd1nruo4_iA

Module-4	**L1,L2,L3**	**8Hrs**

INDUCTANCE & CAPACITANCE CALCULATIONS OF TRANSMISSION LINES

Line conductors, inductance and capacitance of single phase and three phase lines with symmetrical. Composite conductors-transposition, bundled conductors, and effect of earth on capacitance.

Corona: Introduction, disruptive critical voltage, corona loss, Factors affecting corona loss and methods of reducing corona loss, Disadvantages of corona.

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 moduleif any):

http://nptel.iitm.ac.inhttps://youtu.be/lr1jgbR5ca8

Module-5	**L1,L2,L3**	**8Hrs**

A.C. DISTRIBUTION

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 and with respect to respective load voltages. , Testing of HVDC Valves and Equipment.

DC DISTRIBUTION:

Classification of Distribution Systems. - 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 applications

Video link / Additional online information (related to module if any): http://nptel.iitm.ac.inhttps://youtu.be/_iz8ZkjD7z8	
Course outcomes:	
C204.1	Discuss the operation of conventional generating stations and renewable sources of electrical power.
C204.2	Evaluate the economic aspects of power generation and tariff methods
C204.3	Discuss the performance of typical transmission and distribution system components.
C204.4	Determine the electrical circuit parameters of transmission lines
C204.5	Analyse A.C. and D.C. distribution systems for different loads.
Text Books:	
1	D P Kothari & I J Nagrath – Power System Engineering, Second Edition, MC Graw Hill Education, 2007.
2	V.K Mehta & Rohith Mehta- Principles of Power system, Revised Edition, S Chand.
Reference Books:	
1	C.L. Wadhwa –Electrical Power Systems, Fifth Edition, New Age International, 2009
2	M.V. Deshpande –Elements of Electrical Power Station Design, Third Edition, Wheeler Pub. 1998

CIE Assessment:

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

SEE Assessment:

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

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

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

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C204.1	2	1	2	2	2	-	2	-	-	-	-	-

C204.2	2	1	2	3	2	-	-	-	-	-	-	-
C204.3	2	1	2	1	2	-	-	-	-	-	-	-
C204.4	3	2	2	2	2	-	-	-	-	-	-	-
C204.5	2	2	2	1	2	-	-	-	-	-	-	-

Course Title	Electrical and ElectronicsMeasurements	Semester	III
Course Code	MVJ20EE35	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4 L: T : P :: 2 : 1 : 1	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to: This course will enable students to

- Understand the characteristics of measuring systems and operation of Analog meters.
- Understand the working of wattmeter, energy meter and Instrument transformers.
- Measure power factor, Frequency and basic circuit elements using Bridges.
- Understand the working of Function generator and display devices.
- Understand the principles of various types of transducers and sensors.

Module-1	L1,L2,L3	08Hrs.

Standards and Units: SI units of charge, voltage, current, power, energy, flux. Static characteristics: Accuracy, Precision, Sensitivity and Resolution and dynamic characteristics: speed of response and fidelity.

Analog and Digital Indicating Meters: - Types of analog instruments, Digital Instruments: AC digital voltmeter, DC digital voltmeter, multimeter : Measurement of current by digital multimeter, measurement of resistance by digital multimeter, complete circuit of digital multimeter.

Laboratory Sessions/ Experimental learning: Extension of the range of Voltmeter and Ammeter

Applications: Measurement of Voltage and Current in the Laboratories

Video link: https://nptel.ac.in/courses/108/105/108105153/

Module-2	L1,L2,L3	08Hrs.

Measurement of Power and Energy: Dynamometer type wattmeter Torque expression, digital wattmeter, Energy meter and its Calibration.

Instrument Transformers: Use of Instrument Transformers. Ratios and Burden of IT-Ratio and phase angle error of CT and PT, Silsbee's method of testing CT, Difference between CT and PT.

Laboratory Sessions/ Experimental learning: Vlab- Three Power Measurement using two Wattmeter method

Applications: Usage of Instrument Transformers for measurement of high current and Voltage and also used as the protective Relays for Power System

Video link: https://nptel.ac.in/courses/108/105/108105153/		
Module-3	**L1,L2,L3**	**08Hrs.**
DC and AC Bridges: Necessity of Bridges, Resistance Measurement -Wheatstone bridge, Limitations, Kelvin double bridge, four-wire method. Measurement of L and C- Maxwell's Bridge, Schering Bridge. Measurement of Earth resistance – Megger**.** **Measurement of phase and frequency:** Power Factor meter, Synchro scopes, Q meter **Laboratory Sessions/ Experimental learning:** Vlab-Measurement of R,L C **Applications:** Measurement of unknown R,L C values and power factor **Video link :**https://nptel.ac.in/courses/108/105/108105153/		
Module-4	**L1,L2,L3**	**08Hrs.**
Function Generators: Introduction, Basic elements of Function generators**,** Pulse Generator **Display Devices:** Concept of Lissajous' patterns, Basic CRO Circuits, Introduction to DSO, Observation and Measurement of Voltage, Current, Frequency and Phase of a waveform, LCD and LED display **Laboratory Sessions/ Experimental learning**: Generation of different waveforms(eg:Sine, Square, Triangular etc) using simulation tool and measure the amplitude, frequency and other parameters **Applications:** Generate the test signals to analyze the performance of the system **Video link** https://nptel.ac.in/courses/108/105/108105153/		
Module-5	**L1,L2,L3**	**08Hrs.**
Transducers: Classification of transducers, selection factors, Operation of potentiometric transducer. LVDT, Thermistors, Thermocouples, Piezoelectric transducers. **Sensors:** Pressure Sensor, Temperature sensor, Hall effect sensor, photo sensor and its application **Laboratory Sessions/ Experimental learning:** Vlab- Characteristics of LVDT, Thermocouple, Temperature sensor, Strain gauge Sensor **Applications:** Used in various practical applications and in projects **Video link:** https://nptel.ac.in/courses/108/108/108108147/		

Course outcomes:	
C205.1	Distinguish the meters to measure the AC and DC electrical quantities
C205.2	Explain the working of Wattmeter, Energy meter and Instrument transformers.
C205.3	Identify and Select suitable Bridges to measure the basic electrical quantities.
C205.4	Explain the working of Function generator and interpret the waveform using CRO.
C205.5	Select the suitable transducer and sensor for a particular application.

Text Books:	
1	Sawhney A K,A Course in Electrical and Electronic Measurement and Instrumentation‖,

	Dhanpat Rai & Sons, New Delhi, 2011.
2	Doeblin E O and Dhanesh N Manik,Measurement Systems", McGraw-Hill, New Delhi, 2012.
Reference Books:	
1	David A. Bell,Electronic Instrumentation and Measurements, Oxford University Press, New Delhi, 2012.
2	Rangan C S, Sharma G R, Mani V S,Instrumentation Devices and Systems‘, Tata McGraw-Hill, New Delhi, 2004

CIE Assessment:

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

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

SEE Assessment:

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

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

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

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C205.1	2	2	-	-	-	-	-	-	-	-	-	2
C205.2	2	2	-	-	-	-	-	-	-	-	-	2
C205.3	2	2	-	1	-	-	-	-	-	-	-	2
C205.4	-	2	-	-	2	-	-	-	-	-	-	3
C205.5	2	2	-	1	2	-	-	-	-	-	-	3

Course Title	Object Oriented Programming& C++	Semester	III
Course Code	MVJ20EE36	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4 L: T : P :: 2 : 1 : 1	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to: This course will enable students to

- Identify the need for Java - an object-oriented language. Set up Java JDK environment to create, debug and run simple Java programs.
- Illustrate the use of classes and distinguish the usage of different types of Inheritance and constructors in real world.
- Demonstrate the use of exceptions and to create multi-threaded programs
- Design the event driven Graphical User Interface (GUI) programming using swings
- Develop Java Application using JDBC connectivity.

Module-1	L1,L2,L3	08Hrs.

Prerequisites: Basic Knowledge about C or C++

Introduction to Object Oriented Concepts and Java: Java's Magic: the Byte code; Java Development Kit (JDK); The Java Buzz words, Object Oriented Programming - Two Paradigms, Abstraction, The Three OOP Principles, Simple Java programs. Data types, variables and arrays, Operators, Control Statements.

Laboratory Sessions/ Experimental learning:

A professor in college will allow a student to be excused from the final exam if either of the following is true:

- They have a 90% average or higher in the class and have missed 3 or less class lectures.
- They have a 80% average or higher in the class and have not missed any class lectures. The program below will determine whether a student can get out of the exam or not. Rewrite the program so only one if statement is used.

Applications: Arrays in mathematical vectors, matrices.

Video link / Additional online information:

Differences between JVM vs JRE vs JDK in Java:

https://www.youtube.com/watch?v=5Bp6GLU6HKE

Module-2	L1,L2,L3	08Hrs.

Classes, Inheritance, Packages and Interfaces: Classes fundamentals; Declaring objects; Assigning object reference variables; Introducing Methods, Constructors, this keyword, Finalize Method. Inheritance: Inheritance basics, using super, creating multi-level hierarchy, when constructors are called, method overriding, using abstract classes. Packages, Access Protection, Importing Packages, Interfaces.

Laboratory Sessions/ Experimental learning:

Write a program that calculates the number of buckets of paint to use for a room and the optimal number of cans to purchase. You need to ask the height of the room and the length and width of the room. The room is rectangular. You must paint the walls and the ceiling but not the floor. There are no windows or skylights. You can purchase the following size buckets of paint.

- 5-liter bucket costs $15 each and covers 1500 square feet.
- 1-liter bucket costs $4 and covers 300 square feet.

Applications: Inheritance in Banking Sectors

Video link / Additional online information:

Types of Inheritance: https://www.youtube.com/watch?v=ZP27c7i5zpg

Module-3	L1,L2,L3	08Hrs.

Exception Handling and Multi-Threaded Programming: Exception Handling fundamentals, Exception Types, Uncaught Exceptions, Using try catch, Multiple catch clauses, Nested try statements, throw, throws, finally, Java's built-in exceptions, Programming Examples.

Multi-Threaded Programming: The java thread model, Main thread, Creating Thread, creating multiple threads, Using is Alive() and join(),Thread priorities, Synchronization; Inter Thread Communication - Bounded buffer problem.

Laboratory Sessions/ Experimental learning:

The Producer-Consumer problem describes two processes, the producer and the consumer, which share a common, fixed-size buffer used as a queue.

- The producer's job is to generate data, put it into the buffer, and start again.
- At the same time, the consumer is consuming the data (i.e. removing it from the buffer), one piece at a time.

Make sure that the producer won't try to add data into the buffer if it's full and that the consumer won't try to remove data from an empty buffer. Write a java code to get the solution for this multi-process synchronization problem.

Applications: Multithreads in Browsers, Servers

Video link / Additional online information:

Multithreading: https://www.youtube.com/watch?v=O_Ojfq-OIpM

Module-4	L1,L2,L3	08Hrs.

Event Driven Programming: Event Handling: Two event handling mechanisms; The delegation event model; Event classes; Sources of events; Event listener interfaces; Using the delegation event model.

Swings: The origins of Swing; Two key Swing features; Components and Containers; The Swing Packages; A simple Swing Application; Create a Swing Applet; Exploring Swing - Jlabel and Image Icon; JText Field; The Swing Buttons; JT abbed pane; JScroll Pane; JList; JComboBox; JTable

Laboratory Sessions/ Experimental learning:

Develop an Online Exam Project in Java Swing by using java array to store the questions, options and answers without using database.

Applications: Mobile Applications, Web Applications

Video link / Additional online information:

GUI – Simple Animation: https://www.youtube.com/watch?v=I3usNR8JrEE

Module-5	L1,L2,L3	08Hrs.

JDBC: The Concept of JDBC; JDBC Driver Types; JDBC Packages; A Brief Overview of the JDBC process; Database Connection; Associating the JDBC/ODBC Bridge with the Database; Statement Objects; Result Set; Transaction Processing; Metadata, Data types; Exceptions.

Laboratory Sessions/ Experimental learning:

Develop Student Management System application with swings as the front end and database as the back end using JDBC connectivity.

Applications:

Scientific Applications, Financial Applications

Video link / Additional online information:

Java JDBC:https://www.youtube.com/watch?v=hEWBIJxrLBQ

Course outcomes:

C206.1	Illustrate the Object-Oriented Programming concepts and basic characteristics of Java
C206.2	Demonstrate the principles of classes, inheritance, packages and interfaces
C206.3	Experiment with exception handling Mechanisms and Create multi-threaded programs
C206.4	Design event driven Graphical User Interface (GUI) programming application using swings
C206.5	Develop an application with Database using JDBC connectivity.

Text Books:

1	Herbert Schildt, Java The Complete Reference, 7 /9th Edition, Tata McGraw Hill, 2007.
2	Mahesh Bhave and Sunil Patekar, "Programming with Java", First Edition, Pearson Education,2008, ISBN:9788131720806

Reference Books:

1	Rajkumar Buyya , S Thamarasiselvi, xingchen chu, Object oriented Programming with java, Tata McGraw Hill education private limited.
2	E Balagurusamy, Programming with Java A primer, Tata McGraw Hill companies

CIE Assessment:

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

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

SEE Assessment:

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

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

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

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C206.1	3	3	1	-	-	-	-	-	-	-	-	3
C206.2	3	3	1	-	-	-	-	-	-	-	-	3
C206.3	3	3	1	2	-	-	-	-	-	1	-	3
C206.4	3	3	3	3	-	-	-	2	2	2	-	3
C206.5	3	3	3	3	-	-	2	2	3	2	-	3

Course Title	**Circuits And Measurements Laboratory**	**Semester**	III
Course Code	MVJ20EEL37	**CIE**	50
Total No. of Contact Hours	20	**SEE**	50
No. of Contact Hours/week	4L : T : P :: 0 : 2 : 2	**Total**	100
Credits	2	**Exam. Duration**	3 Hours

Course objective is to: This course will enable students to

- Verify network theorems using hardware setup as well as simulation tool
- Measure the resistance, inductance and ratio and phase angle error using suitable circuits/bridges.
- Understand the calibration of Single-Phase energy meter.
- Understand the working of transducers.

Sl No	Experiment Name	RBT Level	Hours
1	Verification of Thevenin's and Norton's Theorem	L3	2
2	Verification of Maximum Power Transfer Theorem	L3	2
3	Verification of Superposition Theorem	L3	2
4	Analysis of Series and Parallel Resonant Circuits	L3	2
5	Measurement of Low Resistance using four wire method	L3	2
6	Measurement of Medium Resistance using Wheatstone Bridge	L3	2
7	Measurement of Inductance using Maxwell's Bridge and Determine Q factor	L3	2
8	Measurement of Capacitance using Schering Bridge	L3	2
Along with mandatory experiments students are advised to complete two open ended experiments. The following are some suggestions for open ended experiments.			
1	Calibration of 1Φ Energy meter.	L3	2
2	Measurement of Linear displacement using LVDT.	L3	2
3	Measurement of temperature using Thermocouple	L3	2

Course outcomes:

C207.1	Apply simulation tool to analyze electrical circuits
C207.2	Verify the network theorem using simulation tool and hardware setup
C207.3	Select suitable bridge to measure the unknown values of Resistance, Inductance and Capacitance.
C207.4	Identify the % error in the energy meter by calibrating the energy meter.
C207.5	Make use of transducer in suitable application.

Scheme of Evaluation	
SEE: Examinations will be conducted for 100 marks and scaled-down to 50. The weight age shall be, Write-up: 20 marks Conduction: 40 marks Analysis of results: 20 marks Viva: 20	
CIE: Regular Lab work :20 Record writing :5 Lab Tests(Minimum 2 tests shall be conducted for 15 marks and average of two will be taken) Viva 10 marks	

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C207.1	3	2	-	2	-	-	-	-	3	-	-	3
C207.2	3	3	-	-	-	-	-	-	3	-	-	3
C207.3	3	2	-	-	1	-	-	-	3	-	-	1
C207.4	3	1	-	-	1	-	-	-	3	-	-	1
C207.5	3	1	-	-	1	-	-	-	3	-	-	2

High-3, Medium-2, Low-1

Course Title	**Analog and Digital Electronics Laboratory**	**Semester**	III
Course Code	MVJ20EEL38	**CIE**	50
Total No. of Contact Hours	20	**SEE**	50
No. of Contact Hours/week	4 L : T : P :: 0 : 2 : 2	**Total**	100
Credits	2	**Exam. Duration**	3 Hours

Course objective is to: This course will enable students to

- Design of different clipper and clamper circuits.
- Design and test different amplifier and oscillator circuits using BJT.
- Realize parallel adders and Subtractors circuits.
- Design and test counters and sequence generators.

Sl No	Experiment Name	RBT Level	Hours
1	Design of different clipping circuits	L3	2
2	Design of different clamping circuits	L3	2
3	Frequency response of single stage BJT and FET RC coupled amplifier and determination of half power points, bandwidth, input and output impedances.	L3	2
4	Realization of parallel adder/Subtractor using 7483 chip	L3	2
5	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	L3	2
6	Realization of 3 bit counters as a sequential circuit and MOD – N counter design using 7476,7490, 74192, 74193	L3	2
7	Design and realization of R-2R ladder DAC.	L3	2
8	Realization of Two bit Flash ADC	L3	2
Along with mandatory experiments students are advised to complete two open ended experiments. The following are some suggestions for open ended experiments.			
1	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	L3	2
2	Design and testing of ring counter and Johnson counter	L3	2
3	Design and verify an IC 555 timer based pulse generator for the specified pulse.	L3	2

Course outcomes:

C208.1	Design of different clipper and clamper circuits.
C208.2	Design and test BJT and FET amplifier and oscillator circuits.
C208.3	Realize parallel adder/ Subtractors using 7483 chip

C208.4	Realize R-2R ladder DAC and two bit flash ADC.
C208.5	Design pulse generators for the specified pulse

Scheme of Evaluation

SEE:

Examinations will be conducted for 100 marks and scaled-down to 50. The weight age shall be,
Write-up: 20 marks
Conduction: 40 marks
Analysis of results: 20 marks
Viva: 20

CIE:

Regular Lab work :20
Record writing :5
Lab Tests(Minimum 2 tests shall be conducted for 15 marks and average of two will be taken)
Viva 10 marks

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C208.1	3	2	-	2	-	-	-	-	3	-	-	3
C208.2	3	3	-	-	-	-	-	-	3	-	-	3
C208.3	3	2	-	-	1	-	-	-	3	-	-	1
C208.4	3	1	-	-	1	-	-	-	3	-	-	1
C208.5	3	1	-	-	1	-	-	-	3	-	-	2

High-3, Medium-2, Low-1

Course Title	Balike Kannada	Semester	III
Course Code	MVJ20BK39/49	CIE	50
Total No. of Contact Hours	15	SEE	50
No. of Contact Hours/week	1 L:T:P :: 1:0:0	Total	100
Credits	1	Exam. Duration	2 Hours

Course objective is to: The course will enable, the students to understand Kannada and communicate in Kannada language.

- Vyavharika Kannada –Parichaya (Introduction to Vyavharikakannada)
- Kannada Aksharamaalehaaguuchcharane(Kannada Alphabets and Pronounciation.
- Sambhashanegaagi Kannada Padagalu (Kannada Vocubulary for Communication).
- Kannada Grammer in Conversations(Sambhasaneyalli Kannada Vyakarana) Activities in Kannada

Module-1	L1, L2	1Hr

Vyavharika Kannada: Necessity of learning a local language, Tips to learn the language with easy methods, Hints for correct and polite conversation, About Kannada language (Kannada Bhase)

Video Links: https://youtu.be/fd966GC8Yko

Module-2	L1, L2	5Hrs.

Kannada Alphabets And Pronunciation: Kannada Aksharamaale(Vowels, consonants & Unstructured consonants),Kannada stress letters, Kannada Khagunitha, Pronunciation (SwaragalaUchcharane, VyanjangalaUcharane), Exercises

Video Links: https://youtu.be/RuRmq7VyCaQ

Module-3	L1, L2	5Hrs.

Sambhasanegaagi Kannada Padagalu: Introduction, EkaavachanaMattuBhavuvachana, Linga (Gender),Prashnarthakapadagalu(Interrogative words),ViruddhaPadagalu (Antonyms),AsamanjasaUcharane (Inappropriate Pronunciations), Sankyavyavasthe (Numbers System) , List of Vegetables, Bhinnamshagalu (Fractions) ,Menu of famous food items in Karnataka , aaharaPadarthgalahesaragalu (Names of the Food Items),Samay /KalakkeSambhandhisidapadagalu (Words Relating to Time) ,Dikkugaligesambhasidhisidapadagalu (words Related to Directions),ManushyanaBhavanegaligesambhadhisidaPadagalu (Words Related to Humen's Feelings and Emotions),Manushyanashareeradabhagagalu (Parts of the Human Body),Sambhandhisidasambhandhakkepadagalu (Words Related to Relationship), Vasadstalakkesambhandhisidapadagalu (Words Related to Place of Living),

SaamanyaSambhasaneyallibhalasuvanthaPadagala Patti (List of Words used in the general communication) & Colors in Kannada **Video Links:** https://youtu.be/PoQ9m16d7QA		
Module-4	**L1, L2**	**8Hrs.**
Kannada Grammer in Conversations (Sambhasaneyalli Kannada Vyakarna):Introduction , Nouns (Naampadagalu), Pronoun (Sarvanaampadagalu) , Use of Pronouns in Kannada Sentences , Adjectives (Kannada namaVishenegalu) , Kannada Verbs (Kriya Padagalu) , Adverbs in Kannada (Kriya Vishenegalu) , Conjuctions in Kannada (Sanyaga) , Preposition in Kannada (Poorvabhavi). **Video Links:** https://youtu.be/fd966GC8Yko		
Module-5	**L1, L2**	**1Hr**
Activies in Kannada (KannadadalliChatuvatikegalu): Activites –Vocubulry (Shabdakosh),Conversation (Shambhasane) **Video Links:** https://youtu.be/fd966GC8Yko		

Course outcomes:	
CO1	Understanding the advantage of learning a local language
CO2	Understanding the difference between pronunciation of English and Kannada
CO3	Understanding the word meaning in Kannada and frame the simple sentences if any difficulty can use any other language words to complete the conversation
CO4	Understanding the word meaning and frame the sentences and try to translate Kannada to English vise versa
CO5	Understanding the Kannada grammar and how to implement in Kannada sentences for communication
Text Books:	
1	Sankispta Kannada Nighantu (Parishkratha), Kannada sahitya Parishatha,Bangalore
2	Mysore vishwavidyalayada English –Kannada Nighantu (Parishkratha) samputa–(A inda Z varage)
Reference Books:	
1	Vyavharika Kannada PatyaPusthaka by L.Thimmesha
2	Kacheri Kaipidi –Dr .Ha .Ma. Nayak, Kannada Adhyanasamsthe .Mysorevishwavidyalayada ,1974

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

marks to be awarded will be the average of three tests - Quizzes/mini tests/Activities (20 Marks)
SEE Assessment:
Question paper of **SEE** consists of 50 Multiple choice questions. Students have to answer all 50 questions and each question carries 1 mark.

Course Title	**SAMSKRUTHIKA KANNADA**	Semester	III
Course Code	**MVJ20SK39**	**CIE**	50
Total No. of Contact Hours	20 L: T: P 1:0:0	**SEE**	50
No. of Contact Hours/week	1	**Total**	100
Credits	1	**Exam. Duration**	3Hrs

Course objective : This course will enable students to understand Kannada and communicate in Kannada language

- Samskruthika Kannada –Parichaya (Introduction to Adalithakannada)
- Kannada Kavyagalaparichaya(Kannada D Ra Bendre, Siddalingaiha)
- Adalithdalli Kannada Padagalu (Kannada KagunithaBalake, PatraLekhana, Prabhandha)
- Kannada Computer Gnyana(Kannada ShabdhaSangraha, Computer Paribashikapadagalu)
- Activities in Kannada.

Module-1	L1	4 Hrs

1. PÀ£ÀßqÀ ¨sÁµÉ-¸ÀAQë¥ÀÛ «ªÀgÀuÉ.
   ±ÁæªÀt ªÀÄvÀÄÛ ¨É°ÑAiÀÄ ºÁqÀÄ (PÀªÀ£ÀUÀ¼ÀÄ), DqÀ½vÀ ¨sÁµÉPÀ£ÀßqÀ, DqÀ½vÀ ¨sÁµÉAiÀÄ ®PÀëtUÀ¼ÀÄ, DqÀ½vÀ ¨sÁµÉAiÀÄ ¥ÀæAiÉÆÃd£ÀUÀ¼ÀÄ.
2. ¨sÁµÁ ¥ÀæAiÉÆÃUÀzÀ¯ÁèUÀÄªÀ ¯ÉÆÃ¥ÀzÉÆÃµÀUÀ¼ÀÄ ªÀÄvÀÄÛ CªÀÅUÀ¼À ¤ªÁgÀuÉ
   PÁUÀÄtÂvÀzÀvÀ¥ÀÄà §¼ÀPÉ ºÁUÀÆ CªÀÅUÀ¼À ¤ªÁgÀuÉ, C®à¥Áæt ªÀÄvÀÄÛ ªÀÄºÁ¥Áæt, «±ÉÃµÀt ºÁUÀÆ «±ÉÃµÀå, £ÁªÀÄ¥ÀzÀUÀ¼ÀÄ, UËgÀªÀ ¸ÀÆZÀPÀUÀ¼À §¼ÀPÉ, C£ÁªÀ±ÀåPÀ °AUÀ ¸ÀÆZÀPÀ.

Module-2	L1	4 Hrs

1. ¯ÉÃR£À aºÉßUÀ¼ÀÄ ªÀÄvÀÄÛ CªÀÅUÀ¼À G¥ÀAiÉÆÃUÀ ¥ÀÆtð «gÁªÀÄ, C®à«gÁªÀÄ, «ªÀgÀt, CzsÀð«gÁªÀÄ, ¥Àæ±ÁßxÀðPÀ, ¨sÁªÀ¸ÀÆZÀPÀ, GzÀÝgÀt, CªÁgÀt aºÉßUÀ¼ÀÄ
2. ¥ÀvÀæ ªÀåªÀºÁgÀ.
   Cfð, SÁ¸ÀV ¥ÀvÀæ, ªÀåªÀºÁjPÀ ¥ÀvÀæzÀ GzÁºÀgÀuÉUÀ¼ÀÄ.

Module-3	L1	4 Hrs

1. DqÀ½vÀ ¥ÀvÀæUÀ¼ÀÄ.
   ¸ÁªÀÄ£Åå ¥ÀvÀæUÀ¼ÀÄ, ¸ÀPÁðj ¥ÀvÀæUÀ¼ÀÄ, CgÉ ¸ÀPÁðj ¥ÀvÀæUÀ¼ÀÄ.
2. ¸ÀPÁðgÀzÀDzÉÃ±À ¥ÀvÀæUÀ¼ÀÄ
   ¸ÀPÁðjDzÉÃ±ÀzÀ «ªÀzsÀ gÀÆ¥ÀUÀ¼ÀÄ, ¸ÀÆvÉÆÛÃ¯É, PÀbÉÃjDzÉÃ±À ¥ÀvÀæ, C¢ü¸ÀÆZÀ£É.

