Course Title:	Mathematics for Electrical Engineering Stream-III [As per NEP 2020, Outcome Based Education (OBE) and Choice Based Credit System (CBCS) Scheme]		
Course Code:	**22MATE31**	**CIE Marks:**	50
Semester:	**3**	**SEE Marks:**	50
Course Type (Theory/Practical/Integrated):	Theory	**Total Marks:**	100
Teaching Hours/Week (L:T:P:S):	2:2:0:0	**Exam Hours:**	3
Total Hours of Pedagogy:	40 hours Theory	**Credits:**	3

Course Objectives: The goal of the course Mathematics for Electrical Engineering Stream-III (22MATE31) is to
1. Familiarize the importance of Random variable and Probability distribution essential for Electrical engineering.
2. Analyze Electrical engineering problems applying Statistical methods to fit a curve and understand co-variance of two
3. Develop the knowledge of complex variable and find the Analyticity of a function.
4. Learn Z-transforms to solve ODE and PDE's.
5. Understand the vector space and associated results.
6. Develop the knowledge of solving EE and EC engineering problems.

MODULE-1: Probability Distribution **08 hours L1, L2,L3**

Probability Distribution: Random variables (discrete and continuous) probability mass/density functions. Binomial distribution, Poisson distribution. Exponential and Normal distributions. Problems.
Self Study : Definition of probability , addition and multiplication rule, Bay's theorem.

MODULE-2: Statistical Methods **08 hours L1, L2, L3**

Basic Statistics: Measures of central tendency, measures of dispersion, range quartile deviation, mean deviation, standard deviation, coefficient of variation, Skewness and Kurtosis, problems.
Statistical Methods: Correlation-karl Pearson's co-efficient of correlation problems. Regression analysis lines of regression, Rank correlation (without proof)-problems.
Curve Fitting: Curve fitting by the method of least square. Fitting of the curves of the formy=ax+b,y=ax^2+bx+c & y=ae^bx.
Self-study: Center and circle of curvature, evolutes and involutes.

MODULE-3: Complex Variable-1 **08 hours L1, L2,L3**

Complex valued function, limit, continuity, differentiability, analytic functions. Cauchy-Riemann Equation in Cartesian, Polar form. Harmonic and orthogonal property and problems on construction of Analytic function.
Self Study :Complex Trigonometry.

MODULE-4: Z-Transforms and Difference equations **08 hours L1, L2, L3**

Z-Transforms: Difference Equations, Basic definitions, Damping rule, Shifting rule, Initial and Final Value theorems (without proof) and problems.
Inverse Z-transforms. Applications of Z-transforms to solve difference equation.
Self Study : Sequence and series , convergent and divergent series.

MODULE-5: Advanced Linear Algebra -2 **08 hours L1, L2, L3**

Change of Basis, Range and Kernel of linear transformation, Rank and Nullity of a matrix, Non-singular Linear Transformation, Eigen value and Eigen vector of Linear Transformation.
Self Study : Groups, rings, fields and definition vector spaces and its properties

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

CO1: Knowing the random variable both discrete and continuous and their probability distribution, Mass density function and solving the problems on various engineering problems.

CO2: Apply the concept of correlation and regression lines for solving the problems and numerical techniques to solve engineering problems and fit a least squares curve to the given data.

CO3: Understanding the definition of Analytic function and how Cauchy-Rieman equations are helping to verify the analyticity and construction of analytic function.

CO4: Apply the knowledge of Z-transforms in solving the difference equation arising in the continuous and discrete time signals and digital processing

CO5: Knowing the concept of Change of Basis, Range and Kernel of linear transformation to solve the examples arising in Electronics and communication Engineering.

Question Paper Pattern:

SEE Assessment:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying 20 marks each.
3. There will be two full questions (with a maximum of four sub questions) from each module.
4. Each full question will have sub questions covering all the topics of the module.
5. Students have to answer any Five Full questions, choosing at least one full question from each module

CIE Assessment:

1. Three tests will be conducted each of 15 marks, average of best of two tests will be considered
2. Session wise Assignment will be 25 Marks. Attendance carry 05 Marks and Library and Seminar will carry 05 Marks. In total

Text Books:

1. B.S. Grewal:"Higher Engineering Mathematics", Khanna publishers, 44th Ed.,2021.
2. E. Kreyszig: "Advanced Engineering Mathematics", John Wiley &Sons, 10thEd., 2018.

Reference Books:

1. V. Ramana:"HigherEngineeringMathematics"McGraw-HillEducation,11th Ed.,2017

2. Srimanta Pal & SubodhC.hunia: "Engineering Mathematics" Oxford University Press, 3rd Ed., 2016.

3. N.P Bali and Manish Goyal: "A textbook of Engineering Mathematics" Laxmi Publications,10th Ed.,2022.

4. C. RayWylie, Louis C. Barrett:"Advanced Engineering Mathematics"McGraw–Hill Book Co., Newyork, 6thEd., 2017.

5. GuptaC.B,Sing S.Rand MukeshKumar:"Engineering Mathematic for Semester I and II" c-Graw Hill Education(India) Pvt. Ltd 2015.

6. H.K.Dass and Er.RajnishVerma: "Higher Engineering Mathematics" S.Chand Publication, 3rdEd. ,2014.
7. James Stewart: "Calculus" Cengage Publications, 7thEd.,2019.
8. David C Lay:"Linear Algebra and its Applications", Pearson Publishers,4th Ed.,2018.

9. Gareth Williams: "Linear Algebra with applications", Jones Bartlett Publishers Inc., 6thEd., 2017.

COURSE OUTCOME AND PROGRAM OUTCOME MAPPING																
Course Name:		Mathematics for Electrical Engineering Stream-III														
Course Code:		22MATE31														
Sl. No.	**CO\PO**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**	**PSO3**
1	**CO1**	3	2	2		1				1			1			
2	**CO2**	3	2	2		1				1			1			
3	**CO3**	3	2	2		1				1			1			
4	**CO4**	3	2	2		1				1			1			
5	**CO5**	3	2	2		1				1			1			
	Average	3	2	2		1				1			1			

Course Title:	ELECTRIC CIRCUIT ANALYSIS		
	[As per NEP 2020, Outcome Based Education (OBE) and Choice Based Credit System (CBCS) Scheme]		
Course Code:	**22EE32**	**CIE Marks:**	50
Semester:	**3**	**SEE Marks:**	50
Course Type (Theory/Practical/Integrated):	Theory	**Total Marks:**	100
Teaching Hours/Week (L:T:P:S):	3:1:0:0	**Exam Hours:**	3
Total Hours of Pedagogy:	50 hours	**Credits:**	4

Course Objectives: This Course will enable the students to:

1. Understand the basic laws, source transformations, Mesh current and Node voltage methods of analyzing electrical circuits.
2. Understand the analysis of electrical circuits by the application of various network theorems.
3. Understand the concept of resonance in electrical circuits and also learn transient analysis.
4. Understand the basics of Network Topology and application of Laplace Transformation in the analysis of DC circuits.
5. Understand the significance of Poles and Zeroes of a function and basics of two port networks.

Module-1 **10 hours L1, L2, L3**

Basic Concepts: Active and passive elements, Concept of ideal and practical sources. Source transformation and Source shifting, Analysis of networks by (i) using star – delta transformation (ii) Mesh current, Node voltage and Super Mesh and Super Node methods for DC and AC circuits with independent sources. Duality.

Module-2 **10 hours L1, L2, L3**

Network Theorems: Super Position theorem, Reciprocity theorem, Thevenin's theorem, Norton's theorem and Maximum power transfer theorem. Analysis of networks using the above theorems with DC and AC independent sources.

Module-3 **10 hours L1, L2,L3**

Resonant Circuits: Concept of Resonance in simple series and parallel RLC circuits and Numerical on Resonant frequency, Bandwidth and Quality factor at resonance.
Transient Analysis: Transient analysis of RL and RC circuits with dc and ac excitations. Behavior of circuit elements under switching action and evaluation of initial conditions.

Module-4 **10 hours L1, L2, L3**

Network Topology: Network Oriented Graph, link, tree, Co-tree, Incidence matrix, Tie set and Cut set schedules of networks.
Laplace Transformation: Laplace transformation (LT), LT of Impulse, Step, Ramp, Sinusoidal signals and shifted functions. Initial and Final value theorems. Inverse Laplace transformation (ILT). Applications of LT to simple DC circuits.

Module-5 **10 hours L1, L2, L3**

Poles and Zeros: Significance of Poles and Zeros of a given network function. Determination of Poles and Zeros for a given network function and plotting the pole zero diagrams.
Two Port networks: Definition, Open circuit impedance, short circuit admittance and Transmission parameters and their evaluation for simple circuits.

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

CO1: Apply fundamental electrical laws, including Ohm's and Kirchhoff's laws, along with source transformations, Mesh analysis, and Node analysis to systematically evaluate and solve electrical circuits.

CO2: Utilize advanced network theorems, such as Thevenin's, Norton's, Superposition, and Maximum Power Transfer, to analyze and simplify complex electrical circuits.

CO3: Determine initial conditions and perform transient analysis of electrical circuits involving capacitors and inductors, and interpret the behavior of resonant circuits under varying frequency conditions.
CO4: Analyze electrical networks using network topology and employ Laplace Transform techniques to analyze electrical circuits, enabling the solution of differential equations and the study of circuit behavior in the s-domain.
CO5: Analyze the frequency response and stability of a circuit using pole-zero diagrams and evaluate the performance parameters of two-port networks, including impedance, admittance, and transmission matrices.
Question Paper Pattern:
SEE Assessment:
1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying 20 marks each.
3. There will be two full questions (with a maximum of four sub questions) from each module.
4. Each full question will have sub questions covering all the topics of the module.
5. Students have to answer any Five Full questions, choosing at least one full question from each module
CIE Assessment:
1. Three tests will be conducted each of 15 marks, average of best of two tests will be considered
2. Session wise Assignment will be 25 Marks. Attendance carry 05 Marks and Library and Seminar will carry 05 Marks. In total this componenet carries 35 Marks all three together.
Text Books:
1. Engineering Circuit Analysis William H Hayt et al Mc Graw Hill 8th Edition,2014
2. Network Analysis M.E. Vanvalkenburg Pearson 3rd Edition,2014
3. Fundamentals of Electric Circuits Charles K Alexander Matthew N O Sadiku Mc Graw Hill 5th Edition,2013
Reference Books:
1. Engineering Circuit Analysis J David Irwin et al Wiley India 10th Edition,2014
2. Electric Circuits Mahmood Nahvi Mc Graw Hill 5th Edition,2009
3. Introduction to Electric Circuits Richard C Dorf and James A Svoboda Wiley 9 th Edition,2015
4. Circuit Analysis; Theory and Practice Allan H Robbins Wilhelm C Miller Cengage 5 th Edition,2013

COURSE OUTCOME AND PROGRAM OUTCOME MAPPING																
Course Name:		ELECTRIC CIRCUIT ANALYSIS														
Course Code:		22EE32														
Sl. No.	**CO\PO**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**	**PSO3**
1	**CO1**	3	2	1		3		1					1	3		
2	**CO2**	3	2	1		3		1					1	3		
3	**CO3**	3	3	2	1	3	2						1	3		
4	**CO4**	3	3	2	1	3	2						1	3		
5	**CO5**	3	3	2	1	3	2						1	3		
	Average	3	2.6	1.6	1	3	2	1					1	3		

Course Title:	INDUCTION MACHINES		
	[As per NEP 2020, Outcome Based Education (OBE) and Choice Based Credit System (CBCS) Scheme]		
Course Code:	**22EE33**	**CIE Marks:**	50
Semester:	**3**	**SEE Marks:**	50
Course Type (Theory/Practical/Integrated):	Theory	**Total Marks:**	100
Teaching Hours/Week (L:T:P:S):	3:0:0:0	**Exam Hours:**	3
Total Hours of Pedagogy:	40 hours	**Credits:**	3

Course Objectives: This Course will enable the students to:		
1. Understand the basic concept, construction, working, Losses and efficiency of a single-phase transformer.		
2. Understand condition for parallel operation and different tests to be carried out for performance evaluation of single phase transformer.		
3. Understand the basics and copper saving in an Autotransformer and also construction, working, different types of connections, conversion techniques of three phase transformers.		
4. Understand the basics and performance evaluation of three phases Induction Motor.		
5. Understand the starting and speed control of three phase Induction motor and also basic concepts of single phase Induction Motor.		
Module-1	**8 hours**	**L1, L2,L3**
Single Phase Transformers: Concept of ideal transformer, operation of power transformer under no-load and load conditions (with phasor diagrams). Equivalent resistance and reactance, Equivalent circuit, losses, efficiency; condition for maximum efficiency, all day efficiency. Numericals.		
Module-2	**8 hours**	**L1, L2,L3**
Testing and Parallel operation: Open circuit & short circuit tests, calculation of parameters of equivalent circuit. Voltage regulation, predetermination of efficiency and regulation. Polarity test and Sumpner's test. Need and conditions to be satisfied for parallel operation of two or more transformers. Load sharing in case of similar and dissimilar transformers. Numericals.		
Module-3	**8 hours**	**L1, L2,L3**
Autotransformer and Three phase Transformers: Auto transformers, copper economy. Introduction to three phase transformers, constructional features, choice between single unit three phase transformer and bank of three single phase transformers, **Transformer connection for 3phase operation:** star/star, delta/delta, star/delta, delta/star and open delta connections. Phase conversions, Scott connection three phase to two phase, cooling of transformers. Numericals.		
Module-4	**8 hours**	**L1, L2,L3**
Three phase Induction Motor: Concept of rotating magnetic field, construction and working of three phase induction motor, starting and running torque, torque-slip characteristics, Induction motor as generalized transformer, phasor diagram, losses, efficiency, No-load and blocked rotor tests, equivalent circuit, circle diagram and performance evaluation of the motors; cogging and crawling. Numericals.		
Module-5	**8 hours**	**L1, L2,L3**

Starting & Speed Control of Three Phase Induction Motor: Need of starter, Direct on line (DOL) starter, Star-Delta starter, autotransformer starting, rotor resistance starting, speed control using voltage, frequency & rotor resistance methods. Numericals.
Single phase induction motor: Double field revolving theory and principle of operation,
Types of single phase Induction motor: split phase, capacitor start, capacitor run, shaded pole motors. Numericals.

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

CO1: Explain in detail the construction, operating principles, and performance characteristics of single-phase transformer .

CO2: Evaluate the performance of transformers by conducting standard tests, such as load test, and configure multiple transformers in parallel for enhanced power capacity and load sharing.

