Course Title	Probability Theory, Complex variables, and Optimization	Semester	IV
Course Code	MVJ19MEE41	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4 L : T : P :: 2 : 2 : 0	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to: This course will enable students to

- Apply discrete and continuous probability distributions in analysing the probability model 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:		
C209.1	Apply discrete and continuous probability distributions in analyzing the probability models arising in engineering field.	
C209.2	Learn the mathematical formulation of linear programming problem	
C209.3	Use the concepts of analytic function and complex potentials to solve the problems arising in electromagnetic field theory	
C209.4	Utilize conformal transformation and complex integral arising in aerofoil theory, fluid flow visualization and image processing	
C209.5	Learn the numerical solutions of partial differential equations	
Text Books:		
1	B.S. Grewal, "Higher Engineering Mathematics" Khanna Publishers, 43rd Edition 2013.	
2	Prof. G.B.Gururajachar, "Engineering Mathematics –IV, Academic Excellent series publications, 2017 – 18.	
Reference Books:		

1	C. Ray Wylie and Louis C Barret: **"Advanced Engineering"**. Mathematics Tata McGraw Hill Publishing Co. Ltd. 6thedition.
2	Bali N. P. & Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, 8th Edition

CIE Assessment:

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

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

SEE Assessment:

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

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

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

CO-PO Mapping

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

High-3, Medium-2, Low-1

Course Title	Electrical Machines -1	Semester	IV
Course Code	MVJ19EE42	CIE	50
Total No. of Contact Hours	50	SEE	50
No. of Contact Hours/week	5 L: T : P :: 3: 1 : 1	Total	100
Credits	4	Exam. Duration	3 Hours

Course objective is to: This course will enable students to

- Understand the constructional details, working principle and 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	10Hrs.

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

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

Applications: Battery charging

Video link / Additional online information:

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

Module-2	L1,L2,L3	10Hrs.

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

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

Applications: Determining more economical way of speed control

Video link / Additional online information:

https://nptel.ac.in/courses/108/105/108105017/		
Module-3	**L1,L2,L3**	**10Hrs.**
Testing of Machines: Methods of Testing - direct, indirect, and regenerative testing - Brake test - Swinburne's test-Retardation test. **Laboratory Sessions/ Experimental learning:** Computer simulation of plotting efficiency curve of DC machine for motor and generator operations at various fractions of load using Swinburne's test data. **Applications:** Countercheck for manufacturers' load test data **Video link / Additional online information:** https://nptel.ac.in/courses/108105017/		
Module-4	**L1,L2,L3**	**10Hrs.**
Single Phase Transformers: Types - constructional details-minimization of hysteresis and eddy current losses- EMF equation - operation on no load and on load - phasor diagrams, Equivalent circuit - losses and efficiency – regulation **Laboratory Sessions/ Experimental learning:** Plotting B-H curve/hysteresis loop of different core material specimen for comparative study. **Applications:** R&D in transformer core manufacture **Video link / Additional online information:** https://nptel.ac.in/content/storage2/courses/112108150/pdf/PPTs/MTS_16_m.pdf		
Module-5	**L1,L2,L3**	**10Hrs.**
Testing Of Transformers And Poly-Phase Transformers: OC and SC tests - Sumpner's test - predetermination of efficiency and regulation-separation of iron losses test-parallel operation with equal voltage ratios - auto transformers. **Laboratory Sessions/ Experimental learning:** Computer simulation of plotting efficiency and regulation curves of a single phase transformer using OC and SC test data. **Applications:** Countercheck for manufacturer's load test data **Video link / Additional online information:** https://nptel.ac.in/courses/108/105/108105017/		

Course outcomes:	
C210.1	Describe the constructional details and operating principle of DC generators.
C210.2	Select the most suitable DC motor for a particular application.
C210.3	Determine/predetermine the efficiency of a DC machine by conducting necessary tests.

C210.4	Explain the constructional details and operating principle of a transformer.
C210.5	Analyse the characteristics of a transformer using test data and demonstrate poly phase operation of transformers.

