B.E, III Semester, Electronics & Communication Engineering

Course Title	Transforms, Fourier Series and Numerical Methods	Semester	III
Course Code	MVJ19MEC31	**CIE**	50
Total No. of Contact Hours	60 L : T : P :: 50 : 10 : 0	**SEE**	50
No. of Contact Hours/week	4	**Total**	100
Credits	3	**Exam. Duration**	3Hrs

Course objective is 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	**RBT Level L1, L2, L3**	12Hrs.

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	**RBT Level L1, L2, L3**	12Hrs.

Fourier Series: Continuous and Discontinuous functions, Convergence and divergence of infinite series of positive terms, Periodic functions, Dirichlet's conditions, Fourier series of periodic functions of period 2π and arbitrary period.

Half Range Fourier Series: Half range fourier sine series and cosine series of period π 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	**RBT Level L1, L2, L3**	12Hrs.
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	**RBT Level L1, L2, L3**	12Hrs.
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	**RBT Level L1, L2, L3**	12Hrs.
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:	
CO1	Learn to solve linear differential equations using Laplace transforms

CO2	Learn to represent a periodic function in terms of sine and cosine functions.
CO3	Evaluate Fourier transforms and use 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, 43rd Edition, 2013.
2.	Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley-India publishers, 10th edition, 2014.
3.	Ramana B. V., "Higher Engineering Mathematics", Tata Mc Graw-Hill, 2006.
4.	Bali N. P. & Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, 8th Edition
5.	H K Dass:"Advanced Engineering Mathematics"- S Chand & Company Ltd.12th edition.

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

High-3, Medium-2, Low-1

Course Title	Network Analysis	Semester	III
Course Code	MVJ19EC32	**CIE**	50
Total No. of Contact Hours	60 L : T : P :: 40 : 10 : 10	**SEE**	50
No. of Contact Hours/week	5	**Total**	100
Credits	4	**Exam. Duration**	3Hrs

Course objective is to:

- Describe basic network concepts emphasizing source transformation source shifting, mesh and nodal techniques to solve for resistance/impedance, voltage, current and power.
- 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.
- Describe Series and Parallel Combination of Passive Components as resonating circuits, related parameters and to analyse frequency response.
- Explain the behaviour of networks subjected to transient conditions. Use applications of Laplace transform to solve network problems.
- Study two port network parameters like Z, Y, T and h and their inter-relationships.

Module-1	**RBT Level L1,L2,L3,L4**	12Hrs.

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: Find the current through and voltage across the load in the given circuit.

Applications: Simplification and analysis of analog circuits, microwave circuit analysis

Video link / Additional online information :https://www.youtube.com/watch?v=UMhBgyK8F0U

Module-2	**RBT Level L1,L2,L3,L4**	12Hrs.

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		
Module-3	**RBT Level L1,L2,L3,L4**	12Hrs.
Network Theorems: Superposition Theorem, Millman's theorem, Thevenin's and Norton's theorems, Reciprocity theorem, Maximum Power transfer theorem. **Laboratory Sessions/ Experimental learning**: 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		
Module-4	**RBT Level L1,L2,L3,L4**	12Hrs.
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:** 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		
Module-5	**RBT Level L1,L2,L3,L4**	12Hrs.
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:** i) Plot the frequency response characteristics for a series RL, RC circuit. ii) Plot the frequency response characteristics for a parallel RL circuit. iii)Measure two port parameters for a given network		

Applications: For analysis of communication systems and antennas.

Video link / Additional online information:https://www.youtube.com/watch?v=YLGrugmDvc0

Course outcomes:	
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.
5.	Charles K Alexander and Mathew N O Sadiku, — Fundamentals of Electric Circuits, Tata McGraw-Hill, 3rd Ed, 2009.

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

High-3, Medium-2, Low-1

Course Title	Analog Electronics	Semester	III
Course Code	MVJ19EC33	**CIE**	50
Total No. of Contact Hours	60 L: T : P :: 40 : 0 : 20	**SEE**	50
No. of Contact Hours/week	3	**Total**	100
Credits	3	**Exam. Duration**	3Hrs

Course objective is to:

- To know the biasing methods of BJT and its low frequency response at various configurations.
- Explain construction and characteristics of JFETs
- Explain various types of FET biasing, and demonstrate the use of FET amplifiers.
- To know about the different topologies of feedback amplifiers.
- Analyse the Power amplifier circuits in different modes of operation.

Module-1	**RBT Level L1,L2,L3**	12Hrs.

Prerequisites: *Transistor basics*

Transistor Biasing: Operating point, Fixed bias circuits, Emitter stabilized biased circuits, Voltage divider biased, DC bias with voltage feedback, Miscellaneous bias configurations, Design operations, and Transistor switching networks.

Transistor at Low Frequencies: BJT transistor modelling, CE Fixed bias configuration, Voltage divider bias, Emitter follower, CB configuration, Collector feedback configuration, Analysis of circuits re model; analysis of CE configuration using h- parameter model; Relationship between h-parameter model of CE,CC and CE configuration.

Experimental learning: Realize BJT Darlington Emitter follower with and without bootstrapping and determine the gain, input and output impedances.

Applications: Amplifier, Switch, Sensor and Display.

Video link/ Additional online information: http://www.nptelvideos.in/2012/12/electronics.html

Module-2	**RBT Level L1,L2,L3,L4**	12Hrs.

BJT Small signal model and FET Amplifiers:

Prerequisites: *BJT,FET*

Transistor Frequency Response: General frequency considerations, low frequency response, Miller effect capacitance, High frequency response, multistage frequency effects.

Small signal operation and Models: Collector current and trans conductance, Base current and input resistance, Emitter current and input resistance, voltage gain.

Field Effect Transistors: Construction and Characteristics of JFETs, Transfer Characteristics, Depletion type MOSFET, Enhancement type MOSFET.

Experimental learning: 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, current limiter

Video link/ Additional online information: http://www.nptelvideos.in/2012/12/electronics.html

Module-3	**RBT Level L1,L2,L3**	12Hrs.

Prerequisites: *FET*

FET Amplifiers: JFET small signal model, Fixed bias configuration, Self bias configuration, Voltage divider configuration, Common Gate configuration, Source-Follower Configuration, Cascade configuration.

JFET Frequency Response: High frequency response - FET Amplifier, Multistage Frequency Effects.

General Amplifiers: Cascade connections, Cascode connections, Darlington connections.

Experimental learning: Design and set-up the crystal oscillator and determine the frequency of oscillation.

Applications: Darlington Transistor finds applications in Power Regulators, Audio Amplifier output stages, Controlling of Motors and light and touch sensors

Video link/ Additional online information:

http://www.nptelvideos.in/2012/12/electronics-for-analog-signal.html

Module-4	**RBT Level L1,L2,L3**	12Hrs.

Prerequisites: *Feedback Amplifier, Oscillators*

Feedback Amplifier: The Four Basic Feedback Topologies, The series-shunt, series-series, shunt-shunt and shunt-series amplifiers. Practical feedback circuits. Design procedures for the feedback amplifiers.