CO3:Analyze the construction, working principles, and applications of autotransformers and three-phase transformers, including various connections, phase conversions, and cooling methods.

CO4: Analyze the construction, operating principles, and performance characteristics of three-phase Induction Motor .

CO5: Examine and compare various starting techniques and speed control methods for three-phase induction motors, ensuring optimal performance and energy efficiency in different industrial applications and also basic concepts of single phase induction motor.

Question Paper Pattern:

SEE Assessment:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying 20 marks each.
3. There will be two full questions (with a maximum of four sub questions) from each module.
4. Each full question will have sub questions covering all the topics of the module.
5. Students have to answer any Five Full questions, choosing at least one full question from each module

CIE Assessment:

1. Three tests will be conducted each of 15 marks, average of best of two tests will be considered

2. Session wise Assignment will be 25 Marks, Seminar & Library Work 5 Marks and Attendance 5 Marks

Text Books:

1. Electric Machines D. P. Kothari, et al McGraw Hill 4th Edition, 2011.
2. Performance and Design of A.C. Machines M. G. Say CBS Publishers 3rd Edition, 2002

Reference Books:

1. Principles of Electric Machines P.C.Sen Wiley 2nd Edition, 2013
2. Electric Machines MulukuntlaS.Sarma,at el Cengage 1st Edition, 2009
3. Electrical Machines M.V. Deshpande PHI 1st Edition, 2013
4. Electrical Machines Abhijit Chakrabarti et al McGraw Hill 1st Edition, 2015

COURSE OUTCOME AND PROGRAM OUTCOME MAPPING																
Course Name:		Induction Machines														
Course Code:		22EE33														
Sl. No.	**CO\PO**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**	**PSO3**
1	**CO1**	2	2				1						2	3		
2	**CO2**	3	3	2	2		1						2	3		
3	**CO3**	2	2				1						2	3		
4	**CO4**	3	3	2	2		1						2	3		
5	**CO5**	2	2				1						2	3		
	Average	2.4	2.4	2	2		1						2	3		

Course Title:	ANALOG AND DIGITAL ELECTRONICS [As per NEP 2020, Outcome Based Education (OBE) and Choice Based Credit System (CBCS) Scheme]		
Course Code:	**22EE34**	**CIE Marks:**	50
Semester:	**3**	**SEE Marks:**	50
Course Type (Theory/Practical/Integrated):	Theory	**Total Marks:**	100
Teaching Hours/Week (L:T:P:S):	3:0:0:0	**Exam Hours:**	3
Total Hours of Pedagogy:	40 hours	**Credits:**	3

Course Objectives: This Course will enable the students to:

1. Understand the diode circuits operations, applications and about BJT biasing.
2. Understand the operation of FET, JFET biasing and its small signal mode.
3. Understand the operation of the Oscillator circuits and power amplifier circuits.
4. Understand the Digital techniquesand combinational circuit design.
5. Understand various types of Flip Flops and their applications.

Module-1	**8 hours L1, L2,L3**

Diode circuits and applications: DC load line, Clippers, Clampers, Zener diode as voltage regulator.
BJT Biasing: Introduction, Operating point, Fixed bias configuration, Voltage divider bias configuration, Emitter bias configuration, Transistor switching networks, Bias stabilization

Module-2	**8 hours L1, L2,L3**

BJT AC analysis: Introduction, BJT transistor modeling, The re transistor model: Common emitter fixed bias configuration, Voltage divider bias configuration. The Hybrid Equivalent model, Approximate hybrid equivalent circuit: Fixed bias configuration, Voltage divider bias configuration.
Field effect transistors: Introduction, Construction and Characteristics of JFETs, Transfer characteristics, Depletion type MOSFET, Enhancement type MOSFET.

Module-3	**8 hours L1, L2,L3**

Feedback and Oscillator circuits: Feedback concepts, Feedback connection types, Oscillator operation, Phase shift oscillator, Tuned Oscillator Circuit, Crystal oscillator (BJT versions only).
Power amplifiers: Introduction-Definitions and amplifier types, Series fed class A amplifier, Transformer coupled Class A amplifier, Class B amplifier operation, Complementary symmetry circuits, Amplifier distortion, Class C and class D amplifiers.

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

Principles of Combinational logic: Definition of Combinational logic, Canonical forms, Generation of switching equations from truth tables, K-Maps- 3, 4 & 5 variables. Incompletely specified functions (Don't care terms). Simplifying Max- term equations.
Digital Technique: Analysis and design of Combinational logic: General approach, Decoders-BCD decoders, Encoders. Digital multiplexers-using multiplexers as Boolean function generators, Adders and Sub tractors-Cascading full adders, Look ahead carry adder.

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

Flip-flops and its applications: Basic Bistable element, Latches, SR latch, application of SR latch, A Switch debouncer, The gated SR latch. The gated D Latch, The Master-Slave Flip-Flops (pulse triggered). The Master- Slave SR Flip-Flops, The Master- Slave JK Flip-Flops. Characteristic equations, Registers, Counters- Binary Ripple Counter, Synchronous Binary counters, Counters based on Shift Registers, Design of Synchronous counters: Design of Synchronous Mod-6 counter using clocked JK Flip-Flops, clocked D, T and SR Flip-Flops.
Course Outcomes: At the end of the course the student will be able to:
CO1: Analyze diode circuits and applications, including DC load line, clippers, clampers, and voltage regulation, along with BJT biasing techniques.
CO2: Evaluate BJT AC models and configurations using re and hybrid equivalent models, and examine the construction, characteristics, and transfer properties of JFETs and MOSFETs in depletion and enhancement modes.
CO3: Analyze feedback and oscillator circuits by exploring feedback types, phase shift, tuned, and crystal oscillators, and evaluate power amplifiers based on their classifications, operation, distortion, and efficiency in Class A, B, C, and D configurations.
CO4: Design and implement high-performance combinational logic circuits for specific applications by employing systematic design methodologies and Boolean logic principles.
CO5: Architect and construct synchronous and asynchronous counters, as well as shift registers, utilizing flip-flops for efficient sequential data processing and control.
Question Paper Pattern:
SEE Assessment:
1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying 20 marks each.
3. There will be two full questions (with a maximum of four sub questions) from each module.
4. Each full question will have sub questions covering all the topics of the module.
5. Students have to answer any Five Full questions, choosing at least one full question from each module
CIE Assessment:
1. Three tests will be conducted each of 15 marks, average of best of two tests will be considered
2. Session wise Assignment will be 25 Marks. Attendance carry 05 Marks and Library and Seminar will carry 05 Marks. In total this componenet carries 35 Marks all three together.
Text Books:
1. Boylested&Nashelsky – Electronic Devices and Circuit Theory, Pearson/PHI.
2. Gayakwad R. A. – OpAmps and Linear IC‘s, PHI.
Reference Books:
1. J. B. Gupta – Electronic Devices and circuits, S .K. KATARIA & SONS.
2. D. Ray Chaudhuri – Digital Circuits-Vol-I & II, 2/e- Platinum Publishers

COURSE OUTCOME AND PROGRAM OUTCOME MAPPING																
Course Name:		ANALOG AND DIGITAL ELECTRONICS														
Course Code:		22EE34														
Sl. No.	**CO\PO**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**	**PSO3**
1	**CO1**	3	3		2								1	3		
2	**CO2**	3	3		3								1	3		
3	**CO3**	3	3		3								1	3		
4	**CO4**	3	3	3	2	2							2	3		
5	**CO5**	3	3	3	2	2							2	3		
	Average	3	3	3	2.4	2							1.4	3		

Course Title:	ELECTROMAGNETIC FIELD THEORY [As per NEP 2020, Outcome Based Education (OBE) and Choice Based Credit System (CBCS) Scheme]		
Course Code:	**22EE35**	**CIE Marks:**	50
Semester:	**3**	**SEE Marks:**	50
Course Type (Theory/Practical/Integrated):	Theory	**Total Marks:**	100
Teaching Hours/Week (L:T:P:S):	3:0:0:0	**Exam Hours:**	3
Total Hours of Pedagogy:	40 hours	**Credits:**	3

Course Objectives: This Course will enable the students to:

1. Understand about Coulomb's law and electric field intensity.
2. Analyze behavior of steady magnetic field.
3. Analyze energy potential and about conductor dielectrics and capacitance.
4. Understand the concept of magnetic forces and time varying field.
5. Analyze about uniform plane waves.

Module-1	**8 hours L1, L2,L3**

Electrostatics: Introduction to different coordinate systems(No questions should be asked in exams on this topic)Coulomb's law, Electric field intensity and its evaluation for (i) point charge (ii) line charge (iii) surface charge (iv) volume charge distributions. Electric flux density,i)line charge (ii) surface charge (iii) volume charge distributions,Gauss law and its applications(point charge). Gauss Divergence theorem.
Numericals on above topics.

Module-2	**8 hours L1, L2,L3**

Steady magnetic fields: Biot - Savart's law, Magnetic field intensity at a point due to current in straight conductor, Ampere's circuital law, applications (Line Conductors), Stokes theorem. Magnetic flux and flux density, Poisson and Laplace equation, Uniqueness theorem. Numericals on above topics .

Module-3	**8 hours L1, L2,L3**

Energy and Potential: Work done, Potential difference, Potential due to point charge, Potential due to line charge. Potential due to dipole.
Conductors, Dielectrics and Capacitance: Current density. Continuity of current, Boundary conditions between conductor and free space,Boundary conditions between Perfect dielectrics.
Numericals on above topics .

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

Magnetic forces: Force on a moving charge and differential current element. Force between differential current elements, Boundary conditions between two magnetic fields.
Time Varying Fields and Maxwell's Equations: Faraday's law, Displacement current. Maxwell's equations in point form and Integral form for time varying fields.
Numericals on above topics.

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

Uniform plane wave: Wave propagation in free space and Conductors(in terms of E,H,D and B), Poynting theorem, Wave Propagation in good conductors, skin effect.
Transmission Lines: Transmission Linesparameters, Transmission Lines equations, Input impedance, Standing wave ratio and power, some applications of Transmission Lines.

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

CO1: Analyze vector analysis concepts, including scalars, vectors, coordinate systems, and vector operations, and apply them to electrostatics by evaluating electric field intensity, flux density, Gauss's law, Maxwell's first equation, and the divergence theorem.

CO2: Analyze Poisson's and Laplace equations for electrostatic potential, and apply the concepts to steady-state magnetic fields.
CO3: Evaluate energy and potential in an electric field, including potential difference, potential gradients, dipoles, and energy density, and analyze conductors and dielectrics by examining current density, boundary conditions, and capacitance calculations for dielectric materials and parallel plate capacitors.
CO4: Investigate the forces on charged particles in magnetic fields, explore the properties of magnetic materials, and analyze time-varying fields and their effects.
CO5: Analyze uniform plane wave propagation in free space and conductors, including electric and magnetic field behavior, Poynting theorem, and skin effect, and evaluate transmission line parameters.
Question Paper Pattern:
SEE Assessment:
1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying 20 marks each.
3. There will be two full questions (with a maximum of four sub questions) from each module.
4. Each full question will have sub questions covering all the topics of the module.
5. Students have to answer any Five Full questions, choosing at least one full question from each module
CIE Assessment:
1. Three tests will be conducted each of 15 marks, average of best of two tests will be considered
2. Session wise Assignment will be 25 Marks. Attendance carry 05 Marks and Library and Seminar will carry 05 Marks. In
Text Books:
1. "Electromagnetics," J. A. Edminister, McGraw Hill, 3 rd Edition,2010.
2. Field theory. R.A. Barapate, Tech max publications.
Reference Books:
1. "Engineering Electromagnetics" ,William H Hayt et al, McGraw Hill ,8thEdition,2014.
2. "Principles of Electromagnetics" ,Matthew N. O. Sadiku, Oxford, 4th Edition,2009.

COURSE OUTCOME AND PROGRAM OUTCOME MAPPING																
Course Name:		ELECTROMAGNETIC FIELD THEORY														
Course Code:		22EE35														
Sl. No.	**CO\PO**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**	**PSO3**
1	**CO1**	3	3	3	2								1	3		
2	**CO2**	3	3	3	2								1	3		
3	**CO3**	3	3	3	2								1	3		
4	**CO4**	3	3	3	2								1	3		
5	**CO5**	3	3	3	2								1	3		
	Average	3	3	3	2								1	3		

Course Title:	ELECTRIC CIRCUIT ANALYSIS LAB [As per NEP 2020, Outcome Based Education (OBE) and Choice Based Credit System (CBCS) Scheme]		
Course Code:	**22EEL36**	**CIE Marks:**	50
Semester:	**3**	**SEE Marks:**	50
Course Type (Theory/Practical/Integrated):	LAB	**Total Marks:**	100
Teaching Hours/Week (L:T:P:S):	2:0:0:0	**Exam Hours:**	3
Total Hours of Pedagogy:	24 hours	**Credits:**	1

Course Objectives: This Course will enable the students to:

1. Understand the Mesh and Nodal analysis in DC circuits.
2. Understand Superposition, Reciprocity, Thevenin's, Norton's and Maximum power transfer theorems.
3. Understand the Analysis of series and parallel Resonance circuits.
4. Understand transient response of RL and RC series circuits.
5. Determine Z and Y parameters of two port networks.

Experiments

1. Determination of current and voltage in DC circuits.
2. Verification of Mesh & Node Analysis.
3. Verification of Superposition theorem.
4. Verification of Reciprocity theorem.
5. Verification of Thevenin 's & Norton's theorem.
6. Verification of Maximum power transfer theorem.
7. Analysis of series and parallel resonance Circuits.
8. Determination of transient response of RC circuits.
9. Determination of transient response of RL circuits.
10. Study of Z and Y parameters of two port network

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

CO1: Analyze and compute current, voltage, and power in DC circuits using fundamental electrical laws.

CO2: Apply Mesh and Nodal analysis techniques to systematically analyze complex DC circuits.
theorems

CO3: Evaluate and solve complex electric circuits using advanced network theorems, including Thevenin's, Norton's, and Superposition theorems.

CO4: Analyze and interpret the behavior of series and parallel resonant circuits, and compute the transient response of RL, RC, and RLC series circuits under various conditions.

CO5: Compute and interpret Z and Y parameters of two-port networks to model and analyze interconnected systems.

Practical Examination Conduction:

SEE Assessment:

1. Students will be given two experiments for their write-up.
2. Students need to conduct one of the two experiments given.
3. 15% of total marks are allotted for writeup, 70% of total marks are given to the conduction of experiment and remaining 15% of total marks will be given to Viva-Voce.

CIE Assessment:

1. One test will be conducted at the end of the semester of 15 marks out of total marks 50.
2. The remaining 35 marks are given to oveall conduction of an experiments by the students and also to the Observation/Assignment book.

