B.E, III Semester, Electronics & Communication Engineering

Semester: III		
Transforms, and Numerical Methods		
Course Code:	MVJ21MA31D	CIE Marks: 50
Credits:	L: T:P:S: 3:2:0:0	SEE Marks: 50
Hours:	30L+20T	SEE Duration: 3 Hrs.
Course Learning Objectives: The students will be able to		
1	Solve the linear differential equations using Laplace transforms	
2	Apprehend and apply Fourier transform	
3	Realize and use of Z-Transforms	
4	Use of numerical methods to solve ordinary differential equation	
5	Use of statistical methods in curve fitting applications.	

UNIT-I	
Laplace Transforms: Definition, Transforms of elementary functions, Properties, Periodic function, Unit step function. **Inverse Laplace Transforms:** Inverse Laplace Transforms, Convolution theorem to find inverse Laplace transform. Solution of linear differential equations using Laplace transforms **Self-study:** Solution of simultaneous first order differential equations. **Applications:** Analysis of electrical and electronic circuits, used in Signal processing and in control systems. **Video Link** : 1. http://nptel.ac.in/courses.php?disciplineID=111	10 Hrs
UNIT-II	
Fourier Transforms: Infinite Fourier transform, Infinite Fourier sine and cosine transforms, Inverse Fourier transforms, Inverse. Fourier sine and cosine transforms, Convolution theorem **Self-study:** Complex form of Fourier series. **Applications:** Fourier transforms used in image **Video Link** : 1. http://nptel.ac.in/courses.php?disciplineID=111	10 Hrs
UNIT-III	
Z-Transforms: Definition, standard Z-transforms, properties of Z-transforms- Shifting property, Reversal property, Multiplication by n,	10 Hrs

initial value and final value theorems. Inverse Z- transform, convolution theorem (proof and problems) Application of Z-transforms to solve difference equations. **Self-study:** Damping rule and problems on them. **Applications:** Fourier transforms used in image processing and Z-transforms in Digital signal processing. **Video Link** : 1. http://nptel.ac.in/courses.php?disciplineID=111	
UNIT-IV	
Numerical solution of ordinary differential equations: Numerical solution of first order and first degree; Taylor's series method, modified Euler's method, Runge-Kutta method of fourth-order. Milne's and Quadratic Spline Method. **Self-study:** Adams Bash-Method . **Applications:** To solve initial value problems **Video Link** : 1. http://nptel.ac.in/courses.php?disciplineID=111	**10 Hrs**
UNIT-V	
Statistical Methods: Correlation and regression-Karl Pearson's coefficient of correlation-problems. Regression analysis- lines of regression –problems. **Curve Fitting:** Curve fitting by the method of least squares, fitting of linear, quadratic and geometric curve. **Self-study:** A study of rank correlation. **Applications:** Applications of Correlation in Signal Processing and application of regression analysis in business **Video Link** : 1. http://nptel.ac.in/courses.php?disciplineID=111	**10 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Learn to solve linear differential equations using Laplace transforms
CO2	Demonstrate Fourier Transform as a tool for solving Integral equations
CO3	Learn to evaluate Z-transform to solve difference equations.
CO4	Learn to solve algebraic, transcendental and ordinary differential equations numerically.

CO5	Make use of the correlation and regression analysis to fit a suitable mathematical model for the statistical data

Reference Books	
1.	B.S. Grewal, "Higher Engineering Mathematics" Khanna Publishers, 44th Edition, 2013.
2.	Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley-India publishers, 10th edition, 2014.
3.	Prof G.B.Gururajachar "Engineering Mathematics-III , Academic Excellent series Publications, 2016-17
4.	Ramana B. V., "Higher Engineering Mathematics", Tata McGraw-Hill, 2006.