Oscillators: Oscillator operation, FET based Phase shift oscillator, Wien bridge oscillator, LC and Crystal Oscillators, UJT construction, UJT oscillators

Experimental learning: 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		
Module-5	**RBT Level L1,L2,L3**	12Hrs.
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. **Experimental learning:** Plot the frequency response using any classes 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		

Course outcomes:	
CO1	Describe the working principle and characteristics of BJT, FET, Single stage, and Cascaded and feedback amplifiers.
CO2	Calculate the gain and impedance for BJT using h parameter models
CO3	Describe the performance characteristics and parameters of BJT and FET amplifier using small signal model
CO4	Describe the Phase shift, Wien bridge, tuned and crystal oscillators using BJT/FET
CO5	Understand the classes of amplifiers and oscillator applications

Reference Books:	
1.	Microelectronic Circuits, Theory and Applications, Adel S Sedra, Kenneth C Smith, 6th Edition, Oxford, 2015.ISBN:978-0-19-808913-1.
2.	"Electronic Devices and circuit Theory", Robert L.Boylestad and louis Nashelsky,PHI/Pearson Education,9TH Edition.
3.	Fundamentals of Microelectronics, Behzad Razavi, John Weily ISBN 2013 978-81- 265-2307-8
4.	K. A. Navas, "Electronics Lab Manual", Volume I, PHI, 5th Edition, 2015,

	ISBN:9788120351424.
5.	J.Millman&C.C.Halkias—Integrated Electronics, 2nd edition, 2010, TMH. ISBN 0-07-462245-5.

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

High-3, Medium-2, Low-1

Course Title	Digital System Design and Verilog	Semester	III
Course Code	MVJ19EC34	**CIE**	50
Total No. of Contact Hours	60 L: T : P :: 40 : 0 : 20	**SEE**	50
No. of Contact Hours/week	3	**Total**	100
Credits	3	**Exam. Duration**	3Hrs

Course objective is to:

- Familiarize with the simplification techniques & design various combinational digital circuits using logic gates.
- Introduce the analysis and design procedures for synchronous and asynchronous sequential circuits.
- Familiarize with Modern EDA tool such as Verilog.
- Acquire knowledge on different types of description in Verilog.
- Know the importance of Synthesis & programmable devices used for designing digital circuits.

Module-1	**RBT Level L1,L2,L3**	12Hrs.

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.

Introduction to HDL: Structure of HDL Module, Operators, Data types, Types of Descriptions, simulation and synthesis, Brief comparison of VHDL and Verilog.

Laboratory Sessions/ Experimental learning:

1. Design a 4-bit Binary to Gray code converter using Pspice, a simulation tool.
2. Write a Verilog code to realize all the gates
3. Write a HDL code to describe the functions of a full adder using three modeling styles.

Video link / Additional online information: https://www.youtube.com/watch?v=FT03XrQ8Bi4

Module-2	**RBT Level L1,L2,L3,L4**	12Hrs.

Design and Analysis of combinational logic: Full Adder & Subtractors, Parallel Adder and Subtractor, Look ahead carry Adder, Binary comparators. Decoder, Encoders, Multiplexers &

Demultiplexer, Decoders & Multiplexers as minterm/maxterm Generator.

HDL Concepts: Units and ports, Verilog constructs, Verilog Models for all above Combinational Circuits (Data flow & Structural descriptions)

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 comaparator using IC7485.
4. Realize a Boolean expression using decoder IC74139.

Video link / Additional online information:

1. https://www.youtube.com/watch?v=RZQTTfU9TNA,
2. https://www.youtube.com/watch?v=36hCizOk4PA,
3. https://www.youtube.com/watch?v=397DDnkBm8A

Module-3	**RBT Level L1,L2,L3**	12Hrs.

Flip-Flops and its Applications: Latches and Flip Flops - SR, JK, Master-slave JK flip-flops, D, T; Timing concerns in sequential circuits, Registers.

HDL Concepts: Verilog statements- assign, if-else, case, loops, always; Sequential circuit design on Flipflops in Verilog (behavioural description)

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**.**

Video link / Additional online information: https://www.youtube.com/watch?v=Nxpei7Kp4Vs

Module-4	**RBT Level L1,L2,L3, L4**	12Hrs.

Sequential Circuit Design: Characteristic equations, Asynchronous Counter, Design of a synchronous mod-n counter using clocked JK, D, T and SR flip-flops, Melay & Moore Models, Synchronous Sequential circuit Analysis.

HDL Concepts: Sequential circuit design on Synchronous and Asynchronous Counters in Verilog.

Laboratory Sessions/ Experimental learning:

1. Design a Synchronous Counter for a given sequence- 0, 2, 4, 6, 0 using Verilog.
2. Design an 4-bit Asynchronous up/down counter using Pspice tool (D,T,JK,SR flipflops)

3. Design an 4-bit binary Synchronous up/down counter using Pspice tool. (D,T,JK,SR flipflops) 4. Design Pseudo Random Sequence generator using 7495 **Video link / Additional online information:** https://www.youtube.com/watch?v=O3If0Nr9to0

Module-5	**RBT Level L1,L2,L3**	12Hrs.
Synthesis Basics: Introduction, Synthesis information from Entity and Module, Mapping Process and Always in the Hardware Domain. **Programmable Logic Devices:** PLA, PAL, FPGA. **Laboratory Sessions/ Experimental learning:** Implement ALU operations on FPGA. **Video link / Additional online information:** https://nptel.ac.in/courses/117108040/		

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	Analyze & 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.	Charles H Roth Jr., Larry L. Kinney —Fundamentals of Logic Design, Cengage Learning, 7th Edition
4.	Samir Palnitkar —Verilog HDL: A Guide to Digital Design and Synthesis", Pearson Education, Second Edition
5.	"HDL Programming (VHDL and Verilog)"- Nazeih M.Botros- John Weily India Pvt. Ltd. 2008

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

High-3, Medium-2, Low-1

Course Title	Electromagnetics& Transmission Lines	Semester	III
Course Code	MVJ19EC35	**CIE**	50
Total No. of Contact Hours	60 L: T : P :: 40 : 10 : 10	**SEE**	50
No. of Contact Hours/week	4	**Total**	100
Credits	3	**Exam. Duration**	3Hrs

Course objective is to:

- Understand the applications of Coulomb's law and Gauss law to different charge Distributions.
- Understand the physical significance of Biot-Savart's Law, Amperes' Circuital Law and Stokes' theorem for different current distributions.
- Know the physical interpretation of Maxwell's equations and its applications in plane waves.
- Understand the concepts of Smith Chart for impedance matching.
- Acquire knowledge on different types of transmission lines.

Module-1	**RBT Level L1, L2, L3**	12Hrs.

Prerequisites: *Vector Algebra, Coordinate systems (Rectangular Coordinate System, Cylindrical Coordinate System and Spherical Coordinate System), gradient, divergence and curl*

Electrostatics:Coulomb's Law, Electric Field Intensity, Flux density and potential:

Coulomb's law , Electric field intensity, Field due to line charge, Field due to Sheet of charge, Field due to continuous volume charge distribution, Electric flux, Electric flux density, Electric potential, Potential difference, relation between Electric field intensity(E) & potential (V), potential gradient, Electric dipole, Energy density in electrostatic fields.

Laboratory Sessions/ Experimental learning:

1. Determine the electric field intensity at a point due to uniform linear charge (ρ L) and point charges using MATLAB.
2. Determine the electric field intensity at a point due to surface charge using MATLAB.
3. Determine the potential difference between two points on a ring having linear charge density, ρ L using MALAB.

Applications: The Van de Graaff generator, Xerography, Ink Jet Printers and Electrostatic Painting, Smoke Precipitators and Electrostatic Air Cleaning

Video link / Additional online information:

1. https://youtu.be/ckAVB3_NP2Q
2. https://youtu.be/IH2fFNaR9YM
3. https://youtu.be/JhTT-wew-OE

Module-2	**RBT Level L1, L2, L3, L4**	12Hrs.