Graduate Attributes (As per NBA)

Engineering Knowledge, Problem Analysis, Individual and Team work, Communication.
Conduct of Practical Examination:
1. Laboratory experiments are to be included for practical examination.
2. Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners.
3. Students can pick one experiment from the questions lot prepared by the examiners.
4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

COURSE OUTCOME AND PROGRAM OUTCOME MAPPING																
Course Name:		ELECTRIC CIRCUIT ANALYSIS LAB														
Course Code:		22EEL36														
Sl. No.	**CO\PO**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**	**PSO3**
1	**CO1**	3	1			2				3	3		1		3	
2	**CO2**	3	1			2				3	3		1		3	
3	**CO3**	3	2			2				3	3		1		3	
4	**CO4**	3	3	1	2	2	2			3	3		1		3	
5	**CO5**	3	3	1	2	2	2			3	3		1		3	
	Average	3	2	1	2	2	2			3	3		1		3	

Course Title:	INDUCTION MACHINES LAB		
	[As per NEP 2020, Outcome Based Education (OBE) and Choice Based Credit System (CBCS) Scheme]		
Course Code:	**22EEL37**	**CIE Marks:**	50
Semester:	**3**	**SEE Marks:**	50
Course Type	Practical	**Total Marks:**	100
Teaching Hours/Week (L:T:P:S):	0:0:2:0	**Exam Hours:**	3
Total Hours of Pedagogy:	24 hours	**Credits:**	1

Course Objectives: This Course will enable the students to:	
1	Conduct different tests on transformers and Induction motors to evaluate their Performance
2	Determine load sharing by connecting two single phase transformers in parallel.
3	Understand the concept of Scott connection.
4	Conduct load test on single phase and three phase induction motors.
5	Conduct tests on induction motor to determine the performance.

Sl. No.	**Experiments**
1	Open Circuit and Short circuit tests on single - phase transformer (a) Determination of efficiency and regulation.(b) I
2	Sumpner's test on transformers.
3	Parallel operation of two dissimilar (different kVA) single-phase transformers.
4	Polarity test of single phase transformer.
5	Scott connection with balanced and unbalanced resistive loads.
6	Load Test of Three 1-Phase Transformer Connected in Star – Delta.
7	Load test on 3-phase induction motor.
8	No Load and Blocked rotor tests on 3-phase induction Motor to obtain equivalent circuit parameters.
9	No Load and Blocked rotor testson 3-phase induction Motor to draw the Circle diagram.
10	Speed control of 3-phase induction motor by varying rotor resistance.
11	Load test on single- phase induction motor.

Course Outcomes: At the end of the course the student will be able to:	
CO1	Analyze and evaluate the performance parameters of transformers using test data obtained from open-circuit and short-circuit tests.
CO2	Configure and operate two single-phase transformers with different kVA ratings in parallel, ensuring proper load sharing and voltage regulation.
CO3	Connect single-phase transformers in appropriate configurations, such as star-delta or delta-delta, to facilitate three-phase operation for balanced and unbalanced loads.
CO4	Conduct load tests on single-phase and three-phase induction motors to assess performance characteristics, including efficiency, power factor, and torque-speed relationship.
CO5	Determine and plot the performance characteristics of a three-phase induction motor under no-load conditions using the circle diagram method or equivalent techniques.

Practical Examination Conduction:

SEE Assessment:
1. Students will be given two experiments for their write-up.
2. Students need to conduct one of the two experiments given.
3. 15% of total marks are allotted for writeup, 70% of total marks are given to the conduction of experiment and remaining
CIE Assessment:
1. One test will be conducted at the end of the semester of 15 marks out of total marks 50.
2. The remaining 35 marks are given to oveall conduction of an experiments by the students and also to the Observation/Assignment book.
Graduate Attributes (As per NBA)
Engineering Knowledge, Problem Analysis, Individual and Team work, Communication.
Conduct of Practical Examination:
1. Laboratory experiments are to be included for practical examination.
2. Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners.
3. Students can pick one experiment from the questions lot prepared by the examiners.
4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

COURSE OUTCOME AND PROGRAM OUTCOME MAPPING																
Course Name:		Induction machines Lab														
Course Code:		22EEL37														
Sl. No.	**CO\PO**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**	**PSO3**
1	**CO1**	3	3		2		1			3	3	1	1		3	
2	**CO2**	3	3		2		1			3	1	1	1		3	
3	**CO3**	3	3		2		1			3	1	1	1		3	
4	**CO4**	3	3		2		1			3	1	1	1		3	
5	**CO5**	3	3		2		1			3	1	1	1		3	
	Average	3	3		2		1			3	1.4	1	1		3	

Course Title:	ANALOG AND DIGITAL ELECTRONICS LAB		
	[As per NEP 2020, Outcome Based Education (OBE) and Choice Based Credit System (CBCS) Scheme]		
Course Code:	**22EEL38**	**CIE Marks:**	50
Semester:	**3**	**SEE Marks:**	50
Course Type (Theory/Practical/Integrated):	LAB	**Total Marks:**	100
Teaching Hours/Week (L:T:P:S):	2:0:0:0	**Exam Hours:**	3
Total Hours of Pedagogy:	24 hours	**Credits:**	1

Course Objectives: This Course will enable the students to:

1. Study Diode clipping and clamping circuits and also to verify the JFET and MOSFET characteristics.
2 .Study and design RC phase shift oscillator, Colpitts's, Hartley and Crystal oscillatorusing BJT.
3. Study and design the Class B push pull power amplifier.
4. Study the realization of Boolean equations, Adders, Subtractors and Comparators.
5. Study and design Mod-6 Counter using JK Flip Flops.

Experiments

1. Design and testing of diode clipping and clamping circuits.
2. Verify JFET and MOSFET characteristics.
3. Design and testing of RC phase shift oscillator.
4. Design and testing of Crystal oscillator using BJT.
5. Design and testing of Colpitts's oscillator, Hartley oscillator using BJT.
6. Set up and study the class B push pull power amplifier and calculate the efficiency.
7. Realization of Boolean equation of two and three variables.
8. Realization of Half adder and Full adder.
9. Realization of Half subtractor and Full subtractor.
10. Design of Mod-6 Counter using JK Flip-Flops.

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

CO1: Analyze Diode clipping and clamping circuits and also obtain the JFET and MOSFET characteristics.
CO2: Design and analyze RC phase shift oscillator, Colpitts's, Hartley and Crystal oscillator using BJT.
CO3: Design and analyze Class B push pull power amplifier.
CO4: Realize Boolean equations, Adders, Subtractors and Comparators.
CO5: Design and analyze Mod-6 Counter using JK Flip Flops.

Practical Examination Conduction:

SEE Assessment:

1. Students will be given two experiments for their write-up.
2. Students need to conduct one of the two experiments given.
3. 15% of total marks are allotted for writeup, 70% of total marks are given to the conduction of experiment and remaining 15% of total marks will be given to Viva-Voce.

CIE Assessment:

1. One test will be conducted at the end of the semester of 15 marks out of total marks 50.
2. The remaining 35 marks are given to oveall conduction of an experiments by the students and also to the Observation/Assignment book.
Graduate Attributes (As per NBA)
Engineering Knowledge, Problem Analysis, Individual and Team work, Communication.
Conduct of Practical Examination:
1. Laboratory experiments are to be included for practical examination.
2. Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners.
3. Students can pick one experiment from the questions lot prepared by the examiners.
4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

5																
Course Name:		ANALOG AND DIGITAL ELECTRONICS LAB														
Course Code:		22EEL38														
Sl. No.	**CO\PO**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**	**PSO3**
1	**CO1**	3	3	3						3	3	1	1		3	
2	**CO2**	3	3	3						3	1	1	1		3	
3	**CO3**	3	3	3						3	1	1	1		3	
4	**CO4**	3	3	3						3	1	1	1		3	
5	**CO5**	3	3	3						3	1	1	1		3	
	Average	3	3	3						3	1.4	1	1		3	

Course Title:	PROJECT-III		
	[As per NEP 2020, Outcome Based Education (OBE) and Choice Based Credit		
Course Code:	**22PRJ39**	**CIE Marks:**	50
Semester:	**3**	**SEE Marks:**	50
Course Type (Theory/Practical/Integrated):	Integrated	**Total Marks:**	100
Teaching Hours/Week (L:T:P:S):	0:1:1:0	**Exam Hours:**	3
Total Hours of Pedagogy:	24	**Credits:**	1

Course Objectives: The goal of the course Project III (22PRJ39)is to

1. Get exposure about the Electrical & Electronics hardware and various software tools.
2. Design the working model of the open ended problem.
3. Understand the Electrical and Electronics concepts.
4. Understand the latest technology trends in the electrcial system.
5. Prepare technical documentation of the project.

STUDENTS WILL BE GIVEN A OPEN ENDED PROBLEM OF THE SOCIETY AND ASKED TO SOLVE BY DESIGNING AND IMPLEMENTING THE SYSTEM IN A TEAM.

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

CO1: Apply the knowledge of electrical and electronics hardware and software components to solve the real time problems of the society

CO2: Analyze the various existing solutions available to solve the real time problem and propose the best solution

CO3: Design and implement the system to solve the real time problem of the society

CO4: Conduct investigations on the output and prepare the technical documentation of the designed /system in a team

CO5: Use the modern tool available like advanced hardware and software tools

Conduction of Assessment:

SEE and CIE Assessment

SEE Assessment: The SEE for the Project shall be evaluated by two examiners jointly and the evaluation shall be based on various components such as, Project work 50% of the maximum marks, Presentation 30 % of the maximum marks, and viva-voce 20% of the maximum marks.

CIE Assessment: Design and fabrication of the project -50% of the maximum marks, Evaluation of project report by the department-30% of the maximum marks , and Mock evaluation/ Presentation20% of the maximum marks.

COURSE OUTCOME AND PROGRAM OUTCOME MAPPING																
Course Name:		PROJECT III														
Course Code:		22PRJ39														
Sl. No.	**CO\PO**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**	**PSO3**
1	**CO1**	3											2	3	2	
2	**CO2**		3										2	3	3	
3	**CO3**			3			3						2	3	3	
4	**CO4**				3		3	3	3	3	3	3	3	3	3	
5	**CO5**					3							2			
	Average	3	3	3	3	3	3	3	3	3	3	3	2	3	3	

Course Title:	SOFT SKILLS		
	[As per NEP 2020, Outcome Based Education (OBE) and Choice Based Credit System (CBCS) Scheme]		
Course Code:	**22HSM310B**	**CIE Marks:**	50
Semester:	**3**	**SEE Marks:**	50
Course Type (Theory/Practical/Integrated):	Theory	**Total Marks:**	100
Teaching Hours/Week (L:T:P:S):	1:0:0:0	**Exam Hours:**	3
Total Hours of Pedagogy:	20 hours	**Credits:**	1

Course Objectives: This Course will enable the students to:

1. Understand the Meaning, definition, importance, purpose, process, types, barriers and Essentials of communication.
2. Develop reading and understanding ability.
3. Learn effective writing.
4. Learn how to write different types of letters.
5. Understand case method of learning.

Module-1	**4 hours L1, L2**

INTRODUCTION TO COMMUNICATION: Meaning, Definition, Importance & Purpose of Communication, Process of Communication, Types of Communication, Communication network in an organization, 7c's of communication, Barriers to Communication and Essential of good Communication.

Module-2	**4 hours L1, L2, L3**

READING AND UNDERSTANDING: Reading Comprehension – Reading rate and reading comprehension, Paraphrasing, Interpretations of graphical information, Book reading and summarizing it.

Module-3	**4 hours L1, L2,L3**

EFFECTIVE WRITING:
Purpose of Writing, Clarity in Writing, Principle of Effective Writing. Better writing using personal Experiences – Describing a person, situation, memorable events etc…

Module-4	**4 hours L1, L2, L3**

DRAFTING OF LETTERS:
Writing different types of letters – writing for employment, joining letter, complaints & follows up , Enquiries, representation etc. Official Communication – e-mail & Social Media.

Module-5	**4 hours L1, L2, L3**

CASE METHOD OF LEARNING:

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

CO1: Explain about basics of Communication.
CO2: Develop reading and understanding ability.
CO3: Develop effective writing.
CO4: Able to write different types of letters.
CO5: Analyze a case study and solve.

Question Paper Pattern:

SEE Assessment:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have multiple choice type questions.
3. Each question will be of 1 marks.

4. 20 questions will be set from each module and students have to answer any 10 questions from each module.
CIE Assessment:
1. Three tests will be conducted each of 15 marks, average of best of two tests will be considered
2. Session wise Assignment will be 25 Marks. Attendance carry 05 Marks and Library and Seminar will carry 05 Marks. In total this componenet carries 35 Marks all three together.
Text Books:
1. Chaturvedi P D & Mukesh chaturvedi - Business communication:Concepts, cases & applications- 2/e, pearson education.
2. Essential of Business communication – Rajendra Pal and J.S Korlhall – Sultan Chand & Sons, New Delhi.
Reference Books:
1. Business correspondence & report writing – R.C.Sharma, Krishna Mohan – Tata Megraw Hill Publising Company Ltd, New Delhi.
2. Business Communcation – K.K. Sinha – Galgotio Publishing Company, New Delhi.

COURSE OUTCOME AND PROGRAM OUTCOME MAPPING																
Course Name:		SOFT SKILLS														
Course Code:		22HSM310B														
Sl. No.	**CO\PO**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**	**PSO3**
1	**CO1**										3		2			
2	**CO2**										3		2			
3	**CO3**										3		2			
4	**CO4**										3		2			
5	**CO5**	3											2			
	Average	0.6									2.4		2			

Course Title:	INTRODUCTION TO VIRTUAL LAB		
	[As per NEP 2020, Outcome Based Education (OBE) and Choice Based Credit System (CBCS) Scheme]		
Course Code:	**22AEE311B**	**CIE Marks:**	50
Semester:	**3**	**SEE Marks:**	50
Course Type (Theory/Practical/Integrated):	LAB	**Total Marks:**	100
Teaching Hours/Week (L:T:P:S):	0:0:2:0	**Exam Hours:**	3
Total Hours of Pedagogy:	24 hours	**Credits:**	1

Course Objectives: This Course will enable the students to:

1. Familiarize with resistor, capacitor and inductor.
2. Study Ohm's law.
3. Study VI characteristics of diode.
4. Understand half wave, full wave rectification and capacitive rectification.
5. Study the basics of induction machines .