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

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

Semester End Examination (SEE):

Total marks: 50+50=100

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

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

Semester: III		
NETWORK ANALYSIS		
Course Code:	MVJ21EC32	CIE Marks: 50
Credits:	L: T:P: 4:0:0	SEE Marks: 50
Hours:	40L	SEE Duration: 3 Hrs.
Course Learning Objectives: The students will be able to		
1	Describe basic network concepts emphasizing source transformation source shifting, mesh and nodal techniques to solve for resistance/impedance, voltage, current and power.	
2	Explain network Thevenin's, Millman's, Superposition, Reciprocity, Maximum Power transfer and Norton's Theorems and apply them in solving the problems related to Electrical Circuits.	
3	Describe Series and Parallel Combination of Passive Components as resonating circuits, related parameters and to analyze frequency response.	
4	Explain the behavior of networks subjected to transient conditions. Use applications of Laplace transform to solve network problems.	
5	Study two port network parameters like Z, Y, T and h and their inter-relationships.	

UNIT-I	
Prerequisites: *Ohm's law, Kirchhoff's laws* **Basic Concepts:** Introduction, Practical sources, Source transformations, Star – Delta transformation, Loop and node analysis with linearly dependent and independent sources for DC and AC networks, Concepts of super node and super mesh. **Laboratory Sessions/ Experimental learning:** 1. Find the current through and voltage across the load in the given circuit. **Applications:** Simplification and analysis of analog circuits, microwave circuit analysis **Video link / Additional online information :** 1. https://www.youtube.com/watch?v=UMhBgyK8F0U	**8 Hrs**

UNIT-II	
Graph Theory and Network equations: Graph of a network, Trees, Co-trees and Loops, Incidence Matrix, Cut-set Matrix, Tie-set Matrix and loop currents, Number of possible trees of a graph, Analysis of networks, Duality. **Laboratory Sessions/ Experimental learning:** NA **Applications:** Simplification and analysis of analog circuits, microwave circuit analysis **Video link / Additional online information:** https://www.youtube.com/watch?v=F8qiM3o0Jc0	**8 Hrs**
UNIT-III	
Network Theorems: Superposition Theorem, Millman's theorem, Thevenin's and Norton's theorems, Reciprocity theorem, Maximum Power transfer theorem. **Laboratory Sessions/ Experimental learning** : 1. Verify superposition theorem for a given circuit. **Applications:** Simplification and analysis of analog circuits, microwave circuit analysis. **Video link / Additional online information:** https://www.youtube.com/watch?v=bnjiLg4xfh8	**8 Hrs**
UNIT-IV	
Prerequisites: *Laplace Transforms, Properties of Laplace Transform and Inverse Laplace Transform using partial fraction method.* **Transient behaviour and initial conditions:** Behaviour of circuit elements under switching condition and their Representation, evaluation of initial and final conditions in RL, RC and RLC circuits for DC and AC excitations, Applications of Laplace Transforms in circuit analysis: Application to circuits. **Laboratory Sessions/ Experimental learning:** 1. Plot the response of a series RLC circuit. **Applications:** In the analysis of transmission lines and waveguides. **Video link / Additional online information :** https://www.youtube.com/watch?v=g-CGI7oUSCA	**8 Hrs**

UNIT-V	
Two port network parameters: Introduction, open circuit impedance parameter, short circuit admittance parameter, hybrid parameters, transmission parameter, relationship between parameters. **Series Resonance-** Variation of Current and Voltage with Frequency, Selectivity and Bandwidth, Q-Factor, Circuit Magnification Factor, Selectivity with Variable Capacitance, Selectivity with Variable Inductance. **Parallel Resonance** - Selectivity and Bandwidth, Maximum Impedance Conditions with C, L and f Variable, current in Anti-Resonant Circuit, The General Case-Resistance Present in both Branches. **Laboratory Sessions/ Experimental learning:** 1. Plot the frequency response characteristics for a series RL, RC circuit. 2. Plot the frequency response characteristics for a parallel RL circuit. 3. Measure two port parameters for a given network **Applications:** For analysis of communication systems and antennas. **Video link / Additional online information:** https://www.youtube.com/watch?v=YLGrugmDvc0	**8 Hrs**

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

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

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

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

Semester End Examination (SEE):

Total marks: 50+50=100

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

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

High-3, Medium-2, Low-1

Semester: III		
ELECTROMAGNETICS &TRANSMISSION LINES (Theory)		
Course Code:	MVJ21EC33	CIE Marks: 50
Credits:	L:T:P: 2:2:0	SEE Marks: 50
Hours:	40L+26T	SEE Duration: 3 Hrs.
Course Learning Objectives: The students will be able to		
1	Understand the applications of Coulomb's law and Gauss law to different charge Distributions.	
2	Understand the physical significance of Biot-Savart's Law, Amperes' Circuital Law and Stokes' theorem for different current distributions.	
3	Know the physical interpretation of Maxwell's equations and its applications in plane waves.	
4	Understand the concepts of Smith Chart for impedance matching.	
5	Acquire knowledge on different types of transmission lines.	

