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 :: 40 : 0 : 20	**SEE**	50
No. of Contact Hours/week	4	**Total**	100
Credits	3	**Exam. Duration**	3hrs

Course objective is to: This course will enable students to

- Apply discrete and continuous probability distributions in analysing 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	**L1, L2**	**10Hrs.**

Probability Theory: Random variables (discrete and continuous), probability density function, cumulative density function.
Probability Distributions: Binomial distribution, Poisson distribution. Normal distribution, Exponential distribution.
Joint probability distributions.
Applications: Discrete and continuous probability distributions help in analyzing the probability models arising in engineering field.
Video Link: https://youtu.be/cp7_ZF2kNi4

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

Optimization: Linear Programming, mathematical formulation of linear programming problem (LPP), Types of solutions, Graphical Method, simplex method, big-M method, Dual – simplex method.
Applications of transport Problems
Applications: Applications of transport Problems
Video Link: https://youtu.be/WZIyL6pcItY

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

Complex Variables: Functions of complex variables, Analytic function, Cauchy-Riemann equations in Cartesian and polar coordinates, Consequences of Cauchy-Riemann equations, Properties of analytic functions.
Application to flow problems- complex potential, velocity potential, equipotential lines, stream functions, stream lines.
Applications: Application to flow problems
Video Link: https://youtu.be/b5VUnapu-qs

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

Complex line integrals- Cauchy's theorem and Cauchy's integral formula, Singularities, Types of Singularities, Poles, Residues-definitions, Cauchy residue theorem – Problems. Conformal transformation, Bilinear transformation and discussion of $w = z^2$, $w = e^z$ and $w = z + \frac{a^2}{z}(z \neq 0)$. **Applications:** To evaluate line integral of analytic function over closed curve **Video Link**:https://youtu.be/qTDDFMAt7j4		
Module-5	**L1, L2, L3**	**10Hrs.**
Numerical solutions of PDE – Classification of second order equations, finite difference approximation to derivatives, solution of heat equations, solution of wave equations and solution of Laplace equation. **Applications:** To solve boundary value problems **Video Link:https://youtu.be/nNnnBMF03lI**		

Course Outcomes:	
CO1	Apply discrete and continuous probability distributions in analyzing the probability models 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 in electromagnetic field theory
CO4	Utilize conformal transformation and complex integral arising in aerofoil theory, fluid flow 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, 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	C. Ray Wylie and Louis C Barret: **"Advanced Engineering"**. Mathematics Tata McGraw Hill Publishing Co. Ltd. 6th edition.
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	0	3	0	0	0	0	0	0	1	1
CO2	3	3	0	3	0	0	0	0	0	0	1	0
CO3	3	2	0	2	0	0	0	0	0	0	0	0
CO4	3	3	0	3	0	0	0	0	0	0	0	1
CO5	3	3	0	3	0	0	0	0	0	0	1	0

High-3, Medium-2, Low-1

Course Title	Electrical Machines -1	**Semester**	3
Course Code	MVJ19EE42	**CIE**	50
Total No. of Contact Hours	60 L: T : P :: 40 : 0 : 20	**SEE**	50
No. of Contact Hours/week	4	**Total**	100
Credits	4	**Exam. Duration**	3Hrs

Course objective is to: This course will enable students to

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

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

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

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

Applications: Battery charging

Video link / Additional online information:

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

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

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

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

Applications: Determining more economical way of speed control

Video link / Additional online information:

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

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

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

Swinburne's test-Retardation test.

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

Applications: Countercheck for manufacturers' load test data

Video link / Additional online information:

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

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

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

Laboratory Sessions/ Experimental learning: Plotting B-H curve/hysteresis loop of different core material specimen for comparative study.

Applications: R&D in transformer core manufacture

Video link / Additional online information:

https://nptel.ac.in/content/storage2/courses/112108150/pdf/PPTs/MTS_16_m.pdf

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

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

Laboratory Sessions/ Experimental learning: Computer simulation of plotting efficiency and regulation curves of a single phase transformer using OC and SC test data.

Applications: Countercheck for manufacturer's load test data

Video link / Additional online information:

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

Course outcomes: At the end of the course, the student will be able to

CO1	Describe the constructional details and operating principle of DC generators.
CO2	Select the most suitable DC motor for a particular application.
CO3	Determine/predetermine the efficiency of a DC machine by conducting necessary tests.
CO4	Explain the constructional details and operating principle of a transformer.
CO5	Analyse the characteristics of a transformer using test data and demonstrate poly phase operation of transformers.