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

Module-3	**RBT Level L1, L2, L3, L4**	12Hrs.

Magnetostatics:Steady Magnetic Field: Biot-Savart Law, Ampere's circuital law, Curl, Stokes' theorem, Gauss's law for magnetic fields, Magnetic flux and Magnetic flux density, Maxwell's equations for static fields, Magnetic Scalar and Vector Potentials.

Magnetic Forces and magnetic materials: Force on a moving charge and differential current element, Force between differential current elements, Magnetization, magnetic susceptibility, permeability, Magnetic boundary conditions, Inductances, magnetic energy, magnetic circuit.

Laboratory Sessions/ Experimental learning: Determine the magnetic field intensity at a point due to magnetic field using MATLAB.

Applications: Motors, Generators, Loudspeakers, MRI

Video link / Additional online information :

1. https://youtu.be/ebGM_q19gY0

2. https://youtu.be/uXQbYJVzlQ0
3. https://youtu.be/aYRBXI63Oqk

Module-4	**RBT Level L1, L2, L3, L4**	12Hrs.

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

Module-5	**RBT Level L1, L2, L3, L4**	12Hrs.

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.

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:	
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.

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

High-3, Medium-2, Low-1

Course Title	Computer Organization and Architecture	Semester	III
Course Code	MVJ19EC36	**CIE**	50
Total No. of Contact Hours	60 L: T : P :: 40 : 0: 20	**SEE**	50
No. of Contact Hours/week	3	**Total**	100
Credits	3	**Exam. Duration**	3Hrs

Course objective is to:

- Explain the basic sub systems of a computer, their organization, structure and Operation.
- Illustrate the concept of programs as sequences of machine instructions.
- To understand the different ways of communicating with I/O devices and to introduce memory types including cache memories.
- Describe memory hierarchy and concept of virtual memory.
- To analyse concepts of Pipelining and other computing systems.

Module-1	**RBT Level L1,L2,L3**	12Hrs.

Basic Structure of Computers: Computer Types, Functional Units, Basic Operational Concepts, Bus Structures, Software, Performance – Processor Clock, Basic Performance Equation.

Machine Instructions and Programs: Numbers, Arithmetic Operations and Characters,IEEE standard for Floating point Numbers, Memory Location and Addresses, Memory Operations, Instructions and Instruction Sequencing.

Laboratory Sessions/ Experimental learning:

1. Understanding various parts of CPU of a PC.
2. Study of Microprocessor and understanding of its various instruction

Applications: Understand the functionality of the various units of computer.

Video link / Additional online information:

1. https://www.youtube.com/watch?v=K7fnDf-P6_c#action=share
2. https://www.youtube.com/watch?v=9-9z32T-5WU#action=share
3. https://www.youtube.com/watch?v=Szn_lwHal04#action=share

Module-2	**RBT Level L1,L2,L3**	12Hrs.

Prerequisite :*Number system*

Addressing Modes: Assembly Language, Basic Input and Output Operations, Stacks and Queues,

Subroutines, Additional Instructions.

Laboratory Sessions/ Experimental learning:

1. Write an ALP to find the sum of two numbers and verify if the sum is an even or odd number and simulate the output.
2. Write an ALP to transfer a block of data from one location to other and simulate the output.

Applications: Project based on microprocessor.

Video link / Additional online information:

1. https://www.youtube.com/watch?v=s4cVdsK3XiQ#action=share
2. https://www.youtube.com/watch?v=xKTNgA_ee58

Module-3	**RBT Level L1,L2,L3**	12Hrs.

Input/Output Organization: Accessing I/O Devices, Interrupts – Interrupt Hardware, Enabling and Disabling Interrupts, Handling Multiple Devices, Controlling Device Requests, Direct Memory Access, and Buses.

Laboratory Sessions/ Experimental learning: Study any one input/output device and examine its various input output ports details.

Applications: Interfacing of Peripheral devices

Video link / Additional online information:

1. https://www.youtube.com/watch?v=Y17TLZCSe4M#action=share
2. https://www.youtube.com/watch?v=Zw79moR2gFs

Module-4	**RBT Level L1,L2,L3**	12Hrs.

Memory System: Basic Concepts, Semiconductor RAM Memories-Internal organization of memory chips, Static memories, Asynchronous DRAMS, Read Only Memories, Cash Memories, Mapping Functions, Replacement Algorithm, Virtual Memories, Secondary Storage-Magnetic Hard Disks.

Laboratory Sessions/ Experimental learning: Implement and simulate a simple memory unit which is capable of reading and writing data within a single clock cycle.

Applications: Understanding the various memories

Video link / Additional online information :

1. https://www.youtube.com/watch?v=lpVyGPNyjEs#action=
2. https://www.youtube.com/watch?v=NhyIUpOj5V8#action=share
3. https://www.youtube.com/watch?v=xXk3WiPGux8#action=share
4. https://www.youtube.com/watch?v=aeDyDIo-G44#action=share

Module-5	RBT Level L1,L2,L3	12Hrs.

Basic Processing Unit: Some Fundamental Concepts, Execution of a Complete Instruction, Multiple Bus Organization, Hardwired Control, Micro programmed Control ,Pipelining ,Basic concepts, Role of Cache memory, Pipeline Performance

Laboratory Sessions/ Experimental learning: Evaluate the possible control sequence for implementing a multiplication instruction using registers for a single bus organization

Applications: Microprocessor

Video link / Additional online information:

1. https://www.youtube.com/watch?v=R41DfN3NpIM#action=share
2. https://www.youtube.com/watch?v=b5thcNYBrQc

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

Reference Books:	
1.	Carl Hamacher, ZvonkoVranesic, SafwatZaky: Computer Organization, 5th Edition, Tata McGraw Hill,2002.
2.	Andrew S. Tanenbaum ,Todd Austin, Structured Computer Organization, 6th Edition, Pearson,2013.
3.	David A. Patterson, John L. Hennessy: Computer Organization and Design – The Hardware / Software Interface ARM Edition, 4th Edition, Elsevier, 2009.
4.	William Stallings: Computer Organization & Architecture, 7th Edition, PHI, 2006.
5.	Vincent P. Heuring& Harry F. Jordan: Computer Systems Design and Architecture, 2nd Edition, Pearson Education, 2004.

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

High-3, Medium-2, Low-1

Course Title	Analog Electronics Lab	Semester	III
Course Code	MVJ19ECL37	**CIE**	50
Total No. of Contact Hours	60 L : T : P :: 0 : 20: 40	**SEE**	50
No. of Contact Hours/week	4	**Total**	100
Credits	2	**Exam. Duration**	3Hrs

Course objective is to:

- Understand the circuit schematic and its working.
- Study the characteristics of different electronic devices.
- Design and test simple electronic circuits as per the specifications using discrete Electronic components.
- Familiarize with EDA /PSPSICE software which can be used for electronic circuit Simulation.

Laboratory Sessions

PART A : Hardware Experiments

1. Wiring of RC coupled Single stage FET & BJT amplifier and determine the gain-frequency response, input and output impedances
2. Wiring of BJT Darlington Emitter follower with and without bootstrapping and determination of the gain, input and output impedances.
3. Design an oscillator with tank circuit having two inductances and one capacitance and compare the practical frequency with theoretical frequency.
4. Design an oscillator with tank circuit having two capacitance and one inductance and compare the practical frequency with theoretical frequency.
5. Conduct experiment to test diode clipping (single/double ended) and clamping circuits (positive/negative).
6. Design an Oscillator using FET whose tank circuit produces a total phase shit of 180, and calculate the frequency of output waveform.
7. Design an oscillator whose frequency is 2MHZ and compare with the theoretical frequency.
8. Find a suitable power amplifier that removes the cross over distortion and calculate the efficiency.