Experiments

1. Familiarisation With Resistor
2. Familiarisation With Capacitor
3. Familiarisation With Inductor
4. Ohm'S Law
5. V-I Characteristics Of A Diode
6. Half Wave Rectification
7. Full Wave Rectification
8. Capacitive Rectification
9. Determination Of Transformer Equivalent Circuit From Open Circuit And Short Circuit Test
10. Speed Control Of Slipring Induction Motor

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

CO1: simulate resistor, capacitor and inductor.

CO2: Verify Ohm's Law for series and parallel combination of resistors.

CO3: Simulate and analyze V-I characteristics of a diode.

CO4: Simulate and analyze half wave, full wave rectification and capacitive rectification.

CO5: Simulate to obtain transformer equivalent circuit from open circuit and short circuit tests and also speed control of slipring induction motor.

Practical Examination Conduction:

SEE Assessment:

1. Students will be given two experiments for their write-up.
2. Students need to conduct one of the two experiments given.
3. 15% of total marks are allotted for writeup, 70% of total marks are given to the conduction of experiment and
CIE Assessment:
1. One test will be conducted at the end of the semester of 15 marks out of total marks 50.
2. The remaining 35 marks are given to oveall conduction of an experiments by the students and also to the Observation/Assignment book.
Graduate Attributes (As per NBA)
Engineering Knowledge, Problem Analysis, Individual and Team work, Communication.
Conduct of Practical Examination:
1. Laboratory experiments are to be included for practical examination.
2. Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners.
3. Students can pick one experiment from the questions lot prepared by the examiners.
4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

COURSE OUTCOME AND PROGRAM OUTCOME MAPPING																
Course Name:		Introduction to Virtual Lab														
Course Code:		22AEE311B														
Sl. No.	**CO\PO**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**	**PSO3**
1	**CO1**	3	3	3						3			1		3	
2	**CO2**	3	3	3						3			1		3	
3	**CO3**	3	3	3						3			1		3	
4	**CO4**	3	3	3						3			1		3	
5	**CO5**	3	3	3						3			1		3	
	Average	3	3	3						3			1		3	

Course Title:	Mathematics for Electrical Engineering Stream-IV [As per NEP 2020, Outcome Based Education (OBE) and Choice Based Credit System (CBCS) Scheme]		
Course Code:	**22MATE41**	**CIE Marks:**	50
Semester:	**4**	**SEE Marks:**	50
Course Type (Theory/Practical/Integrated):	Theory	**Total Marks:**	100
Teaching Hours/Week (L:T:P:S):	3:1:0:0	**Exam Hours:**	3
Total Hours of Pedagogy:	40 hours Theory	**Credits:**	3

Course Objectives: The goal of the course Mathematics for Electrical Engineering Stream-IV(22MATE41) is to

1. Able to analyze and apply the concept of Fourier Series.

2. Understand and apply the concept of Fourier Transforms. Understand
Joint probability distribution and stochastic processes arising in science and
Electrical and Electronics engineering.

3.Understand and analyze the sample data using different distribution

4.Develop the knowledge of sampling theory in day to day life and trace different types ofcurves..

5. Develop the Knowledge of Complex Integration.

MODULE-1: Fourier Series **08 hours L1, L2,L3**

Fourier Series: Periodic functions, Dirichlet's condition, Fourier Series of periodicfunctions with period 2π and with arbitrary period 2c. Fourier series of even and odd functions Half range Fourier Series, practical harmonic analysis(5 Assignment Problem).
Self-Study: Sequence and series of a function, convergent series.

MODULE-2: Fourier Transform **08 hours L1, L2, L3**

Fourier Transforms: Infinite Fourier transforms, Fourier sine and cosine transforms.
Inverse Fourier-transform (5 Assignment Problem).
Self Study:
Applications :

JLE-3: Joint probability distribution and Stochastic processes **08 hours L1, L2,L3**

Joint probability distribution: Joint Probability distribution for two discrete random variables, expectation, covariance, correlation coefficient.
Stochastic process: Stochastic processes, probability vector, stochastic matrices, fixed points, regular stochastic matrices, Markov chains, higher transition probabilitysimple problems.
Applications of Joint probability distribution:

MODULE-4: Sampling theory and curve tracing **08 hours L1, L2, L3**

Sampling theory : Sampling, Sampling distributions, standard error, test of hypothesis for means and proportions, Type I and Type II errors, Level of significance, confidence limits
for means, one tailed and two tailed tests, student's t-distribution, Chi - square distribution as a test of goodness of fit. **Tracing of curves:** Cartesian form - Strophoid, Leminscate, Parametric form - Cycloid,
Astroid, Polar form - Cardioid, Leminscate.**Self Study :** Types of samplings, Cartesian equations and their geometrical representation
Applications of Sampling theory and curve tracing:

MODULE-5: Complex variable-2 **08 hours L1, L2, L3**

Complex line Integrals: Cauchy's Integration theorem, Cauchy integral formula, Laurent's Series, types of singularities. Residue, Poles, Cauchy's Residue theorem (without proof)
and Problems**.Transformations:** Bilinear transformations and problems.**Self Study :** Initial value and boundary value problems

Course Outcomes: At the end of the course the student will be able to:
CO1: Construction of Fourier Series for periodic signals and analyze circuits .

CO2: Analyze the Spectral characteristics of the Signals using Fourier Transform.

CO3: Learn to solve the problems on Joint probability distribution fortwo discrete random variables. Knowing the concept of stochastic processes, probability vector, Probability matrix and studying the examples on Markov's chains in discrete time.

CO4:Analyze the Sample Data using large sample tests.

CO5: Knowing the concept of Change of Basis, Range and Kernel of linear transformation to solve the examples arising in Electronics and communication Engineering.

Question Paper Pattern:

SEE Assessment:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying 20 marks each.
3. There will be two full questions (with a maximum of four sub questions) from each module.
4. Each full question will have sub questions covering all the topics of the module.
5. Students have to answer any Five Full questions, choosing at least one full question from each module

CIE Assessment:

1. Three tests will be conducted each of 15 marks, average of best of two tests will be considered
2. Session wise Assignment will be 25 Marks. Attendance carry 05 Marks and Library and Seminar will carry 05 Marks. In total this componenet carries 35 Marks all three together.

Text Books:

1. B.S. Grewal:"Higher Engineering Mathematics", Khanna publishers, 44th Ed.,2021.
2. E. Kreyszig: "Advanced Engineering Mathematics", John Wiley &Sons, 10thEd., 2018.

Reference Books:

1. V. Ramana:"HigherEngineeringMathematics"McGraw-HillEducation,11th Ed.,2017
2. Srimanta Pal & SubodhC.hunia: "Engineering Mathematics" Oxford University Press, 3rd Ed., 2016.
3. N.P Bali and Manish Goyal: "A textbook of Engineering Mathematics" Laxmi Publications,10th Ed.,2022.

4. C. RayWylie, Louis C. Barrett:“Advanced Engineering Mathematics”McGraw–Hill Book Co., Newyork, 6thEd., 2017.

5. GuptaC.B,Sing S.Rand MukeshKumar:“Engineering Mathematic for Semester I and II” c-Graw Hill Education(India) Pvt. Ltd 2015.

6. H.K.Dass and Er.RajnishVerma: “Higher Engineering Mathematics” S.Chand Publication, 3rdEd. ,2014.
7.James Stewart: “Calculus” Cengage Publications, 7thEd.,2019.

8. David C Lay:“Linear Algebra and its Applications”, Pearson Publishers,4th Ed.,2018.

9. Gareth Williams: “Linear Algebra with applications”, Jones Bartlett Publishers Inc., 6thEd., 2017.

COURSE OUTCOME AND PROGRAM OUTCOME MAPPING																
Course Name:		Mathematics for Electrical Engineering Stream-IV														
Course Code:		22MATE41														
Sl. No.	**CO\PO**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**	**PSO3**
1	**CO1**	3	2	2		1				1			1			
2	**CO2**	3	2	2		1				1			1			
3	**CO3**	3	2	2		1				1			1			
4	**CO4**	3	2	2		1				1			1			
5	**CO5**	3	2	2		1				1			1			
	Average	3	2	2		1				1			1			

Course Title:	Power Generation Transmission and Distribution		
	[As per NEP 2020, Outcome Based Education (OBE) and Choice Based Credit System (CBCS) Scheme]		
Course Code:	**22EE42**	**CIE Marks:**	50
Semester:	**4**	**SEE Marks:**	50
Course Type (Theory/Practical/Integrated):	Theory	**Total Marks:**	100
Teaching Hours/Week (L:T:P:S):	3:0:0:0	**Exam Hours:**	3
Total Hours of Pedagogy:	40 hours	**Credits:**	3

Course Objectives: This Course will enable the students to:

1. Understand the details of hydel power generation, the basics of nuclear thermal power generation and photovoltaic power conversion system.
2. Calculate the parameters of the transmission line for different configurations.
3. Understand the performance of different transmission lines and at different voltage levels.
4. Understand types of insulators for a given voltage level.
5. Study underground cables, types and AC distribution system.

Module-1	**8 hours L1, L2**

Hydel Power Generation: Selection of site. Classification of hydro-electric plants, General arrangement and operation, advantages and disadvantages.

Nuclear Power Generation: Environmental aspects for selecting the sites and locations of nuclear power stations,constituents of nuclear power station & working, advantages and disadvantages.

Thermal Power Generation: Main construction of thermal power generation, Working, advantages and disadvantages.

Photovoltaic Power Conversion systems: Solar Photovoltaic (SPV) systems, Operating principle, Types of solar cells, module, array (Series and parallel connections).

Module-2	**8 hours L1, L2, L3**

Line parameters: Inductance of single phase lines ,Inductance of three phase one line and double line for both symmetrical and unsymmetrical spacing,Inducatnce of composite conductor lines,concept of GMD and GMR,numericals.Capacitance of single phase lines ,capacitance of 3phase 1-line and 2-line for both symmetrical and unsymmetrical spacing, effect of ground on capacitance,numericals.

Module-3	**8 hours L1, L2,L3**

Performance of transmission lines: Classification of transmission lines – Short, Medium and Long lines. Calculation of regulation and efficiency of short, medium lines. Analysis of long transmission lines by Rigorous method.ABCD constants of transmission lines,numerical.

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

Overhead line Insulators: Types of insulators, String efficiency and methods to improve string efficiency. Mechanical design of Transmission lines: Sag calculation of transmission lines for tower at equal heights and at unequal heights. Effect of ice ,wind on sag calculation, string chart, numericals.

Module-5	8 hours L1, L2, L3
Underground cables: Types and construction of single phase and three phase cables, insulation resistance and capacitance of single phase cables. **AC Distribution:** Primary AC distribution systems – Radial feeders, parallel feeders, Secondary AC distribution systems – Three phase 4 wire system ,numericals.	

Course Outcomes: At the end of the course the student will be able to:
CO1: Describe the operational principles, energy conversion mechanisms, and efficiency aspects of hydroelectric, nuclear, thermal and Photovolataic power generating stations, including their environmental and economic impacts.
CO2: Evaluate the parameters of the transmission line for different configurations to assess their Performance.
CO3: Evaluate the operational characteristics of short, medium, and long transmission lines at different voltage levels .
CO4: Assess the selection and performance of various types of insulators suitable for specific voltage applications.
CO5: Explore the structure, configuration, and operational characteristics of various electrical distribution systems, including radial, ring, and interconnected networks, to ensure efficient power delivery to consumers.

Question Paper Pattern:
SEE Assessment:
1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying 20 marks each.
3. There will be two full questions (with a maximum of four sub questions) from each module.
4. Each full question will have sub questions covering all the topics of the module.
5. Students have to answer any Five Full questions, choosing at least one full question from each module
CIE Assessment:
1. Three tests will be conducted each of 15 marks, average of best of two tests will be considered
2. Session wise Assignment will be 25 Marks. Attendance carry 05 Marks and Library and Seminar will carry 05 Marks. In total this componenet carries 35 Marks all three together.

Text Books:
1. A Text book of Power System Engineering, A Chakrabarti, M. L Soni, P. V. Gupta, U. S. Bhatnagar , Dhanpat RaiPublication.
2. Principles of Power System V.K. Mehta, Rohit Mehta S. Chand Publishers 1stEdition 2013

Reference Books:
1. Electric Power Generation: Transmission and Distribution, S. N. Singh, PHI 2 nd edition, 2009.
2. Electrical Power Systems, C.L.Wadhwa, New Age Internationals, 5th edition2009.
3. Electrical power systems Ashfaq Hussain CBSPublication.
4.Electric Power Distribution A.S. Pabla Mc Graw-Hill 6thEdition,2011.

COURSE OUTCOME AND PROGRAM OUTCOME MAPPING																
Course Name:		Power Generation Transmission and Distribution														
Course Code:		22EE42														
Sl. No.	**CO\PO**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**	**PSO3**
1	**CO1**	3	3	3	1		1	1					1	3		
2	**CO2**	3	3	3	1		1	1					1	3		
3	**CO3**	3	3	3	1		1						1	3		
4	**CO4**	3	3	2	1								1	3		
5	**CO5**	3	3	2	1								1	3		
	Average	3	3	2.6	1		1	1					1	3		

Course Title:	DC MACHINES AND SYNCHRONOUS MACHINES		
	[As per NEP 2020, Outcome Based Education (OBE) and Choice Based Credit System (CBCS) Scheme]		
Course Code:	**22EE43**	**CIE Marks:**	50
Semester:	**4**	**SEE Marks:**	50
Course Type (Theory/Practical/Integrated):	Theory	**Total Marks:**	100
Teaching Hours/Week (L:T:P:S):	3:0:0:0	**Exam Hours:**	3
Total Hours of Pedagogy:	40 hours	**Credits:**	3

Course Objectives: This Course will enable the students to:

1. Understand the basic Concepts of DC Generators and DC Motors and their characteristics.
2. Understand the different methods of speed control on DC Motor and also analyze their performance by conducting different tests.
3. Understand the basics of Synchronous generator and its working.
4. Understand different tests on synchronous generator to determine its performance.
5. Understand the parallel operation of synchronous generators and the basics of synchronous motor.

Module-1 **8 hours L1, L2,L3**

Direct current Generator: Construction, types, armature windings, relation between no load and terminal voltage. Armature reaction, Commutation, types and methods to improve commutation, compensating windings, magnetization curve, no load and full load characteristics of DC generators.
DC Motors: Classification, Back emf, Torque equation, and significance of back emf. Characteristics of shunt, series & compound motors.

Module-2 **8 hours L1, L2,L3**

DC Motors (Continued): Speed control of shunt, series and compound motors. Losses in DC motors, power flow diagram, efficiency. Direct & indirect testing on DC motors: Brake load test, Swinburne's test, Retardation test, Hopkinson's test, Field's test, merits and demerits of tests.