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

Applications: The Van de Graaff generator, Xerography, Ink Jet Printers and Electrostatic Painting,Smoke Precipitators and Electrostatic Air Cleaning **Video link / Additional online information:** 1. https://youtu.be/ckAVB3_NP2Q 2. https://youtu.be/IH2fFNaR9YM 3. https://youtu.be/JhTT-wew-OE	
UNIT-II	
Gauss' law, Divergence, Poisson's and Laplace's Equations: Gauss law, Maxwell's First equation, Application of Gauss' law, Divergence theorem, Current, Current density, Conductor, The continuity equation, Boundary conditions (dielectric-dielectric, conductor-dielectric, conductor-free space), Poisson's and Laplace's Equations, Uniqueness theorem. **Laboratory Sessions/ Experimental learning:** 1. Evaluate the current flowing through a given surface using MATLAB. 2. Verify the Divergence theorem using MATLAB. **Applications:** Used for calculation electrical field for a symmetrical distribution of charges **Video link / Additional online information:** 1. https://youtu.be/N_jUbFnlqEg 2. https://youtu.be/XtH2WAhvYIM 3. https://youtu.be/gu934FBac6g 4. https://youtu.be/hp9Jito4vPE	**8 Hrs**
UNIT-III	
Magnetostatics: Steady Magnetic Field-Biot-Savart Law, Ampere's circuital law, Curl, Stokes' theorem, Gauss's law for magnetic fields, Magnetic flux and Magnetic flux density, Maxwell's equations for static fields, Magnetic Scalar and Vector Potentials. **Magnetic Forces and magnetic materials:** Force on a moving charge and differential current element, Force between differential current elements, Magnetization, magnetic susceptibility, permeability,	**8 Hrs**

Magnetic boundary conditions, Inductances, magnetic energy, magnetic circuit. **Laboratory Sessions/ Experimental learning:** Determine the magnetic field intensity at a point due to magnetic field using MATLAB. **Applications:** Motors, Generators, Loudspeakers, MRI **Video link / Additional online information :** 1. https://youtu.be/ebGM_q19gY0 2. https://youtu.be/uXQbYJVzlQ0 3. https://youtu.be/aYRBXI63Oqk	
UNIT-IV	
Time varying Fields and Electromagnetic wave propagation: Time varying fields & Maxwell's equations, Faraday's law, Transformer and Motional Electro Motive Forces, Displacement current, Maxwell's equation in differential and integral form, Time varying potentials. **Electromagnetic wave propagation:** Derivation of wave equations from Maxwell's equations, Relation between E and H, Wave propagation in - lossy dielectrics, lossless dielectrics, free space and good conductor, skin-effect, Poynting theorem. **Laboratory Sessions/ Experimental learning:** Determine the parameters of wave using MATLAB. **Applications:** Optoelectronics **Video link / Additional online information :** 1. https://youtu.be/xxIb9Qv6t7E 2. https://youtu.be/_X061_y9Lqw 3. https://youtu.be/OoQS1ex4kJA	**8 Hrs**
UNIT-V	
Transmission line: Introduction, Transmission line parameters, Transmission line equations, input impedance, standing wave ratio and power, Smith Chart, types of transmission lines - coaxial line, strip line, micro strip line. **Applications of transmission line** : Impedance matching and tuning: single stub tuning, double stub tuning, and the quarter wave transformer.	**8 Hrs**

Laboratory Sessions/ Experimental learning: Simulation of micro strip transmission line using FEKO software. **Applications:** Telephone, Cable TV, Broadband network **Video link / Additional online information:** 1. https://youtu.be/z9GbnMPDCVA 2. https://youtu.be/yk1Mu9fQ6mA 3. https://youtu.be/PO5ExHOKIJM	

Course Outcomes: After completing the course, the students will be able to	
CO1	Evaluate problems on electrostatic force, electric field due to point, linear, surface charge and volume charges.
CO2	Apply Gauss law to evaluate Electric fields due to different charge distributions by using Divergence Theorem. Determine potential and capacitance using Laplace equation and Poisson equation.
CO3	Apply Biot-Savart's and Ampere's laws for evaluating Magnetic field for different current configurations.
CO4	Apply Maxwell's equations for time varying fields and evaluate power associated with EM waves using Poynting theorem.
CO5	Determine the parameters of transmission lines and use Smith chart for determining the impedance and admittance.