PART-B : Simulation using EDA software (EDWinXP, PSpice, MultiSim, Proteus, CircuitLab or any other equivalent tool can be used)

1. RC Phase Shift Ocsillator
2. Colpitts And Hartley Oscillator
3. Crystal Oscillator
4. Precision Half and Full wave Rectifier

Course outcomes:	
CO1	Design and compare the impedance effect in BJT Darlington Emitter follower circuit
CO2	Design analog circuits using BJT/FETs and evaluate their performance characteristics.
CO3	Design of diode clipper and clamper circuits.
CO4	Compare the hardware and software results for different oscillator and filter circuits.
CO5	Simulate and analyse electronic Circuits for different applications.

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

High-3, Medium-2, Low-1

Course Title	Digital System Design & Verilog Lab	Semester	III
Course Code	MVJ19ECL38	**CIE**	50
Total No. of Contact Hours	60 L : T : P :: 0 : 20 : 40	**SEE**	50
No. of Contact Hours/week	4	**Total**	100
Credits	2	**Exam. Duration**	3Hrs

Course objective is to:

- Demorgan's Theorem, SOP, POS forms
- Full/Parallel Adders, Subtractors and code converter BCD to Excess-3 & vice versa.
- Flip-Flops, Shift registers and Counters.
- Familiarize with the CAD tool to write HDL programs.
- Understand simulation and synthesis of digital design.

Laboratory Sessions

PART A- Rig up the circuit for the following and verify on IC Trainer Kit.

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. (a) Design and implement (i) 4-bitParallelAdder/ Subtractor using IC 7483. (ii) BCD to Excess-3 code conversion and vice-versa.
   (b) 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.

PART B- 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/

Course outcomes:

CO1	Demonstrate the truth table of various expressions and combinational circuits using logic gates.
CO2	Design and test various combinational circuits such as adders, subtractors, comparators, multiplexers and demultiplexers.
CO3	Construct and test flips-flops, counters, shift registers and Counters.
CO4	Write the Verilog/VHDL programs to simulate Combinational circuits in Dataflow, Behavioural and Gate level Abstractions.
CO5	Describe sequential circuits like flip flops and counters in Behavioural description and obtain simulation waveforms.

CO-PO Mapping

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

High-3, Medium-2, Low-1

B.E, IV Semester, Electronics & Communication Engineering

Course Title	Probability Theory, Complex variables and Optimization	Semester	IV
Course Code	MVJ19MEC41/MEE41	**CIE**	50
Total No. of Contact Hours	60 L : T : P :: 50 : 10 : 0	**SEE**	50
No. of Contact Hours/week	4	**Total**	100
Credits	3	**Exam. Duration**	3Hrs

Course objective is to:

- Apply discrete and continuous probability distributions in analyzing the probability models arising 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	**RBT Level L1, L2**	12Hrs.

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 models arising in engineering field.

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

Module-2	**RBT Level L1, L2**	12Hrs.

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

method.

Applications: Applications of transport Problems

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

Module-3	**RBT Level L1, L2, L3**	12Hrs.

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	**RBT Level L1, L2, L3**	12Hrs.

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	**RBT Level L2, L3**	12Hrs.

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 solve boundary value problems

Video Link: https://youtu.be/nNnnBMF03lI

Course Outcomes:	
CO1	Apply discrete and continuous probability distributions in analyzing the probability mode arising in engineering field.
CO2	Learn the mathematical formulation of linear programming problem
CO3	Use the concepts of analytic function and complex potentials to solve the problems arising i electromagnetic field theory
CO4	Utilize conformal transformation and complex integral arising in aerofoil theory, fluid flo visualization and image processing
CO5	Learn the numerical solutions of partial differential equations

Reference Books:	
1.	B.S. Grewal, "Higher Engineering Mathematics" Khanna Publishers, 43rd Edition, 2013.
2.	Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley-India publishers, 10thedition, 2014.
3.	Ramana B. V., "Higher Engineering Mathematics", Tata Mc Graw-Hill, 2006.
4.	Bali N. P. & Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, 8th Edition
5.	C. Ray Wylie and Louis C Barret: "Advanced Engineering". Mathematics Tata McGraw Hill Publishing Co. Ltd. 6thedition.
6.	H K Dass: "Advanced Engineering Mathematics"- S Chand & Company Ltd.12th edition.
7.	D. S. Hira and P. K. Gupta - "Operations Research"- S Chand & Company Ltd.6th edition

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

High-3, Medium-2, Low-1

Course Title	Signals and Systems	Semester	IV
Course Code	MVJ19EC42	**CIE**	50
Total No. of Contact Hours	60 L: T : P :: 40 :10 : 10	**SEE**	50
No. of Contact Hours/week	5	**Total**	100
Credits	4	**Exam. Duration**	3Hrs

Course objective is to:

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

Module-1	**RBT Level L1,L2,L3**	12Hrs.

Prerequisites: Definition of step, ramp, impulse response

Introduction and Classification of signals: Definition of signal and systems, Communication and control system as examples, Classification of signals.

Basic Operations on signals: Amplitude scaling, addition, multiplication, differentiation, Integration, time scaling, time shift and time reversal.

Elementary signals/Functions: Exponential, sinusoidal, step, impulse and ramp functions. Expression of triangular, rectangular and other waveforms in terms of elementary signals

Laboratory Sessions/ Experimental learning:

1. Exploring concepts with MATLAB- Generation of both continuous time and discrete time signals of various kinds.
    a) Plot $y(x) = x^2 \cos(x)$, $g(x) = x \cos(x)$, $f(x) = 2^x \sin(x)$, $0 \leq x \leq 2\pi$ in the same figure.
2. Generation of Signals & Signal Operations

    Plot in the time interval $-5 \leq t \leq 10$, the following signals:
    a) $\delta(t) + 2\,\delta(t)$
    b) $u(t) + 2\,u(t) + 1$
    c) $r(t) + u(t)$

Applications: Time shifting operation can be used in artificial intelligence, such as in systems that use Time Delay Neural Network, Multiplication of signals is exploited in the field of analog

communication when performing amplitude modulation (AM),Differentiation of a signal is used in the field of image or video processing.

Video link / Additional online information : https://nptel.ac.in/courses/108/104/108104100/

Module-2	**RBT Level L1,L2,L3**	12Hrs.

System Classification and properties: Linear-nonlinear, Time variant-invariant, Causal-non causal, static-dynamic, stable-unstable, invertible.

Time domain representation of LTI System: Impulse response of an LTI system, convolution sum, Convolution integral. Properties of convolution - Commutative property, Distributive property, Associative Property and system interconnection. Computation of convolution sum and convolution integral using graphical method for unit step and unit step, unit step and exponential, exponential and exponential, unit step and rectangular, and rectangular and rectangular

Laboratory Sessions/ Experimental learning:

1. To compute convolution of two signals using MATLAB.
    a) A system is described by the impulse response h (t) =t, $0 \leq t \leq 10$. Compute and plot the response of the system to the input signal $x(t)=0.8^{t}$, $0 \leq t \leq 10$.
    b) Compute the convolution between the complex sequence =[3+2j,1+j,4+6j] and h=[1-2j,j,3-2j,2].