Module-3 **8 hours L1, L2,L3**

Synchronous generators : Construction and operation of salient & non-salient pole synchronous generators. Armature windings, winding factors, emf equation. Harmonics: Effects, causes and elimination.
Leakage reactance, Armature reaction, Synchronous reactance, Equivalent circuit, Phasor diagram, Generator load characteristics. Power-angle characteristics and synchronizing power, numericals.

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

Synchronous generators(Continued): Effects of saliency, two-reaction theory, Direct and Quadrature reactance, power-angle diagram, reluctance power, slip test. Open circuit and short circuit characteristics, short circuit ratio, Voltage regulation and determination of voltageregulation by EMF, MMF and ZPF methods.

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

Synchronous generators(Continued): Parallel operation of generators, methods of synchronization, synchronous generator connected to infinite bus.
Synchronous motor: Principle of operation, effect of variation in load, effect of variation in excitation, V and inverted V curves, hunting, starting methods.

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

CO1: Evaluate the performance characteristics of DC generators and DC motors and analyze their operational behavior under varying conditions.

CO2: Perform and analyze different tests on DC motors, including load and No- load tests.
CO3: Analyze the Construction , working principle and Performance Characteristics of Synchronous Generator.
CO4: Examine and compare various methods of determining the voltage regulation of synchronous generators, such as the EMF, MMF, and Potier triangle methods.
CO5: Analyze the principles and procedures for the parallel operation of synchronous generators, including load sharing and synchronization techniques, to ensure reliable power system operation also basic concepts of Synchronous Motors.
Question Paper Pattern:
SEE Assessment:
1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying 20 marks each.
3. There will be two full questions (with a maximum of four sub questions) from each module.
4. Each full question will have sub questions covering all the topics of the module.
5. Students have to answer any Five Full questions, choosing at least one full question from each module
CIE Assessment:
1. Three tests will be conducted each of 15 marks, average of best of two tests will be considered
2. Session wise Assignment will be 25 Marks, Seminar & Library Work 5 Marks and Attendance 5 Marks
Text Books:
1.Electric Machines, Ashfaq Hussain, Dhanpat Rai Publication, 2ndEdition.
Reference Books:
1.Electric Machines, D. P. Kothari, I. J. Nagrath, Mc Graw Hill 4thEdition,2011.
2. Performance and Design of A.C. Machines, M. G. Say, CBS Publishers 3rdEdition, 2002.
3. Electrical Technology Volume II, B, L, Theraja S Chand Publications,2015.
4. Electric Machines MulukuntlaS.Sarma, at el Cengage Learning 1st Edition,2009.
5. Electrical Machines, Drives and Power systems Theodore Wild Pearson 6thEdition, 2014.
6. Electrical Machines, M.V. Deshpande, PHI Learning 1stEdition,2013.
7. Electrical Machines, Abhijit Chakrabarti et al Mc GrawHill, 1stEdition,2015.

COURSE OUTCOME AND PROGRAM OUTCOME MAPPING																
Course Name:		DC Machines and Synchronous Machines														
Course Code:		22EE43														
Sl. No.	**CO\PO**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**	**PSO3**
1	**CO1**	3	3	3	1								1	3		
2	**CO2**	3	3	3	1								1	3		
3	**CO3**	3	1		1								1	3		
4	**CO4**	3	3	3	1								1	3		
5	**CO5**	3	3	3									1	3		
	Average	3	2.6	3	1								1	3		

Course Title:	CONTROL SYSTEMS		
	[As per NEP 2020, Outcome Based Education (OBE) and Choice Based Credit System (CBCS) Scheme]		
Course Code:	**22EE44**	**CIE Marks:**	50
Semester:	**4**	**SEE Marks:**	50
Course Type (Theory/Practical/Integrated):	Theory	**Total Marks:**	100
Teaching Hours/Week (L:T:P:S):	3:0:0:0	**Exam Hours:**	3
Total Hours of Pedagogy:	40 hours	**Credits:**	3

Course Objectives: This Course will enable the students to:

1. Understand a control system and to understand modeling of physical systems.
2. Obtain transfer function of a closed loop control systems through block diagram reduction rules and signal flow graph methods.
3. Understand transient and steady state response of a control system and to determine the stability of a system using Routh's stability criterion.
4. Understand the stability analysis using root locus technique and Bode plot.
5. Understand stability of a control system using Nyquist plot and also design of control systems.

Module-1	**8 hours L1, L2,L3**

Introduction to control systems: Introduction, classification of control systems.
Mathematical models of physical systems: Modeling of mechanical system elements, electrical systems, Analogous systems, Transfer function, Single input single output systems, Procedure for deriving transfer functions, servomotors, synchros, gear trains , numericals.

Module-2	**8 hours L1, L2,L3**

Signal flow graphs: Basic properties of signal flow graph and its algebra, construction of signal flow graph for control systems, numericals.

Module-3	**8 hours L1, L2,L3**

Time Domain Analysis: Standard test signals, time response of first and second order systems, steady state errors and error constants, types of control systems.
Routh Stability criterion: Bounded Input Bounded Output stability, Necessary conditions for stability, Routh stability criterion, difficulties in formulation of Routh table, application of Routh stability criterion to linear feedback systems, relative stability analysis, numericals.

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

Root locus technique: Introduction, root locus concepts,rules for the construction of root locus and construction of root loci..
Frequency Response analysis: Co-relation between time and frequency response of second order systems only.
Bode plots: Basic concepts, General procedure for constructing bode plots, computation of gain margin and phase margin.

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

Nyquist plot: Basic concepts, stability criterion, assessment of relative stability.
Design of Control Systems: Introduction, Design with the PD , PI ,PID, Phase-Lead , Phase - Lag and Phase Lead-Lag Controller.

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

CO1: Analyze various types of control systems and develop mathematical models for physical systems using differential equations and analogous systems.

CO2: Design the transfer function of systems by employing block diagram reduction techniques and signal flow graph methods, ensuring accurate system representation.

CO3: Evaluate the time-domain response of control systems, including transient and steady-state behavior, and assess system stability using Routh's stability criterion.

CO4: Perform stability analysis using Root Locus and Bode Plot techniques to examine system dynamics and determine gain margins, phase margins, and system robustness.

CO5: Conduct stability analysis using the Nyquist plot and design appropriate controllers, such as PID controllers, to meet specified performance criteria and enhance system stability.

Question Paper Pattern:

SEE Assessment:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying 20 marks each.
3. There will be two full questions (with a maximum of four sub questions) from each module.
4. Each full question will have sub questions covering all the topics of the module.
5. Students have to answer any Five Full questions, choosing at least one full question from each module

CIE Assessment:

1. Three tests will be conducted each of 15 marks, average of best of two tests will be considered
2. Session wise Assignment will be 25 Marks. Attendance carry 05 Marks and Library and Seminar will carry 05 Marks. In total this component carries 35 Marks all three together.

Text Books:

1. Control Systems ,Anand Kumar PHI 2nd Edition, 2014.
2. Control Systems Engineering by I J Nagarth and M. Gopal

Reference Books:

1. Automatic Control Systems Farid Golnaraghi, Benjamin C. Kuo Wiley 9th Edition, 2010.
2. Control Systems Engineering Norman S. Nise Wiley 4th Edition, 2004.

COURSE OUTCOME AND PROGRAM OUTCOME MAPPING																
Course Name:		**CONTROL SYSTEMS**														
Course Code:		**22EE44**														
Sl. No.	**CO\PO**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**	**PSO3**
1	**CO1**	3	3	1	2	2	1						1	3		
2	**CO2**	3	3	1	2	3							1	3		
3	**CO3**	3	3	1	2	3	1						1	3		
4	**CO4**	3	3	1	2	3	1						1	3		
5	**CO5**	3	3	1	2	3	1						1	3		
	Average	3	3	1	2	2.8	1						1	3		

Course Title:	ELECTRICAL AND ELECTRONIC MEASUREMENTS [As per NEP 2020, Outcome Based Education (OBE) and Choice Based Credit System (CBCS) Scheme]		
Course Code:	**22EE45**	**CIE Marks:**	50
Semester:	**4**	**SEE Marks:**	50
Course Type (Theory/Practical/Integrated):	Theory	**Total Marks:**	100
Teaching Hours/Week (L:T:P:S):	3:0:0:0	**Exam Hours:**	3
Total Hours of Pedagogy:	40 hours	**Credits:**	3

Course Objectives: This Course will enable the students to understand about:

1. Measurement of Resistance using different bridges.
2. Measurement of inductance and capacitance using different bridges.
3. Measurement of Power and Energy using different types of watt meters and energy meters.
4. Methods of Extension of Instrument ranges.
5. Working of Electronic and Digital Instruments.

Module-1 **8 hours L1, L2,L3**

Introduction to Measurement and Measurement of Resistance: Accuracy, Precision, Resolution and Standards of Measurement. Wheatstone bridge, Sensitivity and limitations, Kelvin's Double Bridge, Earth resistance measurement by fall of potential method and Megger, Numericals.

Module-2 **8 hours L1, L2,L3**

Measurement of Inductance and Capacitance: Sources and Detectors, Maxwells Inductance bridge, Maxwells Inductance-Capacitance bridge, Hey's bridge, Anderson's bridge.Measurement of Capacitance by De-Sauty's bridge, Low voltage Schering bridge, Numericals.

Module-3 **8 hours L1, L2,L3**

Measurement of Power and Energy: Dynamometer type wattmeter, Error in dynamometer wattmeter, LPF wattmeter, Dynamometer type power factor meter. Induction type Single phase Energy meter, Error in Energy meter, Calibration of Single-phase Energy meter, Electronic Energy Meter, Numericals.

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

Extension of Instrument ranges: Desirable features of Ammeter and Voltmeters, Shunts and Multipliers, Construction and theory of Instrument transformer,CT and PT , Comparision of CT and PT, Burden of Instrument Transformer, Advantages and Disadvantages of Instrument Transformer, Difference between Instrument and Power Transformers,Numericals.

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

Voltmeter, Electronic Multi-Meter, Classification of Digital Voltmeters, LVDT, Q Meter.

Display Devices: Light Emitting Diode(LED),Liquid Crytsal Displays(LCDs), Comparision between LED and LCD,Dot Matrix Display.

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

CO1: Analyze Wheatstone and Kelvin's Double Bridge circuits, evaluate their sensitivity and limitations, and apply techniques for earth resistance measurement using the fall of potential method and Megger.

CO2: Analyze and apply different bridge methods for inductance and capacitance measurement, evaluating their working principles, accuracy, and limitations.
CO3: Analyze the principles, operation, errors, and calibration of dynamometer-type wattmeters, LPF wattmeters, power factor meters, and induction-type single-phase energy meters
CO4: Analyze and apply the techniques to extend the range of a ammeter , voltmeter , Current transformers and Potential transformers.
CO5: Examine and interpret the operational principles of advanced electronic instruments, display devices, and recording mechanisms, focusing on their applications in measurement and data visualization.
Question Paper Pattern:
SEE Assessment:
1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying 20 marks each.
3. There will be two full questions (with a maximum of four sub questions) from each module.
4. Each full question will have sub questions covering all the topics of the module.
5. Students have to answer any Five Full questions, choosing at least one full question from each module
CIE Assessment:
1. Three tests will be conducted each of 15 marks, average of best of two tests will be considered
2. Session wise Assignment will be 25 Marks. Attendance carry 05 Marks and Library and Seminar will carry 05 Marks. In total this componenet carries 35 Marks all three together.
Text Books:
1. A.K. Sawhney, Electrical and electronics Measurements and Instrumentation, Dhanpat Rai and Co, 10th Edition, SS.
Reference Books:
1. J.B. Gupta, A Course in Electronics and Electrical Measurement and Instrumentation, Katson Books, 2013 Edition.
2. Er. R.K Rajput, Electrical and electronic Measurement and instrumentation, S Chand, 5th Edition, 2012.
3. S.C Bhargava, Electrical Measuring Instruments and Measurements, BS Publications, 2013.
4. David A Bell, Electronic Instrumentation and Measurements, Oxford University, 3rd Edition, 2013.

COURSE OUTCOME AND PROGRAM OUTCOME MAPPING																
Course Name:		**ELECTRICAL AND ELECTRONIC MEASUREMENTS**														
Course Code:		**22EE45**														
Sl. No.	**CO\PO**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**	**PSO3**
1	**CO1**	3	2	1			1						1	3		
2	**CO2**	3	2	1			1						1	3		
3	**CO3**	3	2	1			1						1	3		
4	**CO4**	3	2	1			1						1	3		
5	**CO5**	3	2	1			1						1	3		
	Average	3	2	1			1						1	3		

Course Title:	DC MACHINES AND SYNCHRONOUS MACHINES LAB		
	[As per NEP 2020, Outcome Based Education (OBE) and Choice Based Credit System (CBCS) Scheme]		
Course Code:	**22EEL46**	**CIE Marks:**	50
Semester:	**4**	**SEE Marks:**	50
Course Type (Theory/Practical/Integrated):	Practical	**Total Marks:**	100
Teaching Hours/Week (L:T:P:S):	0:0:2:0	**Exam Hours:**	3
Total Hours of Pedagogy:	24 hours	**Credits:**	1

Course Objectives: This Course will enable the students to:

1	Perform tests on dc machines to determine their characteristics.
2	Control the speed of a dc motor.
3	Conduct test for pre-determination of the performance of dc machines.
4	Conduct different tests on synchronous generator to evaluate its performance.
5	Study of synchronous generator connected to infinite bus.

Sl. No.	Experiments
1	Load test on a DC motor.
2	Load test on DC generator.
3	Field's test on DC series Machines.
4	Speed control of DC motor by armature voltage control and flux control.
5	Swinburne's Test on DC motor.
6	Retardation test on DC shunt motor.
7	Regenerative test on DC Machines.
8	Voltage regulation of a synchronous generator by EMF and MMF methods.
9	Voltage regulation of a synchronous generator by ZPF method.
10	Slip test - measurement of direct and Quadrature axis reactance and predetermination regulation of salient pole synchronous machines.

11	Performance of synchronous generator connected to infinite bus, under constant power and variable excitation & vice - versa. (Demonstration).

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

CO1	Conduct experimental tests on DC machines to determine their performance characteristics, such as torque, efficiency, and speed regulation.
CO2	Implement various speed control techniques for DC motors, including armature control and field control methods, to meet specific operational requirements.
CO3	Perform pre-determination tests, such as the Swinburne's test and Hopkinson's test, to evaluate the efficiency and performance of DC machines under different load conditions.
CO4	Conduct comprehensive tests on synchronous generators, including open-circuit, short-circuit, and load tests, to analyze their operational performance and efficiency.
CO5	Examine the behavior of a synchronous generator connected to an infinite bus, focusing on load sharing, synchronization, and stability under varying operating conditions.