Reference Books:	
1.	I. J. Nagrath , D. P. Kothari, “Electric Machines”, McGraw Hill Education, 2010.
2.	P. S. Bimbhra, “Electrical Machinery”, Khanna Publishers, 2011.
3.	M. G. Say, “Performance and design of AC machines”, CBS Publishers, 2002.
4.	A. E. Clayton and N. N. Hancock, “Performance and design of DC machines”, CBS Publishers, 2004

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

High-3, Medium-2, Low-1

Course Title	Control Systems	Semester	3
Course Code	MVJ19EE43	**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: This course will enable students to

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

Module-1	**L1,L2,L3**	**08Hrs.**

Introduction: Open loop and closed loop systems – Examples, Control system components. Transfer function of physical systems: Mechanical systems - Translational and Rotational systems, Electrical network, Transfer function of DC servomotor, AC servomotor,

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

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

Applications: Modeling of Physical systems helps in Mathematical analysis.

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

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

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

Time domain Analysis:

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

Laboratory Sessions/ Experimental learning: Experiment to obtain the time response of RLC circuit and Determine the time domain specification.

Applications: Performance analysis of second order system in time domain.

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

Module-3	**L1,L2,L3**	**08Hrs.**

Stability Analysis:

Characteristic equation – Location of roots of characteristic equation.

Concept of stability, R H criterion, applications of RH criterion with limitations.

Root locus technique:

Introduction to root locus concepts, Construction rules, Analysis of stability by root locus plot.

Laboratory Sessions/ Experimental learning: Obtain the root locus for the given open loop transfer function and analyze the stability using MATLAB software.

Applications: Stability Analysis of a given system

Video link: https://nptel.ac.in/courses/108102044/

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

Frequency Domain Analysis:

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

Introduction to compensators:

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

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

2. Write a MATLAB program to obtain the Bode plot and analyze the stability of the system in frequency domain.

Applications: Performance analysis of second order system in frequency domain

Video link: http://www.ni.com/tutorial/6450/en/

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

State variable Analysis:

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

Laboratory Sessions/ Experimental learning:

Simulation of state space analysis.

Applications: Analysis of nonlinear systems.

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

Course outcomes: At the end of the course, the student will be able to	
CO1	Obtain the mathematical model of physical systems.
CO2	Evaluate the transfer function of a linear time invariant system.
CO3	Analyse the performance of the system in time domain and frequency domain.

CO4	Analyse the stability of LTI systems in time/frequency domain using different techniques.
CO5	Obtain state models by different techniques and assess controllability and observability.

Reference Books:	
1.	Gopal M, “Control Systems- Principles and Design” Tata McGraw-Hill, New Delhi, 2013.
2.	Norman S Nise, “Control System Engineering”, John Wiley & Sons, New Delhi, 2013.
3.	Ogata K, “Modern Control Engineering”, Prentice Hall of India, New Delhi, 2013
4.	B.C Kuo “Automatic Control Systems”, John Wiley and Sons
5.	A. Anand Kumar “Control systems” PHI, 2nd edition. 2018.

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

High-3, Medium-2, Low-1

Course Title	**Microprocessors and Microcontrollers**	**Semester**	IV
Course Code	MVJ19EE44	**CIE**	50
Total No. of Contact Hours	40	**SEE**	50
No. of Contact Hours/week	3	**Total**	100
Credits	3	**Exam. Duration**	3Hrs

Course objective is to: This course will enable students to

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

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

8051 Microcontroller Basics: Review of numbering systems, Architecture and pin configuration of 8051, PSW and Flag Bits, 8051 Register Banks, Stack, Stack pointer, Program counter, Data pointer, Internal Memory Organization of 8051, Special Function Registers, Addressing Modes

1. **Laboratory Sessions/ Experimental learning**: Conduct a review on different types of microcontrollers available in market.

Applications: Selection of different microcontrollers for various applications/projects.

Video link:

https://youtube.videoken.com/embed/SUusup7FfJo

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

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

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

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

Assembly programming and instructions of 8051: Introduction to 8051 assembly programming, Assembling and running an 8051 program, Data types and Assembler directives, Arithmetic, logic instructions and programs, and program control instruction.