Applications: Convolution concepts are used in Artificial Intelligence, Image Processing, Signal filtering, Audio processing

Video link / Additional online information :

1. https://nptel.ac.in/courses/117105134/
2. http://www.digimat.in/nptel/courses/video/108108109/L63.html

Module-3	**RBT Level L1,L2,L3**	12Hrs.

Prerequisites: Basics of Fourier series concepts

LTI system Properties in terms of impulse response: Memoryless, Causal, Stable, Invertible, and step response.

Fourier Representation of Periodic Signals: CTFS and DTFS and basic problems (excluding properties).

Laboratory Sessions/ Experimental learning:

1. To analyse the spectrum of signal with Fourier series using MATLAB.
    a) Verify the linearity property of the given periodic signals x(t)=cos(t) and

y(t)=sin(2t),scalars are a=3+2j,b=2.

b) Verify the time reversal property of the given periodic signal x(t)=t cos(t) ,$0 \leq t \leq 2\pi$ in one period.

Applications: Signal Processing, Control Theory, Communications Systems, Image and Video Processing, Biomedical Engineering (ECG, MRI), Oil extraction (Seismology), Music Industry (Audio) and Power Quality Analysis.

Video link / Additional online information :

1. https://nptel.ac.in/courses/111106046/
2. https://nptel.ac.in/courses/111106111/

Module-4	**RBT Level L1,L2,L3,L4**	12Hrs.

Prerequisites: Basics of Fourier transform concepts

Fourier Representation of aperiodic Signals: Introduction to Fourier Transform & DTFT, Definition and basic problems. Properties of Fourier Transform: Linearity, Time shift, Frequency shift, scaling, Differentiation and Integration, Convolution and Modulation, Parseval's theorem and problems on properties of Fourier Transform.

Laboratory Sessions/ Experimental learning:

1. Application of Fourier Transform in Modulation and Demodulation Technology using MATLAB.
   a) Compute the Fourier transform of the function $x(t) = e^{-t} u(t)$
   b) Suppose that a signal x(t) is given by $x(t)=te^{-3t}$. Compute the Fourier transform X (w) of the signal of the signal x(t) and plot for $-20 \leq w \leq 20$ rad/sec.

Applications: Fourier Transform in Modulation and Demodulation Technology, Frequency division multiplexing and time division multiplexing, In Filtering Technology

Video link / Additional online information :

1. https://nptel.ac.in/courses/111102129/
2. https://nptel.ac.in/courses/111106046/

Module-5	**RBT Level L1,L2,L3**	12Hrs.

Prerequisites: Basics of Z-transform concepts

The Z-Transforms: Z transform, properties of the region of convergence, properties of the Z-transform, Inverse Z-transform, Causality and stability, Transform analysis of LTI systems.

Laboratory Sessions/ Experimental learning:

1. To compute Z-transform of finite duration sequence using MATLAB.
    a) Compute the z-transform of the sequence fx(n)-[-3,5,6,7,8], $-2 \leq n \leq 2$.
    b) Compute the z-transform of the discrete-time signal $x(n)= n^2 u(n)$.
    c) Compute the convolution between the signals $X_1(z)= z/z-0.9$ and $X_2(z)=z/z+6$

Applications: To analysis of digital filters, Used to simulate the continuous systems, Analyse the linear discrete system, Used to finding frequency response, Analysis of discrete signal, Helps in system design and analysis and also checks the systems stability, For automatic controls in telecommunication.

Video link / Additional online information:https://nptel.ac.in/courses/108104100/

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

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

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

High-3, Medium-2, Low-1

Course Title	Control System	Semester	IV
Course Code	MVJ19EC43	**CIE**	50
Total No. of Contact Hours	60 L: T : P :: 40 : 10 : 10	**SEE**	50
No. of Contact Hours/week	4	**Total**	100
Credits	3	**Exam. Duration**	3Hrs

Course objective is to:

- Formulate the mathematical modelling of systems and understand the concepts of transfer function,
- Obtain transfer function using block diagram reduction and signal flow graph techniques.
- Analyse the response of first and second order systems using standard test signals and analyse steady state error.
- Analyse stability of systems using RH criteria, Root Locus, Nyquist, Bode plot and polar plot.
- Obtain state variable model for electrical systems.

Module-1	**RBT Level L1, L2, L3**	14Hrs.

Introduction to Control Systems: open loop and closed loop systems, Types of feedback, Differential equation of Physical Systems – Mechanical Systems, Electrical Systems, Analogous Systems.

Block diagrams and signal flow graphs: Transfer functions, Block diagram algebra and Signal Flow graphs.

Laboratory Sessions/ Experimental learning: Determine and plot poles and zeros from the transfer function using MATLAB.

Applications: Electric Hand Drier, Automatic Washing Machine, DC motor, Automatic Electric Iron, Voltage Stabilizer

Video link / Additional online information :

1. https://youtu.be/R0E3uKSKdME
2. https://youtu.be/zXMklO-jxIo
3. https://youtu.be/tDXgiStzbcY

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

Time Response of feedback control systems: Standard test signals, Unit step response of First and Second order Systems. Time response specifications, Time response specifications of second order systems, steady state errors and error constants. Introduction to Controllers

Laboratory Sessions/ Experimental learning:

1. Obtain step and impulse response of a unity feedback first order system for a given forward path transfer function using MATLAB.
2. Obtain step and impulse response of a unity feedback second order system for a given forward path transfer function using MATLAB.

Applications: Industrial Control systems

Video link / Additional online information :

1. https://youtu.be/ziu1OTwUrbw
2. https://youtu.be/YuZ3iwA-47I

Module-3	**RBT Level L1, L2, L3,L4**	10Hrs.

Stability analysis using RH Criteria and root locus: Concepts of stability, Necessary conditions for stability, Routh Hurwitz stability criterion, Relative stability analysis, Introduction to Root-Locus Techniques, the root locus concepts, Construction of root loci.

Laboratory Sessions/ Experimental learning: Obtain Root Locus Plot of the system for a given forward path transfer function using MATLAB.

Applications: Used to determine the dynamic response of a s system

Video link / Additional online information:

1. https://youtu.be/cez4InLZ7Pw
2. https://youtu.be/sUDoTw_LIbk
3. https://youtu.be/Irxppc_LCUk

Module-4	**RBT Level L1, L2, L3, L4**	18Hrs.

Stability analysis using Nyquist criteria and Bode plots: Polar plot, Nyquist Stability criterion, Nyquist plots, Bode plots, Gain and phase margin.

Laboratory Sessions/ Experimental learning:

1. Obtain Bode Plot of the system for a given forward path transfer function using MATLAB.
2. Obtain Nyquist Plot of the system for a given forward path transfer function using MATLAB.

Applications: To determine a stability of a system

Video link / Additional online information:

1. https://youtu.be/QzTCRk4nkDg
2. https://youtu.be/Wi6xt7IyjA0

Module-5	RBT Level L1, L2, L3	8Hrs.

Introduction to State variable analysis: Concepts of state, state variable and state models for electrical systems, Solution of state equations, State transition matrix and its properties.

Laboratory Sessions/ Experimental learning: Determining the solution of state equations using MATLAB.