Practical Examination Conduction:

SEE Assessment:

1. Students will be given two experiments for their write-up.

2. Students need to conduct one of the two experiments given.

3. 15% of total marks are allotted for writeup, 70% of total marks are given to the conduction of experiment and remaining 15% of total marks will be given to Viva-Voce.

CIE Assessment:

1. One test will be conducted at the end of the semester of 15 marks out of total marks 50.

2. The remaining 35 marks are given to oveall conduction of an experiments by the students and also to the Observation/Assignment book.

Graduate Attributes (As per NBA)

Engineering Knowledge, Problem Analysis, Individual and Team work, Communication.

Conduct of Practical Examination:

1. Laboratory experiments are to be included for practical examination.

2. Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners.

3. Students can pick one experiment from the questions lot prepared by the examiners.

4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

COURSE OUTCOME AND PROGRAM OUTCOME MAPPING																
Course Name:		**DC Machines and Synchronous machines Lab**														
Course Code:		**22EEL46**														
Sl. No.	**CO\PO**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**	**PSO3**
1	**CO1**	3	3							3	3		1		3	
2	**CO2**	3	3							3	3		1		3	
3	**CO3**	3	3							3	3		1		3	
4	**CO4**	3	3							3	3		1		3	
5	**CO5**	3	3	3	1					3	3		1		3	
	Average	3	3	3	1					3	3		1		3	

Course Title:	CONTROL SYSTEMS LAB		
	[As per NEP 2020, Outcome Based Education (OBE) and Choice Based Credit System (CBCS) Scheme]		
Course Code:	**22EEL47**	**CIE Marks:**	50
Semester:	**4**	**SEE Marks:**	50
Course Type	Practical	**Total Marks:**	100
Teaching Hours/Week	0:0:2:0	**Exam Hours:**	3
Total Hours of Pedagogy:	24 hours	**Credits:**	1

Course Objectives: This Course will enable the students to:

1	Determine speed-torque characteristics of AC and DC servomotors and characteristics of synchro pair.
2	Design and analyze Lead, Lag and Lag – Lead compensators for given specifications.
3	Simulate the effect of various controllers on second order system with step response.
4	Simulate bode plot, Nyquist plot and root locus for a given system.

Sl. No	Experiments
1	Speed torque characteristics of (i) AC servo motor (ii) DC servo motor.
2	Synchro pair characteristics.
3	Frequency response of a second order system.
4	Determination of i) frequency response ii) transfer function of a RC lead compensating network.
5	Determination of i) frequency response ii) transfer function of a RC lag compensating network.
6	Determination of i) frequency response ii) transfer function of a lag- lead compensating network.
7	Simulation of second order system and to determine step response and to evaluate time response specifications.
8	Study the effect of P,PI,PD and PID controllers on the step response of a second order system.
9	Simulation of the effect of open loop gain on transient response of a closed loop system using Root locus.
10	Determination of stability of given transfer function using Bode plot, Nyquist plot and Root locus.

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

CO1: Analyze the time-domain and frequency-domain responses of a given second-order system to evaluate system performance parameters.

CO2: Design and analyze Lag, Lead, and Lag-Lead compensators to meet specific system performance criteria and stability requirements.

CO3: Evaluate the performance characteristics of AC and DC servomotors and synchro-transmitter-receiver pairs through experimental analysis.

CO4: Simulate DC position control and feedback control systems to study the effects of proportional (P), proportional-integral (PI), proportional-derivative (PD), and proportional-integral-derivative (PID) controllers.

CO5: Simulate and interpret root locus, Bode plot, and Nyquist plot to perform stability analysis and enhance system robustnes.

Practical Examination Conduction:

SEE Assessment:

1. Students will be given two experiments for their write-up.
2. Students need to conduct one of the two experiments given.
3. 15% of total marks are allotted for writeup, 70% of total marks are given to the conduction of experiment and remaining 15% of total marks will be given to Viva-Voce.

CIE Assessment:

1. One test will be conducted at the end of the semester of 15 marks out of total marks 50.
2. The remaining 35 marks are given to oveall conduction of an experiments by the students and also to the Observation/Assignment book.

Graduate Attributes (As per NBA)	
Engineering Knowledge, Problem Analysis, Individual and Team work, Communication.	
Conduct of Practical Examination:	
1. Laboratory experiments are to be included for practical examination.	
2. Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners.	
3. Students can pick one experiment from the questions lot prepared by the examiners.	
4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.	

COURSE OUTCOME AND PROGRAM OUTCOME MAPPING																
Course Name:		**CONTROL SYSTEMS LAB**														
Course Code:		**22EEL47**														
Sl. No.	**CO\PO**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**	**PSO3**
1	**CO1**	3	3	3	1	3				3	3		1		3	
2	**CO2**	3	3	3	1	3				3	3		1		3	
3	**CO3**	3	3	3	1	1				3	3		1		3	
4	**CO4**	3	3	3	1	3				3	3		1		3	
5	**CO5**	3	3	3	1	3				3	3		1		3	
	Average	3	3	3	1	2.6				3	3		1		3	

Course Title:	ELECTRICAL AND ELECTRONIC MEASUREMENTS LAB		
	[As per NEP 2020, Outcome Based Education (OBE) and Choice Based Credit System (CBCS) Scheme]		
Course Code:	**22EEL48**	**CIE Marks:**	50
Semester:	**4**	**SEE Marks:**	50
Course Type (Theory/Practical/Integrated):	LAB	**Total Marks:**	100
Teaching Hours/Week (L:T:P:S):	2:0:0:0	**Exam Hours:**	3
Total Hours of Pedagogy:	24 hours	**Credits:**	1

Course Objectives: This Course will enable the students to:
1. Understand the procedure for measuring the Resistance, Inductance and Capacitance of different ranges.
2 . Understand the extension of the range of ammeter and voltmeter.
3. Understand the procedure for testing the error in the current transformer.
4. Perform the experiment to measure R, L and C using Q-meter.
5. Understand the procedure for calibrating LVDT and LPF watt meter.
Experiments
1. Measurement of unknown resistance using Wheatstone bridge.
2. Measurement of low resistance using kelvin's double bridge.
3. Measurement of inductance using Maxwell Inductance Bridge.
4. Measurement of capacitance using Schering Bridge.
5. Measurement of earth resistance using meggar.
6. Range extension of ammeter using shunt resistor.
7. Range extension of voltmeter using multiplier.
8. Measurement of frequency using Wein's bridge
9. Calibration of dynamometer type power factor meter
10. LVDT and capacitance pick up- characteristic and calibration
Course Outcomes: At the end of the course the student will be able to:
CO1: Analyze and quantify electrical resistance across diverse ranges, and determine inductance and capacitance values using advanced measurement techniques.
CO2: Perform precise measurement and assessment of earth resistance using specialized instrumentation and methodologies.
CO3: Enhance the measurement capabilities of voltmeters and ammeters by extending their operational range through appropriate circuit modifications and calibration.
CO4: Accurately determine resistance (R), inductance (L), and capacitance (C) parameters utilizing Q-meter for advanced circuit analysis and testing.
CO5: Conduct calibration of low power factor (LPF) wattmeter and linear variable differential transformers (LVDTs) to ensure accuracy and reliability in practical applications.
Practical Examination Conduction:
SEE Assessment:
1. Students will be given two experiments for their write-up.
2. Students need to conduct one of the two experiments given.
3. 15% of total marks are allotted for writeup, 70% of total marks are given to the conduction of experiment and remaining

CIE Assessment:
1. One test will be conducted at the end of the semester of 15 marks out of total marks 50.
2. The remaining 35 marks are given to oveall conduction of an experiments by the students and also to the
Graduate Attributes (As per NBA)
Engineering Knowledge, Problem Analysis, Individual and Team work, Communication.
Conduct of Practical Examination:
1. Laboratory experiments are to be included for practical examination.
2. Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners.
3. Students can pick one experiment from the questions lot prepared by the examiners.
4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

5																
Course Name:		**ELECTRICAL AND ELECTRONIC MEASUREMENTS LAB**														
Course Code:		**22EEL48**														
Sl. No.	**CO\PO**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**	**PSO3**
1	**CO1**	3	3	1	1					3	3	1	1		3	
2	**CO2**	3	3	1	1		1			3	3	1	1		3	
3	**CO3**	3	3	1	1					3	3	1	1		3	
4	**CO4**	3	3	1	1					3	3	1	1		3	
5	**CO5**	3	3	1	1					3	3	1	1		3	
	Average	3	3	1	1		1			3	3	1	1		3	

Course Title:	PROJECT-IV		
	[As per NEP 2020, Outcome Based Education (OBE) and Choice Based Credit System (CBCS) Scheme]		
Course Code:	**22PRJ49**	**CIE Marks:**	50
Semester:	**4**	**SEE Marks:**	50
Course Type (Theory/Practical/Integrated):	Integrated	**Total Marks:**	100
Teaching Hours/Week (L:T:P:S):	0:1:1:0	**Exam Hours:**	3
Total Hours of Pedagogy:	24	**Credits:**	1

Course Objectives: The goal of the course Project III (22PRJ49)is to

1. Get exposure about the Electrical & Electronics hardware and various software tools.
2. Design the working model of the open ended problem.
3. Understand the Electrical and Electronics concepts.
4. Understand the latest technology trends in the electrcial system.
5. Prepare technical documentation of the project.

STUDENTS WILL BE GIVEN A OPEN ENDED PROBLEM OF THE SOCIETY AND ASKED TO SOLVE BY DESIGNING AND IMPLEMENTING THE SYSTEM IN A TEAM.

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

CO1: Apply the knowledge of electrical and electronics hardware and software components to solve the real time problems of the society

CO2: Analyze the various existing solutions available to solve the real time problem and propose the best solution

CO3: Design and implement the system to solve the real time problem of the society

CO4: Conduct investigations on the output and prepare the technical documentation of the designed /system in a team

CO5: Use the modern tool available like advanced hardware and software tools

Conduction of Assessment:

SEE and CIE Assessment

SEE Assessment: The SEE for the Project shall be evaluated by two examiners jointly and the evaluation shall be based on various components such as, Project work 50% of the maximum marks, Presentation 30 % of the maximum marks, and viva-voce 20% of the maximum marks.

CIE Assessment: Design and fabrication of the project -50% of the maximum marks, Evaluation of project report by the department-30% of the maximum marks , and Mock evaluation/ Presentation20% of the maximum marks.

COURSE OUTCOME AND PROGRAM OUTCOME MAPPING																
Course Name:		**PROJECT IV**														
Course Code:		**22PRJ49**														
Sl. No.	**CO\PO**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**	**PSO3**
1	**CO1**	3											2	3	2	
2	**CO2**		3										2	3	3	
3	**CO3**			3			3						2	3	3	
4	**CO4**				3		3	3	3	3	3	3	3	3	3	
5	**CO5**					3							2			
	Average	3	3	3	3	3	3	3	3	3	3	3	2	3	3	

Course Title:	UNIVERSAL HUMAN VALUES		
	[As per NEP 2020, Outcome Based Education (OBE) and Choice Based Credit System (CBCS) Scheme]		
Course Code:	**22UHV410**	**CIE Marks:**	50
Semester:	**4**	**SEE Marks:**	50
Course Type (Theory/Practical/Integrated):	Theory	**Total Marks:**	100
Teaching Hours/Week (L:T:P:S):	2:1:0:0	**Exam Hours:**	3
Total Hours of Pedagogy:	40 hours	**Credits:**	3

Course Objectives: This Course will enable the students to:

1. To help the students appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.

2.To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.

3. To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature.

Module-1	**8 hours L1, L2**

Introduction to Value Education: Lecture 1: Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education)
Lecture 2: Understanding Value Education
Tutorial 1: Practice Session PS1 Sharing about Oneself
Lecture 3: Self-exploration as the Process for Value Education
Lecture 4: Continuous Happiness and Prosperity – the Basic Human Aspirations
Tutorial 2: Practice Session PS2 Exploring Human Consciousness
Lecture 5: Happiness and Prosperity – Current Scenario
Lecture 6: Method to Fulfill the Basic Human Aspirations
Tutorial 3: Practice Session PS3 Exploring Natural Acceptance

Module-2	**8 hours L1, L2**

Module 2 – Harmony in the Human Being (6 lectures and 3 tutorials for practice session)
Lecture 7: Understanding Human being as the Co-existence of the Self and the Body
Lecture 8: Distinguishing between the Needs of the Self and the Body
Tutorial 4: Practice Session PS4 Exploring the difference of Needs of Self and Body
Lecture 9: The Body as an Instrument of the Self
Lecture 10: Understanding Harmony in the Self
Tutorial 5: Practice Session PS5 Exploring Sources of Imagination in the Self
Lecture 11: Harmony of the Self with the Body
Lecture 12: Programme to ensure self-regulation and Health
Tutorial 6: Practice Session PS6 Exploring Harmony of Self with the Body

Module-3	**8 hours L1, L2,L3**

Harmony in the Family and Society (6 lectures and 3 tutorials for practice session)
Lecture 13: Harmony in the Family – the Basic Unit of Human Interaction
Lecture 14: 'Trust' – the Foundational Value in Relationship
Tutorial 7: Practice Session PS7 Exploring the Feeling of Trust
Lecture 15: 'Respect' – as the Right Evaluation
Tutorial 8: Practice Session PS8 Exploring the Feeling of Respect
Lecture 16: Other Feelings, Justice in Human-to-Human Relationship
Lecture 17: Understanding Harmony in the Society
Lecture 18: Vision for the Universal Human Order

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

Harmony in the Nature/Existence (4 lectures and 2 tutorials for practice session)
Lecture 19: Understanding Harmony in the Nature
Lecture 20: Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature
Tutorial 10: Practice Session PS10 Exploring the Four Orders of Nature
Lecture 21: Realizing Existence as Co-existence at All Levels
Lecture 22: The Holistic Perception of Harmony in Existence
Tutorial 11: Practice Session PS11 Exploring Co-existence in Existence

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

Implications of the Holistic Understanding – a Look at Professional Ethics (6 lectures and 3 tutorials for practice session)
Lecture 23: Natural Acceptance of Human Values
Lecture 24: Definitiveness of (Ethical) Human Conduct
Tutorial 12: Practice Session PS12 Exploring Ethical Human Conduct
Lecture 25: A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order
Lecture 26: Competence in Professional Ethics
Tutorial 13: Practice Session PS13 Exploring Humanistic Models in Education
Lecture 27: Holistic Technologies, Production Systems and Management Models-Typical Case Studies
Lecture 28: Strategies for Transition towards Value-based Life and Profession
Tutorial 14: Practice Session PS14 Exploring Steps of Transition towards Universal Human Order

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

CO1: Present sustainable solutions to the problems in society and nature.