Module-4	L1	4 Hrs

1. ¸ÀAQëÃ¥ÀÛÀ ¥Àæ§AzsÀgÀZÀ£É, ¥Àæ§AzsÀ ªÀÄvÀÄÛ ¨sÁµÁAvÀgÀ ¥Àæ§AzsÀzÀ ««zsÀ ¥ÀæPÁgÀUÀ¼ÀÄ, ®PÀët ªÀÄvÀÄÛ §gÉAiÀÄÄªÀ «zsÁ£ÀUÀ¼ÀÄ, ¨sÁµÁAvÀgÀzÀ ¥ÀæAiÉÆÃd£ÀUÀ¼ÀÄ.
2. PÀ£ÀßqÀ ±À§Ý¸ÀAUÀæºÀ
   eÉÆÃqÀÄ£ÀÄr, C£ÀÄPÀgÀtªÁaUÀ¼ÀÄ, ¸ÀªÀiÁ£ÁxÀðPÀ ¥ÀzÀUÀ¼ÀÄ, £Á£ÁxÀðUÀ¼ÀÄ, «gÀÄzÀÞ ¥ÀzÀUÀ¼ÀÄ, vÀvÀìªÀÄ-vÀzÀãªÀUÀ¼ÀÄ, £ÀÄrUÀlÄÖ,

¢égÀÄQÛ		
Module-5	L1	4 Hrs
1. PÀA¥ÀÆålgï ºÁUÀÆ ªÀiÁ»wvÀAvÀæeÁÕ£À PÀ£ÀßqÀ QÃ°ªÀÄuÉ, PÀ£ÀßqÀmÉÊ¦AUï. **2.** ¥Áj¨sÁ¶PÀ DqÀ½vÀ PÀ£ÀßqÀ ¥ÀzÀUÀ¼ÀÄ ªÀÄvÀÄÛvÁAwæPÀ/PÀA¥ÀÆålgï ¥Áj¨sÁ¶PÀ ¥ÀzÀUÀ¼ÀÄ. ¥ÀzÀPÉÆÃ±ÀPÉÊ¦r: PÀ£ÀßqÀ¢AzÀEAVèµïUÉ, EAVèµï¤AzÀPÀ£ÀßqÀPÉÌ.		

Course Title	**UNIVERSAL HUMAN VALUES I**	Semester	III
Course Code	MVJ20UHV310	**CIE**	50
Total No. of Contact Hours	15 L: T: P:1: 0 :0	**SEE**	50
No. of Contact Hours/week	1	**Total**	100
Credits	1	**Exam. Duration**	2 Hrs.

Course objective is to: This course will enable the students to

- Perceive the need for developing a holistic perspective of life
- Sensitise the scope of life – individual, family (inter-personal relationship), society and nature/existence, Strengthening self-reflection
- Develop more confidence and commitment to understand, learn and act accordingly

Module-1	**L1, L2**	**3 Hrs**

Welcome and Introductions: Getting to know each other (Self-exploration)

Aspirations and Concerns: Individual academic, career, Expectations of family, peers, society, nation, Fixing one's goals (Basic human aspirations Need for a holistic perspective Role of UHV)

Self-Management: Self-confidence, peer pressure, time management, anger, stress, Personality development, self-improvement (Harmony in the human Being)

Health: Health issues, healthy diet, healthy lifestyle, Hostel life (Harmony of the Self and Body Mental and physical health)

Relationships: Home sickness, gratitude, towards parents, teachers and, others Ragging and interaction, Competition and cooperation, Peer pressure (Harmony in relationship Feelings of trust, respect, gratitude, glory, love)

Society: Participation in society (Harmony in the society)

Natural Environment: Participation in nature (Harmony in nature/existence)

Video link:

- https://youtube.com/playlist?list=PLYwzG2fd7hzc4HerTNkc3pS_IvcCfKznV
- https://youtube.com/playlist?list=PLYwzG2fd7hzcZz1DkrAegkKF4TseekPFv

Presentation: https://fdp-si.aicte-india.org/AicteSipUHV_download.php

Module-2	**L1, L2**	**3 Hrs**

Introduction to Value Education: Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education), Self-exploration as the Process for Value Education, Happiness and Prosperity – Current Scenario.

Video link:

- https://www.youtube.com/watch?v=85XCw8SU084
- https://www.youtube.com/watch?v=E1STJoXCXUU&list=PLWDeKF97v9SP_Kt6jqzA3pZ3yA7g_OAQz
- https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw

Module-3	L1, L2	3 Hrs

Introduction to Harmony in the Human Being: Understanding Human being as the Co-existence of the Self and the Body, The Body as an Instrument of the Self, Harmony of the Self with the Body.

Video link:

- https://www.youtube.com/watch?v=GpuZo495F24
- https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw

Module-4	L1, L2	3 Hrs

Introduction to Harmony in the Family and Society: Harmony in the Family – the Basic Unit of Human Interaction, Other Feelings, Justice in Human-to-Human Relationship, Understanding Harmony in the Society.

Video link:

- https://www.youtube.com/watch?v=F2KVW4WNnS8
- https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw

Module-5	L1, L2	3 Hrs

Introduction to Implications of the Holistic Understanding: Natural Acceptance of Human Values,Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Holistic Technologies, Production Systems and Management Models-Typical Case Studies.

Video link:

- https://www.youtube.com/watch?v=BikdYub6RY0
- https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw

Course outcomes: On completion of the course, students would be able to

CO1	Develop a holistic perspective about life
CO2	Explore his/her role (value) in all aspects of living – as an individual, as a member of a family, as a part of the society as an unit in nature
CO3	Become more responsible in life, and in handling problems with sustainable solutions
CO4	Have better critical ability
CO5	Become sensitive to their commitment

Scheme of Evaluation

Details		Marks
Assessment by Faculty mentor (Class Room Evaluation)	CIE(50)	**10**
Self-Assessment + Assessment by peers		**20**
Activities / Experimentations related to courses/Assignment		**10**
Mini Projects / Case Studies		**10**
Semester End Examination	**SEE (50)**	**50**
	Total	**100**

Text Books:

1.	AICTE SIP UHV-I Teaching Material, https://fdp-si.aicte india.org/ AicteSipUHV _download.php
2.	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

Reference Books:

1.	Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010
2.	Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
3.	Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
4.	The Story of Stuff (Book).
5.	The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi

CO-PO Mapping

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

CO5		1				2	2	3	2	1	2	1

High-3, Medium-2, Low-1

Course Title	**Additional Mathematics-I (Common to all branches)**	**Semester**	III
Course Code	**MVJ20MATDIP31**	**CIE**	50
Total No. of Contact Hours	40	**SEE**	50
No. of Contact Hours/week	3, L:T:P :: 2:1:0	**Total**	100
Credits	-	**Exam. Duration**	3 Hours

Course objective is to: This course viz., aims to prepare the students:

To familiarize the important and basic concepts of Differential calculus and Differential Equation, ordinary/partial differential equations and Vector calculus and analyse the engineering problems.

Module-1	**L1, L2, L3**	**8Hrs.**

Differential calculus: Recapitulations of successive differentiations -n^{th} derivative -Leibnitz theorem and Problems, Mean value theorem -Rolle's theorem, Lagrange's Mean value theorem , Cauchy's theorem and Taylor's theorem for function of one variables.

Video Link:
https://users.math.msu.edu/users/gnagy/teaching/ode.pdf

Module-2	**L1, L2, L3**	**8Hrs.**

Integral Calculus:

Review of elementary Integral calculus, Reduction formula
$\int_0^{\frac{\pi}{2}} sin^m x\, dx$,$\int_0^{\frac{\pi}{2}} cos^m x\, dx$, $\int_0^{\frac{\pi}{2}} sin^m cos^n x\, dx$and problems.

Evaluation of double and triple integrals and Simples Problems.

Video Link:
https://www.youtube.com/watch?v=rCWOdfQ3cwQ

https://nptel.ac.in/courses/111/105/111105122/

Module-3	**L1, L2, L3**	**8Hrs.**

Vector Calculus: Derivative of vector valued functions, Velocity, Acceleration and related problems, Scalar and Vector point functions, Gradient, Divergence, Curl, Solenoidal and Irrotational vector fields. Vector identities - div (φA), curl (φA), curl (grad φ), div (curl A).

Video Link:
https://www.whitman.edu/mathematics/calculus_online/chapter16.html

https://www.math.ust.hk/~machas/vector-calculus-for-engineers.pdf

Module-4	**L1, L2, L3**	**8Hrs.**

Probability:

Introduction-Conditional Probability, Multiplication theorem ,Independent events ,Baye's theorem

and Problems.

Video Link:
https://www.khanacademy.org/math/statistics-probability/probability-library

https://nptel.ac.in/courses/111/105/111105041/

Module-5	**L1, L2, L3**	**8Hrs.**

Differential equation: Homogenous differential equation, Linear differential equation, Bernoulli's differential equation and Exact differential equation.

Video Link:
https://www.mathsisfun.com/calculus/differential-equations.html

Course outcomes:

CO1	Apply the knowledge of Differential calculus in the modeling of various physicaland engineering phenomena
CO2	Apply the concept of change of order of integration and variables to evaluate multiple integrals and their usage in computing the area and volumes.
CO3	Study on Vector calculus to understand the various solution to Application to Engineering problems.
CO4	Understand the basic Concepts of Probability
CO5	Solve first order linear differential equation analytically using standard methods.

Text Books:

1	B.S. Grewal, "Higher Engineering Mathematics" Khanna Publishers, 43rd Edition, 2013.
2	Ramana B. V., "Higher Engineering Mathematics", Tata Mc Graw-Hill, 2006.

Reference Books:

1	Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley-India publishers, 10thedition,2014.
2	G. B. Gururajachar: Calculus and Linear Algebra, Academic Excellent Series Publication, 2018-19

CIE Assessment:

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

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

SEE Assessment:

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

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

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

CO-PO Mapping

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

Course Title	**Probability Theory, Complex variables, and Optimization**	**Semester**	IV
Course Code	MVJ20MEE41	**CIE**	50
Total No. of Contact Hours	40	**SEE**	50
No. of Contact Hours/week	4 L : T : P :: 2 : 2 : 0	**Total**	100
Credits	3	**Exam. Duration**	3 Hours

Course objective is to: This course will enable students to

- Apply discrete and continuous probability distributions in analysing the probability modelising in engineering field.
- Learn the mathematical formulation of linear programming problem
- Understand the concepts of Complex variables and transformation for solving Engineering Problems.
- Understand the concepts of complex integration, Poles and Residuals in the stability analysis of engineering problems.
- Learn the solutions of partial differential equations numerically.

Module-1	**L1, L2**	**10Hrs.**

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.

Applications: Discrete and continuous probability distributions help in analyzing the probability modelsarising in engineering field.

Video Link: https://youtu.be/cp7_ZF2kNi4

Module-2	**L1, L2**	**10Hrs.**

Optimization: Linear Programming, mathematical formulation of linear programming problem (LPP), Types of solutions, Graphical Method, simplex method, big-M method, Dual – simplex method. Applications of transport Problems

Applications: Applications of transport Problems

Video Link: https://youtu.be/WZIyL6pcItY

Module-3	**L1, L2, L3**	**10Hrs.**

Complex Variables: Functions of complex variables, Analytic function, Cauchy-Riemann equations in Cartesian and polar coordinates, Consequences of Cauchy-Riemann equations, Properties of analytic functions.

Application to flow problems- complex potential, velocity potential, equipotential lines, stream functions, stream lines.

Applications: Application to flow problems **Video Link**: https://youtu.be/b5VUnapu-qs		
Module-4	**L1, L2, L3**	**10Hrs.**
Complex line integrals- Cauchy's theorem and Cauchy's integral formula, Singularities, Types of Singularities, Poles, Residues-definitions, Cauchy residue theorem – Problems. Conformal transformation, Bilinear transformation and discussion of $w = z^2$, $w = e^z$ and $w = z + \frac{a^2}{z}(z \neq 0)$. **Applications:** To evaluate line integral of analytic function over closed curve **Video Link**: https://youtu.be/qTDDFMAt7j4		
Module-5	**L1, L2, L3**	**10Hrs.**
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. **Applications:** To **s**olve boundary value problems Video Link:https://youtu.be/nNnnBMF03lI		

Course outcomes:	
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	Use the concepts of analytic function and complex potentials to solve the problems arising in electromagnetic field theory
C209.4	Utilize conformal transformation and complex integral arising in aerofoil theory, fluid flow visualization and image processing
C209.5	Learn the numerical solutions of partial differential equations
Text Books:	
1	B.S. Grewal, "Higher Engineering Mathematics" Khanna Publishers, 43rd Edition, 2013.
2	Prof. G.B.Gururajachar, "Engineering Mathematics –IV, Academic Excellent series publications, 2017 – 18.
Reference Books:	
1	C. Ray Wylie and Louis C Barret: **"Advanced Engineering"**. Mathematics Tata McGraw Hill Publishing Co. Ltd. 6thedition.
2	Bali N. P. & Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, 8th Edition

CIE Assessment:

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

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

SEE Assessment:

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

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

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

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C209.1	3	3	-	3	-	-	-	-	-	-	1	1
C209.2	3	3	-	3	-	-	-	-	-	-	1	-
C209.3	3	2	-	2	-	-	-	-	-	-	-	-
C209.4	3	3	-	3	-	-	-	-	-	-	-	1
C209.5	3	3	-	3	-	-	-	-	-	-	1	-

Course Title	Electrical Machines -1	Semester	IV
Course Code	MVJ20EE42	CIE	50
Total No. of Contact Hours	50	SEE	50
No. of Contact Hours/week	5 L: T : P :: 3: 1 : 1	Total	100
Credits	4	Exam. Duration	3 Hours

Course objective is to: This course will enable students to

- Understand the constructional details, working principle and applicationsof DC Machines and to predetermine the efficiency of DC motor from test data
- Study the constructional details and working principle of single/ three phase transformers and to pre-determine the efficiency and regulation of single phase transformer from test data

Module-1	L1,L2,L3	10Hrs.

DC Generators: Principle of operation – Action of commutator – constructional features – armature windings - critical field resistance and critical speed - causes for failure to self-excite and remedial measures. Load characteristics of shunt, series and compound generators – Applications- lap and wave windings.

Laboratory Sessions/ Experimental learning: Study of Internal and External characteristics of self-excited, cumulative compound DC generator.

Applications: Battery charging

Video link / Additional online information:

https://nptel.ac.in/courses/108/105/108105017/

Module-2	L1,L2,L3	10Hrs.

DC Motors: Principle of operation – Back E.M.F.- Torque equation –characteristics and applications of shunt, series and compound motors – Armature reaction and commutation. Speed control of D.C. Motors - Armature voltage and field flux control methods. Motor starters (3 point and 4 point starters) Testing of D.C. machines - Losses – Constant & Variable losses – calculation of efficiency – condition for maximum efficiency.

Laboratory Sessions/ Experimental learning: Speed control of DC motor by armature/field rheostat vs Speed control by a thyristor based device

Applications: Determining more economical way of speed control

Video link / Additional online information:

https://nptel.ac.in/courses/108/105/108105017/

Module-3	L1,L2,L3	10Hrs.

Testing of Machines: Methods of Testing - direct, indirect, and regenerative testing - Brake test -

Swinburne's test-Retardation test.

Laboratory Sessions/ Experimental learning: Computer simulation of plotting efficiency curve of DC machine for motor and generator operations at various fractions of load using Swinburne's test data.

Applications: Countercheck for manufacturers' load test data

Video link / Additional online information:

https://nptel.ac.in/courses/108105017/

Module-4	**L1,L2,L3**	**10Hrs.**

Single Phase Transformers: Types - constructional details-minimization of hysteresis and eddy current losses- EMF equation - operation on no load and on load - phasor diagrams, Equivalent circuit - losses and efficiency – regulation

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

Module-5	**L1,L2,L3**	**10Hrs.**

Testing Of Transformers And Poly-Phase Transformers: OC and SC tests - Sumpner's test - predetermination of efficiency and regulation-separation of iron losses test-parallel operation with equal voltage ratios - auto 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/

Course outcomes:

C210.1	Describe the constructional details and operating principle of DC generators.
C210.2	Select the most suitable DC motor for a particular application.
C210.3	Determine/predetermine the efficiency of a DC machine by conducting necessary tests.
C210.4	Explain the constructional details and operating principle of a transformer.
C210.5	Analyse the characteristics of a transformer using test data and demonstrate poly phase operation of transformers.

Text Books:

1	I. J.Nagrath , D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.
2	P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.

Reference Books:

1	M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
2	A. E. Clayton and N. N. Hancock, "Performance and design of DC machines", CBS Publishers, 2004

CIE Assessment:

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

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

SEE Assessment:

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

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

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

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C210.1	3	3	2	1	2	-	-	-	-	-	-	1
C210.2	3	3	2	1	2	-	-	-	-	-	-	1
C210.3	3	3	2	1	2	-	-	-	-	-	-	1
C210.4	3	3	2	1	2	-	-	-		-	-	1
C210.5	3	3	2	1	2	-	-	-	-	-	-	1

High-3, Medium-2, Low-1

Course Title	Control Systems	Semester	IV
Course Code	MVJ20EE43	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4 L: T : P :: 2 : 1: 1	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to: This course will enable students to

- Demonstrate mathematical modeling of control systems.
- Obtain transfer function and state space model of systems using various techniques.
- Discuss transient and steady state time response of a simple control system
- Determine the stability of LTI systems.
- Conduct control system analysis in the frequency domain.

Module-1	L1,L2,L3	08Hrs.

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,

Block diagram - Reduction techniques. Signal flow graphs – Mason‘s gain formula.

Laboratory Sessions/ Experimental learning: Experiment to obtain the Characteristics of DC/AC servo motor and compare the performance.

Applications: Modeling of Physical systems helps in Mathematical analysis.

Video link: https://nptel.ac.in/courses/108101037/

https://nptel.ac.in/courses/108/106/108106098/

Module-2	L1,L2,L3	08Hrs.

Time domain Analysis: Standard Test signals –Time response of first and second order system, Type of systems. Steady state error constants – position, velocity and acceleration error constants, Effect of PI, PD and PID controllers on the time response of the system.

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/108/106/108106098/

Module-3	L1,L2,L3	08Hrs.

Stability Analysis: Characteristic equation – Location of roots of characteristic equation.

Concept of 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: 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/

Module-4	**L1,L2,L3**	**08Hrs.**

Frequency Domain Analysis: Frequency domain specification, Bode plots, GM and PM, Relative stability.

Introduction to compensators:Introduction to Compensators, Effect of Lag, Lead and Lag-Lead Compensators, Transfer function and Characteristics

Laboratory Sessions/ Experimental learning: 1. To to plot the frequency response of a system, using Lab VIEW and the Lab VIEW Control Design and Simulation Module.

2. 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/

Module-5	**L1,L2,L3**	**08Hrs.**

State variable Analysis:State space representation using physical, phase and canonical variables – Controllability and Observability – Obtaining transfer function from state model.

Laboratory Sessions/ Experimental learning:

Simulation of state space analysis.

Applications: Analysis of nonlinear systems.

Video link:https://www.digimat.in/nptel/courses/video/108107115/L01.html

Course outcomes:

C211.1	Obtain the mathematical model of physical systems.
C211.2	Evaluate the transfer function of a linear time invariant system.
C211.3	Analyse the performance of the system in time domain and frequency domain.
C211.4	Analyze the stability of LTI systems in time/frequency domain using different techniques.
C211.5	Obtain state models by different techniques and assess controllability and observability.

Text Books:

1	Gopal M, "Control Systems- Principles and Design"Tata McGraw-Hill, New Delhi, 2013.
2	Ogata K, "Modern Control Engineering", Prentice Hall of India, New Delhi, 2013

Reference Books:

1	Norman S Nise, "Control System Engineering", John Wiley & Sons, New Delhi, 2013.

2	A. Anand Kumar "Control systems" PHI, 2nd edition. 2018.

CIE Assessment:

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

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

SEE Assessment:

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

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

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

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C211.1	3	3	1	-	1	-	-	-	-	-	-	1
C211.2	3	3	1	-	2	-	-	-	-	-	-	1
C211.3	3	3	1	2	3	-	-	-	1	-	-	1
C211.4	3	3	2	2	3	-	-	-	1	-	-	1
C211.5	3	3	2	3	3	-	-	-	2	-	-	2

High-3, Medium-2, Low-1

Course Title	**Microprocessors and Microcontrollers**	**Semester**	IV
Course Code	MVJ20EE44	**CIE**	50
Total No. of Contact Hours	40	**SEE**	50
No. of Contact Hours/week	4 L: T : P :: 2 : 1 : 1	**Total**	100
Credits	3	**Exam. Duration**	3 Hours

Course objective is to: This course will enable students to

- Explain the working of different microcontrollers and internal organization of 8051.
- Understand the various instructions to write assembly language program for different applications.
- Understand C data types to develop 8051 timer, counter and serial port programs.
- Explain the various interrupts and interfacing of parallel peripheral devices to 8051.
- Understand the basics of ARM Embedded systems.

Module-1	**L1, L2**	**8Hrs.**

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

https://youtube.videoken.com/embed/AdMxMBH393Q

https://youtube.videoken.com/embed/-YYpIdk4_W8

https://youtube.videoken.com/embed/3hltHQXAQm8

Module-2	**L1, L2, L3**	**8Hrs.**

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

Module-3	L1, L2, L3	8Hrs.

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

Module-4	L1, L2, L3, L4	8Hrs.

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

Module-5	L1, L2, L3	8Hrs.

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/

Course outcomes:

C212.1	Select microcontrollers for different applications and explain the functional units of 8051.
C212.2	Develop algorithm and formulate assembly language program for a given task.
C212.3	Develop program for timers and serial port using C.
C212.4	Design interfacing circuitry to interface various peripheral devices to microcontroller.
C212.5	Explain the basics of ARM Embedded systems.

Text Books:

1	8051 Microcontroller and Embedded Systems– using assembly and C by Muhammad Ali Mazidi, Janice Gillespie Mazidi, Rollin D. McKinlay, Pearson Education, 2nd Edition.
2	ARM Systems Developers Guide by Andrew.N. Sloss, Elsevier Publications, 2008.

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.

CIE Assessment:

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

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

SEE Assessment:

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

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

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

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12

C212.1	3	3	2	2	1	-	-	-	3	-	-	3
C212.2	3	3	3	3	3	-	-	-	-	-	-	3
C212.3	3	3	3	3	3	-	-	-	-	-	-	3
C212.4	3	3	3	3	3	-	-	-	-	-	-	3
C212.5	3	3	2	3	3	-	-	-	3	-	-	3

High-3, Medium-2, Low-1

Course Title	Electromagnetic Field Theory	Semester	IV
Course Code	MVJ20EE45	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4 L: T : P :: 2 : 1 : 1	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to: This course will enable students to

- Apply vector calculus to static electric-magnetic fields to solve different engineering problems.
- Understand the concepts of electrostatics and magneto statics and determine field, potential and potential gradient for various charge distributions.
- Understand boundary conditions and solve boundary value problems using Poisson's and Laplace equations.
- Apply Maxwell's equations for time varying fields.
- Explain the phenomena of wave propagation in different media.

Module-1	L1, L2,L3	8Hrs.

Vector Analysis: Scalars and Vectors, Analysis of 3 co-ordinate systems-RCS, SCS, CCS. Relation between different coordinate systems. Gradient, Divergence and Curl.

Electrostatics: Coulomb's law, Electric field intensity, and its evaluation for point charge, line charge, surface charge, volume charge, sheet of charge

Laboratory Sessions/ Experimental learning:

Create an electromagnet and experiment with the ways to change their strength.

Applications: Analysis of electro magnetic fields, gravitational fields and fluid flow using vector calculus and modern life (xerox machines, laser printers) applications of coulombs law.

Video link:

https://youtube.videoken.com/embed/pGdr9WLto4A

https://youtube.videoken.com/embed/EiX3R6IkDDU

https://nptel.ac.in/courses/108106073/

https://nptel.ac.in/courses/108/104/108104087/

Module-2	L1, L2,L3	8Hrs.

Electric flux density, Gauss's law: Electric flux density, Gauss law and its applications (line, sheet and spherical), Maxwell's first equation (Electrostatics). Divergence theorem.

Energy and Potential: Work done in an electric field, Definition of potential difference and potential. The potential field of a point charge and of a system of charges. Potential gradient.

Laboratory Sessions/ Experimental learning: Simulation of magnetic circuit using FEMM software. **Applications**: Application of Gauss's law for solving complex electrostatic problems involving unique symmetries like cylindrical, spherical or planar symmetry and involving tough integration. **Video link** :https://nptel.ac.in/courses/108106073/		
Module-3	**L1, L2,L3**	**8Hrs.**
Conductor and Dielectrics: Current and current density. Continuity of current. Boundary conditions. **Poisson's and Laplace equations:** Derivations and solution for single variables, Uniqueness theorem. **Laboratory Sessions/ Experimental learning**: Develop a simple dc motor with coil, magnet and battery. **Applications**: Analysis of boundary value problems using poison's and Laplace's equations. **Video link** :https://nptel.ac.in/courses/108106073/		
Module-4	**L1, L2,L3**	**8Hrs.**
Time varying magnetic field & Magnetic force: Biot-Savart's law, Magnetic flux and flux density. Ampere's circuital law, Curl. Force on a moving charge and differential current element, Magnetic Boundary Condition.Inductance, Time-varying fields & Maxwell's equations: Faraday's law, Displacement current. Maxwell's equations in point form and integral form, relation between field theory and circuit theory. **Laboratory Sessions/ Experimental learning**: Group discussion on various applications of EMFT and prepare and submit a detailed report. **Applications**: Working principle of different electrical equipments (induction cooker)and electrical machines (transformer, generators, induction motors etc). Analysis of magnetic field strengths using Ampere circuital law. **Video link:** https://nptel.ac.in/courses/108106073/ https://nptel.ac.in/courses/108104130/		
Module-5	**L1, L2,L3**	**8Hrs.**
Uniform plane wave: Wave equation, Wave propagation in free space and in dielectrics. Pointing vector and power considerations, Propagation in good conductors, skin effect, Pointing Theorem **Laboratory Sessions/ Experimental learning:**Simulation of magnetic circuit using FEMM		

software**.**

Applications: waveguides for optical fiber communication, microwave ovens, broad casting and radar installations.

Video link:

https://nptel.ac.in/courses/108106073/
https://nptel.ac.in/courses/117101056/

Course outcomes:

C213.1	Apply vector calculus and the laws of electrostatics to solve diverse engineering problems.
C213.2	Apply the concepts of electrostatics and magneto statics for various applications.
C213.3	Apply boundary conditions for Electromagnetic field and analyze the boundary value problems using Poisson's and Laplace's Equations.
C213.4	Analyze magnetic field intensity using Biot-Savart's & Ampere's circuital law and realize its applications.
C213.5	Examine the methods of wave propagation based on its parameters.

Text Books:

1	Engineering Electro magnetics by William H Hayt, McGraw Hill , 8th Edition 2014.
2	Principles of Electro magnetics by Matthew N. O. Sadiku, Oxford, 6th Edition 2015.

Reference Books:

1	Electro magnetics with Applications by Kraus J.D. and FleischD.A , 5th Edition McGraw-Hill International Book Company.
2	Field and Wave Electro magnetics by Cheng D.K, 2nd Edition, Pearson Education.

CIE Assessment:

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

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

SEE Assessment:

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

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

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

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C213.1	3	3	1	2	3	-	3	-	-	-	-	2
C213.2	2	3	2	2	3	-	3	-	-	-	-	3
C213.3	3	3	2	2	3	-	2	-	-	-	-	3
C213.4	3	1	2	2	3	-	3	-	-	-	-	3
C213.5	3	3	1	2	3	-	2	-	-	-	-	3

High-3, Medium-2, Low-1

Course Title	Linear integrated circuits	Semester	IV
Course Code	MVJ20EE46	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4 L: T : P :: 2 : 1: 1	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to: This course will enable students to

- Discuss the basics of Linear ICs such as Op-amp, Regulator, Timer and PLL.
- Design of various circuit using linear ICs.
- Explain the concept and various types of converters.
- Discuss the specific applications of linear ICs.
- Discuss the basics of PLL and Timer

Module-1	L1,L2,L3	08Hrs.

Operational Amplifiers: Introduction, Block diagram representation of a typical Op-amp, characteristics of an ideal and practical Op-amp, equivalent circuit, open loop and closed loop configuration of op-amp, DC Characteristics, AC Characteristics, Frequency compensation, differential amplifier, inverting & non –inverting amplifier, Op-amp with negative feedback.

General Linear Applications: A.C. amplifier, summing, scaling & averaging amplifier, inverting and non-inverting configuration, Instrumentation amplifier. V to I and I to V converter, Op-amp circuits using Diodes – Half wave rectifier, Full wave rectifier.

Laboratory Sessions/ Experimental learning: Analysis of inverting and non-inverting op-amp circuits

Applications: Analysis of audio mixer to add different signals with equal gains

Video link: https://lake.videoken.com/nptel/search/AC%20Amplifiers/video/J92DIPyPnzY

Module-2	L1,L2,L3	08Hrs.