Reference Books	
1.	Matthew N. O. Sadiku, "Elements of Electromagnetics", Oxford University Press, Edition VII, 2018.
2.	David M Pozar, "Microwave Engineering", John Wiley & Sons, Inc., 4th edition, 2014.
3.	W.H. Hayt. J.A. Buck & M Jaleel Akhtar, "Engineering Electromagnetics", Tata McGraw – Hill, Edition VIII, 2014.

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

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

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

Semester End Examination (SEE):

Total marks: 50+50=100

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

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

High-3, Medium-2, Low-1

Semester: III		
Analog Electronic Circuits (Theory and Practice)		
Course Code:	MVJ21EC34	CIE Marks:50+50
Credits:	L:T:P: 3:0:2	SEE Marks: 50 +50
Hours:	40 L+ 26 P	SEE Duration: 03+03 Hours
Course Learning Objectives: The students will be able to		
1	To know low frequency response for various configurations of BJT and FET amplifier.	
2	Understand the different topologies of feedback amplifiers and oscillators.	
3	Analyse the Power amplifier circuits in different modes of operation	
4	Sketch and explain typical Frequency Response graphs for each of the Filter circuits and switching circuits of Op-Amps and analyse its operations.	
5	Differentiate between various types of DACs and ADCs, Timer IC's and evaluate the performance of each with neat circuit diagrams.	

UNIT-I	
Prerequisites: *Transistor Biasing* **Transistor at Low Frequencies:** BJT transistor modeling, CE Fixed bias configuration, Voltage divider bias, Emitter follower, Analysis of circuits re model; **FET Amplifiers:** JFET small signal model, Fixed bias configuration, Self-bias configuration, Voltage divider configuration, Common Gate configuration, Source-Follower Configuration. **Laboratory Sessions/ Experimental learning:** 1. Plot the transfer and drain characteristics of a JFET and calculate its drain resistance, mutual conductance and amplification factor. **Applications:** Analog switches, Phase shift oscillator, chopper, and current limiter. **Video link/ Additional online information:** http://www.nptelvideos.in/2012/12/electronics.html	**8Hrs**
UNIT-II	
Prerequisites: *Feedback Amplifier, Oscillators* **Feedback Amplifier:** The Four Basic Feedback Topologies, The series-shunt, series-series, shunt-shunt and shunt-series amplifiers.	**8Hrs**

Oscillators: Oscillator operation, FET based Phase shift oscillator, Wien bridge oscillator, LC and Crystal Oscillators. **Laboratory Sessions/ Experimental learning:** 1. Design and test the voltage-shunt feedback amplifier and calculate the parameters using with and without feedback. **Applications:** Radios, Televisions, Communication systems, Computers, Industrial controlled applications. **Video link/ Additional online information:** https://www.youtube.com/watch?v=xHNDrbB-iWY	
UNIT-III	
Output Stages and Power Amplifiers: Introduction, Classification of output stages, Class A output stage, Class B output stage: Transfer Characteristics, Power Dissipation, Power Conversion efficiency, Class AB output stage, Class C tuned Amplifier. **Voltage Regulators:** Discrete transistor voltage regulation -Series and Shunt Voltage regulators. **Laboratory Sessions/ Experimental learning:** 1. Plot the frequency response using any class of power amplifier **Applications:** Audio power amplifiers, Switching type power amplifiers, and Wireless Communication **Video link/ Additional online information:** http://www.nptelvideos.in/2012/12/electronics.html	**8Hrs**
UNIT-IV	
OP-Amps as DC Amplifiers : Direct coupled voltage followers, Non-inverting amplifiers, inverting amplifiers. **Op-Amps as AC Amplifiers:** Capacitor coupled voltage follower, Capacitor coupled non inverting amplifiers, Capacitor coupled inverting amplifiers, Capacitor coupled difference amplifier. **Application:** Summing, Scaling and Averaging Amplifiers, Instrumentation amplifier, Comparators, Zero Crossing Detector, Schmitt trigger. **Laboratory Sessions/ Experimental learning:** 1. Design and find the gain of a Differential Amplifier.	**Hrs**