Laboratory Sessions/ Experimental learning:

1. Simulate a program using Keil to find number of zeroes and ones in a given number.
2. Simulate a program to find whether a number is odd or even using Keil.

Applications: Generating assembly language algorithms for various applications

Video link :

https://youtube.videoken.com/embed/oRPluYsxF28

Module-3	L1, L2, L3	8Hrs.

8051 programming in C: Data types and time delay, I/O programming, Logic operations, TMOD and TCON, Timer Programming in mode 1and 2, Counter programming, SCON and SBUF, Serial port programming.

Laboratory Sessions/ Experimental learning:

3. Generate a Program for reading and manipulating port data.

Applications: Generating baud rates and time delays for various embedded applications.

Video link :

https://youtube.videoken.com/embed/2AVOxLPKjeA

https://youtube.videoken.com/embed/NhurqshD0HA

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

8051 Interrupts: 8051 interrupts, Interrupt priority, Interrupt enable register.

Interfacing: Stepper motor interfacing, DC motor interfacing, ADC 0808 interfacing to 8051, DAC interfacing, LCD and keyboard interfacing.

Laboratory Sessions/ Experimental learning:

Simulate a program using Keil to generate a square wave of frequency 100KHz on pin P2.3. Use timer 1 in mode 1. Take crystal frequency of 22MHz.

Applications: Interfacing of external devices to microcontrollers.

Video link:

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

https://youtube.videoken.com/embed/MqhxeOi8R1Q

Module-5	L1, L2, L3	8Hrs.

ARM Embedded Systems: Microprocessors versus Microcontrollers, The RISC design philosophy, The ARM Design Philosophy, Embedded System Hardware, Embedded System Software, operating system.

ARM Processor Fundamentals: Registers, Current Program Status Register, Pipeline.

Laboratory Sessions/ Experimental learning:

1. Simulate a program using keil to toggle Led's connected to Port 1 continuously with some

delay.

2. Develop any simple project using Microcontroller.
3. Virtual lab experiment: Interface DAC and LCD to 8051

Video link: ARM controllers for embedded applications.

https://nptel.ac.in/courses/106105193/

https://nptel.ac.in/courses/117106111/

Course outcomes: At the end of the course, the student will be able to	
CO1	Select microcontrollers for different applications and explain the functional units of 8051.
CO2	Develop algorithm and formulate assembly language program for a given task.
CO3	Develop program for timers and serial port using C.
CO4	Design interfacing circuitry to interface various peripheral devices to microcontroller.
CO5	Explain the basics of ARM Embedded systems.
Reference Books:	
1.	8051 Microcontroller and Embedded Systems– using assembly and C by Muhammad Ali Mazidi, Janice Gillespie Mazidi, Rollin D. McKinlay, Pearson Education, 2nd Edition.
2.	ARM Systems Developers Guide by Andrew.N. Sloss, Elsevier Publications, 2008.
3.	Embedded Systems: Architecture, Programming and Design by Rajkamal , Tata McGraw-Hill, 7th Edition, 2006.
4.	The 8051 Microcontroller Architecture Programming &Applications by Kenneth J. Ayala, Penram International, 1996.

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

High-3, Medium-2, Low-1

Course Title	Electromagnetic Field Theory	Semester	IV
Course Code	MVJ19EE45	**CIE**	50
Total No. of Contact Hours	40	**SEE**	50
No. of Contact Hours/week	3	**Total**	100
Credits	3	**Exam. Duration**	3Hrs

Course objective is to: This course will enable students to

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

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

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

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

Laboratory Sessions/ Experimental learning:

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

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

Video link:

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

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

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

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

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

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

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

Laboratory Sessions/ Experimental learning: Simulation of magnetic circuit using FEMM software.

Applications: Application of Gauss's law for solving complex electrostatic problems involving unique symmetries like cylindrical, spherical or planar symmetry and involving tough integration.

Video link :

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

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

Conductor and Dielectrics: Current and current density. Continuity of current. Boundary conditions.

Poisson's and Laplace equations: Derivations and solution for single variables, Uniqueness theorem.

Laboratory Sessions/ Experimental learning: Develop a simple dc motor with coil, magnet and battery.

Applications: Analysis of boundary value problems using poison's and Laplace's equations.