CO2: See that these solutions are practicable and draw roadmaps to achieve them.

CO3: Grasp the right utilization of their knowledge in their streams of Technology/Engineering/Management/any other area of study to ensure mutual fulfilment. E.g. mutually enriching production system with rest of nature.

CO4: Sincerely evaluate the course and share with their friends. They are also able to suggest measures to make the course more effective and relevant.

CO5: Make use of their understanding in the course for the happy and prosperous family and society.

Question Paper Pattern:

SEE Assessment:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying 20 marks each.
3. There will be two full questions (with a maximum of four sub questions) from each module.
4. Each full question will have sub questions covering all the topics of the module.
5. Students have to answer any Five Full questions, choosing at least one full question from each module

CIE Assessment:

1. Three tests will be conducted each of 15 marks, average of best of two tests will be considered
2. Session wise Assignment will be 25 Marks, Seminar & Library Work 5 Marks and Attendance 5 Marks

Text Books:

1.The Textbook - A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd
2. The Teacher's Manual- Teachers' Manual for A Foundation Course in Human Values and Professional Ethics, RR Gaur, R

Reference Books:

1. JeevanVidya: EkParichaya, A Nagaraj, JeevanVidyaPrakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4.The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5.Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7.Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj – PanditSunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi

COURSE OUTCOME AND PROGRAM OUTCOME MAPPING																
Course Name:		UNIVERSAL HUMAN VALUES														
Course Code:		22UHV410														
Sl. No.	CO\PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1	CO1						3	3					2			
2	CO2						3	2					2			
3	CO3							3					2			
4	CO4									3			2			
5	CO5						3						2			
	Average						1.8	1.6		0.6			2			

Course Title:	**SIMULATION OF ELECTRICAL MACHINES**		
	[As per NEP 2020, Outcome Based Education (OBE) and Choice Based Credit		
Course Code:	**22AEE411A**	**CIE Marks:**	50
Semester:	**4**	**SEE Marks:**	50
(Theory/Practical/Integrated)	LAB	**Total Marks:**	100
(L:T:P:S):	0:0:2:0	**Exam Hours:**	3
Total Hours of Pedagogy:	24 hours	**Credits:**	1

Course Objectives: This Course will enable the students to:

1. Study of No load and Blocked rotor test on Three Phase Induction Motor.
2. Study of open circuit and short circuit test on Three Phase Alternator.
3. Study the load characteristics of DC shunt generator and separately excited DC motor.
4. Study of speed control of DC motor by field resistance control, Armature resistance control and by Ward-leonard method.
5. Study of Magnetisation Characteristics of DC Shunt Generator.

Experiments

1. No load and blocked rotor test on three phase induction motor.
2. Open Circuit Test on Three Phase Alternator.
3. Short Circuit Test on Three Phase Alternator.
4. Load Test on Three Phase Alternator.
5. To study the Load Characteristics of DC shunt generator.
6. Load Test On Seperately Excited DC Motor.
7. Speed Control of DC Shunt motor by field resistance control.
8. Speed Control of DC Shunt motor by Armature Resistance Control.
9. To perform speed control of DC Shunt motor by using Ward-Leonard Method.
10. To Study Magnetisation Characteristics of DC Shunt Generator.

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

CO1: Simulate Three Phase Induction Motor for conducting No load and Blocked rotor test to evaluating its performance**.**

CO2: Simulate three phase alternator for conducting open circuit and short circuit tests to evaluate its performance .

CO3: Simulate the DC shunt generator and Separately excited DC Motor to evaluate their load characteristics.

CO4: Simulate various speed control methods for a DC Shunt motor .

CO5: Simulate a DC Shunt Generator to determine its magnetization Characteristics.

Practical Examination Conduction:

SEE Assessment:

1. Students will be given two experiments for their write-up.
2. Students need to conduct one of the two experiments given.
3. 15% of total marks are allotted for writeup, 70% of total marks are given to the conduction of experiment and

CIE Assessment:

1. One test will be conducted at the end of the semester of 15 marks out of total marks 50.
2. The remaining 35 marks are given to oveall conduction of an experiments by the students and also to the

Graduate Attributes (As per NBA)

Engineering Knowledge, Problem Analysis, Individual and Team work, Communication.

Conduct of Practical Examination:

1. Laboratory experiments are to be included for practical examination.
2. Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the

3. Students can pick one experiment from the questions lot prepared by the examiners.
4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

COURSE OUTCOME AND PROGRAM OUTCOME MAPPING																
Course Name:		SIMULATION OF ELECTRICAL MACHINES														
Course Code:		22AEE411A														
Sl. No.	**CO\PO**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**	**PSO3**
1	**CO1**	3	3	3						3			1		3	
2	**CO2**	3	3	3						3			1		3	
3	**CO3**	3	3	3						3			1		3	
4	**CO4**	3	3	3						3			1		3	
5	**CO5**	3	3	3						3			1		3	
	Average	3	3	3						3			1		3	

Course Title:	MANAGEMENT AND ENTREPRENEURSHIP DEVELOPMENT [As per NEP 2020, Outcome Based Education (OBE) and Choice Based Credit System (CBCS) Scheme]		
Course Code:	**22HSM51**	**CIE Marks:**	50
Semester:	**5**	**SEE Marks:**	50
Course Type	Theory	**Total Marks:**	100
Teaching Hours/Week (L:T:P:S):	3:0:0:0	**Exam Hours:**	3
Total Hours of Pedagogy:	40 hours	**Credits:**	3

Course Objectives: This Course will enable the students to:

1. Distinguish between management and administration.
2. Understand the need for Entrepreneurs and their skills.
3. Identify the Management functions and Social responsibilities.
4. Distinguish between management and administration.
5. Understand Project identification and Selection.

Module-1 **8 hours L1, L2**

Management: Nature and Functions of Management – Importance, Definition, Management Functions, Levels of Management, Roles of Manager, Managerial Skills, Management & Administration, Management as a Science, Art &Profession.

Planning: Planning-Nature, Importance, Types, Steps and Limitations of Planning; Decision Making – Meaning, Types and Steps in Decision Making.

Module-2 **8 hours L1, L2**

Organizing and Staffing: Organization-Meaning, Characteristics, Process of Organizing, Principles of Organizing, Span of Management (meaning and importance only), Departmentalization, Committees–Meaning, Types of Committees; Centralization Vs Decentralization of Authority and Responsibility; Staffing-Need and Importance, Recruitment and Selection Process.

Directing and Controlling: Meaning and Requirements of Effective Direction, Giving Orders; Motivation-Nature of Motivation, Motivation Theories (Maslow's Need-Hierarchy Theory and Herzberg's Two Factor Theory); Communication – Meaning, Importance and Purposes of Communication; Leadership-Meaning, Characteristics, Behavioral Approach of Leadership; Coordination-Meaning, Types, Techniques of Coordination; Controlling – Meaning, Need for Control System, Benefits of Control, Essentials of Effective Control System, Steps in Control Process.

Module-3 **8 hours L1, L2**

Social Responsibilities of Business: Meaning of Social Responsibility, Social Responsibilities of Business towards Different Groups, Social Audit, Business Ethics and Corporate Governance.

Entrepreneurship: Definition of Entrepreneur, Importance of Entrepreneurship, concepts of Entrepreneurship, Characteristics of successful Entrepreneur, Classification of Entrepreneurs, Myths of Entrepreneurship, Entrepreneurial Development models, Entrepreneurial development cycle, Problems faced by Entrepreneurs and capacity building for Entrepreneurship.

Module-4 **8 hours L1, L2**

Modern Small Business Enterprises: Role of Small Scale Industries, Impact of Globalization and WTO on SSIs, Concepts and definitions of SSI Enterprises, Government policy and development of the Small Scale sector in India, Growth and Performance of Small Scale Industries in India, Sickness in SSI sector, Problems for Small Scale Industries, Ancillary Industry and Tiny Industry (Definition only)

Institutional Support for Business Enterprises: Introduction, Policies & Schemes of Central Level Institutions, State Level Institutions.

Module-5 **8 hours L1, L2**

Projects Management: A Project. Search for a Business idea: Introduction, Choosing an Idea, Selection of product, The Adoption process, Product Innovation, Product Planning and Development Strategy, Product Planning and Development Process. Concepts of Projects and Classification: Introduction, Meaning of Projects, Characteristics of a Project, Project Levels, Project Classification, Aspects of a Project, The project Cycle, Features and Phases of Project management, Project Management Processes. Project Identification: Feasibility Report, Project Feasibility Analysis. Project Formulation: Meaning, Steps in Project formulation, Sequential Stages of Project Formulation, Project Evaluation.

Project Design and Network Analysis: Introduction, Importance of Network Analysis, Origin of PERT and CPM, Network, Network Techniques, Need for Network Techniques, Steps in PERT, CPM, Advantages, Limitations and Differences.

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

CO1: Understand the fundamental concepts of Management and Entrepreneurship and opportunities in order to setup a business.
CO2: Select the best Entrepreneurship model for the required domain of establishment.
CO3: Compare various types of Entrepreneurs.
CO4: Awareness about various sources of funding and institutions supporting entrepreneurs.
CO5: Analyze the Institutional support by various state and central government agencies.

Question Paper Pattern:

SEE Assessment:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying 20 marks each.
3. There will be two full questions (with a maximum of four sub questions) from each module.
4. Each full question will have sub questions covering all the topics of the module.
5. Students have to answer any Five Full questions, choosing at least one full question from each module

CIE Assessment:

1. Three tests will be conducted each of 15 marks, average of best of two tests will be considered
2. Session wise Assignment will be 35 Marks

Text Books:

1. Principles of Management – P.C Tripathi, P.N Reddy, McGraw Hill Education, 6th Edition, 2017. ISBN-13:978-93-5260-535-
2. Entrepreneurship Development Small Business Enterprises- Poornima M Charantimath, Pearson Education 2008, ISBN 978-
3. Dynamics of Entrepreneurial Development and Management by Vasant Desai. HPH 2007, ISBN: 978- 81-8488-801-2.
4. Robert D. Hisrich, Mathew J. Manimala, Michael P Peters and Dean A. Shepherd, “Entrepreneurship”, 8th Edition, Tata Mc-

Reference Books:

1. Essentials of Management: An International, Innovation and Leadership perspective by Harold Koontz, Heinz Weihrich

COURSE OUTCOME AND PROGRAM OUTCOME MAPPING																
Course Name:		Management and Entrepreneurship Development														
Course Code:		22HSM51														
Sl. No.	**CO\PO**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**	**PSO3**
1	**CO1**									1	1		2			
2	**CO2**									1	1		2			
3	**CO3**									1	1		2			
4	**CO4**									1	1		2			
5	**CO5**		3							1	1		2			
	Average		3							1	1		2			

Course Title:	SIGNALS AND SYSTEMS		
	[As per NEP 2020, Outcome Based Education (OBE) and Choice Based Credit System (CBCS) Scheme]		
Course Code:	**22EE52**	**CIE Marks:**	50
Semester:	**5**	**SEE Marks:**	50
Course Type (Theory/Practical/Integrated):	Theory	**Total Marks:**	100
Teaching Hours/Week (L:T:P:S):	3:1:0:0	**Exam Hours:**	3
Total Hours of Pedagogy:	50 hours	**Credits:**	4

Course Objectives: This Course will enable the students to :

1. Understand the classification, basic operations and properties of signals and systems.
2. Understand to obtain the response of LTI system in time domain.
3. Understand to obtain the solution for differential and difference equations of LTI systems
4. Understand the Fourier representation of a periodic signals.
5. Understand the LTI system in Z-transform.

Module-1	10 hours L1, L2,L3

Introduction and Classification of signals: Definition of signal and systems, communication and control systems 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 interms of elementary signals.

Module-2	10 hours L1, L2,L3

System Classification and properties: Linear-nonlinear, Time variant-invariant, causal-non causal, static-dynamic, stable-unstable, invertible systems.
Time domain representation of LTI System: Impulse response, convolution sum, convolution integral. 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.
LTI system Properties in terms of impulse response: System interconnection, Memory less, Causal, Stable, Invertible and De-convolution, and step response.

Module-3	10 hours L1, L2,L3

Differential & Difference Equation representation of LTI systems: Solution for Differential & Difference equations.
Fourier Representation of Periodic Signals: Orthogonality of complex sinusoids, CTFS properties (No derivation)and basic problems.

Module-4	10 hours L1, L2,L3

Fourier Representation of aperiodic Signals: Introduction to Fourier Transform & DTFT, Definition and basic problems.

Properties of Fourier Transform: Periodicity, Linearity, Symmetry, Time shift, Frequency shift, Scaling, Differentiation and Integration, Convolution and Modulation, Parsevals relationships and Duality.

Module-5 **10 hours L1, L2,L3**

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

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

CO1: Classify the signals and perform basic operations on them.

CO2: Classify the systems and analyze the response of LTI system in time domain.

CO3: Solve the differential and difference equations of LTI systems .

CO4: Solve differential equations by applying the properties of Fourier transform.

CO5: Compute Z-transforms, inverse Z- transforms and transfer functions of complex LTI systems.