Text Books:

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

Reference Books:

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

CIE Assessment:

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

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

SEE Assessment:

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

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

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

CO-PO Mapping

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

High-3, Medium-2, Low-1

Course Title	Control Systems	Semester	IV
Course Code	MVJ19EE43	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4 L: T : P :: 2 : 1: 1	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to: This course will enable students to

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

Module-1	L1,L2,L3	08Hrs.

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

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

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

Applications: Modeling of Physical systems helps in Mathematical analysis.

Video link: https://nptel.ac.in/courses/108101037/
https://nptel.ac.in/courses/108/106/108106098/

Module-2	L1,L2,L3	08Hrs.

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

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

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

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

Module-3	L1,L2,L3	08Hrs.

Stability Analysis: Characteristic equation – Location of roots of characteristic equation. Concept of stability, R H criterion, applications of RH criterion with limitations.

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

Laboratory Sessions/ Experimental learning: Obtain the root locus for the given open loop transfer function and analyze the stability using MATLAB software. **Applications**: Stability Analysis of a given system **Video link**: https://nptel.ac.in/courses/108102044/		
Module-4	**L1,L2,L3**	**08Hrs.**
Frequency Domain Analysis: Frequency domain specification, Bode plots, GM and PM, Relative stability. **Introduction to compensators**: Introduction to Compensators, Effect of Lag, Lead and Lag-Lead Compensators, Transfer function and Characteristics **Laboratory Sessions/ Experimental learning**: 1. To to plot the frequency response of a system, using Lab VIEW and the Lab VIEW Control Design and Simulation Module. 2. Write a MATLAB program to obtain the Bode plot and analyze the stability of the system in frequency domain. **Applications**: Performance analysis of second order system in frequency domain **Video link**: http://www.ni.com/tutorial/6450/en/		
Module-5	**L1,L2,L3**	**08Hrs.**
State variable Analysis: State space representation using physical, phase and canonical variables – Controllability and Observability – Obtaining transfer function from state model. **Laboratory Sessions/ Experimental learning**: Simulation of state space analysis. **Applications**: Analysis of nonlinear systems. **Video link**:https://www.digimat.in/nptel/courses/video/108107115/L01.html		
Course outcomes:		
C211.1	Obtain the mathematical model of physical systems.	
C211.2	Evaluate the transfer function of a linear time invariant system.	
C211.3	Analyse the performance of the system in time domain and frequency domain.	
C211.4	Analyze the stability of LTI systems in time/frequency domain using different techniques.	
C211.5	Obtain state models by different techniques and assess controllability and observability.	
Text Books:		
1	Gopal M, "Control Systems- Principles and Design"Tata McGraw-Hill, New Delhi, 2013.	
2	Ogata K, "Modern Control Engineering", Prentice Hall of India, New Delhi, 2013	
Reference Books:		
1	Norman S Nise, "Control System Engineering", John Wiley & Sons, New Delhi, 2013.	

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

CIE Assessment:

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

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

SEE Assessment:

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

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

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

CO-PO Mapping

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

High-3, Medium-2, Low-1

Course Title	Microprocessors and Microcontrollers	Semester	IV
Course Code	MVJ19EE44	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4 L: T : P :: 2 : 1 : 1	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to: This course will enable students to

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

Module-1	L1, L2	8Hrs.

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

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

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

Video link:

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

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

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

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

Module-2	L1, L2, L3	8Hrs.

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

Laboratory Sessions/ Experimental learning:

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

Applications: Generating assembly language algorithms for various applications **Video link** :https://youtube.videoken.com/embed/oRPluYsxF28		
Module-3	**L1, L2, L3**	**8Hrs.**
8051 programming in C: Data types and time delay, I/O programming, Logic operations, TMOD and TCON, Timer Programming in mode 1and 2, Counter programming, SCON and SBUF, Serial port programming. **Laboratory Sessions/ Experimental learning**: Generate a Program for reading and manipulating port data. **Applications**: Generating baud rates and time delays for various embedded applications. **Video link** : https://youtube.videoken.com/embed/2AVOxLPKjeA https://youtube.videoken.com/embed/NhurqshD0HA		
Module-4	**L1, L2, L3, L4**	**8Hrs.**
8051 Interrupts: 8051 interrupts, Interrupt priority, Interrupt enable register. Interfacing: Stepper motor interfacing, DC motor interfacing, ADC 0808 interfacing to 8051, DAC interfacing, LCD and keyboard interfacing. **Laboratory Sessions/ Experimental learning**: Simulate a program using Keil to generate a square wave of frequency 100KHz on pin P2.3.Use timer 1 in mode 1. Take crystal frequency of 22MHz. **Applications**: Interfacing of external devices to microcontrollers. **Video link**: https://youtube.videoken.com/embed/DpMxQzHhyyc https://youtube.videoken.com/embed/MqhxeOi8R1Q		
Module-5	**L1, L2, L3**	**8Hrs.**
ARM Embedded Systems: Microprocessors versus Microcontrollers, The RISC design philosophy, The ARM Design Philosophy, Embedded System Hardware, Embedded System Software, operating system **ARM Processor Fundamentals**: Registers, Current Program Status Register, Pipeline. **Laboratory Sessions/ Experimental learning**: 1. Simulate a program using keil to toggle Led's connected to Port 1 continuously with some delay. 2. Develop any simple project using Microcontroller. 3. Virtual lab experiment: Interface DAC and LCD to 8051		

Video link: ARM controllers for embedded applications. https://nptel.ac.in/courses/106105193/ https://nptel.ac.in/courses/117106111/	
Course outcomes:	
C212.1	Select microcontrollers for different applications and explain the functional units of 8051.
C212.2	Develop algorithm and formulate assembly language program for a given task.
C212.3	Develop program for timers and serial port using C.
C212.4	Design interfacing circuitry to interface various peripheral devices to microcontroller.
C212.5	Explain the basics of ARM Embedded systems.
Text Books:	
1	8051 Microcontroller and Embedded Systems– using assembly and C by Muhammad Ali Mazidi, Janice Gillespie Mazidi, Rollin D. McKinlay, Pearson Education, 2nd Edition.
2	ARM Systems Developers Guide by Andrew.N. Sloss, Elsevier Publications, 2008.
Reference Books:	
1	Embedded Systems: Architecture, Programming and Design by Rajkamal , Tata McGraw-Hill, 7th Edition, 2006.
2	The 8051 Microcontroller Architecture Programming &Applications by Kenneth J. Ayala, Penram International, 1996.

CIE Assessment:

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

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

SEE Assessment:

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

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

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

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C212.1	3	3	2	2	1	-	-	-	3	-	-	3
C212.2	3	3	3	3	3	-	-	-	-	-	-	3

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

High-3, Medium-2, Low-1

Course Title	Electromagnetic Field Theory	Semester	IV
Course Code	MVJ19EE45	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4 L: T : P :: 2 : 1 : 1	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to: This course will enable students to

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

Module-1	L1, L2,L3	8Hrs.

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

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

Laboratory Sessions/ Experimental learning:

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

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

Video link:

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

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

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

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

Module-2	L1, L2,L3	8Hrs.

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

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

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

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

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

Video link:

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

Course outcomes:

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

Text Books:

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

Reference Books:

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

CIE Assessment:

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

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

SEE Assessment:

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

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

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

CO-PO Mapping

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

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

High-3, Medium-2, Low-1

Course Title	Linear integrated circuits	Semester	IV
Course Code	MVJ19EE46	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4 L: T : P :: 2 : 1: 1	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to: This course will enable students to

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

Module-1	L1,L2,L3	08Hrs.

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

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

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

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

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

Module-2	L1,L2,L3	08Hrs.

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

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

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

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

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

Text Books:

1	Operational Amplifiers and Linear ICs David A. Bell Oxford 3rd Edition 2011
2	Linear Integrated Circuits S. Salivahanan, et al McGraw Hill 2nd Edition,2014

Reference Books:

1	Op-Amps and Linear Integrated Circuits , Ramakant A Gayakwad Pearson 4thEdition 2015
2	Linear Integrated Circuits; Analysis, Design and Applications B. Somanthan Nair Wiley India 2013

CIE Assessment:

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

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

SEE Assessment:

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

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

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

CO-PO Mapping

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

C214.3	3	2	3	2	2	-	-	-	-	-	-	2
C214.4	3	2	3	2	2	-	-	-	-	-	-	2
C214.5	2	2	2	2	-	-	-	-	-	-	-	2

High-3, Medium-2, Low-1

Course Title	Electrical Machines-1 Laboratory	Semester	IV
Course Code	MVJ19EEL47	CIE	50
Total No. of Contact Hours	20	SEE	50
No. of Contact Hours/week	4 L : T : P :: 0: 2 : 2	Total	100
Credits	2	Exam. Duration	3 Hours

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

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

Course outcomes:

C215.1	Determine the no load and load characteristics of DC shunt /compound generator
C215.2	Determine the efficiency of DC shunt motor by conducting brake test
C215.3	Predetermine the efficiency of DC shunt motor/ DC series machine by conducting necessary tests
C215.4	Predetermine the efficiency and regulation of transformer by conducting necessary tests

C215.5	Scott-connect two single phase transformers for three phase to two phase conversion and to find the core loss components of transformer by a suitable test.

Scheme of Evaluation

SEE :

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

Write-up : 20 marks

Conduction : 40 marks

Analysis of results : 20 marks

Viva : 20

CIE :

Regular Lab work :20

Record writing :5

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

Viva 10 marks

CO-PO Mapping

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

High-3, Medium-2, Low-1

Course Title	Microcontroller Laboratory	Semester	IV
Course Code	MVJ19EEL48	CIE	50
Total No. of Contact Hours	20	SEE	50
No. of Contact Hours/week	4 L : T : P :: 0: 2 : 2	Total	100
Credits	2	Exam. Duration	3 Hours

Course objective is to: This course will enable students to

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

Sl No	Experiment Name	RBT Level	Hours
1	Develop code for data movement and block exchange.	L3	2
2	Find largest or smallest numbers in a series & Sorting numbers in ascending / descending order.	L3	2
3	Develop data conversion programs.	L3	2
4	Design counters using conditional statements and loop structures.	L3	2
5	Perform 16-bit addition and subtraction, 16-bit multiplication and division.	L3	2
6	Control the speed of a DC motor using PWM.	L3	2
7	Rotate the Stepper motor in specified direction (clockwise or counter-clockwise).	L3	2
8	Generate waveforms using DAC.	L3	2

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

1	Study of implementation analysis and interfacing of seven segment display	L3	2
2	Interface an Elevator with 8051 Microcontroller.	L3	2
3	Hardware implementation of a LCD control using 8051 microcontrollers	L3	2

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

Scheme of Evaluation

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

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

CO-PO Mapping

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

High-3, Medium-2, Low-1

Course Title	CONSTITUTION OF INDIA, PROFESSIONAL ETHICS AND CYBER LAW	Semester	IV
Course Code	MVJ19CPH49	CIE	50
Total No. of Contact Hours	15,	SEE	50
No. of Contact Hours/week	1 L : T : P :: 1 :0 : 0	Total	100
Credits	1	Exam. Duration	3 Hours

Course objective is to:

- To know the fundamental political codes, structure, procedures, powers, and duties of Indian constitution, Indian government institutions, fundamental rights, directive principles and the duties of the citizens.
- To provide overall legal literacy to the young technograts to manage complex societal issues in the present scenario.
- To understand engineering ethics & their responsibilities, identify their individual roles and ethical responsibilities towards society.

Module-1	L1,L2,L3	03Hrs.

Introduction to Indian Constitution

The Necessity of the Constitution, The Societies before and after the Constitution adoption. Introduction to the Indian Constitution, The Making of the Constitution, The role of the Constituent Assembly – Preamble and Salient features of the Constitution of India. Fundamental Rights and its Restriction and Limitations in different Complex Situations. Directive Principles of State Policy (DPSP) and its present relevance in our society with examples. Fundamental Duties and its Scope and Significance in Nation Building.

Module-2	L1,L2,L3	03Hrs.

Union Executive and State Executive

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

Module-3	L1,L2,L3	03Hrs.

Elections, Amendments and Emergency Provisions

Elections, Electoral Process, and Election Commission of India, Election Laws.