Video link :

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

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

Time varying magnetic field & Magnetic force: Biot-Savart's law, Magnetic flux and flux density. Ampere's circuital law, Curl. Force on a moving charge and differential current element, Magnetic Boundary Condition.

Inductance, Time-varying fields & Maxwell's equations: Faraday's law, Displacement current. Maxwell's equations in point form and integral form, relation between field theory and circuit theory.

Laboratory Sessions/ Experimental learning: Group discussion on various applications of EMFT and prepare and submit a detailed report.

Applications: Working principle of different electrical equipments (induction cooker)and electrical machines (transformer, generators, induction motors etc).

Analysis of magnetic field strengths using Ampere circuital law.

Video link:

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

https://nptel.ac.in/courses/108104130/

Module-5	L1, L2, L3	8Hrs.

Uniform plane wave: Wave equation, Wave propagation in free space and in dielectrics. Pointing vector and power considerations. Propagation in good conductors, skin effect, Poynting Theorem.

Laboratory Sessions/ Experimental learning: Simulation of magnetic circuit using FEMM software.

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

Video link:

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

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

Course outcomes: At the end of the course, the student will be able to	
CO1	Apply vector calculus and the laws of electrostatics to solve diverse engineering problems.
CO2	Apply the concepts of electrostatics and magneto statics for various applications.
CO3	Apply boundary conditions for Electromagnetic field and analyze the boundary value problems using Poisson's and Laplace's Equations.
CO4	Analyse magnetic field intensity using Biot-Savart's & Ampere's circuital law and realize its applications.
CO5	Examine the methods of wave propagation based on its parameters.

CO1 Apply vector calculus and the laws of electrostatics to solve diverse engineering problems.

Reference Books:	
1.	Engineering Electromagnetics by William H Hayt, McGraw Hill , 8th Edition 2014.
2.	Principles of Electromagnetics by Matthew N. O. Sadiku, Oxford, 6th Edition 2015.
3.	Electromagnetics by Joseph Edminster , Schaum's Outline Series, McGraw-Hill, Edition IV, 2013.
4.	Electromagnetics with Applications by Kraus J.D. and Fleisch D.A , 5th Edition McGraw-Hill International Book Company.
5.	Field and Wave Electromagnetics by Cheng D.K, 2nd Edition, Pearson Education.

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

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

High-3, Medium-2, Low-1

Course Title	Linear integrated circuits	Semester	3
Course Code	MVJ19EE46	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: This course will enable students to

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

Module-1	L1,L2,L3	08Hrs.

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

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

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

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

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

Module-2	L1,L2,L3	08Hrs.

Active Filters: First & Second order high pass & low pass Butterworth filters. Band pass filters, all pass filters.

DC Voltage Regulators: voltage regulator basics, voltage follower regulator, adjustable output regulator, LM317 Integrated circuits regulators.

Laboratory Sessions/ Experimental learning: Design and realize an op – amp based first order Butterworth (a) low pass (b) high pass and (c)band pass filters for a given cut off frequency/frequencies to verify the frequency response Characteristic.

Applications: Analysis of constant power supply.

Video link: https://lake.videoken.com/nptel/search/ACTIVE%20FILTER/video/b37hZCpVnuc		
Module-3	**L1,L2,L3**	**08Hrs.**
Signal Generators: Triangular / rectangular wave generator. **Comparators & Converters:** Basic comparator, zero crossing detector, inverting & non-inverting Schmitt trigger circuit, voltage to current converter with grounded load, current to voltage converter and basics of voltage to frequency and frequency to voltage converters. **Laboratory Sessions/ Experimental learning**: Design and realize Schmitt trigger circuit using an op – amp. (Virtual Lab) **Applications**: Study of different ways to remove noise from signals used in digital circuits. **Video link**: https://lake.videoken.com/nptel/search/Schmitt%20trigger%20circuit/video/IfOclVN4ERo		
Module-4	**L1,L2,L3**	**08Hrs.**
Signal processing circuits: Precision half wave & full wave rectifiers **Application of op-amp:** Clipper and clamper circuit using opamp, oscillators,phase shift oscillator. **Laboratory Sessions/ Experimental learning**: Design and verify the output waveform of an op – amp RC phase shift oscillator for a desired frequency. **Applications**: Generation of high frequency signals. **Video link**: https://lake.videoken.com/nptel/search/oscillator%20circuits/video/7opJx3dcyG4		
Module-5	**L1,L2,L3**	**08Hrs.**
Timers: Functional block diagram of 555, Applications-Astable and Monostable multivibrators, Ramp generator. **Phase locked loops:** Introduction, Basic principles, phase detector/comparator, voltage controlled oscillator (VCO). **Laboratory Sessions/ Experimental learning**: Design and verify an IC 555 timer based pulse generator for the specified pulse. **Applications**: Application on 555 timer in pulse width modulation **Video link:** https://lake.videoken.com/nptel/search/555%20timer/video/9RZfFOnPtqg		