Applications: Industrial areas (Temperature Indicator, Light Intensity Meter, Temperature Controller) **Video link / Additional online information:** https://www.youtube.com/watch?v=GjG8oshYNLQ	
UNIT-V	
Op-Amp Circuits: DAC - Weighted resistor and R-2R ladder, ADC- Successive approximation type, Small Signal half wave rectifier, Active Filters, First and second order low-pass and high-pass Butterworth filters, Band-pass filters, Band reject filters. **555 Timer and its applications:** Mono-stable and Astable Multivibrators. **Laboratory Sessions/ Experimental learning:** 1. Demonstrate a simple light circuit that uses a decade counter to drive two traffic lights and uses 555 timer chip as clock. **Applications:** PWM (Pulse Width Modulation) & PPM (Pulse Position Modulation), Analog frequency meters, Digital logic probes. **Video link / Additional online information** : https://www.youtube.com/watch?v=-KMAQxc3J3g	**Hrs**
LABORATORY EXPERIMENTS	
1. Design and set up the RC coupled Single stage BJT amplifier and determine the gain-frequency response, input and output impedances 2. Design and set up BJT Darlington Emitter follower without bootstrapping and determine the gain, input and output impedances. 3. Design and set-up BJT i) Colpitts Oscillator, and ii) Crystal Oscillator. 4. Design active second order Butterworth low pass and high pass filters. 5. Design Adder, Integrator and Differentiator circuits using Op-Amp 6. Test a comparator circuit and design a Schmitt trigger for the given UTP and LTP values and obtain the hysteresis. 7. Design 4 bit R – 2R Op-Amp Digital to Analog Converter (i) using 4 bit binary input from toggle switches and (ii) by generating digital inputs using mod-16 counter. 8. Design Monostable and Astable Multivibrator using 555 Timer. Simulation using PSpice Software 9. RC Phase shift oscillator and Hartley oscillator	

10. Precision Half and Full wave Rectifier
11. JFET Amplifier
12. Monostable and Astable Multivibrator using 555 Timer

Course Outcomes: After completing the course, the students will be able to	
CO1	Analyse the frequency response of BJT Amplifier and FET amplifier
CO2	Design various Feedback amplifiers and oscillators using BJT/FET
CO3	Understand the classes of amplifiers and Voltage regulator
CO4	Describe DC amplifier, AC Amplifiers and application.
CO5	Acquire knowledge about Active Filters, DAC, ADC and Timer.

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

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

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study are 20 (2 presentations are be held for 10 marks each). The marks obtained in test, quiz and self -studies are added to get marks out of 100 and report CIE for 50 marks.

Laboratory- 50 Marks

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

Semester End Examination (SEE):

Total marks: 50+50=100

SEE for 50 marksare executed by means of an examination.

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Laboratory- 50 Marks

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

CO-PO Mapping												
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CO2	3	3	3	2	2	1	-	-	-	-	-	1
CO3	3	3	3	2	2	1	-	-	-	-	-	1
CO4	3	3	3	2	2	1	-	-	-	-	-	1
CO5	3	3	3	2	2	1	-	-	-	-	-	1

High-3, Medium-2, Low-1

Semester: III		
DIGITAL SYSTEM DESIGN & VERILOG (Theory and Practice)		
Course Code:	MVJ21EC35	CIE Marks:50+50
Credits:	L:T:P: 3:0:2	SEE Marks: 50 +50
Hours:	40 L+ 26 P	SEE Duration: 03+03 Hours
Course Learning Objectives: The students will be able to		
1	Familiarize with the simplification techniques & design various combinational digital circuits using logic gates.	
2	Introduce the analysis and design procedures for synchronous and asynchronous sequential circuits.	
3	Familiarize with Modern EDA tool such as Verilog.	
4	Acquire knowledge on different types of description in Verilog.	
5	Know the importance of Synthesis & programmable devices used for designing digital circuits.	