Amendments - Methods in Constitutional Amendments (How and Why) and Important Constitutional Amendments. Amendments – 7,9,10,12,42,44,61,73,74,75,86, and 91,94,95,100,101,118 and some important Case Studies. Recent Amendments with explanation. Important Judgements with Explanation and its impact on society (from the list of Supreme Court Judgements).

Emergency Provisions, types of Emergencies and it's consequences.

Constitutional Special Provisions:

Special Constitutional Provisions for SC & ST, OBC, Special Provision for Women, Children & Backward Classes.

Module-4	L1,L2,L3	03Hrs.

Professional / Engineering Ethics

Scope & Aims of Engineering & Professional Ethics - Business Ethics, Corporate Ethics, Personal Ethics. Engineering and Professionalism, Positive and Negative Faces of Engineering Ethics, Code of Ethics as defined in the website of Institution of Engineers (India) : Profession, Professionalism, Professional Responsibility. Clash of Ethics, Conflicts of Interest.

Responsibilities in Engineering - Responsibilities in Engineering and Engineering Standards, the impediments to Responsibility. Trust and Reliability in Engineering, IPRs (Intellectual Property Rights), Risks, Safety and liability in Engineering

Module-5	L1,L2,L3	03Hrs.

Internet Laws, Cyber Crimes and Cyber Laws:

Internet and Need for Cyber Laws, Modes of Regulation of Internet, Types of cyber terror capability, Net neutrality, Types of Cyber Crimes, India and cyber law, Cyber Crimes and the information Technology Act 2000, Internet Censorship, Cybercrimes and enforcement agencies.

Course outcomes:

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

Text Books:

1	Durga Das Basu (DD Basu): "Introduction to the Constitution on India", (Students Edition.) Prentice –Hall EEE, 19th/20thEdn., (Latest Edition) or 2008.
2	Shubham Singles, Charles E. Haries, and Et al : "Constitution of India and Professional Ethics" by Cengage Learning India Private Limited, Latest Edition – 2018.
Reference Books:	
1	M.Govindarajan, S.Natarajan, V.S.Senthilkumar, "Engineering Ethics", Prentice – Hall of India Pvt. Ltd. New Delhi, 2004.
2	M.V.Pylee, "An Introduction to Constitution of India", Vikas Publishing, 2002.
CIE Assessment:	
CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests - Quizzes/mini tests/Activities (20 marks)	
SEE Assessment:	
Question paper of SEE consists of 50 Multiple choice questions. Students have to answer all 50 questions and each question carries 1 mark.	

Course Title	Additional Mathematics-II (Common to all branches)	Semester	IV
Course Code	MVJ19MATDIP41	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4, L: T: P :: 0:2:0	Total	100
Credits	-	Exam. Duration	3 Hours

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

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

Module-1	L1,L2	08Hrs.

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

Video Link:

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

Module-2	L1,L2	08Hrs.

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

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

Module-3	L1,L2	08Hrs.

Analytical solid geometry :

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

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

Module-4	L1,L2,L3	08Hrs.

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

Video Link:

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

Module-5	L1,L2,L3	08Hrs.

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

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

Video Link:

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

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

Course outcomes:

CO1	Apply the knowledge of Matrices to solve the system of linear equations and to understand the concepts of Eigen value and Eigen vectors for engineering problems.
CO2	Demonstrate various physical models ,find Maxima and Minima for a function of one variable., Point of inflections and Problems .Understand Beta and Gamma function

CO3	Understand the 3-Dimentional geometry basic, Equation of line in space-different forms, Angle between two line and studying the shortest distance .
CO4	Concepts OF Probability related to engineering applications..
CO5	Construct a variety of partial differential equations and solution by exact methods.

Text Books:	
1	B.S. Grewal, "Higher Engineering Mathematics" Khanna Publishers, 43rd Edition, 2013.
2	Ramana B. V., "Higher Engineering Mathematics", Tata Mc Graw-Hill, 2006.
Reference Books:	
1	Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley-India publishers, 10th edition,2014.
2	G. B. Gururajachar: Calculus and Linear Algebra, Academic Excellent Series Publication, 2018-19

CIE Assessment:

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

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

SEE Assessment:

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

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

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

CO-PO Mapping

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

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

High-3, Medium-2, Low-1