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.

Video link:https://lake.videoken.com/nptel/search/ACTIVE%20FILTER/video/b37hZCpVnuc

Module-3	L1,L2,L3	08Hrs.
Signal Generators: Triangular / rectangular wave generator. **Comparators & Converters:** Basic comparator, zero crossing detector, inverting & non-inverting 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**: Design and realize Schmitt trigger circuit using an op – amp. (Virtual Lab) **Applications**: Study of different ways to remove noise from signals used in digital circuits. **Video link**:https://lake.videoken.com/nptel/search/Schmitt%20trigger%20circuit/video/IfOclVN4ERo		
Module-4	**L1,L2,L3**	**08Hrs.**
Signal processing circuits: Precision half wave & full wave rectifiers **Application of op-amp:** Clipper and clamper circuit using opamp, oscillators, phase shift oscillator. **Laboratory Sessions/ Experimental learning**: Design and verify the output waveform of an op – amp RC phase shift oscillator for a desired frequency. **Applications**: Generation of high frequency signals. **Video link**:https://lake.videoken.com/nptel/search/oscillator%20circuits/video/7opJx3dcyG4		
Module-5	**L1,L2,L3**	**08Hrs.**
Timers: Functional block diagram of 555, Applications-Astable and Monostable multivibrators, Ramp generator. **Phase locked loops:** Introduction, Basic principles, phase detector/comparator, voltage controlled oscillator (VCO). **Laboratory Sessions/ Experimental learning**: Design and verify an IC 555 timer based pulse generator for the specified pulse. **Applications**: Application on 555 timer in pulse width modulation Video link:https://lake.videoken.com/nptel/search/555%20timer/video/9RZfFOnPtqg		

Course outcomes:	
C214.1	Describe the characteristics of ideal and practical operational amplifier.
C214.2	Design filters and signal generators using linear ICs.
C214.3	Demonstrate the application of Linear ICs as comparators and rectifiers.
C214.4	Design of various circuits using op-amp.
C214.5	Explain the basics of PLL and Timer.

Text Books:	
1	Operational Amplifiers and Linear ICs David A. Bell Oxford 3rd Edition 2011

2	Linear Integrated Circuits S. Salivahanan, et al McGraw Hill 2nd Edition,2014
Reference Books:	
1	Op-Amps and Linear Integrated Circuits , Ramakant A Gayakwad Pearson 4thEdition 2015
2	Linear Integrated Circuits; Analysis, Design and Applications B. Somanthan Nair Wiley India 2013

CIE Assessment:

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

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

SEE Assessment:

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

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

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

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C214.1	2	1	-	-	-	-	-	-	-	-	-	-
C214.2	3	2	3	2	2	--	-	-	-	-	-	2
C214.3	3	2	3	2	2	-	-	-	-	-	-	2
C214.4	3	2	3	2	2	-	-	-	-	-	-	2
C214.5	2	2	2	2	-	-	-	-	-	-	-	2

High-3, Medium-2, Low-1

Course Title	**Electrical Machines-1 Laboratory**	**Semester**	IV
Course Code	MVJ20EEL47	**CIE**	50
Total No. of Contact Hours	20	**SEE**	50
No. of Contact Hours/week	4L : T : P :: 0: 2 : 2	**Total**	100
Credits	2	**Exam. Duration**	3 Hours

Course objective is to: enables students to get practical experience in testing and performance evaluation of DC Generators, DC Motors and transformers.

Sl No	Experiment Name	RBT Level	Hours
1	Open Circuit Characteristics of DC shunt generator	L3	2
2	Hopkinson's test on identical DC shunt machines	L3	2
3	Fields test on DC series machines	L3	2
4	Swinburne's test on a DC shunt motor and speed control of DC shunt motor	L3	2
5	Brake test on DC shunt motor	L3	2
6	O.C. & S.C. Tests on Single phase Transformer-Predetermination of efficiency and regulation	L3	2
7	Sumpner's test on identical single phase transformers	L3	2
8	Scott Connection of two single phase transformers	L3	2
Along with mandatory experiments students are advised to complete two open ended experiments. The following are some suggestions for open ended experiments.			
1	Parallel operation of Single-phase Transformers.	L3	2
2	Separation of core losses in a single phase transformer	L3	2
3	Load test on DC compound generator	L3	2

Course outcomes:

C215.1	Determine the no load and load characteristics of DC shunt /compound generator
C215.2	Determine the efficiency of DC shunt motor by conducting brake test
C215.3	Predetermine the efficiency of DC shunt motor/ DC series machine by conducting necessary tests
C215.4	Predetermine the efficiency and regulation of transformer by conducting necessary tests
C215.5	Scott-connect two single phase transformers for three phase to two phase conversion and to find the core loss components of transformer by a suitable test.

Scheme of Evaluation

SEE :

Examinations will be conducted for 100 marks and scaled-down to 50. The weight age shall be,

Write-up : 20 marks

Conduction : 40 marks

Analysis of results : 20 marks

Viva : 20

CIE :

Regular Lab work :20

Record writing :5

Lab Tests(Minimum 2 tests shall be conducted for 15 marks and average of two will be taken)

Viva 10 marks

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C215.1	3	3	3	3				2	3	3		
C215.2	3	3	3	3				2	3	3		
C215.3	3	3	3	3				2	3	3		3
C215.4	3	3	3	3				2	3	3		
C215.5	3	3	3	3				2	3	3		3

High-3, Medium-2, Low-1

Course Title	**Microcontroller Laboratory**	**Semester**	IV
Course Code	MVJ20EEL48	**CIE**	50
Total No. of Contact Hours	20	**SEE**	50
No. of Contact Hours/week	4 L : T : P :: 0: 2 : 2	**Total**	100
Credits	2	**Exam. Duration**	3 Hours

Course objective is to: This course will enable students to

- To write algorithm and demonstrate assembly language programs for data transfer, arithmetic, Boolean and logical instructions.
- To write algorithm and demonstrate assembly language programs for code conversions.
- To write algorithm and demonstrate assembly language programs using subroutines for generation of delays, counters, configuration of SFRs for serial communication and timers.
- To experiment interfacing of stepper motor and dc motor for controlling the speed and DAC interface to generate different waveforms.
- To experiment interfacing of LCD and elevator to 8051.

Sl No	Experiment Name	RBT Level	Hours
1	Develop code for data movement and block exchange.	L3	2
2	Find largest or smallest numbers in a series & Sorting numbers in ascending / descending order.	L3	2
3	Develop data conversion programs.	L3	2
4	Design counters using conditional statements and loop structures.	L3	2
5	Perform 16-bit addition and subtraction, 16-bit multiplication and division.	L3	2
6	Control the speed of a DC motor using PWM.	L3	2
7	Rotate the Stepper motor in specified direction (clockwise or counter-clockwise).	L3	2
8	Generate waveforms using DAC.	L3	2
Along with mandatory experiments students are advised to complete two open ended experiments. The following are some suggestions for open ended experiments.			
1	Study of implementation analysis and interfacing of seven segment display	L3	2
2	Interface an Elevator with 8051 Microcontroller.	L3	2
3	Hardware implementation of a LCD control using 8051 microcontrollers	L3	2

Course outcomes:	
C216.1	Design and develop assembly programs using 8051 assembly language instructions.
C216.2	Design and develop C programs for a given problem statement.
C216.3	Create a hex file, program the microcontroller and conduct a hardware experiment
C216.4	Plan and work with a small team to carryout experiments using microcontroller concepts to solve engineering problems.

Scheme of Evaluation

SEE :

Examinations will be conducted for 100 marks and scaled-down to 50. The weight age shall be,
Write-up : 20 marks
Conduction : 40 marks
Analysis of results : 20 marks
Viva : 20

CIE :

Regular Lab work :20
Record writing :5
Lab Tests(Minimum 2 tests shall be conducted for 15 marks and average of two will be taken)
Viva 10 marks

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C216.1	3	3	2	2	1	-	-	-	3	-	-	3
C216.2	3	3	2	2	1	-	-	-	3	-	-	3
C216.3	3	3	3	3	1	-	-	-	3	-	2	3
C216.4	3	3	3	3	3	-	-	-	3	-	3	3

High-3, Medium-2, Low-1

Course Title	**CONSTITUTION OF INDIA, PROFESSIONAL ETHICS AND CYBER LAW**	**Semester**	IV
Course Code	MVJ20CPH49	**CIE**	50
Total No. of Contact Hours	15,	**SEE**	50
No. of Contact Hours/week	1L : T : P :: 1 :0 : 0	**Total**	100
Credits	1	**Exam. Duration**	3 Hours

Course objective is to:

- 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.
- To provide overall legal literacy to the young technograts to manage complex societal issues in the present scenario.
- To understand engineering ethics & their responsibilities, identify their individual roles and ethical responsibilities towards society**.**

Module-1	**L1,L2,L3**	**03Hrs.**

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.

Module-2	**L1,L2,L3**	**03Hrs.**

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.

Module-3	**L1,L2,L3**	**03Hrs.**

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.

Module-4	**L1,L2,L3**	**03Hrs.**

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

Module-5	**L1,L2,L3**	**03Hrs.**

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.

Course outcomes:

CO1	Have constitutional knowledge and legal literacy
CO2	Understand Engineering and Professional ethics and responsibilities of Engineers.
CO3	Understand the cyber crimes and cyber laws for cyber safety measure.

Text 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.

Reference Books:

1	M.Govindarajan, S.Natarajan, V.S.Senthilkumar, "Engineering Ethics", Prentice –Hall of India Pvt. Ltd. New Delhi, 2004.

2	M.V.Pylee, “An Introduction to Constitution of India”, Vikas Publishing, 2002.

CIE Assessment:

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

- Quizzes/mini tests/Activities (20 marks)

SEE Assessment:

Question paper of **SEE** consists of 50 Multiple choice questions. Students have to answer all 50 questions and each question carries 1 mark.

Course Title	**Additional Mathematics-II (Common to all branches)**	**Semester**	IV
Course Code	MVJ20MATDIP41	**CIE**	50
Total No. of Contact Hours	40	**SEE**	50
No. of Contact Hours/week	4, L: T: P :: 0:2:0	**Total**	100
Credits	-	**Exam. Duration**	3 Hours

Course objective is to: This course viz., aims to prepare the students:

- To familiarize the important and basic concepts of Differential calculus and Differential Equation, ordinary/partial differential equations and Vector calculus and analysethe engineeringproblems.

Module-1	**L1,L2**	**08Hrs.**

Linear Algebra:

Introduction,Rank of a matrix-echelon form. Solution of system of linear equations – consistency. Gauss-elimination method and problems. Eigen values and Eigen vectors of square matrix and Problems.

Video Link:

https://www.math.ust.hk/~machas/matrix-algebra-for-engineers.pdfhttps://nptel.ac.in/content/storage2/courses/122104018/node18.html

Module-2	**L1,L2**	**08Hrs.**

Differential calculus:

Tangent and normal, sub tangent and subnormal both Cartesian and polar forms. Increasing and decreasing functions, Maxima and Minima for a function of one variable. Point of inflections and Problems

Beta and Gamma functions: Beta functions, Properties of Beta function and Gamma function ,Relation Between beta and Gamma function-simple problems.

Module-3	**L1,L2**	**08Hrs.**

Analytical solid geometry :

Introduction –Directional cosine and Directional ratio of a line, Equation of line in space- different forms, Angle between two line, shortest distance between two line, plane and equation of plane in different forms and problems.

Video Link:

https://www.toppr.com/guides/maths/three-dimensional-geometry/

https://www.toppr.com/guides/maths/three-dimensional-geometry/distance-between-skew-lines/

Module-4	L1,L2,L3	08Hrs.

Probability:

Random variable, Discrete probability distribution, Mean and variance of Random Variable, Theoretical distribution-Binomial distribution, Mean and variance Binomial distribution -Problems. Poisson distribution as a limiting case of Binomial distribution, Mean and variance of Poisson distribution. Normal Distribution-Basic properties of Normal distribution –standard form of normal distribution and Problems.

Video Link:

https://nptel.ac.in/courses/111/105/111105041/
https://www.mathsisfun.com/data/probability.html

Module-5	L1,L2,L3	08Hrs.

Partial differential equation: Formation of PDE's by elimination of arbitrary constants and functions.

Solution of non-homogeneous PDE by direct integration. Homogeneous PDEs involving derivative with respect to one independent variable only.

Video Link:

http://tutorial.math.lamar.edu/Classes/DE/IntroPDE.aspx

https://www.studyyaar.com/index.php/module-video/watch/233-cauchys-legendres-de-a-method-of- variation-of-parameters

Course outcomes:

CO1	Apply the knowledge of Matrices to solve the system of linear equations and to understand the concepts of Eigen value and Eigen vectors for engineering problems.
CO2	Demonstrate various physical models ,findMaxima and Minima for a function of one variable., Point of inflections and Problems .Understand Beta and Gamma function
CO3	Understand the 3-Dimentional geometry basic, Equation of line in space- different forms, Angle between two line and studying the shortest distance .
CO4	Concepts OF Probability related to engineering applications..
CO5	Construct a variety of partial differential equations and solution by exact methods.

Text Books:

1	B.S. Grewal, "Higher Engineering Mathematics" Khanna Publishers, 43rd Edition, 2013.
2	Ramana B. V., "Higher Engineering Mathematics", Tata Mc Graw-Hill, 2006.

Reference Books:

1	Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley-India publishers, 10th edition,2014.

2	G. B. Gururajachar: Calculus and Linear Algebra, Academic Excellent Series Publication, 2018-19

CIE Assessment:

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

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

SEE Assessment:

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

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

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

CO-PO Mapping

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

High-3, Medium-2, Low-1

Course Title	**Technical Management & Entrepreneurship**	**Semester**	V
Course Code	MVJ20TEM51	**CIE**	50
Total No. of Contact Hours	40	**SEE**	50
No. of Contact Hours/week	4,2:0:2 (L:T:P)	**Total**	100
Credits	3	**Exam. Duration**	3 Hours

Course objective is to: This course will enable students to

- Introduce the field of management, task of the manager, importance of planning and types of planning, staff recruitment and selection process.
- Understand staff recruitment and selection process and explain need of coordination between the manager and staff.
- Explain the social responsibility of business, role and importance of the entrepreneur in economic development.
- Discuss the importance of Small-Scale Industries and the related terms and problems involved.
- Explain project feasibility study and project appraisal and discuss project financing.

Module-1	**L1,L2**	**8Hrs.**

Management: Definition, Importance – Nature and Characteristics of Management, ManagementFunctions, 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/

Module-2	**L1,L2**	**8Hrs.**

Organizing and Staffing: Meaning, Nature and Characteristics of Organization – Process ofOrganization, Principles of Organization, Departmentalization, Committees –meaning, Types ofCommittees, 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 ofCoordination, controlling– Meaning and Steps in Controlling.

Laboratory Sessions/ Experimental learning: Case study of steel plant departmentalization.

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

Module-3	**L1,L2**	**8Hrs.**

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, Concepts 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 a software company

Web Link and Video Lectures:

1.https://nptel.ac.in/courses/110/106/110106141/

2.https://nptel.ac.in/courses/127/105/127105007/

Module-4	**L1,L2**	**8Hrs.**

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, Growth and Performance of Small-Scale Industries in India, Sickness in SSI sector, Problems for 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

Module-5	**L1,L2**	**8Hrs.**

Project Management: Meaning of Project, Project Objectives and Characteristics, Project

Identification-Meaning and Importance; Project Life Cycle, Project Scheduling, Capital Budgeting, 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 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:

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

Text Books:

1	Entrepreneurship Development and Small Business Enterprises, Poornima M.Charanthimath, Pearson, 2nd Edition,2014
2	Tripathy PC & Reddy PN, "Principles of Management", Tata McGraw Hill, 1999

Reference Books:

1	Stephen A. Robbins & David A. Decenzo & Mary Coulter, Fundamentals of Management, Pearson Education, 7th Edition, 2011.
2	Stephen P. Robbins & Mary Coulter, Management, Prentice Hall (India) Pvt. Ltd., 10th Edition, 2009

CIE Assessment:

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

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

SEE Assessment:

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

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

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

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
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

High-3, Medium-2, Low-1

Course Title	Power Electronics	Semester	V
Course Code	MVJ20EE52	CIE	50
Total No. of Contact Hours	50	SEE	50
No. of Contact Hours/week	5, 3:1:1 (L:T:P)	Total	100
Credits	4	Exam. Duration	3 Hours

Course objective is to: This course will enable students to

- Understand the working of power diodes and power transistor.
- Understand the operation, characteristics and performance parameters of thyristor.
- Explain the working of controlled rectifier for different loads.
- Explain the working of AC voltage controller for different loads.
- Design chopper and pulse width modulated inverter for different applications.

Module-1	L1, L2, L3	10Hrs.

Introduction: Power electronic systems, Application of power electronics, Advantage and disadvantage of power electronics, Types of power electronic converter.

Power Diodes: Introduction, Power Diode Characteristics, Reverse Recovery Characteristics, Types of power diodes.

Power Transistors: Introduction, Power MOSFETs: 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.

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

Module-2	L1, L2, L3	8Hrs.

Thyristors: Introduction, Static Characteristics, switching characteristics, turn on methods, Two-Transistor Model, Bidirectional Triode Thyristors, Protection Circuits.

Laboratory Sessions/ Experimental learning: Build a firing circuit for thyristor

Applications: 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/

Module-3	L1, L2, L3	12Hrs.

Controlled Rectifiers: Introduction, Performance Parameters, Single-Phase half wave Converters with R and RL load, Single-Phase Full waveBridge Converters 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.

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

Module-4	L1, L2, L3	8Hrs.

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.

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

Module-5	L1, L2, L3	12Hrs.

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.

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
6. https://www.youtube.com/watch?v=-WU3BxOxvII

Course outcomes:

C302.1	Explain types of power diodes and power transistors
C302.2	Explain the operation, characteristics and performance parameters of thyristor.
C302.3	Explain steady state, switching characteristics and gate control requirements of controlled rectifiers
C302.4	Discuss the principle of operation of AC voltage controllers.
C302.5	Design DC – DC and DC –AC converters for different application.

Text Books:

1	Power Electronics: Circuits Devices and Applications Mohammad H Rashid, Pearson 4th Edition,2014
2	Power Electronics, Dr. P S Bimbhra, Khanna Publishers,

Reference Books:

1	Power Electronics: Converters, Applications and Design Ned Mohan et al Wiley 3rd Edition, 2014
2	Power Electronics Daniel W Hart McGraw Hill 1 st Edition, 2011

CIE Assessment:

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

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

SEE Assessment:

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

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

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

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C302.1	3	1	1	1	2	3	-	-	3	2	-	3

C302.2	3	1	1	1	2	3	-	-	3	2	-	3
C302.3	3	3	2	1	2	3	-	-	3	2	-	3
C302.4	3	3	2	3	3	3	-	-	3	2	-	3
C302.5	3	3	3	3	3	3	-	-	3	2	3	3

High-3, Medium-2, Low-1

Course Title	Electrical Machines II	Semester	V
Course Code	MVJ20EE53	CIE	50
Total No. of Contact Hours	50	SEE	50
No. of Contact Hours/week	5, 3:1:1 (L:T:P)	Total	100
Credits	4	Exam. Duration	3 Hours

Course objective is to: This course will enable students to

- Understand the detailed working of AC machines.
- Discuss the performance characteristics of AC machines.
- Explain the concept of voltage regulation in alternator.
- Explain the construction and working of special machines.

Module-1	L1, L2, L3	10Hrs.

Poly-Phase Induction Machines: Constructional details of cage and wound rotor machines, principle of operation, slip, rotor EMF and rotor frequency, rotor reactance, rotor current and power factor at standstill and during operation.

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:

1. https://www.youtube.com/watch?v=dZyO5gcWP-o
2. https://youtu.be/leXNHZM-CZE

Module-2	L1, L2, L3	10Hrs.

Characteristics of Induction Machines: Rotor power input, rotor copper loss, mechanical power developed and their inter relation, torque equation,torque slip characteristic, equivalent circuit, phasor diagram, crawling and cogging, no-load test and blocked rotor test, direct on line starter, star-delta starter, and auto transformer starter, speed control by voltage/frequency, and rotor resistance control methods.

Laboratory Sessions/ Experimental learning: Brake test on slipring induction motor.

Applications: Induction motor drives.

Web Link and Video Lectures:

1. https://www.youtube.com/watch?v=ze8LY4yq9Wk
2. https://youtu.be/eMq9j0KY2Ak

Module-3	L1, L2, L3	10Hrs.

Synchronous Generator: Principle of operation, construction of salient and non-salient pole machines, 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.

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:

1. https://youtu.be/59Jg5zEguVY
2. https://youtu.be/nu8wtbxKCRM

Module-4	**L1, L2, L3**	**10Hrs.**

Synchronization: Parallel operation of alternators -synchronization.

Synchronous Motors: Theory of operation, phasor diagram, variation of current and power factor with excitation, synchronous condenser, mathematical analysis for power developed, hunting and its suppression, methods of starting.

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:

1. https://youtu.be/b24jORRoxEc
2. https://youtu.be/edJFTap0zYw

Module-5	**L1, L2, L3**	**10Hrs.**

Single Phase and Special Machines: Single phase induction motor, constructional features, double revolving field theory, split-phase motors, shaded pole motor, universal motors, reluctance motors.

Laboratory Sessions/ Experimental learning: Brake test on single phase induction motor.

Application: Home Appliances.

Web Link and Video Lectures:

1. https://youtu.be/KPMy_L7oyOk
2. https://youtu.be/dBP3VvKFV84

Course outcomes:

C303.1	Understand the concepts of rotating magnetic fields and operation of AC machines.
C303.2	Analyse performance characteristics of induction machines
C303.3	Determine the regulation of an alternator by various methods

C303.4	Describe the importance of Synchronization of Alternator and discuss V and inverted V curves.
C303.5	Understand the working of single-phase induction motors and applications.

Text Books:	
1	P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
2	I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.
Reference Books:	
1	B.L Theraja "Electrical Technology" Volume2, S. Chand, 22nd Edition
2	P. C. Sen, "Principles of Electric Machines and Power Electronics", John Wiley & Sons, 2007.

CIE Assessment:

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

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

SEE Assessment:

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

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

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

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C303.1	3	2	-	-	-	-	-	-	3	-	-	1
C303.2	3	2	-	-	-	-	-	-	3	-	-	1
C303.3	3	2	-	-	-	-	-	-	3	-	-	1
C303.4	3	2	-	-	-	-	-	-	3	-	-	1
C303.5	3	2	-	-	-	-	-	-	3	-	-	1

High-3, Medium-2, Low-1

Course Title	Signals and Systems	Semester	V
Course Code	MVJ20EE54	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4,2:1:1 (L:T:P)	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to: This course will enable students to

- Explain basic operations on signals and properties of systems.
- Apply continuous Fourier representation to periodic and aperiodic signals.
- Compute DFT for a given time domain signal.
- Design FIR filter by applying appropriate transformation techniques.
- Design IIR filter by applying appropriate transformation techniques.

Module-1	L1, L2, L3	8 Hrs.

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.

Application: Speech recognition.

Web Link and Video Lectures: https://www.youtube.com/watch?v=879pXoml0XI

Module-2	L1, L2, L3	8 Hrs.

Impulse response of an LTI system, convolution integral, graphical convolution, solution of differential and difference equations, block diagram representation system.

Laboratory Sessions/ Experimental learning: Evaluate impulse response of a system using MATLAB.

Application: Digital Speedometer.

Web Link and Video Lectures: https://www.youtube.com/watch?v=U8riFeiiu3s

Module-3	L1, L2, L3	8 Hrs.

Z Transform: Introduction Z-transform, Properties of ROC, Properties of z transform. 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.

Application: Image processing.

Web Link and Video Lectures:

1. https://www.youtube.com/watch?v=gkC7cXa8ewk
2. https://www.youtube.com/watch?v=6spPyJH6dkQ

Module-4	**L1, L2, L3**	**8 Hrs.**

Design of IIR Filters from Analog Filters: IIR Filter design by impulse invariance, Bilinear transformation. Characteristics of analog filters -Butterworth and Chebyshev, frequency transformation in analog domain

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.

Web Link and Video Lectures:

1. https://www.youtube.com/watch?v=3QWvi8EC_DI
2. https://youtu.be/ryfaCpTHVtQ

Module-5	**L1, L2, L3**	**8 Hrs.**

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.

Web Link and Video Lectures:

1. https://www.youtube.com/watch?v=nsK7mmRSTDY

2.https://www.youtube.com/watch?v=Xl5bJgOkCGU

Course outcomes:

C304.1	Explain the generation of signals, behaviour of system and the basic operations that can be performed on signals and properties of systems.
C304.2	Apply convolution in both continuous and discrete domain for the analysis of systems given impulse response of a system.
C304.3	Introduction to Z transform. Perform Fourier analysis for continuous and discrete time, linear time invariant systems.
C304.4	Design FIR filters by use of window function and frequency sampling method.
C304.5	Develop a digital IIR filter by direct, cascade, parallel, ladder methods of realization.

Text Books:

1	Simon Haykin, Barry Van Veen, "Signals and Systems", John Wiley & Sons,2nd edition 2002
2	Jhon G. Proakis, Dimitris G. Manolakis, "Digital Signal Processing –Principles, Algorithms, and Applications", Pearson, 4th Edition, 2007.

Reference Books:

1	A .Nagoor Kani, "Digital Signal Processing", McGraw Hill Education; 2nd edition, 2017
2	Oppenheim, Willsky and Nawab,"Signals and Systems", Phi Learning, 2nd Edition, 1997.

CIE Assessment:

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

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

SEE Assessment:

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

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

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

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C304.1	3	2	2	2	2	1	-	1	1	3	3	2
C304.2	3	2	2	2	2	1	-	1	1	3	3	2
C304.3	3	2	2	2	3	-	-	1	2	3	3	3
C304.4	3	2	2	2	3	-	-	1	2	3	3	3
C304.5	3	2	2	2	3	-	-	1	2	3	3	3

High-3, Medium-2, Low-1

Course Title	**Solar and Wind Energy Conversion System**	**Semester**	V
Course Code	MVJ20EE551	**CIE**	50
Total No. of Contact Hours	40	**SEE**	50
No. of Contact Hours/week	4, 2:1:1 (L: T: P)	**Total**	100
Credits	3	**Exam. Duration**	3 Hours

Course objective is to: This course will enable students to

- Understand the fundamentals of solar energy and solar thermal systems.
- Illustrate the sizing and design of typical solar PV systems and their applications.
- Discuss inverters, system components, cabling used to connect the components and mounting methods of the PV system.
- Discuss wind energy, its applications and wind turbine site selection.
- Explain wind energy conversion systems, operation schemes and environmental effects.

Module-1	**L1, L2**	**08Hrs.**

Fundamentals of Energy Resources: Introduction, Classification of energy resources, Environmental aspects of energy, Availability of resources and future trends.

Solar Energy: Introduction, effect of earth atmosphere on solar radiation, quantifying solar radiation, instruments for measuring solar radiation, solar radiation geometry.

Solar Thermal Systems: Solar collectors, classification, performance indices, parabolic dish Stirling engine system, direct solar thermal applications- Solar water heating systems, space cooling, air heating, crop drying, solar cooker and solar pond.

Laboratory Sessions/ Experimental learning: Designing a box type solar cooker

Applications: Estimation of solar energy availability.

Video link: https://nptel.ac.in/courses/121/106/121106014/

Module-2	**L1, L2, L3**	**08Hrs.**

Solar Photovoltaic Systems: Introduction, solar cell fundamentals, photoconduction, solar cell characteristics, equivalent circuits: single diode model, solar cell classification, solar cell module and panel construction, current status and future development of solar cells and modules, Basic components in solar PV system, classification of solar PV systems and its applications, Maximum Power Point Tracker.