UNIT-I	
Prerequisites: *Number systems, Boolean Algebra, Logic Gates, Comparison of Combinational & Sequential Circuits.* **Principles of combinational logic** : Introduction, Canonical forms, Karnaugh maps-3, 4 variables, Quine- McClusky techniques- 3 & 4 variables. **Laboratory Sessions/ Experimental learning** : 1. Study of Logic Gates – NOT, OR, AND, NOR, NAND, XOR and XNOR. 2. Design a 4-bit Binary to Gray code converter using Pspice, a simulation tool. **Applications:** OR gate in detecting exceed of threshold values and producing command signal for the system and AND gate in frequency measurement. **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=FT03XrQ8Bi4	**8 Hrs**
UNIT-II	

Prerequisites: *Decoder, Encoders, Multiplexers & Demultiplexer* **Design and Analysis of combinational logic:** Full Adder & Subtractors, Parallel Adder and Subtractor, Look ahead carry Adder, Binary comparators, Decoders & Multiplexers as minterm/maxterm Generator. **Introduction to Verilog** : Structure of verilog Module, Operators, Data types, Units and ports, Verilog constructs. **Laboratory Sessions/ Experimental learning:** 1. Design a full adder using two half adders in Pspice tool. 2. Design an Adder cum Subtractor circuit which adds when input bit operation=1 or subtract if 0, using Pspice. 3. Design 4-bit comparator using IC7485. 4. Realize a Boolean expression using decoder IC74139. **Applications:** Communication systems, Speed synchronization of multiple motors in industries. **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=RZQTTfU9TNA, 2. https://www.youtube.com/watch?v=36hCizOk4PA, https://www.youtube.com/watch?v=397DDnkBm8A	**8 Hrs**
UNIT-III	
Prerequisites: *SR, JK, D, T flipflops* **Flip-Flops and its Applications:** Latches and Flip Flops, Master-slave JK flip-flop, Timing concerns in sequential circuits, Shift Registers – SISO, SIPO, PISO PIPO, Universal shift register, Counters – Synchronous and Asynchronous. **Verilog Concepts**: Verilog statements- assign, if-else, case, loops, always. **Laboratory Sessions/ Experimental learning:** 1. Develop the Verilog code for the following flip-flops SR, D, JK &T. 2. Design a 6-bit Register using D-Flipflop using Verilog which stores every bit for each clock cycle. **Applications:** Frequency divider circuit, frequency counter.	**8 Hrs**

Video link / Additional online information: https://www.youtube.com/watch?v=Nxpei7Kp4Vs	
UNIT-IV	
Sequential Circuit Design: Characteristic equations, Design of a synchronous mod-n counter using clocked JK, D, T and SR flip-flops, Melay & Moore Models. **Programmable Logic Devices:** PLA, PAL, FPGA. **Laboratory Sessions/ Experimental learning:** 1. Design a Synchronous Counter for a given sequence- 0, 2, 4, 6, 0 using Verilog. 2. Design a 4-bit Asynchronous up/down counter using Pspice tool (D,T,JK,SR flipflops) 3. Design a 4-bit binary Synchronous up/down counter using Pspice tool. (D,T, JK, SR flipflops) 4. Implement ALU operations on FPGA **Applications:** Data synchronizer, Counter. **Video link / Additional online information:** https://www.youtube.com/watch?v=O3If0Nr9to0	**8 Hrs**
UNIT-V	
Synthesis Basics : Introduction, Synthesis information from Entity and Module, Mapping Process and Always in the Hardware Domain. **Laboratory Sessions/ Experimental learning:** 1. Verilog code for weather forecast Entity. 2. Mapping logic operators. **Applications:** Timing verification, test documentation. **Video link / Additional online information:** https://nptel.ac.in/courses/117108040/	**8 Hrs**
LABORATORY EXPERIMENTS	
1. Verify (a) Demorgan's Theorem for 2 variables. (b) The sum-of product and product-of-sum expressions using universal gates.	

2.Design and implement

(a) Full Adder using basic logic gates.

(b) Full subtractor using basic logic gates.