Applications: State variables are used to describe the future response of a dynamic response

Video link / Additional online information: https://youtu.be/xajgSUci9zs

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

Reference Books:	
1.	Modern Control Engineering, K.Ogata, Pearson Education Asia/PHI, 4th Edition, 2002. ISBN 978-81-203-4010-7.
2.	Nagarath and M.Gopal, ― Control Systems Engineering‖, New Age International (P) Limited, Publishers, Fifth edition-2005, ISBN: 81-224-2008-
3.	Automatic Control Systems‖, Benjamin C. Kuo, John Wiley India Pvt. Ltd., 8th Edition, 2008.

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

High-3, Medium-2, Low-1

Course Title	Linear Integrated Circuits	Semester	IV
Course Code	MVJ19EC44	**CIE**	50
Total No. of Contact Hours	60 L: T : P :: 40 : 0 : 20	**SEE**	50
No. of Contact Hours/week	3	**Total**	100
Credits	3	**Exam. Duration**	3Hrs

Course objective is to:

- Define the basic concepts of OP-Amp ,various parameters of Op-Amp, its characteristics and specifications.
- Analyse Op-Amp circuits to determine Input Impedances, output Impedances and other performance parameters.
- Sketch and Explain typical Frequency Response graphs for each of the Filter circuits.
- Describe and Sketch the various switching circuits of Op-Amps and analyse its operations.
- Differentiate between various types of DACs and ADCs and evaluate the performance of each with neat circuit diagrams.

Module-1	**RBT Level L1,L2,L3,L4**	12Hrs.

Operational Amplifier Fundamentals: Basic Op-amp circuit, Op-Amp parameters – Input and output voltage, CMRR and PSRR, offset voltages and currents, Input, and output impedances, Slew rate and Frequency limitations. OP-Amps as DC Amplifiers – Biasing OP-amps, Direct coupled voltage followers, Non-inverting amplifiers, inverting amplifiers, Summing amplifiers, and Difference amplifiers. Interpretation of OP-amp LM741 & TL081 datasheet. (Text1)

Laboratory Sessions/ Experimental learning:

1. Design a circuit for calculating slew rate.
2. Design a non-inverting amplifier with closed loop gain is equal to 2V/V.

Applications: Sensors, Mixers.

Video link / Additional online information :https://www.youtube.com/watch?v=clTA0pONnMs

Module-2	**RBT Level L1,L2,L3,L4**	12Hrs.

Op-Amps as AC Amplifiers: Capacitor coupled voltage follower, High input impedance – Capacitor coupled voltage follower, Capacitor coupled non inverting amplifiers, High input impedance – Capacitor coupled Non inverting amplifiers, Capacitor coupled inverting amplifiers, setting the upper cut-off frequency, Capacitor coupled difference amplifier. OP-Amp Applications:

Voltage sources, current sources and current sinks, current amplifiers, instrumentation amplifier, precision rectifiers.

Laboratory Sessions/ Experimental learning: Design a capacitor coupled Non-inverting amplifier with gain is equal to3V/V.

Applications: Industrial areas (Temperature Indicator, Light Intensity Meter, Temperature Controller)

Video link / Additional online information: https://www.youtube.com/watch?v=GjG8oshYNLQ

Module-3	**RBT Level L1,L2,L3,L4**	12Hrs.

Op-amp Applications: Limiting circuits, Clamping circuits, Peak detectors, Sample and hold circuits, V to I and I to V converters, Differentiating Circuit, Integrator Circuit, Phase shift oscillator, Wein bridge oscillator, Zero Crossing detectors, inverting Schmitt trigger. (Text 1)

Log and antilog amplifiers, Multiplier, and divider. (Text2)

Laboratory Sessions/ Experimental learning:

1. Design a comparator using IC 741.
2. Design a Difference Amplifier.

Applications: Quartz watches, various radio, TV, and other communication devices, alarms and buzzes

Video link / Additional online information:https://www.youtube.com/watch?v=xki9taCqsWY

Module-4	**RBT Level L1,L2,L3,L4**	12Hrs.

Active Filters: First order and second order active Low-pass and high pass filters, Bandpass Filter, Band stop Filter. (Text 1) Voltage Regulators: Introduction, Series Op-amp regulator, IC voltage regulators. 723 general purpose regulators, DC-Voltage Regulators: Voltage regulator basics, Voltage follower regulator, adjustable output regulator. (Text 2).

Laboratory Sessions/ Experimental learning:

1. Design first order low-pass and high-pass filter for f0=2KHZ
2. Design Three Terminal Voltage Regulators (7805, 7809 And 7912).

Applications: Communication systems, Audio systems and Biomedical instruments

Video link / Additional online information:https://www.youtube.com/watch?v=y5s4bQnmV-g

Module-5	**RBT Level L1,L2,L3,L4**	12Hrs.

Phase locked loop: Basic Principles, Phase detector/comparator, VCO.DAC and ADC convertor: DAC using R-2R, ADC using Successive approximation. Other IC Application: 555 timer, Basic timer circuit, 555 timer used as astable and monostable multivibrator, Specialized IC Applications: Universal active filters, Power amplifiers (Text 2)

Laboratory Sessions/ Experimental learning:

1. Design a lamp dimmer using IC 555.
2. Design a duty cycle oscillator.

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

Course outcomes:	
CO1	Acquire knowledge about fundamental concepts of Op-Amp circuit and parameters.
CO2	Develop circuits for Op-Amp based linear and non-linear circuits
CO3	Describe AC Amplifiers and application
CO4	Acquire knowledge about Active Filters and Voltage Regulators
CO5	Explain applications of linear ICs in phase detector, VCO, DAC, ADC and Timer

Reference Books:	
1.	"Operational Amplifiers and Linear IC"s", David A. Bell, 2nd edition, PHI/Pearson, 2004. ISBN 978-81-203-2359-9.
2.	"Linear Integrated Circuits", D. Roy Choudhury and Shail B. Jain, 4th edition, Reprint 2006, New Age International ISBN 978-81-224-3098-1.
3.	Ramakant A Gayakwad, "Op-Amps and Linear Integrated Circuits," Pearson, 4th Ed, 2015. ISBN 81-7808-501-1.

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

High-3, Medium-2, Low-1

Course Title	Electronic Instrumentation	Semester	IV
Course Code	MVJ19EC45	**CIE**	50
Total No. of Contact Hours	60 L : T : P :: 40 : 0 : 20	**SEE**	50
No. of Contact Hours/week	3	**Total**	100
Credits	3	**Exam. Duration**	3Hrs

Course objective is to:

- Define and describe accuracy and precision, types of errors.
- Describe the operation of Ammeters, Voltmeters, Multimeters and develop circuits for multirange Ammeters and Voltmeters.
- Describe functional concepts and operation of various Analog and Digital measuring instruments.
- Describe basic concepts and operation of Digital Voltmeters.
- Describe and discuss functioning and types of Oscilloscopes, Signal generators, AC and DC bridges,Transducers.

Module-1	**RBT Level L1,L2,L3,L4**	12Hrs.

Measurement and Error: Definitions, Accuracy, Precision, Resolution and Significant Figures, Types of Errors, Measurement error combinations.

Ammeters: DC Ammeter, Multirange Ammeter, The Ayrton Shunt or Universal Shunt, Requirements of Shunt, Extending of Ammeter Ranges, RF Ammeter (Thermocouple), Limitations of Thermocouple.

Voltmeters and Multimeters: Introduction, Basic Meter as a DC Voltmeter, DC Voltmeter, Multirange Voltmeter, Extending Voltmeter Ranges, Loading, AC Voltmeter using Rectifiers. True RMS Voltmeter, Multimeter.