Laboratory Sessions/ Experimental learning: PV cell simulation using MATLAB/Simulink

Applications: Designing devices using solar power for heating cooling and drying

Video link: https://nptel.ac.in/courses/117/108/117108141/#

Module-3	L1, L2, L3	08Hrs.
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, Metering, Net metering, Gross metering. **Laboratory Sessions/ Experimental learning:** Design of solar photovoltaic array using MATLAB. **Applications:** Maximizing output of a PV system **Video link:** https://nptel.ac.in/courses/117/108/117108141/		
Module-4	**L1, L2, L3**	**08Hrs.**
Wind Energy: Introduction, factors affecting distribution of wind energy on the surface of earth**,** nature of winds, applications of wind power, wind turbine siting, wind turbine types and their construction, speed control strategies for wind turbine, power versus wind speed characteristics of wind turbines. **Laboratory Sessions/ Experimental learning:** Wind turbine blade design using CATIA **Applications:** Choice of proper site for installing wind turbine **Video link:** 1. https://www.youtube.com/watch?v=GExTwRNkQBg, 2. https://www.youtube.com/watch?v=ntk-zX7zz6o		
Module-5	**L1, L2, L3**	**08Hrs.**
Wind Energy Conversion System: Introduction, operation schemes, effects of wind speed and grid condition, wind energy storage, environmental aspects, wind energy programme in India. **Laboratory Sessions/ Experimental learning:** Visiting nearest wind power plant **Applications:** Selecting appropriate WEC systems **Video link:** https://youtu.be/UJJLIVNvIVg		

Course outcomes:	
C305.1.1	Explain fundamentals of solar energy and solar thermal systems.
C305.1.2	Discuss the sizing and design of typical solar PV systems and their applications
C305.1.3	Discuss inverters, system components, cabling used to connect the components and mounting methods of the PV system.
C305.1.4	Explain wind energy, its applications and wind turbine site selection.
C305.1.5	Explain wind energy conversion systems, operation schemes and environmental effects.

Text Books:	
1	B. H. Khan, "Non-Conventional Energy Resources" , McGraw Hill, 2nd Edition 2017
2	Geoff Stapleton, Susan Neill "Grid Connected Solar Electric Systems: The Earthscan Expert Handbook for Planning, Design and Installation", Earthscan Expert Series, 1st Edition, 2012
Reference Books:	
1	Shobh Nath Singh, "Non-Conventional Energy Resources", Pearson, 1st Edition, 2015
2	Ahmad Hemami, " Wind Turbine Technology", Cengage, 1st Edition, 2012

CIE Assessment:

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

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

SEE Assessment:

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

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

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

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C305.1.1	3	3	3	3	-	2	3			1		-
C305.1.2	3	3	3	1	3	3	3			1		1
C305.1.3	3	3	3	1	3	3	3			1		1
C305.1.4	3	3	3	1	3	3	3			1		1
C305.1.5	3	3	3	1	-	3	3			1		1

High-3, Medium-2, Low-1

Course Title	Sensor and Transducers	Semester	V
Course Code	MVJ20EE552	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4, 2:1:1 (L: T:P)	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to: This course will enable students to

- Understand the working of different types of sensors.
- Discuss recent trends in sensor technology and their selection.
- Explain basics of smart sensors
- Discuss need of transducers, their classification, advantages and disadvantages.
- Explain basics of signal conditioning and signal conditioning equipment

Module-1	L1, L2	08Hrs

Introduction to sensors: Capacitance, magnetism, Induction, Resistance, Piezoelectric Effect, Hall effect, Thermoelectric effect, Sound waves, Temperature and thermal properties of materials. Different types of sensors-Displacement and Level Sensors: Inductive, Magnetic and Optical

Acceleration: Accelerometers, Seismic Sensors.

Force and Strain: Strain Gauge, Pressure sensors.

Laboratory Sessions/ Experimental learning: Measurement of level in a tank using capacitive type level probe in virtual lab

Applications: Automation.

Web Link and Video Lectures: https://www.youtube.com/watch?v=onNkjSbcSWc

Module-2	L1, L2, L3	10Hrs

Acoustic sensor: Resistive and Fiber-optic microphones, Humidity and Moisture sensor: capacitive, resistive and thermal conductivity, Light Detectors: Photodiode, Phototransistor, Photo resistor, Radiation Detectors: Scintillating Detectors and Ionization Detectors

Temperature sensor: Pyroelectric Effect, Coupling with object, Static & Dynamic heat exchange, RTD, Thermistors, Thermocouple circuits, proximity sensors-inductive, optical, capacitive, magnetic and ultrasonic, Hall effect sensors

Gas sensors: Optical gas sensor, Metal oxide semiconductor gas sensor, Field effect transistor gas sensor, Piezoelectric gas sensor, Polymer gas sensor, Nano-structured based gas sensors

Laboratory Sessions/ Experimental learning: Characteristics the temperature sensor (RTD) in virtual lab

Applications: Medical applications, temperature control, position control.

Web Link and Video Lectures: https://nptel.ac.in/courses/108/108/108108147/

Module-3	**L1, L2**	**06Hrs**

Basics of smart sensors: Introduction, Mechanical-Electronic transitions in sensing, nature of sensors, types of smart sensors, overview of smart sensing and control systems. Interfacing sensors with microprocessors and micro controllers, Emerging fields of sensor technologies

Laboratory Sessions/ Experimental learning: Interfacing of sensors through micro controller.

Application: Sensor array

Web Link and Video Lectures: https://www.youtube.com/watch?v=q8UuRkOQ9A0

Module-4	**L1, L2,L3**	**08Hrs**

Introduction to Transducers: Introduction, Different types of transducers Resistive transducers: Potentiometers, metal, and semiconductor strain gauges. Strain gauge applications: Load and torque measurement. Self and mutual inductive transducers- capacitive transducers, eddy current transducers, tacho generators and stroboscope. Piezoelectric transducers, photoelectric transducers, Magneto strictive transducers, Basics of Gyroscope.

Laboratory Sessions/ Experimental learning: Strain gauge characteristics using virtual lab.

Application: Torque measurement, vibration measurement, velocity measurement.

Web Link and Video Lectures: https://www.youtube.com/watch?v=1uPTyjxZzyo

Module-5	**L1, L2**	**08Hrs**

Signal Conditioning: Introduction, Functions of Signal Conditioning Equipment, Amplification, Types of Amplifiers, Mechanical Amplifiers Fluid Amplifiers, Optical Amplifiers, Electrical and electronicAmplifiers.

Data Acquisition Systems and Conversion: Introduction, Objectives and Configuration of Data Acquisition System, Data Acquisition Systems, Data Conversion.

Laboratory Sessions/ Experimental learning: Signal amplification.

Application: Automation.

Web Link and Video Lectures: https://www.youtube.com/watch?v=MGC2LWeNKSI

Course outcomes:

C305.2.1	Explain working of different types of transducers and sensors.
C305.2.2	Describe different type of sensors and its application.
C305.2.3	Explain basics of smart sensors

C305.2.4	Identify need of transducers, their classification, advantages and disadvantages.
C305.2.5	Discuss basics of signal conditioning and signal conditioning equipment
Text Books:	
1	R.K Rajput, "Electrical and Electronic Measurements and instrumentation", S. Chand, 3rdEdition, 2013.
2	Daniel E. Suarez, "Smart Sensors and Sensing Technology", Nova Science Publishers, 2011
Reference Books:	
1	Murthy D. V. S, "Transducers and Instrumentation", Prentice Hall, New Delhi, 2nd Edition, 2008.
2	Patranabis, "Sensors and Transducers", Prentice Hall India Pvt. Ltd, 2nd Edition, 2003.

CIE Assessment:

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

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

SEE Assessment:

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

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

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

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C305.2.1	3	3	3	1	1	-	-	-	-	-	-	3
C305.2.2	3	3	3	3	3	-	-	-	-	-	-	3
C305.2.3	3	3	3	3	3	-	-	-	-	-	-	3
C305.2.4	3	3	3	3	3	-	-	-	-	-	-	3
C305.2.5	3	3	3	3	3	-	-	-	-	-	-	3

High-3, Medium-2, Low-1

Course Title	Embedded Systems	Semester	V
Course Code	MVJ20EE553	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4, 2:1:1 (L: T:P)	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to: This course will enable students to

- Understand the concepts of embedded system design such as ROM variants, RAM.
- Learn the technological aspects of embedded system such as signal conditioning, Sample &Hold.
- Understand the design trade-offs.
- Explain the software aspects of embedded system.
- Understand the subsystem interfacing.

Module-1	L1, L2, L3	08Hrs

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.

Application: Digital electronics.

Web Link and Video Lectures: https://nptel.ac.in/courses/106/105/106105193/

Module-2	L1, L2, L3	08Hrs

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.

Application: Telecommunications.

Web Link and Video Lectures: https://nptel.ac.in/courses/108/102/108102169/

Module-3	L1, L2, L3	08Hrs

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.

Application: Computer networks.

Web Link and Video Lectures: https://nptel.ac.in/courses/106/103/106103182/

Module-4	**L1, L2, L3**	**08Hrs**

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.

Application: Systems with artificial intelligence and robotics.

Web Link and Video Lectures: https://nptel.ac.in/noc/courses/noc20/SEM2/noc20-ee98/

Module-5	**L1, L2, L3**	**08Hrs**

Subsystem interfacing: With external systems user interfacing, Serial I/O devices, Parallel port Interfaces: Input switches, Keyboards and Memory interfacing.

Laboratory Sessions/ Experimental learning:

1. Implementation of Serial Communication by using 8051 serial ports.

2. Simple test program usingARM 9 mini 2440 kit (Interfacing LED with ARM 9 mini-2440 kit).

Application: Military defence systems.

Web Link and Video Lectures: https://www.youtube.com/watch?v=csttt3VHxf8

Course outcomes:

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.

Text Books:

1	Shibu K V," Introduction to Embedded Systems", Second Edition, McGraw Hill Education India Private Limited, 2017.
2	Raj Kamal, "Embedded System, Architecture, Programming and Design Operational

	Amplifiers",McGraw Hill Education, 2nd Edition, 2008
Reference Books:	
1	Embedded Microcomputer systems: Real time interfacing Valvano, J.W Cengage Learning India Private Limited, 2nd edition, 2011.
2	Embedded System Design: A Unified Hardware / Software Introduction, Wiley, Student edition, 2006.

CIE Assessment:

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

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

SEE Assessment:

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

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

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

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
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

High-3, Medium-2, Low-1

Course Title	**Electrical Machines-IILaboratory**	**Semester**	V
Course Code	MVJ20EEL56	**CIE**	50
Total No. of Contact Hours	20	**SEE**	50
No. of Contact Hours/week	4,0:2:2 (L:T:P)	**Total**	100
Credits	2	**Exam. Duration**	3 Hours

Course objective is to: This course will enable students to

- Understand the operation and performance of synchronous machines.
- Understand the analysis of power angle curve of a synchronous machine
- Understand the equivalent circuit of single-phase induction motor and three phase induction motor.
- Understand the circle diagram of an induction motor by conducting a blocked rotor test.

Sl No	Experiment Name	RBT Level	Hours
1	Load test on three phase Induction Motor	L3	2
2	Conduct suitable test to draw the equivalent circuit of single-phase induction motor	L3	2
3	Load test on a single-phase induction motor.	L3	2
4	No-load & Blocked rotor test on three phase Induction motor	L3	2
5	Brake test on three phase Induction Motor.	L3	2
6	Regulation of a three –phase alternator by synchronous impedance &m.m.f. methods	L3	2
7	Determination of Xd and Xq of a salient pole synchronous machine.	L3	2
8	V and Inverted V curves of a three-phase synchronous motor	L3	2
Along with mandatory experiments students are advised to complete two open ended experiments. The following are some suggestions for open ended experiments.			
1	Efficiency of a three-phase alternator	L3	2
2	Speed control of 3 phase slip ring Induction motor- rotor Resistance control, stator voltage control.	L3	2
3	Regulation of three-phase alternator by Z.P.F. method	L3	2

Course outcomes:

C306.1	Assess the performance of Induction machines using different testing methods
C306.2	Assess the performance of synchronous machines using different testing methods
C306.3	Analyse the active and reactive power flows in synchronous machines
C306.4	Illustrate starting and control of AC machines.

Scheme of Evaluation

SEE :

Examinations will be conducted for 100 marks and scaled-down to 50. The weight age shall be,
Write-up : 20 marks
Conduction : 40 marks
Analysis of results : 20 marks
Viva : 20

CIE :

Regular Lab work :20
Record writing :5
Lab Tests(Minimum 2 tests shall be conducted for 15 marks and average of two will be taken)
Viva 10 marks

CO-PO Mapping

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

High-3, Medium-2, Low-1

Course Title	**Power Electronics Laboratory**	**Semester**	V
Course Code	MVJ20EEL57	**CIE**	50
Total No. of Contact Hours	20	**SEE**	50
No. of Contact Hours/week	4,0:2:2 (L: T:P)	**Total**	100
Credits	2	**Exam. Duration**	3 Hours

Course objective is to: This course will enable the students to

- Conduct experiments on semiconductor devices to obtain their static characteristics.
- Demonstrate the performance of single phase controlled full wave rectifier and AC voltage controller with R and RL loads.
- Control the speed of a DC motor and universal motor.
- Demonstrate the working of single phase full bridge inverter connected to resistive load.

Sl No	Experiment Name	RBT Level	Hours
1	Static Characteristics of SCR	L3	2
2	Static Characteristics of MOSFET and IGBT	L3	2
3	Single phase controlled full wave rectifier with R load, R –L load, R-L-E load with and without freewheeling diode	L3	2
4	AC voltage controller with R and RL loads.	L3	2
5	Speed control of universal motor using ac voltage regulator.	L3	2
6	Speed control of DC motor using single semi converter.	L3	2
7	Speed control of a separately excited D.C. Motor using chopper.	L3	2
8	Single phase MOSFET/IGBT based PWM inverter	L3	2
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	L3	2
2	Study of charging and discharging of capacitor in snubber circuit.	L3	2
3	SCR digital triggering circuit for a single-phase controlled rectifier and ac voltage regulator	L3	2

Course outcomes:

C307.1	Obtain static characteristics of semiconductor devices to discuss their performance.
C307.2	Verify the performance of single phase controlled full wave rectifier and AC voltage controller with R and RL loads.
C307.3	Illustrate the speed control of a DC motor and universal motor

C307.4	Verify the performance of single-phase full bridge inverter connected to resistive load.

Scheme of Evaluation

SEE :

Examinations will be conducted for 100 marks and scaled-down to 50. The weight age shall be,
Write-up : 20 marks
Conduction : 40 marks
Analysis of results : 20 marks
Viva : 20

CIE :

Regular Lab work :20
Record writing :5
Lab Tests(Minimum 2 tests shall be conducted for 15 marks and average of two will be taken)
Viva 10 marks

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C307.1	3	-	-	-	3	2	-	2	3	-	-	3
C307.2	3	-	-	-	3	2	-	2	3	-	-	3
C307.3	3	3	3	1	3	2	-	2	3	-	-	3
C307.4	3	3	3	1	3	2	-	2	3	-	-	3

High-3, Medium-2, Low-1

Course Title	Control System Laboratory	Semester	V
Course Code	MVJ20EEL58	CIE	50
Total No. of Contact Hours	20	SEE	50
No. of Contact Hours/week	4,0:2:2 (L:T:P)	Total	100
Credits	2	Exam. Duration	3 Hours

Course objective is to: This course will enable the students to

- Understand the performance characteristics of ac and DC servomotors and synchro-transmitter receiver pair.
- Design and analyze Lead, Lag and Lag – Lead compensators for given specifications.
- Determine the time and frequency domain responses of a given second order system using software package or discrete components.
- Study the DC position and feedback control system and the effect of P, PI, PD and PID controller on the step response of the system.
- Determine effect of addition of poles and zeros and pole location on stability of a system.

Sl No	Experiment Name	RBT Level	Hours
1	Speed torque characteristics of (i) AC servo motor (ii) DC servo motor	L3	2
2	Synchro pair characteristics	L3	2
3	Determine frequency response of a second order system	L3	2
4	Frequency response of a passive RC lead compensating network for the given specifications	L3	2
5	Frequency response of a passive RC lag compensating network for the given specifications	L3	2
6	Frequency response characteristics of the lag – lead compensating network for the given specifications.	L3	2
Perform the experiments using standard simulation package			
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 order system. (c) Evaluate the effect of pole location on stability	L3	2
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.	L3	2
Along with mandatory experiments students are advised to complete two open ended experiments. The following are some suggestions for open ended experiments.			
1	Examine the open-loop frequency response, stability and transient response. Compare with close loop system.	L3	2

2	Simulate a D.C. Position control system and obtain its step response	L3	2
3	Simulate a DC Servomotor and study its stability.	L3	2

Course outcomes:

C308.1	Determine the performance characteristics of AC and DC servomotors and synchro-transmitter receiver pair used in control systems.
C308.2	Design, analyse and simulate Lead, Lag and Lag – Lead compensators for given specifications.
C308.3	Utilize software package and discrete components in assessing the time and frequency domain response of a given second order system.
C308.4	Simulate the DC position and feedback control system and study the effect of P, PI, PD and PID controller on the step response of the system.
C308.5	Determine effect of addition of poles and zeros and pole location on stability of a system.

Scheme of Evaluation

SEE :

Examinations will be conducted for 100 marks and scaled-down to 50. The weight age shall be,
Write-up : 20 marks
Conduction : 40 marks
Analysis of results : 20 marks
Viva : 20

CIE :

Regular Lab work :20
Record writing :5
Lab Tests(Minimum 2 tests shall be conducted for 15 marks and average of two will be taken)
Viva 10 marks

CO-PO Mapping

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

High-3, Medium-2, Low-1

Course Title	ENVIRONMENTAL STUDIES	Semester	V
Course Code	MVJ20ENV59	CIE	50
Total No. of Contact Hours	15 L: T: P :: 1 : 0 :0	SEE	50
No. of Contact Hours/week	1	Total	100
Credits	1	Exam. Duration	2 Hrs.

Course objective is to: This course will enable the students to

- Relatetointerdisciplinaryapproachtocomplexenvironmentalproblemsusingbasictoolsofthenatural and social sciences including geo-systems, biology, chemistry, economics, political science and international processes; Study drinking water quality standards and to illustrate qualitative analysis of water.
- Critically evaluate the science and policy ramifications of diverse energy portfolios on air and water quality, climate, weapons proliferation and societal stability.

Module-1	L1, L2	4 Hrs

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/

Module-2	L1,L2	4 Hrs.

AdvancesinEnergySystems(Merits,Demerits,GlobalStatusandApplications): Hydrogen,Solar,OTEC, Tidal andWind.

Natural Resource Management (Concept and case-study): Disaster Management, Sustainable Mining, Cloud Seeding, and Carbon Trading.

Video link: https://nptel.ac.in/courses/121/106/121106014/

Module-3	L1	4 Hrs.

Environmental Pollution (Sources, Impacts, Corrective and Preventive measures, Relevant EnvironmentalActs,Case-studies): SurfaceandGroundWaterPollution;Noisepollution;SoilPollutionand Air Pollution.

Waste Management & Public Health Aspects: Bio-medical Waste; Solid waste; Hazardous waste; 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/

Module-4	**L1,**	**4 Hrs.**

Global Environmental Concerns (Concept, policies, and case-studies): Global Warming ClimateChange;AcidRain;OzoneDepletion;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

Module-5	**L1,L2**	**4 Hrs.**

Latest Developments in Environmental Pollution Mitigation Tools (Concept and Applications): G.I.S. & Remote Sensing, Environment Impact Assessment, Environmental Management Systems, ISO 14001.

Video link:

- https://nptel.ac.in/courses/105/102/105102015/
- https://nptel.ac.in/courses/120/108/120108004/

Course outcomes:

C309.1	Describe the principles of ecology and environmental issues that apply to air, land, and water issues on a global scale.
C309.2	Develop critical thinking and/or observation skills, and apply them to the analysis of a problem or question related to the environment.
C309.3	Demonstrate ecology knowledge of a complex relationship between biotic and Abiotic components.
C309.4	Apply their ecological knowledge to illustrate and graph a problem and describe the realities that managers face when dealing with complex issues.

Text Books:

1	Environmental Studies Benny Joseph Tata Mc Graw – Hill. 2nd Edition, 2012
2	Environmental Studies S M Prakash Pristine Publishing House, Mangalore 3rd Edition, 2018.

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
	Textbook of Environmental and Ecology, Pratiba Singh, Anoop Singh & Piyush Malaviya , ACME Learning Pvt. Ltd. New Delhi, 1st Edition.

CIE Assessment:

Details		**Marks**
Average of three Internal Assessment (IA) Tests of 30 Marks each i.e. Σ (Marks Obtained in each test) / 3	**CIE (50)**	**40**
Quizzes		**10**
Semester End Examination	**SEE (50)**	**50**
Total		**100**

SEE Assessment:

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

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

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

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C309.1	3	1	1	1	2	3	-	-	3	2	-	3
C309.2	3	1	1	1	2	3	-	-	3	2	-	3
C309.3	3	3	2	1	2	3	-	-	3	2	-	3
C309.4	3	3	2	3	3	3	-	-	3	2	-	3

Course Title	**UNIVERSAL HUMAN VALUES II - UNDERSTANDING HARMONY AND ETHICAL HUMAN CONDUCT**	Semester	V
Course Code	MVJ20UHV510	**CIE**	50
Total No. of Contact Hours	30 L: T : P :: 1 : 2 :0	**SEE**	50
No. of Contact Hours/week	3	**Total**	100
Credits	2	**Exam. Duration**	2 Hrs.

Course objective is to: This course will enable the students to

- Appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
- 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.
- 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.

Prerequisites: *Universal Human Values I*

Module-1	**L1,L2**	**6 Hrs**

Review on Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education), Self-exploration as the Process for Value Education, Happiness and Prosperity – Current Scenario,

Value Education: Understanding Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, , Method to Fulfill the Basic Human Aspirations,

Practical Sessions: Sharing about Oneself (Tutorial 1), Exploring Human Consciousness (Tutorial 2), Exploring Natural Acceptance (Tutorial 3)

Video link:

- https://www.youtube.com/watch?v=85XCw8SU084
- https://www.youtube.com/watch?v=E1STJoXCXUU&list=PLWDeKF97v9SP_Kt6jqzA3pZ3yA7g_OAQz

- https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw

Module-2	L1,L2	6 Hrs

Review on Understanding Human being as the Co-existence of the Self and the Body, The Body as an Instrument of the Self, Harmony of the Self with the Body.

Harmony in the Human Being: Distinguishing between the Needs of the Self and the Body, Understanding Harmony in the Self, Programme to ensure self-regulation and Health.

Practical Sessions: Exploring the difference of Needs of Self and Body (Tutorial 4), Exploring Sources of Imagination in the Self (Tutorial 5), Exploring Harmony of Self with the Body (Tutorial 6).

Video link:

- https://www.youtube.com/watch?v=GpuZo495F24
- https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw

Module-3	L1,L2	6 Hrs

Review on Harmony in the Family – the Basic Unit of Human Interaction, Other Feelings, Justice in Human-to-Human Relationship, Understanding Harmony in the Society.

Harmony in the Family and Society: Trust' – the Foundational Value in Relationship, 'Respect' – as the Right Evaluation, Vision for the Universal Human Order,

Practical Sessions: Exploring the Feeling of Trust (Tutorial 7), Exploring the Feeling of Respect (Tutorial 8), Exploring Systems to fulfill Human Goal (Tutorial 9).

Video link:

- https://www.youtube.com/watch?v=F2KVW4WNnS8
- https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw

Module-4	L1,L2	6 Hrs

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: Exploring the Four Orders of Nature (Tutorial 10), Exploring Co-existence in Existence (Tutorial 11).

Video link:

- https://www.youtube.com/watch?v=1HR-QB2mCF0
- https://www.youtube.com/watch?v=lfN8q0xUSpw
- https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw

Module-5	L1,L2	6 Hrs

Review on Natural Acceptance of Human Values,Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Holistic Technologies, Production Systems and

Management Models-Typical Case Studies.

Implications of the Holistic Understanding – a Look at Professional Ethics: Definitiveness of (Ethical) Human Conduct, Competence in Professional Ethics, Strategies for Transition towards Value-based Life and Profession

Practical Sessions: Exploring Ethical Human Conduct (Tutorial 12), Exploring Humanistic Models in Education (Tutorial 13), Exploring Steps of Transition towards Universal Human Order (Tutorial 14).

Video link:

- https://www.youtube.com/watch?v=BikdYub6RY0
- https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw

Course outcomes: On completion of the course, students would be able to

C310.1	Explore themselves, get comfortable with each other and with the teacher
C310.2	Enlist their desires and the desires are not vague.
C310.3	Restate that the natural acceptance (intention) is always for living in harmony, only competence is lacking
C310.4	Differentiate between the characteristics and activities of different orders and study the mutual fulfillment among them
C310.5	Present sustainable solutions to the problems in society and nature

Scheme of Evaluation

Details		**Marks**
Assessment by Faculty mentor (Class Room Evaluation)	**CIE(50)**	**10**
Self-Assessment + Assessment by peers		**20**
Activities / Experimentations related to courses/Assignment		**10**
Mini Projects / Case Studies		**10**
Semester End Examination	**SEE (50)**	**50**
	Total	**100**

Text Books:

1.	AICTE SIP UHV-I Teaching Material, https://fdp-si.aicte india.org/ AicteSipUHV _download.php

2.	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

Reference Books:

1.	Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010
2.	Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
3.	Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
4.	Annie Leonard, The Story of Stuff (Book), Free Press; Reprint edition (22 February 2011)
5.	The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C310.1		1				2	2	3	2	1	2	1
C310.2		1				2	2	3	2	1	2	1
C310.3		1				2	2	3	2	1	2	1
C310.4		1				2	2	3	2	1	2	1
C310.5		1				2	2	3	2	1	2	1

High-3, Medium-2, Low-1

Course Title	Power System Analysis	Semester	VI
Course Code	MVJ20EE61	CIE	50
Total No. of Contact Hours	50	SEE	50
No. of Contact Hours/week	5, 3:1:1 (L: T:P)	Total	100
Credits	4	Exam. Duration	3 Hours

Course objective is to: This course will enable students to

- Understand per unit quantities, network models and bus admittance matrix
- Compute steady state load flow analysis with numerical iterative techniques
- Compute short circuit faults occurring in power systems
- Explain numerical solution of swing equation for multi-machine stability
- Illustrate problems of unit commitment and economic load dispatch

Module-1	L1, L2, L3	10Hrs.

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://www.youtube.com/watch?v=dmNlW2q-tbI

Module-2	L1, L2, L3	10Hrs.

Power flow analysis: Bus classification, Formulation of Power Flow problems, Power flow solution using Gauss Seidel method, Handling of Voltage controlled buses, Power Flow Solution by Newton Raphson method, Fast Decoupled Power Flow Solution.

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://www.youtube.com/watch?v=rEyE3NxK8vE

Module-3	L1, L2, L3	10Hrs.

Short Circuit Analysis: Symmetrical short circuit on Synchronous Machine, Bus Impedance matrix building algorithm, Symmetrical fault analysis through bus impedance matrix, Symmetrical components, Sequence impedance, Sequence networks, Analysis of unsymmetrical fault at generator terminals, use of bus impedance matrix for analyzing unsymmetrical fault occurring at any point in a power system.