3. Design and implement

(i) 4-bitParallelAdder/ Subtractor using IC 7483.

(ii) BCD to Excess-3 code conversion and vice-versa.

Realize

(i) Adder & Subtractors using IC 74153

(ii) 4-variable function using IC 74151(8:1MUX)

4. Realize the following flip-flops using NAND Gates.

(a) Clocked SR Flip-Flop

(b) JK Flip-Flop

(c) D-Flip-Flop

5. Realize the following shift registers using IC7474

(a)SISO (b) SIPO (c) PISO (d) PIPO (e) Ring Counter (f) Johnson Counter.

6. Realize

(i) Design Mod – N Synchronous Up Counter & Down Counter using 7476 JK Flip-flop

(ii) Mod-N Counter using IC7490 / 7476.

Simulate the following using Verilog Code and Implement on FPGA

7. Write a Verilog program for the following combinational designs a) 2 to 4 decoder b) 8 to 3 (encoder without priority & with priority) c). 8 to 1 multiplexer d) 4 bit binary to gray converter e) Multiplexer, De-multiplexer, Comparator.

8. Design 4 bit binary, BCD counters with Synchronous reset and asynchronous reset and "any sequence" counters using Verilog code.

9. Write HDL code to display messages on alpha numeric LCD display.

10. Write a HDL code to control speed, direction of DC and Stepper motor

11.Write HDL code to interface Hex key pad and display the key code on seven segment display.

12. Write a HDL code to accept Analog signal, Temperature sensor and display the data on LCD or Seven Segment Display.

Virtual Lab Links: http://vlabs.iitkgp.ernet.in/dec/ Any 12 experiments to be conducted

Course outcomes:	
CO1	Illustrate simplification of Algebraic equations using K-map & Quine-McCluskey Technique.
CO2	Use the modern engineering tools such as verilog, necessary for engineering practice.
CO3	Analyse& design different applications of Combinational & Sequential Circuits to meet desired need within realistic constraints.
CO4	Write code & verify the functionality of digital circuit/system using test benches to solve engineering problems in digital circuits.
CO5	Know the importance of Synthesis & programmable devices used for designing digital circuits.

Reference Books:	
1.	John M Yarbrough, "Digital Logic Applications and Design", Thomson Learning, 2001.
2.	Donald D. Givone, "Digital Principles and Design", McGraw Hill, 2002.
3.	NazeihM.Botros- "HDL Programming (VHDL and Verilog)"- John Weily India Pvt. Ltd. 2008
4.	Samir Palnitkar "Verilog HDL: A Guide to Digital Design and Synthesis", Pearson Education, Second Edition

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

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

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

Laboratory- 50 Marks

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

Semester End Examination (SEE):

Total marks: 50+50=100

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

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

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

High-3, Medium-2, Low-1

Semester: III/IV		
CONSTITUTION OF INDIA, PROFESSIONAL ETHICS AND CYBER LAW (Theory)		
Course Code:	MVJ21EC36	CIE Marks: 50
Credits:	L:T:P: 1:0:0	SEE Marks: 50
Hours:	15L	SEE Duration: 3 Hrs.
Course Learning Objectives: The students will be able to		
1	To know the fundamental political codes, structure, procedures, powers, and duties of Indian constitution, Indian government institutions, fundamental rights, directive principles and the duties of the citizens.	
2	To provide overall legal literacy to the young technocrats to manage complex societal issues in the present scenario.	
3	To understand engineering ethics & their responsibilities, identify their individual roles and ethical responsibilities towards society.	

UNIT 1	
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.	3Hrs.
UNIT II	
Union Executive and State Executive: Parliamentary System, Federal System, Centre-State Relations. Union Executive – President, Prime Minister, Union Cabinet, Parliament - LS and RS, Parliamentary Committees, Important Parliamentary Terminologies. Supreme Court of India, Judicial Reviews and Judicial Activism. State Executives – Governor, Chief Minister, State Cabinet, State Legislature, High Court and Subordinate Courts, Special Provisions (Article 370, 371, 371J) for some States.	3Hrs.
UNIT III	