Laboratory Sessions/ Experimental learning:

- Understanding the structure of the ammeter, voltmeter, and ohmmeter. Learning how to use those meters and using them to measure the current, voltage, and resistance of an electric circuit.
- Calibration of Voltmeters and Ammeters using Potentiometers.

Applications: Measuring Devices. Ammeters and Voltmeters are used as measuring devices in Laboratory for the measurement of current and voltage.

Video link / Additional online information:

1. https://nptel.ac.in/courses/108/105/108105153/
2. https://www.digimat.in/nptel/courses/video/108105153/L13.html
3. https://www.digimat.in/nptel/courses/video/108105153/L14.html
4. https://www.digimat.in/nptel/courses/video/108105153/L15.html

Module-2	**RBT Level L1,L2,L3**	12Hrs.

Digital Voltmeters: Introduction, RAMP technique, Dual Slope Integrating Type DVM, Integrating Type DVM, Most Commonly used principles of ADC, Successive Approximations, -Digit, Resolution and Sensitivity of Digital Meters, General Specifications of DVM

Digital Instruments: Introduction, Digital Multimeters, Digital Frequency Meter, Digital Measurement of Time, Universal Counter, Digital Tachometer, Digital pH Meter, Digital Phase Meter, Digital Capacitance Meter.

Laboratory Sessions/ Experimental learning: Demonstrate how an universal counter can be used for measuring time, frequency, pulse rates, pulse counting, periodic times, speeds and velocities.

Applications: Automatic Measurements. Digital Instruments provide greater speed, increased accuracy, better resolution, reduction in operator errors and the ability to provide automatic measurements in system application.

Video link / Additional online information :

1. https://www.digimat.in/nptel/courses/video/108105153/L64.html
2. https://www.digimat.in/nptel/courses/video/108105153/L65.html

Module-3	**RBT Level L1,L2,L3**	12Hrs.

Oscilloscopes: Introduction, Basic principles, CRT features, Block diagram of Oscilloscope, Simple CRO, Vertical Amplifier, Horizontal Deflecting System, Sweep or Time Base Generator, Measurement of Frequency by Lissajous Method, Digital Storage Oscilloscope.

Signal Generators: Introduction, Fixed and Variable AF Oscillator, Standard Signal Generator, Laboratory Type Signal Generator, AF sine and Square Wave Generator, Function Generator.

Laboratory Sessions/ Experimental learning: Testing of Energy meters

Applications: Laboratory Equipment. An oscilloscope can help the user get more detailed electrical measurements. A signal generator is used to produce various patterns of voltage at a variety of frequencies and amplitudes.

Video link / Additional online information:

1. https://nptel.ac.in/courses/115/105/115105121/
2. https://nptel.ac.in/courses/108/105/108105153/

Module-4	**RBT Level L1,L2,L3**	12Hrs.

Measuring Instruments: Field Strength Meter, Stroboscope, Phase Meter, Q Meter, Megger.

Bridges: Introduction, Wheatstone's bridge, Kelvin's Bridge; AC bridges, Capacitance Comparison Bridge, Inductance Comparison Bridge, Maxwell's bridge, Wien's bridge.

Laboratory Sessions/ Experimental learning:

- Measurement of Low Resistance by Kelvin's Double Bridge Method.
- Measurement of Resistance using Wheatstone's bridge.

Applications: Measurement and control**.** Measuring instruments are used for Control of processes and operations. Bridge circuits are used in measurement, filtering and power conversion applications.

Video link / Additional online information:

1. https://www.youtube.com/watch?v=rQPemWEWNYg
2. https://www.digimat.in/nptel/courses/video/108105153/L28.html

Module-5	**RBT Level L1,L2,L3**	12Hrs.

Transducers: Introduction, Electrical transducers, Selecting a transducer, Resistive transducer, Resistive position transducer, Strain gauges, Resistance thermometer, Thermistor, Inductive transducer, LVDT, Piezoelectric transducer, Photo cell, Photo voltaic cell, Semiconductor photo diode and transistor.

Laboratory Sessions/ Experimental learning:

Characteristics of RTD,Strain gauges,Photocell,LVDT

Applications: Automation and control. Transducers are used at the boundaries of automation, measurement, and control systems, where electrical signals are converted to and from other physical quantities.

Video link / Additional online information:

1. https://www.youtube.com/watch?v=1uPTyjxZzyo
2. https://www.youtube.com/watch?v=nv3GuJArjNU
3. https://www.youtube.com/watch?v=f6miNLVGTqU

Course outcomes:	
CO1	Describe instrument measurement errors and calculate them.
CO2	Describe the operation of Ammeters, Voltmeters, Multimeters and develop circuits for multirange Ammeters and Voltmeters.
CO3	Describe functional concepts and operation of Digital voltmeters and instruments to measure voltage, frequency, time period, phase difference of signals, rotation speed, capacitance and pH of solutions.
CO4	Describe functional concepts and operation of various Analog measuring instruments to measure field Strength, impedance, stroboscopic speed, in/out of phase, Q of coils, insulation resistance.
CO5	Describe and discuss functioning and types of Oscilloscopes, Signal generators and Transducers.

Reference Books:	
1.	H. S. Kalsi, "Electronic Instrumentation", McGraw Hill, 3 rd Edition, 2012, ISBN: 9780070702066.
2.	David A. Bell, "Electronic Instrumentation & Measurements", Oxford University Press PHI 2nd Edition, 2006, ISBN 81-203-2360-2.
3.	A. K. Sawhney, ―Electronics and Electrical Measurements‖, Dhanpat Rai & Sons. ISBN -81-7700-016-0
4.	A. D. Helfrick and W.D. Cooper, "Modern Electronic Instrumentation and Measuring Techniques", Pearson, 1st Edition, 2015, ISBN: 9789332556065.

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

High-3, Medium-2, Low-1

Course Title	Python foundation for Electronics Engineering	Semester	IV
Course Code	MVJ19EC46	**CIE**	50
Total No. of Contact Hours	60 L: T : P :: 40 : 0 : 20	**SEE**	50
No. of Contact Hours/week	3	**Total**	100
Credits	3	**Exam. Duration**	3Hrs

Course objective is to:

- To know the basics of Python Programming and to read and write simple Python programs with expression and statements.
- To develop Python programs with conditionals and loops.
- To define Python functions and call the function.
- To implement Python Programming in Arduino.
- To Understand the Python programming for Data Science.

Module-1	**RBT Level L1, L2,L3**	12Hrs.

Prerequisite: *Basic mathematical calculation skills and logical skills*

The Context of Software Development: Software, Development Tools, Learning Programming with Python, The Python Interactive Shell.Values and Variables, Integer and String Values, Variables and Assignment, Identifiers, Floating-point Numbers, Control Codes within Strings, User Input , Controlling the print , String , Multi-line Strings Writing a Python Program and a Longer Python program.

Laboratory Sessions/ Experimental learning: Print "Python foundation for Electronics Engineering "by executing python programming.

Applications: Printing of Results from the modules.

Video link / Additional online information:

https://pythonprogramming.net › introduction-learn-python-3-tutorials

Module-2	**RBT Level L1, L2,L3**	12Hrs.