Laboratory Sessions/ Experimental learning: Evaluation of sequence components of phase currents and voltages for a LG fault in simple 4 bus system using MATLAB programming. **Applications**: Selection of appropriate protective devices **Video link:** https://www.youtube.com/watch?v=HcMh7ahJxfo		
Module-4	**L1, L2, L3**	**10Hrs.**
Power System Stability: Introduction, 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 and its application, Critical Clearing Angle Calculation. Methods to improve Stability - Application of Auto Reclosing and Fast Operating Circuit Breakers **Laboratory Sessions/ Experimental learning**: Determination of Power Angle curves using MATLAB. **Applications:** To determine nature of the relaying system needed, critical clearing time of circuit breakers, voltage level of and transfer capability between systems **Video link:** https://www.youtube.com/watch?v=-NkoZx8gdqM		
Module-5	**L1, L2, L3**	**10Hrs.**
Economic Operation of Power System: Introduction and Performance curves, Economic load dispatch of hydro-thermal scheduling neglecting losses and generator limits Economic generation scheduling including generator limits and neglecting losses Economic dispatch including transmission losses Derivation of transmission loss formula. **Unit Commitment:** Introduction, Constraints and unit commitment solution by prior list method andDynamic forward DP approach (Flow chart and Algorithm only). **Laboratory Sessions/ Experimental learning:** Optimal generation scheduling for thermal power plants using Mi-power. **Applications:** To minimize the total cost of system production, yet maintain all the requirements such as loads, operating restrictions **Video link:** https://nptel.ac.in/courses/108/104/108104052/		
Course outcomes:		
C311.1	Prepare per unit reactance diagram and formulate network matrices and models for solving load flow problems.	
C311.2	Perform steady state power flow analysis of power systems using numerical iterative techniques	
C311.3	Analyze short circuit faults in power system.	
C311.4	Analyse steady state and transient stability in power systems.	
C311.5	Solve economic load dispatch and unit commitment problems.	
Text Books:		

1	D. P. Kothari , "Modern Power System "McGraw Hill , 4th Edition, 2011 .
2	John.J.Grainger, William D. Stevenson, "Power System Analysis", Tata Mc Graw Hill Publishing company, New Delhi, 2003.
Reference Books:	
1	J.Duncan Glover et al, " Power System Analysis and Design" , Cengage, 4th Edition, 2008
2	Hadi Sadat, " Power System Analysis", McGraw Hill , 1st Edition, 2002

CIE Assessment:

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

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

SEE Assessment:

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

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

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

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C311.1	3	2	2	1	-	-	3	-	-	-	-	2
C311.2	3	2	2	1	-	-	3	-	-	-	-	2
C311.3	3	2	2	1	-	-	3	-	-	-	-	2
C311.4	3	2	2	1	-	-	3	-	-	-	-	2
C311.5	3	2	2	1	-	-	3	-	-	-	-	2

High-3, Medium-2, Low-1

Course Title	**Industrial Drives and Applications**	**Semester**	VI
Course Code	MVJ20EE62	**CIE**	50
Total No. of Contact Hours	50	**SEE**	50
No. of Contact Hours/week	5, 3:1:1 (L:T:P)	**Total**	100
Credits	4	**Exam. Duration**	3 Hours

Course objective is to: This course will enable students to

- Understand the electric drive
- Explain dynamics and modes of operation of electric drives.
- Explain selection of motor power ratings and control of dc motor using rectifiers.
- Analyze the performance of induction motor drives under different conditions
- Explain the control of induction motor, synchronous motor and stepper motor drives.

Module-1	**L1, L2, L3**	**10Hrs.**

Electrical Drives: Electrical Drives, Advantages of Electrical Drives. Parts of Electrical Drives,Choice of Electrical Drives, Status of dc and ac Drives.

Dynamics of Electrical Drives: Fundamental Torque Equations, Speed TorqueConventions andMultiquadrant Operation. Equivalent Values of DriveParameters, Components of Load Torques,Nature and Classification of LoadTorques, Calculation of Time and Energy Loss in TransientOperations, SteadyState Stability, Load Equalization.

Control of Electrical Drives: Modes of Operation, Speed Control and Drive Classifications.

Laboratory Sessions/ Experimental learning: MATLAB Simulation of closed loop control of drives.

Applications: AC Drives on hotel air conditioning fans

Web Link and Video Lectures:

3. https://www.electrical4u.com/classification-of-electrical-drives/
4. https://www.watelectrical.com/electric-drive-working-and-its-applications/

Module-2	**L1, L2, L3**	**10Hrs.**

Selection of Motor Power Ratings: Thermal Model of Motor for Heating and Cooling, Classes ofMotor Duty, Determination of Motor Rating.

Direct Current Motor Drives: Controlled Rectifier Fed dc Drives, Single Phase Fully ControlledRectifier Control of dc Separately Excited Motor,SinglePhase Half Controlled Rectifier Control of dcSeparately Excited Motor, Three Phase Fully Controlled Rectifier Control of dc Separately Excited motor.

Four Quadrant Operations of DC Drives Introduction to Four quadrant operation – Motoring

operations, Electric Braking – Plugging, Dynamic, and Regenerative Braking operations. Closed-loop operation of DC motor (Block Diagram Only)

Laboratory Sessions/ Experimental learning: Demonstration of the operation of controlled rectifier fed dc drives.

Applications: Hybrid electric vehicles

Web Link and Video Lectures:

1.https://nptel.ac.in/content/storage2/courses/108105066/PDF/L-10(DK)(PE)%20((EE)NPTEL).pdf

2.https://nptel.ac.in/content/storage2/courses/108105066/PDF/L13(DK)(PE)%20((EE)NPTEL)%20.pdf

Module-3	**L1, L2, L3**	**10Hrs.**

Induction Motor Drives: Analysis and Performance of Three Phase Induction Motors, Operationwith Unbalanced Source Voltage and Single Phasing, Operation with Unbalanced Rotor Impedances, Analysis of induction motor fed from the non-sinusoidal voltage supply, Starting- star-delta starter, Auto-transformer starter, Rotor resistance starter, Braking-Regenerative braking, Plugging, AC dynamic braking.

Speed Control Techniques-Stator Voltage Control by semiconductor voltage controller, Variable Frequency Control of Induction Motor, Voltage Source Inverter (VSI) Control, Cycloconverter Control, Closed Loop Speed Control and Converter Rating for VSI and Cycloconverter Induction Motor Drives, Variable Frequency Control from a Current Source, Current Source Inverter (CSI) Control, current regulated voltage source inverter control.

Laboratory Sessions/ Experimental learning: MATLAB simulation of induction motor fed from the non-sinusoidal voltage supply

Application: Conveyors, pumps, winders

Web Link and Video Lectures:

3. https://www.electrical4u.com/squirrel-cage-induction-motor/
4. https://instrumentationtools.com/squirrel-cage-induction-motor-vs-slip-ring-induction-motor/

Module-4	**L1, L2, L3**	**10Hrs.**

Synchronous Motor Drives Operation from fixed frequency supply-starting, synchronous motor,Self-controlled synchronous motor drive employing loadcommutated thruster inverter, Starting Large Synchronous Machines, Permanent Magnet ac (PMAC)Motor Drives, Sinusoidal PMAC Motor Drives, Brushless dc Motor Drives.

Laboratory Sessions/ Experimental learning: Simulation of Synchronous Motor Drives using MATLAB simulation

Application: Robot actuators

Web Link and Video Lectures: https://nptel.ac.in/content/storage2/courses/108103009/download/M7.pdf		
Module-5	**L1, L2, L3**	**10Hrs.**

Stepper Motor Drives: Variable Reluctance, Permanent Magnet, Important Features of StepperMotors, Torque Versus Stepping rate Characteristics, Drive Circuits for Stepper Motor.

Industrial Drives: Textile Mills, Steel Rolling Mills, Cranes and Hoists, Machine Tools.

Laboratory Sessions/ Experimental learning: Simulation of stepper motor drives using MATLABsimulation

Application: CNC milling machines.

Web Link and Video Lectures:

1. https://nptel.ac.in/courses/112/106/112106153/
2. https://nptel.ac.in/courses/108/102/108102156/

Course outcomes:

C312.1	Explain the electric drives and its advantages
C312.2	Understand the multi-quadrant operation of dc Separately Excited Motor
C312.3	Explain the various speed control techniques
C312.4	Interpret the self-controlled synchronous motor drive
C312.5	Understand the applications of drives in various industries

Text Books:

1	Gopal K Dubey, Fundamentals of electrical drives, Narosa publishing house, 2014.
2	Nagrath .I.J. and Kothari .D.P, Electrical Machines, Tata McGraw-Hill, 2006

Reference Books:

1	Vedam Subrahmaniam, Electric Drives (Concepts and Applications), Tata McGraw-Hill, 2010
2	Pillai.S.K , A First Course on Electric Drives, Wiley Eastern Limited, 2012

CIE Assessment:

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

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

SEE Assessment:

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

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

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

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C312.1	3	2		2	-	-	-	-	-	-	-	2
C312.2	3	1	1	2	-	-	-	-	-	-	-	3
C312.3	3	2	1	2	-	-	-	-	-	-	-	3
C312.4	3	2	1	2	-	-	-	-	-	-	-	2
C312.5	3	2	-	2	-	-	-	-	-	-	-	2

High-3, Medium-2, Low-1

Module 3: No Problems only theory.

Module 4: No Problems only theory.

Module 5: No Problems only theory.

Course Title	HVDC and FACTS	Semester	VI
Course Code	MVJ20EE631	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4, 2:1:1 (L:T:P)	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to: This course will enable students to

- Explain the basic concepts and requirements of FACTS
- Understand the working and design of shunt devices.
- Understand the working and design of series devices.
- Understand the working and design of combined devices.
- Understand the phenomena of HVDC, converter control techniques.

Module-1	L1, L2	8Hrs.

FACTS Concept and General System Considerations: Transmission Interconnections, Flow ofPower in an AC System, What Limits the Loading Capability? Power Flow and Dynamic StabilityConsiderations of a Transmission Interconnection, Relative Importance of Controllable Parameters,Basic Types of FACTS Controllers, Brief Description and Definitions of FACTS Controllers,Checklist of Possible Benefits from FACTS Technology, In Perspective: HVDC or FACTS.

Laboratory Sessions/ Experimental learning: Cost benefit analysis of HVDC v/s FACTS

Applications: Reactive power compensation, enhancement of power flow in the line.

Video link :https://nptel.ac.in/courses/108/107/108107114/

Module-2	L1, L2, L3	8Hrs.

Static Shunt Compensators: Objectives of Shunt Compensation - Midpoint Voltage Regulation for Line Segmentation, End of Line Voltage Support to Prevent Voltage Instability, Improvement of transient stability. methods of controllable VAR generation –Thyristor controlled Reactor (TCR) and Thyristor Switched Reactor (TSR), Thyristor Switched Capacitor (TSC).Operation of Single Phase TSC – TSR. Switching Converter Type Var Generators.

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/

Module-3	L1, L2, L3, L4	8Hrs.

Static Series Compensators: Objectives of Series Compensation, Concept of Series CapacitiveCompensation, Voltage Stability, Improvement of Transient Stability. GTO Thyristor-ControlledSeries Capacitor, Thyristor-Switched Series Capacitor, Thyristor-Controlled Series Capacitor, TheStatic Synchronous Series Compensator, transmitted power versus transmission angle characteristic. **Laboratory Sessions/ Experimental learning**: Design a control scheme of series compensator in SIMULINK. **Applications**: Power flow control and enhancement of power handling capacity of transmission line. **Video link** : https://nptel.ac.in/courses/108/107/108107114/		
Module-4	**L1, L2, L3, L4**	**8Hrs.**
Combined compensators: Introduction, Unified Power Flow Controller-basic operating principles, conventional control capabilities, independent real and reactive power control, control structure, basic control system for P and Q control, Interline Power Flow Controller- basic operating principles,control structure, practical and application considerations, Generalized and Multifunctional FACTS controllers. **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/		
Module-5	**L1, L2, L3, L4**	**8Hrs.**
Basic Concepts of DC Transmission: Introduction, Comparison of AC and DC, Advantages of HVDC Systems, HVDC System Costs, Overview and Organization of HVDC Systems, HVDC Characteristics and Economic Aspects. **Analysis of HVDC Converters and System Control:** Types of converters, converter configurations (Only diagrams), Converter Control for an HVDC System, HVDC Control and Design, HVDC Control Functions, Reactive Power and Voltage Stability. **Laboratory Sessions/ Experimental learning**: Design the firing angle control scheme for converter station in the SIMULINK. **Applications**: Design of HVDC transmission lines and converter stations, Design of control schemes for converter station. **Video link** :https://nptel.ac.in/courses/108/104/108104013/		
Course outcomes:		
C313.1.1	Understanding the requirements of FACTS devices	

C313.1.2	Design of shunt devices
C313.1.3	Design of series devices
C313.1.4	Design of combined devices
C313.1.5	Develop the knowledge on HVDC converter and system controls.

Text Books:

1	Narain G Hingorani, Laszlo Gyugyi, "Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems", Wiley Publications.
2	Chan-Ki Kim et al, "HVDC Transmission: Power Conversion Applications in Power Systems", Wiley Publications.

Reference Books:

1	K.R.Padiyar, "HVDC Power Transmission Systems: Technology and system Interactions", New Age International (P) Limited, and Publishers.
2	E.W.Kimbark, ,"Direct Current Transmission", John Wiley & SonsPublications

CIE Assessment:

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- Quizzes/mini tests (4 marks)
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SEE Assessment:

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

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

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C313.1.1	2	1	-	-	3	-	-	-	-	-	-	1
C313.1.2	2	2	-	-	3	-	-	-	-	-	-	1
C313.1.3	2	1	-	-	3	-	-	-	-	-	-	1
C313.1.4	2	2	-	-	2	-	-	-	-	-	-	1
C313.1.5	2	2	-	-	2	-	-	-	-	-	-	1

Course Title	Industrial Automation	Semester	VI
Course Code	MVJ20EE632	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4, 2:1:1 (L:T:P)	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to: Students will enable students to

- Discuss architecture of industrial automation system and draw block diagram of industrial automation & control system.
- Describe the basic and application of PLC for automation.
- Discuss the fundamentals of PLC Wiring Diagram and Ladder Logic Program**.**
- Discuss different program control instruction in PLC
- Discuss the fundamentals of SCADA and HMI.

Module-1	L1, L2	08Hrs.

Introduction to automation: Automation overview, Requirement of automation systems, Architecture of Industrial Automation system, different automation components, Introduction of PLC and supervisory control and data acquisition (SCADA).

Industrial bus systems: modbus & profibus

Laboratory Sessions/ Experimental learning: Study hardware and software used in PLC

Applications: Industrial and commercial applications.

Web Link and Video Lectures: https://nptel.ac.in/courses/108/105/108105088/

Module-2	L1, L2, L3	08Hrs.

Programmable logic controllers: Programmable controllers, Programmable logic controllers, Analog digital input and output modules, PLC programming, Ladder diagram, Sequential flow chart, PLC Communication and networking, PLC selection, PLC Installation, Advantage of using PLC for Industrial automation, Application of PLC to process control industries.

Laboratory Sessions/ Experimental learning: Implementation Logic Gates and verification of truth table in virtual lab or Logix Pro 500.

Applications: Industrial and commercial applications

Web Link and Video Lectures: http://www.digimat.in/nptel/courses/video/108105088/L31.html

Module-3	L1, L2, L3	08Hrs.

Developing Fundamental PLC Wiring Diagrams and Ladder Logic Programs: converting Relay

Schematics into PLC LadderPrograms, writing a Ladder Logic Program TimerInstructions, On/offDelay Timer Instruction, Retentive Timer, Cascading TimersProgramming Counter Instructions, Up-Counter,Down-Counter, CascadingCounters, Incremental 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 **Web Link and Video Lectures:**https://www.youtube.com/watch?v=qD1WGwe0AQ0		
Module-4	**L1, L2, L3**	**08Hrs.**
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. **Web Link and Video Lectures:** https://www.youtube.com/watch?v=grr-3XhBSuY		
Module-5	**L1, L2, L3**	**08Hrs.**
SCADA Fundamentals: Introduction, Open system: Need and advantages, building blocks of SCADA systems, Remote terminal unit (RTU): Evolution of RTUs, Components of RTU, Communication subsystem, Logic subsystem, Termination subsystem, Testing and human-machine interface (HMI) subsystem, Power supplies, Advanced RTU functionalities, Intelligent electronic devices (IEDs), Data concentrators and merging units, SCADA communication systems. **Laboratory Sessions/ Experimental learning:** Study of key concepts within SCADA systems **Application:** Temperature control using PLC and SCADA **Web Link and Video Lectures:**https://youtu.be/X0U8-4ZPcro		
Course outcomes:		
C313.2.1	Explain the architecture of industrial automation system and draw a block diagram of industrial automation & control system	
C313.2.2	Explain basic concepts and Application of PLC to process control industries.	
C313.2.3	Develop the fundamental PLC Wiring Diagrams and Ladder Logic Programsfor different applications.	
C313.2.4	Develop the ladder diagram using different program control instructions.	
C313.2.5	Explain the fundamentals of SCADA and HMI.	
Text Books:		

1	Industrial Instrumentation, Control and Automation, S. Mukhopadhyay, S.Sen and A.K. Deb, Jaico Publishing House, 2013
2	Programmable Logic controllers, Frank D Petruzella, The McGraw Hill ,4th edition.
Reference Books:	
1	Process Control Instrumentation Technology By. C.D. Johnson, PHI
2	Industrial Instrumentation and Control By. S.K. Singh The McGraw Hill Companies

CIE Assessment:

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

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

SEE Assessment:

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

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

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

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C313.2.1	3	2		2		-	-	-	-	-	-	3
C313.2.2	3	2	2	2	2	-	-	-	-	-	-	3
C313.2.3	3	3	3	2	2	-	-	-	-	-	-	3
C313.2.4	3	2	2	2	1	-	-	-	-	-	-	2
C313.2.5	3	2		2		-	-	-	-	-	-	2

High-3, Medium-2, Low-1

Course Title	VLSI Design	Semester	VI
Course Code	MVJ20EE633	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4, 2:1:1 (L: T:P)	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to: This course will enable students to

- Understand the characteristics of CMOS circuit construction
- Introduce the concepts and techniques of modern integrated circuit design and testing (CMOS VLSI).
- Design CMOS combinational and sequential logic at the transistor level, with mask layout.
- Design for higher performance or lower area using alternative circuit families
- Testing and Verification of VLSI Design

Module-1	L1, L2	8Hrs.

Introduction: A Brief History, MOS Transistors, MOS Transistor Switches, CMOS Logic, Circuit and System Representations, MOS Transistor Theory, Ideal I-V Characteristics, Non-ideal I-V Effects, DC Transfer Characteristics, Review of MOS electrical properties, Expression for threshold voltage and drain current, Secondary effects of MOSFET, review of CMOS and bipolar technologies.

Laboratory Sessions/ Experimental learning: Design and demonstrate the MOS transistor connected as a diode using any CAD tool.

Applications: integrated circuit (IC) chips, including microprocessors, microcontrollers, memory chips.

Video link:https://nptel.ac.in/courses/117/101/117101058/

Module-2	L1, L2, L3	8Hrs.

MOS and Bi-CMOS Circuit Design Processes: MOS Layers, Stick Diagrams, Design Rules and Layout.Bi-CMOS processes, Integration and Isolation considerations, Integrated Analog/Digital CMOS Process.

Basic inverter - Inverter Device sizing, Enhancement load and Depletion load inverters, CMOS inverter, CMOS inverter logic levels, Inverter device sizing, combinational logic implementation using NMOS and CMOS inverters.

Laboratory Sessions/ Experimental learning: Draw layout of inverter using Cadence Tool.

Applications: Design of CMOS inverter circuit with different scaling functions.

Video link: 1. https://nptel.ac.in/courses/117106093/

2. https://nptel.ac.in/courses/117106092/		
Module-3	**L1, L2, L3**	**8Hrs.**
Scaling of MOS Circuits: Scaling Models & Scaling Factors for Device Parameters. **Subsystem Design Processes:** Some General considerations, An illustration of Design Processes, Illustration of the Design Processes- Regularity, Design of an ALU Subsystem, The Manchester Carry-chain and Adder Enhancement Techniques, Semiconductor memories, memory chip organization, RAM Cells, dynamic memory cell. **Laboratory Sessions/ Experimental learning**: Simulation of CMOS Inverter characteristics with different values of Inverter Ratio (Kr) using LTspice/Pspice software. **Applications**: Design of nMOS and CMOS inverter circuit. **Video link**: 1. https://www.youtube.com/watch?v=eqnMAaYU4OY 2. https://www.youtube.com/watch?v=zNqmohJHDwc		
Module-4	**L1, L2, L3**	**8Hrs.**
Subsystem Design: Some Architectural Issues, Switch Logic, Gate(restoring) Logic, Parity Generators, Multiplexers, The Programmable Logic Array (PLA), CMOS Logic Gate Design, Basic Physical Design of Simple Gate, CMOS Logic Structures, Clocking Strategies, I/O Structures, Low Power Design. **Laboratory Sessions/ Experimental learning**: Design Manchester Carry-chain using CMOS transistors using any CAD tool. **Applications**: Designing of PLA and PLD **Video link**: https://nptel.ac.in/courses/117106093/		
Module-5	**L1, L2, L3**	**8Hrs.**
Memory, Registers and Aspects of system Timing- System Timing Considerations, Some commonly used Storage/Memory elements. **Testing and Verification:** Introduction, Logic Verification, Logic Verification Principles, Manufacturing Test Principles, Design for testability, Chip Level Test Techniques, System Level Test Techniques, Layout Design for Improved Testability. **Laboratory Sessions/ Experimental learning**: Perform a survey on Prime-Time CAD tool from Synopsis for timing Analysis. **Applications**:Testing of Imperfections in chip fabrication. **Video link:** 1. https://youtu.be/V-GL-oQSa14 (Fault design & Testability) 2. https://youtu.be/P7AQJn7K8Os (Combinational Circuit Test Pattern Generation-ATPG)		
Course outcomes:		

C314.2.1	Demonstrate understanding of MOS transistor theory, CMOS fabrication flow and technology scaling.
C314.2.2	Draw the basic gates using the stick and layout diagrams with the knowledge ofphysical design aspects
C314.2.3	Demonstrate ability to design Combinational, sequential and dynamic logic circuits as per the requirements
C314.2.4	Interpret Memory elements along with timing considerations
C314.2.5	Interpret testing and testability issues in VLSI Design
Text Books:	
1	"CMOS Digital Integrated Circuits: Analysis and Design" - Sung Mo Kang & Yosuf Leblebici, Third Edition, Tata McGraw-Hill.
2	"CMOS VLSI Design- A Circuits and Systems Perspective"- Neil H. E. Weste, and David Money Harris4th Edition, Pearson Education.
Reference Books:	
1	Adel Sedra and K. C. Smith, "Microelectronics Circuits Theory and Applications", 6th or 7th Edition,Oxford University Press, International Version, 2009.
2	Douglas A Pucknell & Kamran Eshragian, "Basic VLSI Design", PHI 3rd Edition, (original Edition – 1994).

CIE Assessment:

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

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

SEE Assessment:

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

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

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

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C404.3.1	2	1	2	2	2	-	-	-	-	-	-	3
C404.3.2	2	2	2	2	2	-	-	-	-	-	-	3
C404.3.3	2	2	2	1	2	-	-	-	-	-	-	3

C404.3.4	3	3	2	2	2	-	-	-	-	-	-	3
C404.3.5	2	3	2	1	2	-	-	-	-	-	-	3

High-3, Medium-2, Low-1

Course Title	High Voltage Engineering	Semester	VI
Course Code	MVJ20EE641	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4, 2:1:1 (L:T:P)	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to: This course will enable students to

- Comprehend Breakdown phenomenon in air, solid and liquid insulation
- Understand the basic generation of High voltage and High current for testing purposes
- Understand the basic measurement of High voltage and High current
- Measurement of - dielectric loss.
- Test high voltage electrical Equipment with various testing devices

Module-1	L1, L2, L3	8Hrs.

Breakdown in Gases: Ionization processes and de-ionization processes, Types of Discharge, Gases as insulating materials, Breakdown in Uniform gap, non-uniform gaps, Townsend's theory, Streamer mechanism, Corona discharge.

Breakdown in Liquid and Solid Insulating Materials: Breakdown in pure and commercial liquids, Solid dielectrics and composite dielectrics, intrinsic breakdown, electromechanical breakdown and thermal breakdown, Partial discharge, applications of insulating medium.

Laboratory Sessions/ Experimental learning: Experiment on measuring insulation strength of air.

Applications: In design of switchgear components having dielectrics subjected to High voltage.

Video link:https://nptel.ac.in/courses/108/108/108108078/

Module-2	L1, L2, L3	8Hrs.

Generation of High Voltages: Generation of high D. C. and A.C. voltages, generation of impulse voltages, generation of impulse currents, tripping and control of impulse generators.

Laboratory Sessions/ Experimental learning: Industrial visit to IISC Bangalore to witness generation of HV.

Applications: Nuclear physics, lightning arrestors and fuse testing

Video link: https://nptel.ac.in/courses/108/108/108108078/

Module-3	L1, L2, L3	8Hrs.

Measurements of High Voltages and Currents: Peak voltage, impulse voltage and high direct current measurement method, cathode ray oscillographs for impulse voltage and current measurement, measurement of dielectric constant and loss factor, partial discharge measurements

Laboratory Sessions/ Experimental learning: Study of Impulse Voltage Generator (virtual lab) **Applications:** To diagnose the insulation condition **Video link**:https://nptel.ac.in/courses/108/108/108108078/		
Module-4	**L1, L2, L3**	**8Hrs.**
Lightning and switching over-voltages: Charge formation in clouds, stepped leader, Dart leader, Lightning Surges. Switching overvoltage, Protection against over-voltages, Surge diverters, Surge modifiers. **Laboratory Sessions/ Experimental learning**: Critical Flashover of a Sphere Gap using IVG (virtual lab) **Applications:** to bypass surge currents or limiting voltage on equipment **Video link** : https://nptel.ac.in/courses/108/108/108108078/		
Module-5	**L1, L2, L3**	**8Hrs.**
High Voltage Testing of Electrical Apparatus:IEC standards for HV Testing of electrical apparatus, testing of insulators and bushings, testing of isolators and circuit breakers, testing of cables, power transformers and some high voltage equipment, High voltage laboratory layout, indoor and outdoor laboratories, testing facility requirements, safety precautions in H. V. Labs **Laboratory Sessions/ Experimental learning**: Parametric Analysis of Impulse Voltage Waveform. (Virtual lab). **Applications:** Design of insulators and cables. **Video link** : https://nptel.ac.in/courses/108/108/108108078		

Course outcomes:	
C314.1.1	Comprehend Breakdown phenomenon in air, solid and liquid insulation
C314.1.2	Understand the basic generation of High voltage and High current for testing purposes
C314.1.3	Understand the basic measurement of High voltage and High current
C314.1.4	Measurement of dielectric loss.
C314.1.5	Test high voltage electrical Equipment with various testing devices

Text Books:	
1	Naidu M. S. and Kamaraju V., "High Voltage Engineering", fourth Edition, Tata McGraw- Hill Publishing Company Limited, New Delhi, 2009.
2	Wadhwa C.L., "High Voltage Engineering", third edition, New Age publishers, New Delhi, 2010.

Reference Books:	
1	Rakosh Das Begamudre, "High Voltage Engineering, Problems and Solutions", New AgeInternational Publishers, New Delhi, 2010.
2	Dieter Kind, Kurt Feser, "High Voltage Test Techniques", Reed educational and

	professionalpublishing ltd. (Indian edition), New Delhi-2001

CIE Assessment:

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

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

SEE Assessment:

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

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

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

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C314.1.1	3	2	-	2	-	-	-	-	-	-	-	2
C314.1.2	3	2	-	2	-	-	-	-	-	-	-	2
C314.1.3	3	2	-	2	-	-	-	-	-	-	-	2
C314.1.4	3	2	-	2	-	-	-	-	-	-	-	2
C314.1.5	3	2	-	3	-	-	-	-	-	-	-	2

High-3, Medium-2, Low-1

Course Title	**Energy Storage andManagement system for ElectricVehicles**	**Semester**	VI
Course Code	MVJ20EE642	**CIE**	50
Total No. of Contact Hours	40	**SEE**	50
No. of Contact Hours/week	4, 2:1:1 (L:T:P)	**Total**	100
Credits	3	**Exam. Duration**	3 Hours

Course objective is to: This course will enable students to

- Understand the needsand types of energy storage.
- Explain the battery characteristics and dynamics.
- Explain IoT based BMS
- Understand energy management systems for EV
- Analyze energy management system for HESS.

Module-1	**L1,L2**	**8Hrs.**

Energy storage: Introduction to energy storage requirements in Hybrid and Electric vehicles, Battery Parameters, Types of Batteries, modeling of Battery, Battery based energy storage and its analysis, Fuel cell basic principle and operations, Types of Fuel cells, Hybridization of different energy storage devices. super capacitors and Flywheel based energy storage and its analysis

Activity: Poster presentation of different types electrical energy storage systems.