Course outcomes: At the end of the course, the student will be able to	
CO1	Describe the characteristics of ideal and practical operational amplifier.
CO2	Design filters and signal generators using linear ICs.
CO3	Demonstrate the application of Linear ICs as comparators and rectifiers.

CO4	Design of various circuits using op-amp.
CO5	Explain the basics of PLL and Timer.

Reference Books:	
1.	Op-Amps and Linear Integrated Circuits , Ramakant A Gayakwad Pearson 4thEdition 2015
2.	Operational Amplifiers and Linear ICs David A. Bell Oxford 3rd Edition 2011
3.	Linear Integrated Circuits; Analysis, Design and Applications B. Somanthan Nair Wiley India 2013
4.	Linear Integrated Circuits S. Salivahanan, et al McGraw Hill 2nd Edition,2014

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

High-3, Medium-2, Low-1

Course Title	**Electrical Machines-1 Laboratory**	**Semester**	IV
Course Code	MVJ19EEL47	**CIE**	50
Total No. of Contact Hours	42 L : T : P :: 12 : 0 : 30	**SEE**	50
No. of Contact Hours/week	2	**Total**	100
Credits	1	**Exam. Duration**	3hrs

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

Sl. No	**Name of Experiment**
1	Open Circuit Characteristics of DC shunt generator
2	Load test on DC compound generator
3	Swinburne's test on a DC shunt motor and speed control of DC shunt motor
4	Brake test on DC shunt motor
5	O.C. & S.C. Tests on Single phase Transformer-Predetermination of efficiency and regulation
6	Sumpner's test on identical single phase transformers
7	Separation of core losses in a single phase transformer

Course outcomes: At the end of the course, the student will be able to

CO1	Determine the no load and load characteristics of DC shunt /compound generator
CO2	Determine the efficiency of DC shunt motor by conducting brake test
CO3	Predetermine the efficiency of DC shunt motor/ DC series machine by conducting necessary tests
CO4	Predetermine the efficiency and regulation of transformer by conducting necessary tests
CO5	Scott-connect two single phase transformers for three phase to two phase conversion and to find the core loss components of transformer by a suitable test.

CO-PO Mapping

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

High-3, Medium-2, Low-1

Course Title	**Microcontroller Laboratory**	**Semester**	IV
Course Code	MVJ19EEL48	**CIE**	50
Total No. of Contact Hours	42 L : T : P :: 12 : 0 : 30	**SEE**	50
No. of Contact Hours/week	2	**Total**	100
Credits	1	**Exam. Duration**	3hrs

Course objective: This course will enable students to

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

Sl. No	**Name of Experiment**
	PART A: SOFTWARE PROGRAMS The experiments here can be implemented on a simulator using KEIL IDE using assembly language.
1	Data movement and block exchange.
2	Find largest or smallest numbers in a series & Sorting numbers in ascending / descending order
3	Data conversion programs
4	Counters using conditional statements and loop structures.
	PART B: HARDWARE PROGRAMS The experiments may be implemented using KEIL IDE with embedded ‘c’ programming
	Control the speed of a DC motor using PWM.
	Rotate the Stepper motor in specified direction (clockwise or counter-clockwise).
	Generate waveforms using DAC.
	Hardware implementation of LCD control using 8051 microcontrollers.

Course outcomes: At the end of the course, the student will be able to	
CO1	Design and develop assembly programs using 8051 assembly language instructions.
CO2	Design and develop C programs for a given problem statement.
CO3	Create a hex file, program the microcontroller and conduct a hardware experiment
CO4	Plan and work with a small team to carryout experiments using microcontroller concepts to solve engineering problems.

CO-PO Mapping

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