Elections, Amendments and Emergency Provisions: Elections, Electoral Process, and Election Commission of India, Election Laws. Amendments - Methods in Constitutional Amendments (How and Why) and Important Constitutional Amendments. Amendments – 7,9,10,12,42,44,61,73,74,75,86, and 91,94,95,100,101,118 and some important Case Studies. Recent Amendments with explanation. Important Judgements with Explanation and its impact on society (from the list of Supreme Court Judgements). Emergency Provisions, types of Emergencies and its consequences. **Constitutional Special Provisions:** Special Constitutional Provisions for SC & ST, OBC, Special Provision for Women, Children & Backward Classes.	3Hrs.
UNIT IV	
Professional / Engineering Ethics: Scope & Aims of Engineering & Professional Ethics - Business Ethics, Corporate Ethics, Personal Ethics. Engineering and Professionalism, Positive and Negative Faces of Engineering Ethics, Code of Ethics as defined in the website of Institution of Engineers (India): Profession, Professionalism, Professional Responsibility. Clash of Ethics, Conflicts of Interest. **Responsibilities in Engineering** - Responsibilities in Engineering and Engineering Standards, the impediments to Responsibility. Trust and Reliability in Engineering, IPRs (Intellectual Property Rights), Risks, Safety and liability in Engineering.	3Hrs.
UNIT V	
Internet Laws, Cyber Crimes and Cyber Laws: Internet and Need for Cyber Laws, Modes of Regulation of Internet, Types of cyber terror capability, Net neutrality, Types of Cyber Crimes, India and cyber law, Cyber Crimes and the information Technology Act 2000, Internet Censorship, Cybercrimes and enforcement agencies.	3Hrs.

Course Outcomes: On completion of this course, students will be able to	
CO1	Have constitutional knowledge and legal literacy

CO2	Understand Engineering and Professional ethics and responsibilities of Engineers.
CO3	Understand the cybercrimes and cyber laws for cyber safety measure.

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

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Semester End Examination (SEE):

Total marks: 50+50=100

SEE for 50 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective

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

Semester: III		
Additional Mathematics-I (Common to all branches)		
Course Code:	MVJ21MATDIP1	CIE Marks:50
Credits:	L:T:P:S: 4:0:0:0	SEE Marks: 50
Hours:	40L	SEE Duration: 3 Hrs
Course Learning Objectives: The students will be able to		
1	To familiarize the important and introductory concepts of Differential calculus	
2	Aims to provide essential concepts integral calculus	
3	To gain knowledge of vector differentiation	
4	To learn basic study of probability	
5	Ordinary differential equations of first order and analyze the engineering problems.	

UNIT-I	
Differential calculus: Recapitulation of successive differentiation -nth derivative -Leibnitz theorem (without proof) and Problems, Polar curves - angle between the radius vector and tangent, angle between two curves, pedal equation, Taylor's and Maclaurin's series expansions- Illustrative examples. **Video Link** : 1. http://nptel.ac.in/courses.php?disciplineID=111	8 Hrs
UNIT-II	
Integral Calculus: Statement of reduction formulae for the integrals of $\sin^n(x)$, $\cos^n(x)$, $\sin^n(x)\cos^n(n)$ and evaluation of these integrals with standard limits-problems. Double and triple integrals-Simple examples. **Video Link** : 1. http://nptel.ac.in/courses.php?disciplineID=111	8 Hrs
UNIT-III	
Vector Differentiation: Scalar and Vector point functions, Gradient, Divergence, Curl, Solenoidal and Irrotational vector fields. **Vector identities** - $div(\phi\vec{A}), curl(\phi\vec{A}), curl(grad(\phi)), div(curl\vec{A})$. **Video Link** : 1. http://nptel.ac.in/courses.php?disciplineID=111	8Hrs
UNIT-IV	
Probability: Basic terminology, Sample space and events. Axioms of probability. Conditional probability – illustrative examples. Bayes theorem-examples. **Video Link** : 1. http://nptel.ac.in/courses.php?disciplineID=111	8Hrs
UNIT-V	
Ordinary Differential Equations of First Order: Introduction – Formation of differential equation, solutions of first order and first	8Hrs

degree differential equations: variable separable form, homogeneous, exact, linear differential equations. **Video Link** : 1. http://nptel.ac.in/courses.php?disciplineID=111	

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

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

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

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