Applications: Electric vehicles

Video link: https://youtu.be/2D3h8zwj6QQ

Module-2	**L1,L2,L3**	**8Hrs.**

Battery Characteristics &Battery Pack: Cells and Batteries- conversion of chemical energy to electrical energy- Battery Specifications: Variables to characterize battery operating conditions, Efficiency of batteries;Selection of battery for EVs & HEVs, Traction Battery Pack design, Requirement of Battery Monitoring, Battery State of Charge Estimation methods.

Laboratory Sessions/ Experimental learning: MATLABSimulation for design of battery pack and estimation of SOC.

Applications: Design of battery packs for EVs.

Web Link and Video Lectures:https://youtu.be/WBbefOjmiEQ

Module-3	**L1,L2,L3**	**8Hrs.**

IoT based Battery Management System: Battery Management System: Definition, 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 IoT based BMS

Application: Design of smart BMS.

Web Link and Video Lectures:https://youtu.be/DSoHQupqC30

Module-4	**L1,L2,L3**	**8Hrs.**

Energy Management System: Energy Management Strategies, Automotive networking and communication, EV charging standards, V2G, G2V, V2B, V2H. Business: E-mobility business, electrification challenges, Business- E-mobility business, electrification challenges.

Laboratory Sessions/ Experimental learning:MATLABSimulation of an EV charger.

Application: Design of EV charger, Start up and Marketing aspects of electric vehicles.

Web Link and Video Lectures:https://youtu.be/V004WUdpHeA

Module-5	**L1,L2,L3**	**8Hrs.**

Energy Management of Hybrid Energy Storage System (HESS) in PHEV With Various Driving Mode: Introduction, Problem Description, and Formulation, Modelling of HESS and its Analysis.

Laboratory Sessions/ Experimental learning: Industrial Visit to EV industry.

Application: Design of energy storage for PHEV.

Web Link and Video Lectures:https://youtu.be/G8g1WI1L2YY

Course outcomes:

C314.2.1	Explain needs and typesof energy storage for EVs.
C314.2.2	Select and design battery pack for EVs.
C314.2.3	Discuss IoT based battery management system.
C314.2.4	Explain different charging methods for EVs.
C314.2.5	Model and analyse energy management of HESS in PHEV

Text Books:

1	Artificial Intelligent Techniques for Electric and Hybrid Electric Vehicles, Chitra A, P. Sanjeevikumar, and S. Himavathi, Wiley, 2020.
2	Modern Electric, Hybrid Electric, andFuel Cell Vehicles: Fundamentals,Theory, and Design, M. Ehsani, Y. Gao, S.Gay and Ali Emadi, CRC Press, 2005

Reference Books:

1	Electric and Hybrid Vehicles:Design Fundamentals, Iqbal Husain CRC Press, 2003
2	Energy Management Strategies forElectric and Plug-in Hybrid ElectricVehicles, Sheldon S. Williamson, Springer, 2013

CIE Assessment:

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

marks to be awarded will be the average of three tests

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

SEE Assessment:

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

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

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

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C314.2.1	2	2	-	-	2	2	1	-	-	-	-	1
C314.2.2	2	3	-	-	1	2	1	-	-	-	-	1
C314.2.3	2	3	-	-	1	2	1	-	-	-	-	1
C314.2.4	2	3	-	-	2	2	1	-	-	-	-	1
C314.2.5	2	2	-	-	2	2	1	-	-	-	-	1

High-3, Medium-2, Low-1

Course Title	Advanced Control System	Semester	VI
Course Code	MVJ20EE643	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4, 2:1:1 (L: T: P)	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to: This course will enable students to

- Explain development of state models for linear continuous – time and discrete – time systems
- Define controllability and observability of a system and testing techniques for controllability and observability of a given system
- Explain about inherent and intentional nonlinearities that can occur in control system and developing the describing function for the nonlinearities.
- Explain stability analysis of nonlinear systems using describing function analysis.
- Explain the analysis of nonlinear systems using Lyapunov function and design of Lyapunov function for stable systems.

Module-1	L1, L2, L3	8Hrs.

State Variable Analysis and Design: State Space Representation,Solution of State Equation, State Transition Matrix, Canonical Forms – Controllable Canonical Form, Observable Canonical Form, Jordan Canonical Form.

Laboratory Sessions/ Experimental learning: State space design of servomotors.

Applications: State space design of real systems for developing controllers.

Web Link and Video Lectures:

1. https://youtu.be/6iqj_vUxMXc
2. https://youtu.be/xhIaD2lNsZc

Module-2	L1, L2, L3	8Hrs.

Controllability and Observability: Concepts of Controllability and Observability, Controllability and observability tests for continuous time, linear time-invariant systems. Controllability and Observability modes in State. Jordan's canonical form, Controllable and Observable companion forms for single input single output Systems, pole placement by State feedback.

Laboratory Sessions/ Experimental learning: Identification of systems controllability and observability through MATLAB.

Applications: Checking of stability of real systems.

Web Link and Video Lectures: https://youtu.be/eKSoJlQjwgg

Module-3	L1, L2, L3	8Hrs.
Nonlinear Systems: Behaviour of Nonlinear systems, jump resonance, Sub-harmonic oscillation, Limit cycles, common physical non-linearity, Singular points. **Laboratory Sessions/ Experimental learning**: **Applications**: Identification of non-linear system behavior. **Web Link and Video Lectures:** https://www.youtube.com/watch?v=tBfWD1xbHhc		
Module-4	**L1, L2, L3**	**8Hrs.**
Phase plane-method: Construction of phase plane trajectories, Isoclines method, Delta method, Describing function Analysis – Basic concepts. **Laboratory Sessions/ Experimental learning:** MATLAB design of Sliding Mode Controller **Applications**: Visualizing the behavior and design of physical systems. **Web Link and Video Lectures:** https://www.youtube.com/watch?v=gA0CmZKyJcs		
Module-5	**L1, L2, L3**	**8Hrs.**
Stability: Lyapunov's stability criteria, Theorems, Direct method of Lyapunov For linear systems, Non-Linear Systems, Methods of constructing Lyapunov function, Krasovki's Method. **Laboratory Sessions/ Experimental learning:** MATLAB simulation of Lyapunov's stability **Applications**: Closed-loop nonlinear control of any electrical system. **Web Link and Video Lectures:** https://youtu.be/dm0k8jINX-A		

Course outcomes:	
C314.3.1	Determine the state model for electrical, mechanical, and electromechanical systems.
C314.3.2	Solve the state equations by different methods.
C314.3.3	Analyze the controllability of the system and design the controller.
C314.3.4	Analyze the observability of the system and design the observer.
C314.3.5	Understand nonlinear systems and evaluate the stability of nonlinear systems.
Text Books:	
1	Ogata K, ―Modern Control Engineering‖, Prentice Hall of India, New Delhi, 2013.
2	M.Gopal, "Digital Control and State Variable Methods: Conventional and Intelligent Control Systems", Tata McGraw-Hill, 2007.
Reference Books:	
1	Norman S Nise, ―Control System Engineering ―, John Wiley & Sons, New Delhi, 2013.
2	A. Anand Kumar "Control systems" PHI, 2nd edition. 2018.
CIE Assessment:	
CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA	

marks to be awarded will be the average of three tests

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

SEE Assessment:

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

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

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

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C314.3.1	3	3	2	2	2	2	1	-	1	2	2	3
C314.3.2	3	3	2	3	3	2	1	-	1	2	1	2
C314.3.3	3	3	2	3	3	2	1	-	-	-	1	2
C314.3.4	3	3	2	3	-	-	-	-	-	1	1	1
C314.3.5	3	3	2	2	-	1	2	-	-	1	-	1

High-3, Medium-2, Low-1

Course Title	Renewable Energy Sources	Semester	VI
Course Code	MVJ20EE651	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4, 2:1:1 (L:T:P)	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to: This course will enable students to

- Understand energy resources and availability of renewable energy
- Examine types of solar collectors, their configurations, solar cell system, their characteristics, and their applications.
- Discuss generation of energy from hydrogen, wind, and geothermal system
- Discuss production of energy from biomass, biogas and tidal.
- Discuss sea wave energy and OTEC.

Module-1	L1,L2	8hrs

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 RES available.

Applications: Get awareness about available RES.

Web Link and Video Lectures:https://youtu.be/e0nkkKDjY50

Module-2	L1,L2, L3	8hrs

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		
Module-3	**L1,L2**	**8hrs**
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		
Module-4	**L1,L2**	**8hrs**
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 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		
Module-5	**L1,L2**	**8hrs**

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

Course outcomes:	
C315.1.1	Understand energy resources and availability of renewable energy
C315.1.2	Examine types of solar collectors, their configurations, solar cell system, its characteristics and their applications
C315.1.3	Discuss generation of energy from hydrogen, wind and geothermal system
C315.1.4	Discuss production of energy from biomass, biogas and tidal.
C315.1.5	Discuss sea wave energy and OTEC.

Text Books:	
1	Nonconventional Energy Resources ShobhNath Singh Pearson 1 st Edition, 2015
2	Nonconventional Energy Resources B.H. Khan McGraw Hill 3 rd edition

Reference Books:	
1	Renewable Energy; Power for a sustainable Future Godfrey Boyle Oxford 3 rd Edition, 2012
2	Renewable Energy Sources: Their Impact on global Warming and Pollution Tasneem Abbasi S.A. Abbasi PHI

CIE Assessment:

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

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

SEE Assessment:

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

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

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

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C315.1.1	1	1	1	-	-	2	2	1	3	1	1	1
C315.1.2	1	1	1	-	-	2	2	2	-	2	1	2
C315.1.3	1	1	1	-	-	2	3	1	3	2	1	1
C315.1.4	1	2	1	-	-	2	2	1	-	1	1	2
C315.1.5	1	2	1	-	-	2	1	1	-	1	1	1

High-3, Medium-2, Low-1

Course Title	Industrial Instrumentation	Semester	VI
Course Code	MVJ20EE652	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4, 2:1:1 (L: T:P)	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to: This course will enable students to

- Understand the basics in measurement techniques of force, torque and speed and
- Learn about methods of measurement of acceleration, Vibration and density
- Gain knowledge on basics of transmitter and types of transmitters.
- Understand micro electromechanical systems.
- Understand the digital data acquisition system and control

Module-1	L1,L2,L3	8Hrs.

Measurement of force, torque and speed Different types of load cells - Hydraulic, Pneumatic, strain gauge. Magneto elastic and Piezoelectric load cells - Different methods of torque measurement Strain gauge-Relative angular twist-Speed measurement-Capacitive tacho-Drag cup type tacho-D.C and A.C tacho generators - Stroboscope.

Laboratory Sessions/ Experimental learning: Speed measurement of machines.

Applications: Electrical and mechanical engineering

Web Link and Video Lectures:

1.https://youtu.be/EakRe6ICM-Q

2. https://www.watelectrical.com/electric-drive-working-and-its-applications/

Module-2	L1,L2,L3	8Hrs.

Measurement of acceleration, vibration and density - Accelerometers - LVDT, Piezoelectric, Strain gauge and Variable reluctance type accelerometers - Mechanical type vibration instruments - Seismic instruments as accelerometer - Vibration sensor - Calibration of vibration pickups - Units of density and specific gravity - Baume scale and API scale - Pressure type densitometers - Float type densitometers - Ultrasonic densitometer - gas densitometer.

Laboratory Sessions/ Experimental learning:LVDT experiment for measurement of displacement.

Applications: Manufacture industries

Web Link and Video Lectures:

1.https://youtu.be/EakRe6ICM-Q

2.https://nptel.ac.in/content/storage2/courses/108105066/PDF/L13(DK)(PE)%20((EE)NPTEL)%20.pdf

Module-3	L1,L2,L3	8Hrs.
TRANSMITTER: Pneumatic transmitter: Operation – Electronic transmitter: Study of 2wire and 4 wire transmitters –Operation of Electronics and Smart transmitters – Principle of operation of flow, level, temperature and pressure transmitters – Installation and Calibration of smart and conventional transmitters **Laboratory Sessions/ Experimental learning**: Demonstration of Different types of transmitters **Application:**Communication sectors **Web Link and Video Lectures:** 1. https://freevideolectures.com/course/4600/nptel-energy-conservation-waste-heat-recovery/52 2. https://youtu.be/E76q-9q7ZDg		
Module-4	**L1,L2,L3**	**8Hrs.**
Micro Electromechanical system (MEMS): Advantages and Applications, MEMS micro sensors and actuators, Manufacturing process: Bulk micro machining and surface micromachining, MEMS accelerometers Virtual instrumentation system: architecture of virtual instruments – Virtual instruments and traditional instruments – concepts of graphical programming. **Laboratory Sessions/ Experimental learning:** Case study on Virtual instrumentation system. **Application:** automation industries **Web Link and Video Lectures:** 1.https://nptel.ac.in/content/storage2/courses/108103009/download/M7.pdf 2. https://youtu.be/l46GUVBisUo		
Module-5	**L1,L2,L3**	**8Hrs.**
Digital Data Acquisition systems & control: Use of signal conditioners, scanners, signal converters, recorders, display devices, A/D & D/A circuits in digital data acquisition. Instrumentation systems. Types of Instrumentation systems. Components of an analog Instrumentation Data – Acquisition system. Multiplexing systems. Uses of Data Acquisition systems. Use of Recorders in Digital systems. Digital Recording systems. Modern Digital Data Acquisition system. Analog Multiplexed operation, operation of sample Hold circuits. **Laboratory Sessions/ Experimental learning:** working of A/D & D/A in circuit. **Application:**signal transmission and microprocessor applications **Web Link and Video Lectures:** **1.** https://www.youtube.com/watch?v=_LAuDTNW5dw **2.** **https://new.siemens.com/global/en/products/buildings/fire-safety/applications/li-ion-battery-storage-system.html**		

Course outcomes:

C315.2.1	Describe the different types of measurement techniques to measure force, torque and speed.
C315.2.2	Describe the techniques of acceleration, Vibration and density

C315.2.3	Describe the basics of transmitter and its types.
C315.2.4	Describe the basics of micro electromechanical system
C315.2.5	Describe the digital data acquisition systems & control.
Text Books:	
1	S.K. Singh, 'Industrial Instrumentation and Control', Tata McGraw Hill, 2003. 7. D.P. Eckman', Industrial Instrumentation', Wiley Eastern Ltd
2	R.K. Jain, 'Mechanical and Industrial Measurements', Khanna Publishers, New Delhi,1999.
Reference Books:	
1	D. Patranabis, 'Principles of Industrial Instrumentation', Tata McGraw Hill Publishing Company Ltd, 1996.
2	A.K. Sawhney and P. Sawhney, 'A Course on Mechanical Measurements, Instrumentation and Control', DhanpathRai and Co, 2004.

CIE Assessment:

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

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

SEE Assessment:

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

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

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

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C315.2.1	3	1	-	2	-	-	-	-	-	-	-	2
C315.2.2	3	1	-	2	-	-	-	-	-	-	-	2
C315.2.3	3	2	-	2	-	-	-	-	-	-	-	2
C315.2.4	3	2	-	2	-	-	-	-	-	-	-	2
C315.2.5	3	2	-	2	-	-	-	-	-	-	-	2

High-3, Medium-2, Low-1

Course Title	Utilization of Electrical Power	Semester	VI
Course Code	MVJ20EE653	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4, 2:1:1 (L: T:P)	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to: This course will enable students to

- Discuss electric heating, air-conditioning and electric welding.
- Explain the terminology of illumination, laws of illumination, construction and working of electric lamps.
- Discuss systems of electric traction, speed time curves and mechanics of train movement.
- Discuss braking of electric motors, traction systems and power supply and other traction systems.

Module-1	L1, L2, L3	08Hrs.

Heating and welding: Electric Heating, Resistance ovens, Radiant Heating, Induction Heating, Highfrequency Eddy Current Heating, Dielectric Heating, The Arc Furnace, Heating of Buildings, Air-Conditioning, Electric Welding and Modern Welding Techniques.

Electrolytic Process: Ionization, Faraday's Laws of Electrolysis, Definitions, Extraction of Metals, Refining of Metals, Electro Deposition.

Laboratory Sessions/ Experimental learning: Demonstration of welding

Applications: Impure metal refining.

Web Link and Video Lectures:

1.https://nptel.ac.in/content/storage2/courses/113104058/mme_pdf/Lecture38.pdf

2. https://nptel.ac.in/content/storage2/courses/103103027/module9/lec3/2.html

Module-2	L1, L2, L3	08Hrs.

Illumination: Introduction, Radiant Energy, Definitions, Laws of Illumination, Polar Curves,Photometry, Measurement of Mean Spherical Candle Power by Integrating Sphere, IlluminationPhotometer, Energy Radiation and luminous Efficiency, electric Lamps, Cold Cathode Lamp,Lighting Fittings, Illumination for Different Purposes, Requirements of Good Lighting.

Laboratory Sessions/ Experimental learning: Measurement of candle power of a lamp

Applications: Street lighting

Web Link and Video Lectures:

1.https://nptel.ac.in/content/storage2/courses/108105061/Illumination%20%20Engineering/Lesson-

06/pdf/L-6(NKK)(IE)%20((EE)NPTEL).pdf

2. https://nptel.ac.in/courses/108/105/108105060/

Module-3	L1, L2, L3	08Hrs.

Electric Traction: Introduction, Systems of Traction, Systems of electric Traction, Speed - Time Curves for TrainMovement,Mechanics of Train Movement, Train Resistance, Adhesive Weight, Coefficient ofAdhesion.

Motors for Electric traction: Introduction, Series and Shunt Motors for Traction Services, Two SimilarMotors (Series Type) are used to drive a Motor Car, Tractive Effort and Horse Power, AC Series Motor,Three Phase Induction Motor.

Laboratory Sessions/ Experimental learning: Demonstration on speed control of Three Phase Motors.

Application: Locomotive control

Web Link and Video Lectures:

1.https://nptel.ac.in/courses/108/104/108104140/

2. https://nptel.ac.in/content/syllabus_pdf/108104140.pdf

Module-4	L1, L2, L3	08Hrs.

Braking: Introduction, Regenerative Braking with Three Phase Induction Motors, Braking with Single Phase Series Motors, Mechanical braking, Magnetic Track Brake, Electro – Mechanical DrumBrakes.

Electric Traction Systems and Power Supply: System of Electric Traction, AC Electrification, Transmission Lines to Sub - Stations, Sub – Stations, Feeding and Distribution System of AC Traction,Feeding and Distribution System for DC Tramways, Electrolysis by Currents through Earth,Negative Booster, System of Current Collection, Trolley Wires.

Laboratory Sessions/ Experimental learning: Demonstration of regenerative braking

Application: Braking of a electric vehicle.

Web Link and Video Lectures:

1.https://nptel.ac.in/content/storage2/courses/112105125/pdf/mod12les2.pdf

2. https://nptel.ac.in/courses/108/105/108105153/

Module-5	L1, L2, L3	08Hrs.

Electric Vehicles: Configurations of Electric Vehicles, Performance of Electric Vehicles, Tractive Effort in Normal Driving, Energy Consumption, Battery charging management in EV.

Hybrid Electric Vehicles: Concept of Hybrid Electric Drive Trains, Architectures of Hybrid ElectricDrive Trains.

Laboratory Sessions/ Experimental learning: Performance analysis of electric vehicles using

simulation.

Application: Electric transport.

Web Link and Video Lectures:

1.https://nptel.ac.in/courses/108/103/108103009/

2. https://nptel.ac.in/courses/108/102/108102121/

Course outcomes:	
C315.3.1	Explain the different methods of electric heating & welding
C315.3.2	Explain the laws of electrolysis, extraction, refining of metals and electro deposition process
C315.3.3	Explain the laws of illumination, different types of lamps, lighting schemes and design of lighting systems
C315.3.4	Explain the systems of electric traction, speed time curves and mechanics of train movement
C315.3.5	Interpret the motors used for electric traction, their control & braking and power supply system used for electric traction

Text Books:	
1	A Textbook on Power System Engineering, A. Chakrabarti et al, DhanpatRai and Co, 2nd Edition, 2010.
2	Utilization, Generation and Conservation of Electrical Energy, Sunil S Rao, Khanna Publishers, 1stEdition, 2011.

Reference Books:	
1	Utilization of Electric Power and Electric Traction, G.C. Garg, Khanna Publishers, 9th Edition, 2014.
2	R.K.Rajput, Utilisation of Electric Power, Laxmi publications Private Limited.,2007.

CIE Assessment:

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

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

SEE Assessment:

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

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

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

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C315.3.1	2	2	2	1	3	-	-	-	2	2	2	1
C315.3.2	2	2	2	1	3	-	-	-	2	2	2	1
C315.3.3	1	1	1	1	-	-	-	2	2	2	2	2
C315.3.4	2	2	2	1	-	-	-	2	2	2	2	2
C315.3.5	2	2	2	1	-	-	-	2	2	2	2	2

High-3, Medium-2, Low-1

Course Title	**Machine Design and Electrical Drawing**	**Semester**	VI
Course Code	MVJ20EEL66	**CIE**	50
Total No. of Contact Hours	20	**SEE**	50
No. of Contact Hours/week	4,0:2:2 (L:T:P)	**Total**	100
Credits	2	**Exam. Duration**	3 Hours

Course objective is to: This course will enable students to

- Design the electrical machines winding diagram
- Design and draw the sectional view & elevation view of DC machines
- Design and draw the sectional view & elevation view ofAC machines
- Design and draw the sectional view & elevation view oftransformers.
- Draw the single line diagram of the substation

Sl No	Experiment Name	RBT Level	Hours
1	Design and draw the progressive simplex single layer lap winding and wave winding for DC machines.	L3	2
2	Design and draw the progressive simplex single layer lap winding and wave winding for a three-phase AC machine.	L3	2
3	Design and draw the single layer mush type winding for a three-phase AC machine.	L3	2
4	Design and draw the sectional view and elevation view of the DC machine.	L3	2
5	Design and draw the sectional view and elevation view of the squirrel cage induction motor.	L3	2
6	Design and draw the sectional view and elevation view of slipring induction motor.	L3	2
7	Design and draw the sectional view elevation view of single-phase core type transformer.	L3	2
8	Draw the single line diagram of a substation for given details.	L3	2
Along with mandatory experiments students are advised to complete two open ended experiments. The following are some suggestions for open ended experiments.			
1	Design and draw the progressive simplex double layer lap winding and wave winding for DC machine.	L3	2
2	Design and draw the retrogressive simplex double layer lap	L3	2

	winding and wave winding for DC machine.		
3	Design and draw the sectional view and elevation view of salient pole alternator.	L3	2

Course outcomes:

C316.1	Design, winding diagram of electrical machines using AUTOCAD tool.
C316.2	Design, DC machine using AUTOCAD tool.
C316.3	Design, AC machine using AUTOCAD tool.
C316.4	Design different sectional views of the transformer using the AUTOCAD tool.
C316.5	Design single line diagram of generating, transmitting, and distributing station using AUTOCAD tool.

Scheme of Evaluation

SEE :

Examinations will be conducted for 100 marks and scaled-down to 50. The weight age shall be,
Write-up : 20 marks
Conduction : 40 marks
Analysis of results : 20 marks
Viva : 20

CIE :

Regular Lab work :20
Record writing :5
Lab Tests(Minimum 2 tests shall be conducted for 15 marks and average of two will be taken)
Viva 10 marks

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C316.1	3	3	3	1	1	-	-	-	-	-	1	2
C316.2	3	3	3	3	3	-	-	-	-	-	1	2
C316.3	3	3	3	3	3	-	-	-	-	-	1	2
C316.4	3	3	3	3	3	-	-	-	-	-	2	2
C316.5	3	3	3	3	3	-	-	-	-	-	2	2

High-3, Medium-2, Low-1

Course Title	**Power System Simulation Lab**	**Semester**	VI
Course Code	MVJ20EEL67	**CIE**	50
Total No. of Contact Hours	20	**SEE**	50
No. of Contact Hours/week	4, 0:2:2 (L:T:P)	**Total**	100
Credits	2	**Exam. Duration**	3 Hours

Course objective is to: This course will enable students to

- Understand the Y-bus and Z-bus formation for transmission system using MATLAB
- Understand the load flow analysis of power system using MATLAB
- Understand the transfer function models of power system equipment using MATLAB.
- Understand the power system analysis using MI-Power software
- **U**nderstand the optimal scheduling of thermal plants using MI-Power software

Sl No	Experiment Name	RBT Level	Hours
1	Y Bus Formation for Power Systems with and without Mutual Coupling, by Singular Transformation and Inspection Method.	L3	2
2	Formation of Z Bus (without mutual coupling) using Z-Bus Building Algorithm.	L3	2
3	ABCD parameters: i) Formation for symmetric π/T configuration ii) Verification of AD-BC=1	L3	2
4	Load flow analysis of transmission system using N-R method.	L3	2
5	Formation of Jacobian for a System not Exceeding 4 Buses (No PV Buses) in Polar Coordinate Using Mi Power package.	L3	2
6	Load flow analysis using Gauss siedel and NR methods Using Mi-Power package	L3	2
7	Short Circuit Studies using Using Mi-Power package	L3	2
8	To obtain Swing Curve and to Determine Critical Clearing Time, Regulation, Inertia Constant/Line Parameters /Fault Location/Clearing Time/Pre-Fault Electrical Output for a Single Machine connected to Infinite Bus through a Pair of identical Transmission Lines Under 3-Phase Fault On One of the two Lines.	L3	2
Along with mandatory experiments students are advised to complete two open ended experiments. The following are some suggestions for open ended experiments.			
1	Optimal placement of distributed generation in the distribution system using PSO	L3	2
2	Frequency control in micro grid with two generating plants with a step load change.	L3	2

3	Transfer function model for microgrid with multiple energy resources using SIMULINK.	L3	2

Course outcomes:

C317.1	Build the Y-bus and Z-bus for a given transmission system.
C317.2	Analyze the power system with the help of load flow analysis using MATLAB
C317.3	Build the transfer function models of the power system.
C317.4	Analyze the power system with the help of Mi-Power software
C317.5	Schedule the thermal power plant with the help of Mi-Power software

Scheme of Evaluation

SEE :

Examinations will be conducted for 100 marks and scaled-down to 50. The weight age shall be,
Write-up : 20 marks
Conduction : 40 marks
Analysis of results : 20 marks
Viva : 20

CIE :

Regular Lab work :20
Record writing :5
Lab Tests(Minimum 2 tests shall be conducted for 15 marks and average of two will be taken)
Viva 10 marks

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C317.1	3	3	3	3	2	-	-	-	1	2	2	1
C317.2	3	3	3	3	3	-	-	-	1	3	3	3
C317.3	3	3	3	3	3	-	-	-	1	3	2	2
C317.4	3	3	2	3	3	-	-	-	1	3	2	1
C317.5	3	3	2	3	3	-	-	-	1	3	2	1

High-3, Medium-2, Low-1

Course Title	MINI PROJECT	Semester	VI
Course Code	MVJ20EEMP68	CIE	50
Total No. of Contact Hours	L : T : P :: 0 : 0 : 6	SEE	50
No. of Contact Hours/week	-	Total	100
Credits	03	Exam. Duration	3 Hours

Course Objective: The objective of the course is to

- Support independent learning and innovative attitude.
- Guide to select and utilize adequate information from varied resources upholding ethics.
- Guide to organize the work in the appropriate manner and present information (acknowledging the sources)clearly.
- Develop interactive, communication, organisation, time management, and presentation skills.
- 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: At the end of the course the student will be able to:

C318.1	Describe the project and be able to defend it. Develop critical thinking and problem-solving skills.
C318.2	Learn to use modern tools and techniques. Communicate effectively and present ideas clearly and coherently both in written and oral forms.
C318.3	Develop skills to work in a team to achieve a common goal. Develop skills in project management and finance.
C318.4	Develop skills of self-learning, evaluate their learning and take appropriate actions to improve it.
C318.5	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
C318.1	2	2	2	3	3	2	1	1	2	1	1	2
C318.2	2	2	2	3	3	2	1	1	2	1	2	2
C318.3	2	2	2	3	3	2	1	1	2	1	2	2
C318.4	2	2	2	3	3	2	1	1	2	1	2	2
C318.5	2	2	2	3	3	2	1	1	2	1	2	2

Course Title	Switchgear and Protection	Semester	VII
Course Code	MVJ20EE71	CIE	50
Total No. of Contact Hours	50	SEE	50
No. of Contact Hours/week	5, 3:1:1 (L: T:P)	Total	100
Credits	4	Exam. Duration	3 Hours

Course objective is to: This course will enable students to

- Discuss performance of protective relays, components of protection scheme andrelayterminology.
- Explain Overcurrent protection using electromagnetic relays and Overcurrent protective schemes.
- Explain construction, operating principles of various distance relays for distance protection.
- Discuss protection of generators, motors, Transformer and Bus Zone Protection.
- Discuss construction, operating principles of staticand numerical relays for Numerical protection.
- Explain the principle of circuit interruption and different types of circuit breakers.