Expressions and Arithmetic: Expressions; Mixed Type Expressions; Operator Precedence and Associativity; Formatting Expressions; Errors ; Syntax Errors; Run-time Exceptions ; Logic Errors ; Arithmetic Operators;

Conditional Execution: Boolean Expressions, Statements, Compound Boolean Expressions, Floating-point Equality, Nested Conditionals, Multi-way Versus Sequential Conditionals, Conditional Expressions, Errors, Logic Complexity **Laboratory Sessions/ Experimental learning:** Find the Greatest Number among "12345, 32145 and 23154" by executing python programming. **Applications:** Arithmetic / Conditional Operations **Video link / Additional online information:** https://www.coursera.org/lecture/interactive-python-1/arithmetic-expressions-rMvoA		
Module-3	**RBT Level L1,,L2, L3**	12Hrs.
Iterations And Functions; Iteration: While Statement; Definite Loops vs Indefinite Loops; for Statement; Nested Loops; Abnormal Loop Termination; while/else and for/else; Infinite. **Functions:** Introduction to Using Functions ; Functions and Modules ; Function Basics ; Types of Functions; Parameter Passing ; Documenting Functions and Custom Functions vs. Standard Functions Turtle Graphics ; Techniques for Importing Functions and Modules; Writing Functions. **Laboratory Sessions/ Experimental learning:** Compute Square Root, Drawing a Tree, Printing Prime Numbers and Insisting on Proper Input by using Iterations. **Applications:** Iterative operations can be implemented Video link / Additional online information: https://www.codementor.io/@kaushikpal/user-defined-functions-in-python-8s7wyc8k2		
Module-4	**RBT Level L1,L2, L3**	12Hrs.
Lists, Tuples, Dictionaries; Lists: list operations, slices, methods and parameters; **Tuples:** tuple assignment, tuple as return value; **Dictionaries:** operations and methods; **Arduino with Python:** Introduction to Arduino programming History; Why Arduino; Arduino variants; Comments; Variables; Constants; Data types; Conversions; Functions and statements; setup function; loop function; pin Mode function; Working with pins; Statements **Laboratory Sessions/ Experimental learning:** How to apply the Firmata Protocol and to connect the Arduino board for python programming execution. **Applications:** Implementation of modules in Aurdino board **Video link / Additional online information :** https://www.electronicshub.org/arduino-rf-transmitter-receiver-module/		
Module-5	**RBT Level**	12Hrs.

	L4, L5	
Data Science and Python: Considering the emergence of data science; Outlining the core competencies of a data scientist ; Linking data science and big data ;Understanding the role of programming ; Creating the Data Science Pipeline ; Understanding Python's Role in Data Science; Considering the shifting profile of data scientists; Working with a multipurpose, simple, and efficient language; Learning to Use Python Fast. **Laboratory Sessions/ Experimental learning:** How to Load, Train and View a simple model using python programming. **Applications:** Machine Learning Project in Python **Video link / Additional online information:** https://data-flair.training/blogs/train-test-set-in-python-ml/		

Course outcomes:	
CO1	Understand the Basics of Python Programming
CO2	Implement the expression, conditional executions in Python flow.
CO3	Understand the iterations and functions in Python Programming.
CO4	Implement the Python Programming in Arduino.
CO5	Demonstrate python proficiency in handling Data Science.

Reference Books:	
1.	Fundamentals of Python Programming, Richard L. Halterman, Southern Adventist University, Year: 2019
2.	Python Programming for Arduino, Pratik Desai , Packt Publishing Ltd, 2015.
3.	Python for Data Science by Luca Massaron and John Paul Mueller Published by: John Wiley & Sons, Inc., 2015.

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

High-3, Medium-2, Low-1

Course Title	Linear Integrated Circuits Lab	Semester	IV
Course Code	MVJ19ECL47	**CIE**	50
Total No. of Contact Hours	60 L : T : P :: 0 : 20 :40	**SEE**	50
No. of Contact Hours/week	4	**Total**	100
Credits	2	**Exam. Duration**	3Hrs

Course objective is to:

- Design, Demonstrate and Analyse instrumentation amplifier, filters, DAC, adder, differentiator and integrator circuits, using op-amp.
- Design, demonstrate and Analyse multivibrators and oscillator circuits using Op-amp.

Laboratory Sessions

1. Design an instrumentation amplifier of a differential mode gain of "A" using three Amplifiers.
2. Design of RC Phase shift and Wien's bridge oscillators using Op-amp.
3. Design active second order Butterworth low pass and high pass filters
4. 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.
5. Demonstrate flat top sampling and reconstruction.
6. Design Adder, Integrator and Differentiator using Op-Amp.
7. Design of Monostable and Astable Multivibrator using 555 Timer.
8. Frequency modulation using IC 8038/2206 and demodulation.
9. DSBSC generation using Balance Modulator IC 1496/1596.
10. DC power supply using LM317 and LM723.
11. Study of switched-mode power supply (SMPS).
12. Frequency synthesis using PLL.

Course outcomes:

CO1	Gain hands-on experience in building analog systems for a given specification using the basic building blocks.
CO2	Gain hands-on experience in FM techniques, frequency synthesis
CO3	Gain hands-on experience in pulse and flat top sampling techniques Make the right choice of an IC and design the circuit for a given application.

CO4	Design and analyse the performance of instrumentation amplifier, LPF, HPF, DAC and oscillators using linear IC.
CO5	Understand the applications of Linear IC for addition, integration and 555 timer operations to generate signals/pulses.

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

High-3, Medium-2, Low-1

Course Title	Python Programming Lab	Semester	IV
Course Code	MVJ19ECL48	**CIE**	50
Total No. of Contact Hours	60 L : T : P :: 0 : 20 : 40	**SEE**	50
No. of Contact Hours/week	4	**Total**	100
Credits	2	**Exam. Duration**	3Hrs

Course objective is to:

- Interpret the use of procedural statements like assignments, conditional statements, loops and function calls.
- Infer the supported data structures like lists, dictionaries and tuples in Python.
- Illustrate the application of matrices and regular expressions in building the Python programs.
- Discover the use of external modules in creating excel files and navigating the file systems.
- Describe the need for Object-oriented programming concepts in Python.

Laboratory Sessions

Programs

1. Print all the Disarium numbers between 1 and 100.
2. Encrypt the text using Caesar Cipher technique. Display the encrypted text. Prompt the user for input and the shift pattern.
3. Perform Jump Search for a given key and report success or failure. Prompt the user to enter the key and a list of numbers.
4. The celebrity problem is the problem of finding the celebrity among n people. A celebrity is someone who does not know anyone (including themselves) but is known by everyone. Write a Python program to solve the celebrity problem.
5. Construct a linked list. Prompt the user for input. Remove any duplicate numbers from the linked list.
6. Traverse a path and display all the files and subdirectories in each level till the deepest level for a given path. Also, display the total number of files and subdirectories.
7. How to create a menu drive with a dictionary for words and their meanings. How to add the Write functions to add a new entry (word: meaning), search for a particular word and retrieve meaning, given meaning find words with the same meaning, remove an entry, display all words sorted alphabetically.
8. Identify a word with a sequence of one upper case letter followed by lower case letters.

9. Plot the Line chart in MS Excel Sheet using Xlsx Writer module to display the annual net income of the companies mentioned below.

Course outcomes:	
CO1	Describe the Python language syntax including control statements, loops and functions to write programs for a wide variety problem in mathematics and science.
CO2	Examine the core data structures like lists, dictionaries, tuples and sets in Python to store, process and sort the data.
CO3	Interpret the concepts of Object-oriented programming as used in Python using encapsulation, polymorphism and inheritance.
CO4	Discover the capabilities of Python regular expression for data verification and utilize matrices for building performance efficient Python programs.
CO5	Identify the external modules for creating and writing data to excel files and inspect the file operations to navigate the file systems.

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

High-3, Medium-2, Low-1