Module-1	L1, L2	10Hrs

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:

5. https://nptel.ac.in/courses/108/101/108101039/
6. https://youtu.be/NEXWcOgqZOI

Module-2	L1, L2, L3	10Hrs

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:

3. https://nptel.ac.in/courses/108/101/108101039/
4. https://youtu.be/XdE149Hk_h0

Module-3	**L1, L2, L3**	**10Hrs**

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:

5. https://nptel.ac.in/courses/108/101/108101039/
6. https://youtu.be/ZXyq-xxRLnQ

Module-4	**L1, L2, L3**	**10Hrs**

Numerical ProtectionStatic 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:

3. https://nptel.ac.in/courses/108/101/108101039/
4. https://youtu.be/NEXWcOgqZOI

Module-5	**L1, L2, L3**	**10Hrs**

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:

3. https://nptel.ac.in/courses/108/101/108101039/
4. https://youtu.be/JRv2RVyYMtM

Course outcomes:

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

Text Books:

1	Badriram and D.N. Vishwakarma, Power System Protection and Switchgear, TMH 2001
2	J B Gupta,Fundamentals of Switchgear and Protection, Technical Publications, 2001.

Reference Books:

1	Y.G.Paithankar and S.R.Bhide ,Fundamentals of Power system protection, PHI private limited,NewDelhi,2010
2	Sunil S Rao, Switch Gear and Protection, Khanna Publication, 1999.

CIE Assessment:

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

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

SEE Assessment:

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

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

xv. One question must be set from each unit. The duration of examination is 3 hours.												
CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
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

High-3, Medium-2, Low-1

Course Title	**Power Quality**	**Semester**	VII
Course Code	MVJ20EE72	**CIE**	50
Total No. of Contact Hours	50	**SEE**	50
No. of Contact Hours/week	5, 3:1:1 (L: T:P)	**Total**	100
Credits	4	**Exam. Duration**	3 Hours

Course objective is to: This course will enable students to

- Understand power quality related terms
- Illustrate power quality issues for short and long interruptions
- Construct study of characterization of voltage sag magnitude.
- Understand the fundamentals and effect of harmonics.

Module-1	**L1, L2**	**10Hrs.**

Introduction: Introduction of the Power Quality (PQ) issues, Voltage Sag, Swell, Surges, Harmonics, over voltages, spikes, Voltage fluctuations, Transients, Interruption,Characteristics and Causes of various power quality problem, overview of power quality phenomenon, power quality monitoring, IEEE guidelines, standards and recommended practices.

Laboratory Sessions/ Experimental learning: Study of effect of nonlinear loads on power quality by usingMATLAB simulation

Applications: Identification and classification of power quality issues.

Video link: https://nptel.ac.in/courses/108/107/108107157

Module-2	**L1, L2, L3, L4**	**10Hrs.**

Voltage sags – Sources of Sags and Interruptions, Estimating Voltage Sag Performance, Fundamental Principles of Protection, Solutions at the End-User Level, Evaluating the Economics of Different Ride-Through Alternatives, Motor-Starting Sags, Utility System Fault-Clearing Issues

Mitigation of voltage sag – Introduction to mitigation of voltage sags, DVR, Static transferswitches and fast transfer switches.

Laboratory Sessions/ Experimental learning: Design of dynamic voltage restorer using MATLAB

Applications: Mitigation of voltage sag

Video link :https://nptel.ac.in/content/storage2/108/107/108107157/MP4/mod02lec06.mp4

Module-3	**L1, L2, L3**	**10Hrs.**

Transient over Voltages: Sources of Transient Overvoltage, Principles of Overvoltage protection, devices for Overvoltage protection, Utility Capacitor-Switching Transients, Utility System Lightning Protection. , Ferro resonance phenomenon, , Switching Transient Problems with Loads, Computer Tools for Transients Analysis

Laboratory Sessions/ Experimental learning: Simulation for generation of transients **Applications**: Selection of equipment rating. **Video link:** https://nptel.ac.in/content/storage2/108/107/108107157/MP4/mod02lec07.mp4		
Module-4	**L1, L2, L3**	**10Hrs.**
Fundamentals of Harmonics: IEEE guide lines, standards and recommended practices, Harmonic Distortion, Voltage versus Current Distortion, Harmonics versus Transients, Harmonic Indexes, Harmonic Sources from Commercial Loads, Harmonic Sources from Industrial Loads, Locating Harmonic Sources, Effects of Harmonic distortion, Inter harmonics, Harmonic distortion Evaluations, Principles for compensating Harmonics **Laboratory Sessions/ Experimental learning**: Study of current harmonics by using MATLAB simulation. **Applications**: Identification of harmonics for designing harmonic filters. **Video link:** https://www.youtube.com/watch?v=FiGjNyX6h8c		
Module-5	**L1, L2, L3, L4**	**10Hrs.**
Effects of Harmonics Distortion: Introduction, Resonances, Effects of Harmonics on Rotating Machines, Effect of Harmonics on Static Power Plant, Power Assessment with Distorted Waveforms, Harmonic Interference with Power System Protection, Effect of Harmonics on Consumer Equipment. **Power Quality Monitoring**: Monitoring considerations, Power Quality Measurement Equipment, Assessment of Power Quality Measurement Data, Application of intelligent Systems, Power Quality Monitoring Standards, Monitoring considerations **Laboratory Sessions/ Experimental learning:** Design of active shunt compensator for harmonics compensation **Applications:** Active filters **Video link:** https://www.youtube.com/watch?v=FiGjNyX6h8c		

Course outcomes:	
C402.1	Discuss the various power quality phenomenon
C402.2	Interpret and evaluate the voltage sags and interruptions
C402.3	Interpret and evaluate the Transient over voltages
C402.4	Discuss the fundamental, effects of harmonics.
C402.5	Understand the power quality problems in distribution system

Text Books:	
1	Dugan, Roger C, Santoso, Surya, McGranaghan, Mark F Beaty, “Electric Power Quality,” H Wayne McGraw-Hill professional publication 2003.
2	Math H. J.Bollen, “Understanding power quality problems voltage sags and interruptions”-. IEEE Press, 2000.

Reference Books:	
1	Power System Harmonics, J. Arrillaga, N.R. Watson, John Wiley & Sons Ltd, Second Edition, 2003.
2	Power Quality: Problems and Mitigation Techniques, Bhim Singh, Ambrish Chandra, Kamal AlHaddad, Wiley, 2014.

CIE Assessment:

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

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

SEE Assessment:

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

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

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

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C402.1	3	3	3	2	3	2	2	-	2	1	-	2
C402.2	3	3	3	2	3	2	2	-	2	1	-	2
C402.3	3	3	3	3	3	2	2	-	2	1	-	2
C402.4	3	3	3	3	3	2	2	-	2	1	-	2
C402.5	3	3	3	3	3	2	2	-	2	1	-	2

High-3, Medium-2, Low-1

Course Title	Smart Grid	Semester	VII
Course Code	MVJ20EE731	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4, 2:1:1 (L:T:P)	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to: This course will enable students to

- Understand the basics of power system and renewable generation integration.
- Understand concept of smart grid and communications in smart grid.
- Understand the demand side management
- Understand the wide area measurement, security and privacy.
- Understand the economics of power system.

Module-1	L1, L2, L3	8Hrs.

Smart Grid: Introduction to Smart Grid: Evolution of Electric Grid, Concept of Smart Grid, Definitions, Need of Smart Grid, Functions of Smart Grid, Opportunities & Barriers of Smart Grid, Difference between conventional & smart grid, Present development & International policies in Smart Grid.

Renewable Generation: Renewable Resources: Wind and Solar, Micro-grid Architecture, Distributed Storage and Reserves, dealing with short term variations, stochastic models of solar and wind generation, forecasting of renewable power generation.

Laboratory Sessions/ Experimental learning: Forecasting of wind power generation

Applications: Renewable generation integration and microgrid formation

Video link :https://nptel.ac.in/courses/108/107/108107113/

Module-2	L1, L2, L3	8Hrs.

Smart Grid Communications: Two-way Digital Communications Paradigm, Network Architectures, IP-based Systems Power Line Communications, Advanced Metering Infrastructure.

Laboratory Sessions/ Experimental learning: Design any network architecture using suitable software

Applications: Design of smart grid: A case study

Video link :https://nptel.ac.in/courses/108/107/108107113/

Module-3	L1, L2, L3	8Hrs.

Demand Side Management: Definition, Applications, Load characteristics, load curve and load duration curve, Energy Consumption Scheduling, Controllable Load Models, Dynamics, and Challenges, Plug-in-hybrid Vehicles and smart appliances.

Laboratory Sessions/ Experimental learning: Apply demand side management to your house **Applications**: System unloading **Video link** :https://nptel.ac.in/courses/108/107/108107113/		
Module-4	**L1, L2, L3**	**8Hrs.**
Wide Area Measurement: Sensor Networks, Phasor Measurement Units, Communications Infrastructure, Fault Detection and Self-Healing Systems, Applications and Challenges. **Security and Privacy:** Cyber Security Challenges in Smart Grid, Load Altering Attacks, False Data Injection Attacks, Defence Mechanisms, Privacy Challenges. **Laboratory Sessions/ Experimental learning**: A case study of cyber-attack on the power grid. **Applications**: Strengthening the smart grid security. **Video link** :https://nptel.ac.in/courses/108/107/108107113/		
Module-5	**L1, L2, L3**	**8Hrs.**
Economics and Market Operations: Power system generation economics, Modelling of Consumers and producers, Electricity market structures, types of markets, Location Marginal price,financial transmission rights price forecasting models **Laboratory Sessions/ Experimental learning:** A case study on Indian electricity market. **Applications:** Analysis of energy market **Video link:**https://nptel.ac.in/courses/108/107/108107113/		

Course outcomes:	
C403.1.1	Analyze the complexities in integration of renewable energy sources.
C403.1.2	Design the communication systems in the smart grid.
C403.1.3	Implement the demand side management techniques.
C403.1.4	Analyze the security issues in the smart grid.
C403.1.5	Analyse the pricing mechanism and electricity market.
Text Books:	
1	D.S. Kirshen, Fundamental of Power System Economics, John Wiley & Sons
2	A. J. Wood, B. F. Wollenberg, Power Generation Operation and Control, John Wiley & Sons
Reference Books:	
1	G. M. Masters, Renewable and Efficient Electric Power Systems, John Wiley & Sons
2	S. Stoft, Power System Economics: Designing Markets for Electricity, Wiley-Interscience

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

marks to be awarded will be the average of three tests

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

SEE Assessment:

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

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

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

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C403.1.1	3	3	2	2	2	2	1	-	-	1	-	2
C403.1.2	3	3	2	2	3	2	1	-	-	1	-	2
C403.1.3	3	3	3	3	3	2	1	-	-	1	1	2
C403.1.4	3	3	3	3	3	2	1	-	-	2	1	2
C403.1.5	3	3	3	3	3	2	1	-	-	2	1	2

High-3, Medium-2, Low-1

Course Title	**AI Techniques to Power Systems**	**Semester**	VII
Course Code	MVJ20EE732	**CIE**	50
Total No. of Contact Hours	40	**SEE**	50
No. of Contact Hours/week	4, 2:1:1 (L: T:P)	**Total**	100
Credits	3	**Exam. Duration**	3 Hours

Course objective is to: This course will enable students to

- Provide insight into fundamentals of Artificial Intelligence Techniques to the students.
- Understanding of fuzzy theory and its applications
- Concept of neural networks
- Use of genetic algorithm and evolutionary programming
- Convey application of Artificial Intelligence techniques in power system.

Module-1	**L1, L2**	**8 Hrs.**

Artificial Intelligence: Definition, History and Evolution, Intelligence, Communication, Learning, Artificial Intelligence, AI Applications, Problem Solving methods of ANN, ES and GA, Searching Techniques. Knowledge representation, predicate logic, predicate calculus, multivalued logic

Laboratory Sessions/ Experimental learning: Case study on AI evolution.

Applications: Learning and problem solving by machines.

Video link: https://youtu.be/fV2k2ivttL0?list=PLCD819D1E1C4F91C3

Module-2	**L1,L2,L3,L4**	**8 Hrs.**

Fuzzy logic: Introduction, Representing Fuzzy Elements, Basic Terms and Operations, Properties of Fuzzy Sets, Fuzzification, Arithmetic operations of Fuzzy Numbers, Fuzzy linguistic Descriptions, Fuzzy Relation Inferences, Defuzzification methods

Laboratory Sessions/ Experimental learning: Design fuzzy logic controller for speed control of a fan.

Applications: Handling of uncertainty.

Video link: https://youtu.be/H9SikB7HbSU

Module-3	**L1,L2,L3**	**8 Hrs.**

Artificial Neural Network: Definition and Fundamental concepts, Biological neural network, Artificial neuron, concept ofperceptron, ADALINE, Neural network architectures, feedback in neural network, Application of neural network in power system.

Laboratory Sessions/ Experimental learning: State Estimations using Neural Network

Applications: Classification, pattern recognition, estimation

Video link:https://youtu.be/_l58zd2OFwg

Module-4	**L1,L2,L3**	**8 Hrs.**

Genetic Algorithms and Evolutionary Programming: Introduction, Genetic algorithms and representations, Initialization and Selection, Genetic Operators, Mutations, Evolutionary Programming and working.

Laboratory Sessions/ Experimental learning: Optimal placement of capacitor in the distribution system.

Applications: Solving optimization problems in power systems

Video link:https://youtu.be/Z_8MpZeMdD4

Module-5	**L1,L2,L3**	**8 Hrs.**

Applications of AI Techniques: Load forecasting,Load flow studies, Economic Load dispatch, Load frequency control, Reactive power control, Speed control of DC and AC motors

Laboratory Sessions/ Experimental learning: Load Flow analysis using Neural Network

Applications: state estimation, load and power flow

Video link:https://youtu.be/Y46zXHvUB1s

Course outcomes:

C403.2.1	Understand concepts of Artificial Intelligence
C403.2.2	Design Fuzzy logic of controllers
C403.2.3	Understand the concept of Neural Network
C403.2.4	Optimize problems in power system
C403.2.5	Analyze how AI techniques used in power system.

Text Books:

1	Artificial Intelligence and Intelligent Systems, OXFORD University Press, New Delh 2005- N. P. Padhy
2	Understanding Neural Networks and Fuzzy Logic: Basic concepts and Applications, Prentice Hall India Private Limited, New Delhi,2002- Stamations V. Kartalopoulos

Reference Books:

1	Artificial Intelligence Techniques in Power Systems, IEE Power Engineering Series, UK, 1997- Kevin Warwick, Arthur Ekwue and Raj Aggarwal
2	Intelligent Systems and Signal Processing in Power Engineering, Springer Berlin Heidelberg, New York- AbhisekUkil

CIE Assessment:

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

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

SEE Assessment:

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

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

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

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C403.2.1	3	3	2	1	3	-	-	-	2	2	2	3
C403.2.2	3	3	2	1	3	-	-	-	2	2	2	3
C403.2.3	3	3	2	1	3	-	-	-	2	2	2	3
C403.2.4	3	3	2	1	3	-	-	-	2	2	2	3
C403.2.5	3	3	2	1	3	-	-	-	2	2	2	3

High-3, Medium-2, Low-1

Course Title	System On Chip	Semester	VII
Course Code	MVJ20EE733	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4, 2:1:1(L: T:P)	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to: This course will enable students to

- Understand the components of system, hardware and software
- Know the basic concepts of processor architecture and instructions
- Describe external and internal memory of SOC
- Get knowledge of bus models of SOC
- Understand SOC customization and reconfiguration technologies

Module-1	L1, L2	8 Hrs.

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

Module-2	L1, L2	8 Hrs.

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/

Module-3	L1, L2	8 Hrs.

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/		
Module-4	**L1, L2**	**8 Hrs.**
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/		
Module-5	**L1, L2, L3**	**8 Hrs.**
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/		
Course outcomes:		
C403.3.1	Memorize the system architecture, components of system hardware and software	
C403.3.2	Know the basic concepts of processor architecture and instructions and delays	
C403.3.3	Describe external and internal memory of SOC and organization	
C403.3.4	Explain bus architectures and models of SOC	
C403.3.5	Apply the knowledge of SOC design in real time applications	
Text Books:		
1	Design of System on a Chip: Devices and Components – Ricardo Reis, 1st Ed., 2004, Springer	
2	Co-Verification of Hardware and Software for ARM System on Chip Design (Embedded Technology) – Jason Andrews – Newness, BK and CDROM.	

Reference Books:	
1	System on Chip Verification – Methodologies and Techniques –Prakash Rashinkar, Peter Paterson and Leena Singh L, 2001, Kluwer Academic Publishers.
2	C.Rowen, Engineering the Complex SOC: Fast,Flexible design with configurable processors, Prentice Hall, 2004

CIE Assessment:

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

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

SEE Assessment:

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

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

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

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C403.3.1	2	2	2	1	2	-	-	-	-	-	-	-
C403.3.2	2	2	2	2	3	-	-	-	-	-	-	-
C403.3.3	2	2	2	2	3	-	-	-	-	-	-	-
C403.3.4	2	3	3	2	3	-	-	-	-	-	-	-
C403.3.5	2	2	3	2	3	-	-	-	-	-	-	-

High-3, Medium-2, Low-1

Course Title	**Power system operation and control**	**Semester**	VII
Course Code	MVJ20EE741	**CIE**	50
Total No. of Contact Hours	40	**SEE**	50
No. of Contact Hours/week	4, 2:1:1 (L: T:P)	**Total**	100
Credits	3	**Exam. Duration**	3 Hours

Course objective is to: This course will enable students to

- Understand the significance of power system operation and control.
- Understand the reactive power-voltage interaction and to learn the control actions to be implemented for maintaining the voltage profile against varying system load.
- Understand the basics of speed governing system, various methods to control frequency.
- Understand the significance economic operation of power system.
- Understand the SCADA and its application for real time operation and control of power systems

Module-1	**L1,L2**	**08Hrs.**

Preliminaries on power system operation and control: Power scenario in Indian grid – National and Regional load dispatching centres – requirements of good power system - necessity of voltage and frequency regulation - real power vs frequency and reactive power vs voltage control loops - system load variation, basic concepts of load dispatching - load forecasting.

Experimental learning: Visiting national and regional load dispatch centre websites.

Applications: Power system operation.

Web Link and Video Lectures:

1.https://engmag.in/power-scenario-india-now-insight/

2.https://www.eeeguide.com/requirements-of-a-distribution-system/

Module-2	**L1,L2**	**08Hrs.**

Reactive power and Voltage control: Generation and absorption of reactive power, basics of reactive power control, Automatic Voltage Regulator (AVR), block diagram representation of AVR loop, static and dynamic analysis, stability compensation, voltage drop in transmission line, methods of reactive power injection, tap changing transformer, SVC (TCR + TSC) and STATCOM for voltage control.

Experimental learning: Design of Simulink model for AVR

Applications: Reactive power control

Web Link and Video Lectures:

1.https://www.electricalindia.in/reactive-power-management-voltage-control-to-avoid-blackouts/

2.https://electrical-engineering-portal.com/how-reactive-power-is-helpful-to-maintain-a-system-healthy

Module-3	L1,L2	08Hrs.

Load –Frequency Control: Basics of speed governing mechanism and modelling – speed load characteristics – load sharing between two synchronous machines in parallel. Control area concept LFC control of a single-area system. Static and dynamic analysis of uncontrolled and controlled cases. Integration of economic dispatch control with LFC. Twoarea system – modelling - static analysis of uncontrolled case - tie line with frequency bias control of two-area system - state variable model.

Experimental learning: Two area LFC control.

Applications: Frequency control.

Web Link and Video Lectures:

1.https://jntua.ac.in/gate-online-classes/registration/downloads/material/a159041328312.pdf

2.https://www.allumiax.com/blog/top-5-advantages-of-parallel-operation-of-generators-or-alternators

Module-4	L1,L2	08Hrs.

Economic operation of power system : Statement of economic dispatch problem - input and output characteristics of thermal plant - incremental cost curve - optimal operation of thermal units without and with transmission losses (no derivation of transmission loss coefficients) - base point and participation factors method - statement of unit commitment (UC) problem - constraints on UC problem - solution of UC problem using priority list – special aspects of short term and long term hydrothermal problems.

Experimental learning: Solving unit commitment problem using software.

Applications: Solving unit commitment problems

Web Link and Video Lectures:

1.https://nptel.ac.in/content/storage2/courses/108107028/module1/lecture1/lecture1.pdf

2.https://www.power-technology.com/features/feature-the-top-10-biggest-thermal-power-plants-in-india/

Module-5	L1,L2	08Hrs.

Computer Control of Power Systems: Need of computer control of power systems. Concept of energy control centre (or) load dispatch centre and the functions - system monitoring - data acquisition and control. System hardware configuration – SCADA and EMS functions. Network topology – Importance of Load Forecasting and simple techniques of forecasting.

Experimental learning: Visiting substation equipped with SCADA.

Applications: Automation.

Web Link and Video Lectures:

1.https://www.inductiveautomation.com/resources/article/what-is-scada 2.https://www.youtube.com/watch?v=nlFM1q9QPJw	
Course outcomes:	
C404.1.1	Describe the day-to-day operation of electric power system.
C404.1.2	Understand the reactive power-voltage interaction.
C404.1.3	Acquire knowledge on real power-frequency interaction.
C404.1.4	Describe the significance of power system operation and control
C404.1.5	Design SCADA and its application for real time operation.
Text Books:	
1	Kothari D.P. and Nagrath I.J., 'Power System Engineering', Tata McGraw-Hill Educatior Second Edition, 2008.
2	Hadi Saadat, 'Power System Analysis', McGraw Hill Education Pvt. Ltd., New Delhi, 21st reprint, 2010.
Reference Books:	
1	Kundur P., 'Power System Stability and Control, McGraw Hill Education Pvt. Ltd., New Delhi, 10th reprint, 2010.
2	Allen. J. Wood and Bruce F. Wollen berg, 'Power Generation, Operation and Control', John Wiley & Sons, Inc., 2016.

CIE Assessment:

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

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

SEE Assessment:

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

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

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

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C404.1.1	3	3	-	3	-	-	-	-	-	-	2	1
C404.1.2	3	3	-	3	-	-	-	-	-	-	3	1

C404.1.3	3	3	1	3	-	-	-	-	-	-	2	-
C404.1.4	3	3	-	3	-	-	-	-	-	-	3	1
C404.1.5	3	3	-	3	-	-	-	-	-	-	2	1

High-3, Medium-2, Low-1

Course Title	Electric Vehicle Technologies	Semester	VII
Course Code	MVJ20EE742	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4, 2:1:1 (L:T:P)	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to: This course will enable students to

- Understand fundamental laws and vehicle mechanics.
- Understand upcoming technology of hybrid electric vehicles.
- Ability to develop the electric propulsion unit for EVs.
- Understand about drives and control of EVs.
- Ability to analyze different power converter topologies used for EVs application

Module-1	L1,L2	8Hrs.

Vehicle Mechanics: Roadway Fundamentals, Laws of Motion, Vehicle Kinetics, Dynamics of VehicleMotion, Propulsion Power, Force-Velocity Characteristics, Maximum Gradeability, Velocity and Acceleration,Constant FTR, Level Road, Velocity Profile, Distance Traversed, Tractive Power, Energy Required, Non-constantFTR, General Acceleration, Propulsion System Design.

Laboratory Sessions/ Experimental learning: Simulation of a vehicle to understand the different forces acting on vehicle.

Applications: Stability check and mechanical design of EVs.

Video link:

1. https://youtu.be/wypbLRe9xUg
2. https://nptel.ac.in/courses/108/102/108102121/

Module-2	L1,L2,L3	8Hrs.

Introduction to Electric Vehicles: Introduction, conventional vehicles, and Electric vehicles, vehicle fundamentals, Types, performanceand 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

Module-3	L1,L2,L3	8Hrs.

Electric Propulsion System: Electric propulsion unit,EV consideration, Configuration and speed

control: DC motor drives, Induction motor drives, Permanent Magnet Motor Drives, Switch Reluctance Motor Drive for Electric Vehicles, Sizing of Electric Machine for EVs and HEVs, Drive System Efficiency

Laboratory Sessions/ Experimental learning: Analysis of Speed control of different types of motor in EVs using Simulink

Applications: Electric vehicles

Video link:https://nptel.ac.in/courses/108/102/108102121/

Module-4	**L1,L2,L3**	**8Hrs.**

Design of Electric and Hybrid Electric Vehicles:

Series Hybrid Electric Drive Train Design: Operatingpatterns, control strategies, Sizing of major components, power rating of traction motor, power rating ofengine/generator, design of PPS

Parallel Hybrid Electric Drive Train Design: Control strategies of parallel hybriddrive train, design of engine power capacity, design of electric motor drive capacity, transmission design, energystorage 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/

Module-5	**L1,L2,L3,L4**	**8Hrs.**

Power Electronic Converter for Battery Charging: Charging methods for battery, Termination methods, charging from grid, The Z-converter, Isolated bidirectional DC-DC converter, High-frequency transformer basedisolated charger topology, Transformer less topology.

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

Course outcomes:

C404.2.1	Explain roadway fundamental, laws of motion and vehicle mechanics
C404.2.2	Acquire fundamental concepts and principles of hybrid electric vehicles (HEV)
C404.2.3	Develop the electric propulsion unit for application of EVs.
C404.2.4	Analyze and apply electric drives in vehicles / traction
C404.2.5	Design converters for battery charging and explain transformer less topologies.

Text Books:

1	Modern Electric, Hybrid Electric, andFuel Cell Vehicles: Fundamentals,Theory, an Design, M. Ehsani, Y. Gao, S.Gay and Ali Emadi, CRC Press, 2005
2	Modern Electric Vehicle Technology C.C. Chan and K.T.Chau, OxfordUniversity, 2001
Reference Books:	
1	Husain, I. "Electric and Hybrid Vehicles" Boca Raton, CRC Press, 2010
2	Larminie, James, and John Lowry, "Electric Vehicle Technology Explained" John Wiley and Sons, 2012

CIE Assessment:

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

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

SEE Assessment:

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

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

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

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C404.2.1	2	3	1	1	-	-	-	-	-	-	-	-
C404.2.2	2	3	1	2	-	-	-	-	-	-	-	-
C404.2.3	2	3	1	2	-	-	-	-	-	-	-	-
C404.2.4	2	3	1	2	-	-	-	-	-	-	-	-
C404.2.5	2	3	1	3	-	-	-	-	-	-	-	-

High-3, Medium-2, Low-1

Course Title	Advanced Power Electronics	Semester	VII
Course Code	MVJ20EE743	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4, 2:1:1 (L:T:P)	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to: This course will enable students to

- Determine the operation and characteristics of DC-DC switched mode converters
- Understand the various topologies of multilevel inverters.
- Study the basic topologies of resonant converters.
- Estimate various power supplies involves in the power electronics circuit.
- Apply the concept of power converters in various electrical applications

Module-1	L1, L2, L3	8Hrs.

DC-DC SWITCHED MODE CONVERTERS: Buck Converter, Boost Converter, Buck-Boost Converter, Cuk converters, SEPIC.

Laboratory Sessions/ Experimental learning: To study Cuk converter and SEPIC converter along with simulation

Applications: Portable electronic devices

Web Link and Video Lectures:

1. https://nptel.ac.in/courses/108/108/108108036/#
2. https://youtu.be/SOHXMx-8F5g
3. https://youtu.be/J6Sewi4WvNY

Module-2	L1, L2, L3	8Hrs.

Multilevel Inverter: Introduction, multilevel concept, types of multilevel inverters, Diode clamped multilevel inverter, flying capacitor multilevel inverter, cascaded multilevel inverter: principle of operation and features, Applications.

Laboratory Sessions/ Experimental learning: To study Diode clamped multilevel inverter along with simulation.

Applications: UPS, High voltage DC transmission, Variable Frequency Drives

Web Link and Video Lectures:

1. https://nptel.ac.in/content/storage2/108/102/108102157/MP4/mod03lec11.mp4
2. https://nptel.ac.in/content/storage2/108/102/108102157/MP4/mod03lec12.mp4
3. https://www.youtube.com/watch?v=vKKO7uPe6fI

Module-3	L1, L2, L3	8Hrs.
RESONANT CONVERTERS: Introduction, need of resonant converters, Classification of resonantconverters, load resonant converters, Resonant switch converters, zerovoltage switching dc-dc converters, zero current switching dc-dcconverters, clamped voltage topologies **Laboratory Sessions/ Experimental learning**:To study MOSFET/IGBT based single-phase series-resonant inverter with simulation. **Applications**:induction cookers, portable power supplies, network connection of renewable energy mains, hybrid and electric vehicles **Web Link and Video Lectures:** 1.https://nptel.ac.in/courses/108/107/108107128/ 2. https://www.youtube.com/watch?v=53avTO3BYnI		
Module-4	**L1, L2, L3**	**8Hrs.**
POWER SUPPLIES: Introduction, DC power supplies: flyback converter, forward converter, push-pull converter, half bridge converter, full bridge converter. **AC power supplies**: Switched mode AC power supplies, resonant ACpower supplies, bidirectional AC power supplies. **Laboratory Sessions/ Experimental learning:**To study various designof power supplies through simulation **Applications**: Battery charging, automotive **Web Link and Video Lectures:** 1.https://nptel.ac.in/content/storage2/108/107/108107128/MP4/mod05lec23.mp4 2. https://nptel.ac.in/content/storage2/108/107/108107128/MP4/mod05lec24.mp4		
Module-5	**L1, L2, L3**	**8Hrs.**
APPLICATIONS: Uninterrupted power supplies, High voltage DC transmission, static switches, Static circuit breakers, solid state relays, Induction heating **Laboratory Sessions/ Experimental learning:** To study single phase AC switch using two thyristors along with waveforms using simulation. **Web Link and Video Lectures:** **1.** https://nptel.ac.in/courses/108/108/108108034/ 2.https://youtu.be/lKRW4fEB6bE		

Course outcomes:	
C404.3.1	Analyze the operation and characteristics of DC-DC switched mode converters
C404.3.2	Understanding various topologies of multilevel inverters
C404.3.3	Develop the basic topologies of resonant converters
C404.3.4	Estimation of various power supplies involves in the power electronics circuitry

C404.3.5	Apply the concepts of power converters in various electrical applications
Text Books:	
1	Power Electronics-circuits, devices an application, Muhammad H Rashid, Prentice-hall of India,3rd edition
2	Power Electronics, Dr. P S Bimbhra, Khanna Publishers, 5th edition, 2012
Reference Books:	
1	Power Electronics - converters, application & design, Mohan N, Undeland T.M., Robins, W.P,John Wiley ,3rd Edition 2008
2	Power Electronics Daniel W Hart McGraw Hill 1 st Edition, 2011

CIE Assessment:

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

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

SEE Assessment:

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

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

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

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C404.3.1	3	2	2	1	-	-	-	-	-	-	-	3
C404.3.2	3	2	2	1	-	-	-	-	-	-	-	3
C404.3.3	3	2	2	1	-	-	-	-	-	-	-	3
C404.3.4	3	2	2	1	-	-	-	-	-	-	-	3
C404.3.5	3	2	2	1	-	-	-	-	-	-	-	3

High-3, Medium-2, Low-1

Course Title	Special Electrical Machines	Semester	VII
Course Code	MVJ20EE751	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4, 2:1:1 (L:T:P)	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to: This course will enable students to

- Understand the construction, operation and performance of Permanent magnet synchronous motor.
- Learn the operation and applications ofSynchronous Reluctance Motors.
- Understand and compare the performance of different Single phase special electric machines
- Discuss operation, control and characteristics of servo motors and brushless D.C. motors.
- Evaluate the operation, control and performance of stepper motors and linear electric machines.

Module-1	L1,L2	8Hrs.

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/

Module-2	L1,L2,L3	8Hrs.

Synchronous Reluctance Motors: Constructional features, operating principles, Types, Axial and Radial flux motors, Voltage equation, Characteristics, Advantages, disadvantages and application: SRM for automotive applications.

Laboratory Sessions/ Experimental learning: Industrial Visit

Applications: Conveyor belts, rice mills, paper mills

Video link:https://nptel.ac.in/courses/108/102/108102156/

Module-3	L1,L2,L3	8Hrs.

Single phase Special Electric machines: AC Series Motor – Construction, Principle of Working, EMF equation, Torque-Speed Characteristics. Repulsion Motor- Construction and Working, Types of Repulsion motors & characteristics.Hysteresis Motor, Universal Motor –Construction and Types, principle of operation, Applications.

Laboratory Sessions/ Experimental learning: Speed control of universal motor (Hardware/simulation)

Applications: Domestic appliances, High-speed lifts, Air compressors, Mining tools, Devices with noiseless operation

Videolink:

1. https://nptel.ac.in/courses/108/102/108102156
2. https://www.youtube.com/watch?v=aMYGv0MM6UQ

Module-4	L1,L2,L3	8Hrs.

Servo Motors:DC Servo Motors – Construction, Principle of Operation, AC Servo Motors – Construction & Working, Analysis of Two-phase AC Servo Motor, Torque speed characteristics, Transfer Function.

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:

1. https://www.youtube.com/watch?v=UmHtWX2XYSM
2.https://www.youtube.com/watch?v=EQzm51BK6UE&list=PLA5CA7D35114BA425&index=23

Module-5	L1,L2,L3	8Hrs.

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:

1.https://www.youtube.com/watch?v=UmHtWX2XYSM
2.https://www.youtube.com/watch?v=Tp724MqrosA

Course outcomes:

C405.1.1	Explain the operation and control of permanent magnet synchronous motors.
C405.1.2	Use the concept of operation and control of synchronous reluctance motor for choosing

	such motors in a wide range of applications.
C405.1.3	Distinguish the different single phase special electric machines.
C405.1.4	Explain Servo motors and brushless DC motors.
C405.1.5	Analyse the performance of stepper motors and linear electric machines.
Text Books:	
1	E.G. Janardanan, "Special Electrical Machines" PHI, 1 st Edition 2014.
2	T J E Miller, "Brushless Permanent Magnet and Reluctance Motor Drives" Clerendon Press, Oxford 1989.
Reference Books:	
1	Kenjo T and Nagamori S, "Permanent Magnet and Brushless DC Motors", Clerendon Press, Oxford,1985.
2	Kenjo, "Stepping Motors and their Microprocessor Control", Clerendon Press Oxford,1984.

CIE Assessment:

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

SEE Assessment:

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

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

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

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C405.1.1	3	3	1	3	-	-	-	-	-	-	2	-
C405.1.2	3	3	-	3	-	-	-	-	-	-	2	-
C405.1.3	3	3	-	3	-	-	-	-	-	-	1	2
C405.1.4	3	3	-	3	-	--	-	-	-	-	1	-
C405.1.5	3	3	-	3	-	--	-	-	-	-	2	-

High-3, Medium-2, Low-1

Course Title	Energy Storage Systems	Semester	VII
Course Code	MVJ20EE752	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4,2:1:1 (L:T:P)	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to: This course will enable students to

- Understand the needs for energy storage.
- Understand the types of electrical energy storage Systems.
- Understand the various technologies availableand their applications.
- Explain various devices used for the energy storage systems.

Module-1	L1,L2	8Hrs.

Needs for Electrical Energy Storage: Emerging needs for EES, Smart Grid uses, The roles of electrical energy storage technologies, The rolesfrom the viewpoint of a utility, consumers and generators of renewable energy, Classification of EES systems.

Laboratory Sessions/ Experimental learning: Case study on the need of energy storage.

Applications: Uninterrupted power supply.

Web Link and Video Lectures: https://www.youtube.com/watch?v=EakRe6ICM-Q

Module-2	L1,L2,L3	8Hrs.

Mechanical Energy Storage Systems: Mechanical storage systems, Pumped hydro storage (PHS), Compressed air energy storage (CAES), Flywheel energy storage (FES).

ElectricalEnergy Storage Systems: Electrical Energy storage-super-capacitors, Magnetic EnergyStorage-Superconducting systems,

Laboratory Sessions/ Experimental learning: Demonstration of energy storage using capacitor.

Applications: Power grids

Web Link and Video Lectures:https://nptel.ac.in/courses/108/106/108106182/

Module-3	L1,L2,L3	8Hrs.

Chemical Energy Storage Systems: Chemical-Hydrogen production and storage, Principle of direct energy conversion using fuel cells,thermodynamics of fuel cells, Types of fuel cells, AFC, PEMFC, MCFC, SOFC, Microbial fuel cell, Fuel cellperformance,

Laboratory Sessions/ Experimental learning: Demonstration of Fuel cell

Application: Domestic, commercial and transport

Web Link and Video Lectures:https://nptel.ac.in/courses/108/106/108106182/

Module-4	L1,L2,L3	8Hrs.
Electrochemical Energy Storage: Battery, primary, secondary and flow batteries. **Thermal Energy Storage systems:** Thermal Energy storage, sensible and latent heat, phase change materials, Energyand energy analysis of thermal energy storage. **Laboratory Sessions/ Experimental learning:** Demonstration of Battery. **Application:** Electrical vehicles and RES **Web Link and Video Lectures:** https://www.youtube.com/watch?v=HUlQ09x6Tmo		
Module-5	**L1,L2,L3**	**8Hrs.**
Design and Applications of Energy Storage: Renewable energy storage-Battery sizing and stand-aloneapplications, stationary (Power Grid application), Small scale application-Portable storage systems andmedical devices, Mobile storage Applications- Electric vehicles (EVs), types of EVs, batteries and fuel cells, future technologies, hybrid systems for energy storage. **Laboratory Sessions/ Experimental learning:** Battery energy management in electric vehicles **Application:** RES, Smart grid. **Web Link and Video Lectures:** https://nptel.ac.in/courses/108/106/108106182/		

Course outcomes:	
C405.2.1	Explain needs for Electrical Energy Storage.
C405.2.2	Analyse the characteristics of energy from various sources.
C405.2.3	Classify various types of energy storage systems and various devices used for the purpose
C405.2.4	Understand the types of electrical energy storage Systems.
C405.2.5	Identify various real time applications.

Text Books:	
1	"James M. Eyer, Joseph J. Iannucci and Garth P. Corey ", "Energy Storage Benefits and Market Analysis", Sandia National Laboratories, 2004
2	"Jim Eyer, Garth Corey", Energy Storage for the Electricity Grid: Benefits and Market Potential Assessment Guide, Report, Sandia National Laboratories, Feb 2010.

Reference Books:	
1	Pillai.S.K A First Course on Electric Drives, Wiley Eastern Limited, 2012
2	Singh. M.D., K.B.Khanchandani, Power Electronics, Tata McGraw-Hill, 2006.

CIE Assessment:

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

- Quizzes/mini tests (4 marks)
- Mini Project / Case Studies (8 Marks)

- Activities/Experimentations related to courses (8 Marks)

SEE Assessment:

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

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

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

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C405.2.1	1	1	1	-	2	2	2	-	3	1	1	3
C405.2.2	1	1	1	-	2	2	2	-	2	2	1	3
C405.2.3	1	1	1	-	2	2	1	-	3	1	1	1
C405.2.4	1	1	1	-	1	2	2	-	2	1	1	2
C405.2.5	1	1	1	-	3	2	1	-	2	1	1	2

High-3, Medium-2, Low-1

Course Title	Reliability of Engineering Systems	Semester	VII
Course Code	MVJ20EE753	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4, 2:1:1 (L:T:P)	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to: This course will enable students to

- Familiarize with reliability evaluation
- Understand the probability theory for reliability evaluation
- Familiarize with different probability distribution functions.
- Assess the reliability of simple and complex system.
- Understand the Monte Carlo simulation and its applications.

Module-1	L1, L2	8Hrs.

Basic Probability Theory: Elements of probability, probability distributions, Random variables, Density and Distribution functions, Binomial distribution, Poisson distribution, normal distribution, exponential distribution, Weibull distribution, Expected value and standard deviation.

Laboratory Sessions/ Experimental learning: Probability distribution function fitting in MATLAB for a random variable.

Applications: Estimation of failure and repair time by using probability distribution functions.

Video link:

1. https://nptel.ac.in/courses/114/106/114106041/
2. https://nptel.ac.in/courses/105/108/105108128/

Module-2	L1, L2, L3	8Hrs.

Concept of Reliability: Definition of terms used in reliability, Component reliability, Hazard rate, derivation of the reliability function in terms of the hazard rate. Hazard models – Bath tub curve, Effect of preventive maintenance. Measures of reliability: Mean Time to Failure and Mean Time Between Failures.

Laboratory Sessions/ Experimental learning: Evaluation of MTF and MTBF for a component.

Applications: Estimation of failure and repair times for reliability evaluation.

Video link:

1. https://nptel.ac.in/courses/114/106/114106041/
2. https://nptel.ac.in/courses/105/108/105108128/

Module-3	L1, L2, L3	8Hrs.

Network Modelling and Evaluation Of Simple Systems: Basic concepts- Evaluation of network Reliability / Unreliability – Series systems, Parallel systems- Series-Parallel systemsPartially redundant systems- Examples.

Evaluation of Complex systems: Conditional probability method, tie set, Cutset approach- Event tree and reduced event tree methods- Relationships between tie and cutsets- Examples. Fault tree, Quantitative assessment of a top event, Duplicated basic events, Minimal cut sets

Laboratory Sessions/ Experimental learning: Develop a fault tree for transformer failure assessment.

Applications: Reliability evaluation of simple and complex systems using analytical methods

Video link:

1. https://nptel.ac.in/courses/114/106/114106041/
2. https://nptel.ac.in/courses/105/108/105108128/

Module-4	**L1, L2, L3**	**8Hrs.**

Time Dependent Probability: Basic concepts- Reliability function f(t). F(t), R(t) and h(t) – Relationship between these functions. Network Reliability Evaluation Using Probability Distributions: Reliability Evaluation of Series systems, Parallel systems – Partially redundant systems- determination of reliability measure- MTTF for series and parallel systems – Examples.

Laboratory Sessions/ Experimental learning: Evaluation of reliability for series and parallel system.

Applications: Evaluation of time dependent reliability

Video link:

1.https://nptel.ac.in/courses/114/106/114106041/
2.https://nptel.ac.in/courses/105/108/105108128/

Module-5	**L1, L2, L3,L4**	**8Hrs.**

Monte Carlo Simulation: Introduction, Concepts of simulation, Random variants, Simulation output, Application of MCS techniques, Number of simulations: Stopping rules, Variance reduction techniques

Laboratory Sessions/ Experimental learning: Calculate the failure probability of any equipment in your discipline.

Applications: Assessment of reliability considering the uncertainty in the failures.

Video link:

1. https://nptel.ac.in/courses/114/106/114106041/
2. https://nptel.ac.in/courses/105/108/105108128/

Course outcomes:

C405.3.1	Application of probability theory for reliability evaluation.
C405.3.2	Understanding of basic reliability concepts.
C405.3.3	Reliability evaluation of simple and complex system.
C405.3.4	Application of time dependent probability theory
C405.3.5	Reliability evaluation using Monte Carlo Technique

Text Books:

1	Roy Billinton and Ronald N Allan, Reliability Evaluation of Engineering Systems, Plenum Press, 1983.
2	E. Balagurusamy, Reliability Engineering, Tata McGraw-Hill Publishing Company Limited, 2002.

Reference Books:

1	K. K. Agarwal, Reliability Engineering-Kluwer Academic Publishers, 1993
2	Charles E. Ebeling, An Introduction to Reliability and Maintainability Engineering, Tata McGraw-Hill Publishing Company Limited,

CIE Assessment:

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

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

SEE Assessment:

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

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

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

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C405.3.1	1	1	1	-	2	2	2	-	3	1	1	3
C405.3.2	1	1	1	-	2	2	2	-	2	2	1	3
C405.3.3	1	1	1	-	2	2	1	-	3	1	1	1
C405.3.4	1	1	1	-	1	2	2	-	2	1	1	2
C405.3.5	1	1	1	-	3	2	1	-	2	1	1	2

High-3, Medium-2, Low-1

Course Title	**Simulation of Power Electronic Converters**	**Semester**	VII
Course Code	MVJ20EEL76	**CIE**	50
Total No. of Contact Hours	20	**SEE**	50
No. of Contact Hours/week	4,0:2:2(L:T:P)	**Total**	100
Credits	2	**Exam. Duration**	3 Hours

Course objective is to: This course will enable the students to

- Design three phase converters with different loads.
- Design ZVS and ZCS resonant converters.
- Design DC-DC converters
- Design a solar system for DC Loads

Sl No	Experiment Name	RBT Level	Hours
1	Simulation of three phase-controlled rectifiers with R and RL load	L3	2
2	Simulation of three phase inverter with PWM controller.	L3	2
3	Simulation of zero current switching resonant converter	L3	2
4	Simulation of zero voltage switching resonant converter.	L3	2
5	Simulation of Buck and Boost converter	L3	2
6	Simulation Buck-Boost converter	L3	2
7	Simulation of single phase two stage photovoltaic system.	L3	2
8	Simulation of Multilevel converter	L3	2
Along with mandatory experiments students are advised to complete two open ended experiments. The following are some suggestions for open ended experiments.			
1	Simulation of a bidirectional converter	L3	2
2	Simulation of Power Quality mitigation devices	L3	2
3	Linear control of power electronics converter	L3	2

Course outcomes:	
C406.1	Design switching technique of three phase rectifier and inverter for practical applications.
C406.2	Design switching techniques of ZVS and ACS resonant converters.
C406.3	Design of Buck-Boost converter for real time applications.
C406.4	Design a solar system with boost converter for dc loads.

Scheme of Evaluation

SEE :

Examinations will be conducted for 100 marks and scaled-down to 50. The weight age shall be, Write-up : 20 marks Conduction : 40 marks Analysis of results : 20 marks Viva : 20
CIE : Regular Lab work :20 Record writing :5 Lab Tests(Minimum 2 tests shall be conducted for 15 marks and average of two will be taken) Viva 10 marks

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C406.1	3	3	2	2	3	1	-	-	3	-	-	3
C406.2	3	3	2	2	3	1	-	-	3	-	-	3
C406.3	3	3	2	2	3	1	-	-	3	-	-	3
C406.4	3	3	2	2	3	1	-	-	3	-	-	3

High-3, Medium-2, Low-1

Course Title	**Power System Protection Lab**	**Semester**	VII
Course Code	MVJ20EEL77	**CIE**	50
Total No. of Contact Hours	20	**SEE**	50
No. of Contact Hours/week	4, 0:2:2(L: T:P)	**Total**	100
Credits	2	**Exam. Duration**	3 Hours

Course objective is to: This course will enable students to

- Understand the operation of over current relays.
- Understand the operation of under voltage and over voltage relays.
- Analyze the lightning impulse voltage.
- Measure the HVDC and HVAC using Standard Spheres.
- Explain the various protection schemes.

Sl No	Experiment Name	RBT Level	Hours
1	IDMT non-directional characteristics and calculation of error in operating time for Over current Relay (Electro mechanical type)	L3	2
2	Operating characteristics of Over voltage & Under voltage Relay (Electro mechanical type)	L3	2
3	Operating characteristics of Microprocessor – based (numeric) Over / Under voltage Relay.	L3	2
4	Operating Characteristics of Microprocessor Based (Numeric) Over Current Relay.	L3	2
5	Motor protection scheme Studies.	L3	2
6	Spark over characteristics of air insulation subjected to High Voltage AC – with Spark over voltage corrected to STP.	L3	2
7	Breakdown strength of transformer oil using oil test kit.	L3	2
8	Generator Protection Scheme	L3	2
Along with mandatory experiments students are advised to complete two open ended experiments. The following are some suggestions for open ended experiments.			
1	Field mapping using electrolytic tank for capacitor model	L3	2
2	Generation of standard lightning impulse voltage.	L3	2
3	Spark over characteristics of air insulation subjected to High Voltage DC.	L3	2

Course outcomes:

C407.1	Understand the IDMT characteristics of Electro – mechanical relays.
C407.2	Interpret the breakdown strength of transformer oil using oil test kit.

C407.3	Show the operating characteristics of microprocessor based relay
C407.4	Summarize the generator and motor protection schemes
C407.5	Obtain the spark over characteristics of air insulation subjected to HVDC and HVAC.

Scheme of Evaluation

SEE :

Examinations will be conducted for 100 marks and scaled-down to 50. The weight age shall be,
Write-up : 20 marks
Conduction : 40 marks
Analysis of results : 20 marks
Viva : 20

CIE :

Regular Lab work :20
Record writing :5
Lab Tests(Minimum 2 tests shall be conducted for 15 marks and average of two will be taken)
Viva 10 marks

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C407.1	3	1	2	2	1	-	-	-	-	-	-	1
C407.2	3	2	2	3	1	-	-	-	-	-	-	1
C407.3	3	1	2	2	1	-	-	-	-	-	-	1
C407.4	3	2	2	2	1	-	-	-	-	-	-	1
C407.5	3	2	2	2	1	-	-	-	-	-	-	1

High-3, Medium-2, Low-1

Course Title	**PROJECT PHASE – 1**	**Semester**	VII
Course Code	MVJ20EEP78	**CIE**	100
Total No. of Contact Hours	L : T : P :: 0 : 0 : 4	**SEE**	
No. of Contact Hours/week	-	**Total**	100
Credits	02	**Exam. Duration**	3 Hours

Course Objective: This course will enable the students to

- Develop interactive, communication, organization, time management, and presentation skills.
- Impart flexibility and adaptability.
- Inspire independent and team working.
- Expand intellectual capacity, credibility, judgment, intuition.
- Adhere to punctuality, setting and meeting deadlines.
- Instill responsibilities to oneself and others.
- Train students to present the topic of project work in a seminar without any fear, face audience confidently, enhance communication skill, involve in group discussion to present and exchange ideas.

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

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

C408.1	Describe the project and be able to defend it. Develop critical thinking and problem-solving skills.
C408.2	Learn to use modern tools and techniques. Communicate effectively and to present ideas clearly and coherently both in written and oral forms.
C408.3	Develop skills to work in a team to achieve common goal. Develop skills of project management and finance.
C408.4	Develop skills of self-learning, evaluate their learning and take appropriate actions to improve it.
C408.5	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 (100 marks) evaluation shall be based on Phase wise completion of the project work, Project report, Presentation and Demonstration of the actual/model/prototype of the project.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C408.1	2	2	2	3	3	2	1	1	2	1	1	2
C408.2	2	2	2	3	3	2	1	1	2	1	2	2
C408.3	2	2	2	3	3	2	1	1	2	1	2	2
C408.4	2	2	2	3	3	2	1	1	2	1	2	2
C408.5	2	2	2	3	3	2	1	1	2	1	2	2

Course Title	**PROJECT PHASE – 2**	**Semester**	VIII
Course Code	MVJ20EEP81	**CIE**	50
Total No. of Contact Hours	L : T : P :: 0 : 0 : 14	**SEE**	50
No. of Contact Hours/week	-	**Total**	100
Credits	07	**Exam. Duration**	3 Hours

Course Objective: This course will enable the students to

- Develop interactive, communication, organization, time management, and presentation skills.
- Impart flexibility and adaptability.
- Inspire independent and team working.
- Expand intellectual capacity, credibility, judgment, intuition.
- Adhere to punctuality, setting and meeting deadlines.
- Instill responsibilities to oneself and others.
- 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 the project report as per the norms avoiding plagiarism.

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

C409.1	Describe the project and be able to defend it. Develop critical thinking and problem-solving skills.
C409.2	Learn to use modern tools and techniques. Communicate effectively and to present ideas clearly and coherently both in written and oral forms.
C409.3	Develop skills to work in a team to achieve common goal. Develop skills of project management and finance.
C409.4	Develop skills of self-learning, evaluate their learning and take appropriate actions to improve it.
C409.5	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
C409.1	2	2	2	3	3	2	1	1	2	1	1	2
C409.2	2	2	2	3	3	2	1	1	2	1	2	2
C409.3	2	2	2	3	3	2	1	1	2	1	2	2
C409.4	2	2	2	3	3	2	1	1	2	1	2	2
C409.5	2	2	2	3	3	2	1	1	2	1	2	2

High-3, Medium-2, Low-1

Course Title	INTERNSHIP	Semester	VIII
Course Code	MVJ20EEI82	CIE	-
Total No. of Contact Hours	Industrial Oriented	SEE	-
No. of Contact Hours/week	-	Total	100
Credits	3	Exam. Duration	-

Course Objective:

- To get the field exposure and experience
- To apply the theoretical concept in field application
- 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: At the end of the course the student will be able to:

C410.1	Develop skills to work in a team to achieve common goal.
C410.2	Develop skills of self-learning, evaluate their learning and take appropriate actions to improve it.
C410.3	Prepare them for life-long learning to face the challenges and support the technological changes to meet the societal needs.
C410.4	Develop skills of project management and finance.
C410.5	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
C410.1	2	2	2	3	3	2	1	1	2	1	1	2
C410.2	2	2	2	3	3	2	1	1	2	1	2	2
C410.3	2	2	2	3	3	2	1	1	2	1	2	2
C410.4	2	2	2	3	3	2	1	1	2	1	2	2
C410.5	2	2	2	3	3	2	1	1	2	1	2	2

High-3, Medium-2, Low-1

Course Title	SEMINAR	Semester	VIII
Course Code	MVJ20EES83	CIE	-
Total No. of Contact Hours	15	SEE	-
No. of Contact Hours/week	2 L: T: P :: 0: 0: 2	Total	100
Credits	1	Exam. Duration	-

Course Objective:

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

C411.1	Develop knowledge in the field of Civil Engineering and other disciplines through independent learning and collaborative study.
C411.2	Identify and discuss the current, real-time issues and challenges in engineering & technology. Develop written and oral communication skills.
C411.3	Explore concepts in larger diverse social and academic contexts.
C411.4	Apply principles of ethics and respect in interaction with others.
C411.5	Develop the skills to enable life-long learning.

Scheme of Evaluation:

The evaluation shall be based on presentation, to a panel comprising seminar guide, a senior faculty from the department and head of the department. Each student should submit the Seminar report at the end of semester.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C411.1	2	2	2	3	3	2	1	1	2	1	1	2
C411.2	2	2	2	3	3	2	1	1	2	1	2	2
C411.3	2	2	2	3	3	2	1	1	2	1	2	2
C411.4	2	2	2	3	3	2	1	1	2	1	2	2
C411.5	2	2	2	3	3	2	1	1	2	1	2	2

High-3, Medium-2, Low-1

Course Title	CERTIFICATION	Semester	VIII
Course Code	MVJ20EEC84	CIE	-
Total No. of Contact Hours	-	SEE	-
No. of Contact Hours/week	-	Total	-
Credits	2	Exam. Duration	-

Course Objective:

- To inculcate self-learning, enhancethe skill in different field of Engineering

Certification: Each student, under the guidance of a faculty, is required to undergo online certification course minimum of 30 hours (number of courses is not limited) preferably, a recent topic of his/her interest. Each student should submit the Course details and Qualification Certificates at the end of semester.

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

C412.1	Develop knowledge in different fields of Engineering
C412.2	Develop the skills to enable life-long learning.