Question Paper Pattern:

SEE Assessment:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to
2. The question paper will have ten full questions carrying 20 marks each.
3. There will be two full questions (with a maximum of four sub questions) from each module.
4. Each full question will have sub questions covering all the topics of the module.
5. Students have to answer any Five Full questions, choosing at least one full question from each module

CIE Assessment:

1. Three tests will be conducted each of 15 marks, average of best of two tests will be considered
2. Session wise Assignment will be 25 Marks, Seminar & Library Work 5 Marks and Attendance 5 Marks

Text Books:

1. Simon Haykins and Barry Van Veen, “Signals and Systems”, 2nd Edition, 2008, WileyIndia. ISBN 9971-51-239-4.

Reference Books:

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

COURSE OUTCOME AND PROGRAM OUTCOME MAPPING																
Course Name:		SIGNALS AND SYSTEMS														
Course Code:		22EE52														
Sl. No.	**CO\PO**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**	**PSO3**
1	**CO1**	3	3	2	1								1	3		
2	**CO2**	3	3	2	1								1	3		
3	**CO3**	3	3	2	1	1							1	3		
4	**CO4**	3	3	2	1	1							1	3		
5	**CO5**	3	3	2	1	1							1	3		
	Average	3	3	2	1	1							1	3		

Course Title:	POWER ELECTRONICS		
	[As per NEP 2020, Outcome Based Education (OBE) and Choice Based Credit System (CBCS) Scheme]		
Course Code:	**22EE53**	**CIE Marks:**	50
Semester:	**5**	**SEE Marks:**	50
Course Type (Theory/Practical/Integrated):	Theory	**Total Marks:**	100
Teaching Hours/Week (L:T:P:S):	3:0:0:0	**Exam Hours:**	3
Total Hours of Pedagogy:	40 hours	**Credits:**	3

Course Objectives: This Course will enable the students to :		
1 Understand the fundamental concepts of Power Electronic Circuits, Power Diode and Diode Rectifiers.		
2 Understand the characteristics of Power Transistors like IGBT's, MOSFET etc..		
3 Understand the Basic concept of Thyristor , it's characteristics and applications		
4 Understand the analysis of Controlled rectifiers and AC voltage controllers		
5 Understand the principle and applications of DC-DC converters and DC-AC converters.		
Module-1	**8 hours**	**L1, L2,L3**
Introduction: Applications of Power Electronics, Types of Power Electronic Circuits, Peripheral Effects. **Power Diodes**: Introduction, Diode Characteristics, Reverse Recovery Characteristics, Freewheeling diodes,Freewheeling diodes with RL load. **Diode Rectifiers**: Introduction, Diode Circuits with DC Source connected to R and RL load, Single-Phase Full-Wave Rectifiers with R load ,Single-Phase Full-Wave Rectifier with RL Load ,Review of Diode Clipping and Clamping Circuits.Review of Schottky Diodes and their Applications in Power Circuits		
Module-2	**8 hours**	**L1, L2,L3**
Power Transistors: Introduction, Power MOSFETs – Steady State Characteristics, Switching Characteristics Bipolar Junction Transistors – Steady State Characteristics, Switching Characteristics, Isolation of Gate and Base Drives, Pulse transformers and Opto-couplers.Insulated Gate Bipolar Transistor (IGBT) Characteristics and Applications, MOSFET Gate drive.		
Module-3	**8 hours**	**L1, L2,L3**
Thyristors: Introduction, Thyristor Characteristics, Two-Transistor Model of Thyristor, Thyristor TurnOn, Thyristor Turn-Off, A brief study on Thyristor Types, di/dtProtection, dv/dtProtection, Thyristor Firing Circuits,UJT Firing Circuit.		
Module-4	**8 hours**	**L1, L2,L3**
Controlled Rectifiers: Introduction, Single phase half wave circuit with RL Load, Single phase half wave circuit with RL Load and Freewheeling Diode, Single-Phase Full Converters with RL Load, Single-Phase Dual Converters and Principle of operation of Three- Phase dual Converters. **AC Voltage Controllers:** Introduction, Principle of phase control, Single-Phase Full-Wave Controllers with Resistive Loads, Single- Phase Full-Wave Controllers with Inductive Loads, Three-Phase Full-Wave Controllers.		
Module-5	**8 hours**	**L1, L2,L3**

DC-DC Converters: Introduction, principle of step down and step up chopper with RL load, performance parameters, DC-DC converter classification.
DC-AC Converters: Introduction, principle of operation single phase bridge inverters, voltage control of single phase inverters, harmonic reductions.Current source inverters.

Course Outcomes: At the end of the course the student will be able to:	
CO1: Analyze and explain the types of power semiconductor devices along with their construction, operation, and switching characteristics.	
CO2: Evaluate and compare the performance and switching characteristics of MOSFETs, IGBTs, and BJTs in power electronic applications.	
CO3: Explain and analyze the basic concepts of thyristors its characteristics and applications.	
CO4: Analyze and design-controlled rectifiers and AC voltage controllers for various power control applications.	
CO5: Analyze DC-DC converters and DC-AC inverters for efficient power conversion.	

Question Paper Pattern:

SEE Assessment:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying 20 marks each.
3. There will be two full questions (with a maximum of four sub questions) from each module.
4. Each full question will have sub questions covering all the topics of the module.
5. Students have to answer any Five Full questions, choosing at least one full question from each module

CIE Assessment:

1. Three tests will be conducted each of 15 marks, average of best of two tests will be considered
2. Session wise Assignment will be 25 Marks, Seminar & Library Work 5 Marks and Attendance 5 Marks

Text Books:

1. Power Electronics: Circuits Devices and Applications, Mohammad H Rashid, Pearson 4th Edition, 2014

Reference Books:

1. Power Electronics, P.S. Bimbhra ,Khanna Publishers, 5th Edition, 2012.
2. Power Electronics: Converters, Applications and Design, Ned Mohan et al, Wiley ,3rd Edition, 2014.
3. Power Electronics ,Daniel W Hart, McGraw Hill, 1 st Edition, 2011.
4.Elements of Power Electronics, Philip T Krein, Oxford Indian Edition, 2008.

COURSE OUTCOME AND PROGRAM OUTCOME MAPPING																
Course Name:		**POWER ELECTRONICS**														
Course Code:		**22EE53**														
Sl. No.	**CO\PO**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**	**PSO3**
1	**CO1**	3	2										1	3		
2	**CO2**	3	3	1									1	3		
3	**CO3**	3	3	1									1	3		
4	**CO4**	3	3	2	2								1	3		
5	**CO5**	3	3	2	2								1	3		
	Average	3	2.8	1.5	2								1	3		

Course Title:	SWITCHGEAR AND PROTECTION		
	[As per Choice Based Credit System (CBCS) Scheme]		
Course Code:	**22EE541**	**CIE Marks:**	50
Semester:	**5**	**SEE Marks:**	50
Course Type (Theory/Practical/Integrated):	Theory	**Total Marks:**	100
Teaching Hours/Week (L:T:P:S):	3:0:0:0	**Exam Hours:**	3
Total Hours of Pedagogy:	40 hours	**Credits:**	3

Course Objectives: This Course will enable the students to:

1. Understand the principle of fuse and relays.
2. Understand the protective schemes using over current, microprocessor based relay and distance relay.
3. Understand the differential protection and protection of generators, motors, transformers and bus zone.
4. Understand the basic principle and different types of circuit breakers.
5. Understand the principle of protection against over voltages.

Module-1	**8 hours L1, L2**

Fuses: Introductions, Definitions, Fuse Characteristics, Types of Fuses (HRC and Liquid), Application of Fuses, Selection of Fuses.
Introduction to Power System Protection: Need for protective schemes, Zones of Protection, Primary and Backup Protection. **Relay Construction and Operating Principles:** Typical relay circuit elements, basic terms related to relay, Essential Qualities of Relay, Classification of Protective Relays. Electromechanical Relays, Static Relays – Merits and Demerits of Static Relays, Numerical Relays, Comparison between Electromechanical Relays, Static Relay and Numerical Relays.

Module-2	**8 hours L1, L2,L3**

Over current Protection: Introduction, Time – current Characteristics, Current Setting, Time Setting, Overcurrent Protective Schemes, Reverse Power or Directional Relay, Earth Fault and Phase Fault Protection, Directional Earth Fault Relay.
Feeder protection: Protection of Parallel Feeders, Protection of Ring Mains,
Microprocessor based Protective Relays: Introduction, Overcurrent relay,Impedance Relay.

Module-3	**8 hours L1, L2,L3**

Differential Protection: Introduction, Differential Relays, Simple Differential Protection, Percentage or Biased Differential Relay, Differential Protection of 3 Phase Circuits, Balanced (Opposed) Voltage Differential Protection.
Rotating Machines Protection: Introduction, Protection of Generators.
Transformer and Bus zone Protection: Introduction, Transformer Protection, Buszone Protection.

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

Circuit Breakers: Introduction, Fault Clearing Time of a Circuit Breaker, Arc Voltage, Arc Interruption, Restriking Voltage and Recovery Voltage, Current Chopping, Interruption of Capacitive Current, Classification of Circuit Breakers, Air – Break Circuit Breakers, Oil Circuit Breakers, Air – Blast Circuit Breakers, SF6 Circuit Breakers, Vacuum Circuit Breakers, High Voltage Direct Current Circuit Breakers, Rating of Circuit Breakers, Testing of Circuit Breakers.

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

Protection against Overvoltage: Causes of Overvoltage, Lightning phenomena, Wave Shape Voltage of due to Lightning, Over Voltage due to Lightning, Klydonograph and Magnetic Link Protection of Transmission Lines against Direct Lightning Strokes, Protection of Stations and Sub-Stations from Direct Strokes, Protection against Travelling Waves.

Modern Trends in Power System Protection: Introduction, gas insulated substation/switchgear (GIS).

Course Outcomes: At the end of the course the student will be able to:	
CO1: Analyze and evaluate the essential qualities, construction, and operating principles of different types of Fuse and relays.	
CO2: Analyze and implement protective schemes using overcurrent and distance relays to ensure efficient fault detection and isolation.	
CO3: Develop and assess various differential protection strategies, and advanced protection mechanisms for generators, motors, transformers, and bus zones.	
CO4: Analyze and compare the operating principles, performance, and application of various circuit breakers to optimize system protection.	
CO5: Evaluate effective overvoltage protection strategies to enhance system reliability and safety.	

Question Paper Pattern:

SEE Assessment:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying 20 marks each.
3. There will be two full questions (with a maximum of four sub questions) from each module.
4. Each full question will have sub questions covering all the topics of the module.
5. Students have to answer any Five Full questions, choosing at least one full question from each module

CIE Assessment:

1. Two tests will be conducted each of 15 marks, average of the two tests will be considered.
2. Remaining 35 Marks will be considered for other components like Assignment, Attendance, Library, Seminar, etc

Text Books:

1. Power system protection and switchgear, Badri Ram D.N Vishwakarma,McGrawHill,2ndEdition.
2. Priciples of Power System by V.K.Mehata and Rohit Mehta, S.Chand Publications.

Reference Books:

1.Protection and Switchgear ,Bhaveshetal ,Oxford ,1st Edition,2011
System Switchgear and Protection ,N. Veerappan ,S.R. Krishnamurthy ,S. Chand ,1st Edition, 2009
3. Fundamentals of Power System Protection ,Y.G.Paithankar ,S.R. Bhide ,PHI ,1st Edition,2009.
4. A text book of Power System Engineering by R.K.Rajput.

COURSE OUTCOME AND PROGRAM OUTCOME MAPPING																
Course Name:		Switchgear and Protection														
Course Code:		**22EE541**														
Sl. No.	**CO\PO**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**	**PSO3**
1	**CO1**	3					2						1	3		
2	**CO2**	3	1				2						1	3		
3	**CO3**	3	3				2						1	3		
4	**CO4**	3	3				2						1	3		
5	**CO5**	3	3				3						1	3		
	Average	3	2.5				2.2						1	3		

Course Title:	ARM CORTEX M3 & EMBEDDED SYSTEM		
	[As per NEP 2020, Outcome Based Education (OBE) and Choice Based Credit		
Course Code:	**22EE542**	**CIE Marks:**	50
Semester:	**5**	**SEE Marks:**	50
Course Type (Theory/Practical/Integrated):	Theory	**Total Marks:**	100
Teaching Hours/Week (L:T:P:S):	3:0:0:0	**Exam Hours:**	3
Total Hours of Pedagogy:	40 hours	**Credits:**	3

Course Objectives: This Course will enable the students to :
of an embedded system.

2. Understand the hardware software co-design and firmware design approaches.

3 .Understand the need of real time operating system for embedded system applications.

4 . Understand the architectural features and instruction set of 32 bit Microcontroller ARM Cortex M3.

5 . Understand to Program ARM Cortex M3 using the various instructions and C language for different applications

Module-1	**8 hours L1, L2,L3**
Embedded System Components: Embedded Vs General computing system, Classification of Embedded systems(ES), Major applications and purpose of ES. Elements of an Embedded System (Block diagram and explanation), Differences between RISC and CISC, Harvard and Von-neumann, Big and Little Endian formats, Memory (ROM and RAM types), Sensors, Actuators, Optocoupler, Communication Interfaces (I2C, SPI, IrDA, Bluetooth, Wi-Fi, Zigbee only)	
Module-2	**8 hours L1, L2,L3**
Embedded System Design Concepts: Characteristics and Quality Attributes of Embedded Systems, Operational and non-operational quality attributes, Embedded Systems-Application and Domain specific, Hardware and Software Co-Design and Program Modeling (excluding UML), Embedded firmware design and development (excluding C language).	
Module-3	**8 hours L1, L2,L3**
RTOS and The Embedded product development life cycle(EDLC): Operating System basics, Types of operating systems, Task, process and threads (Only POSIX Threads with an example program), Thread preemption, Preemptive scheduling techniques, How to choose an RTOS, The Embedded product development life cycle (EDLC): What is EDLC?,Why EDLC?, objectives of EDLC, Different phases of EDLC,EDLC approaches(Modeling the EDLC)	
Module-4	**8 hours L1, L2,L3**
ARM-32 bit Microcontroller: Thumb-2 technology and applications of ARM, Architecture of ARM Cortex M3, Various Units in the architecture, Debugging support, General Purpose Registers, Special Registers, exceptions, interrupts, stack operation, reset sequence	
Module-5	**8 hours L1, L2,L3**

ARM Cortex M3 Instruction Sets and Programming: Assembly basics, Instruction list and description, Useful instructions, Memory mapping, Bit-band operations and CMSIS, Assembly and C language Programming .

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

CO1: Interpret the basic hardware components and their selection method .

CO2: Analyze hardware and software co-design and firmware design approaches.

CO3: Explain the need of real time operating system for embedded system applications.

CO4: Explain the architectural features and instruction set of 32 bit Microcontroller ARM Cortex M3.

CO5: Develop Program ARM Cortex M3 using various Assembly instructions and C language for different applications

Question Paper Pattern:

SEE Assessment:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying 20 marks each.
3. There will be two full questions (with a maximum of four sub questions) from each module.
4. Each full question will have sub questions covering all the topics of the module.
5. Students have to answer any Five Full questions, choosing at least one full question from each module

CIE Assessment:

1. Three tests will be conducted each of 15 marks, average of best of two tests will be considered
2. Session wise Assignment will be 25 Marks, Seminar & Library Work 5 Marks and Attendance 5 Marks

Text Books:

1. Shibu K V, ―Introduction to Embedded Systems‖, Tata McGraw Hill Education Private Limited, 2nd Edition.
2. Joseph Yiu, ―The Definitive Guide to the ARM Cortex-M3‖, 2nd Edition, Newnes, (Elsevier), 2010.

Reference Books:

1.James K. Peckol, "Embedded systems- A contemporary design tool", John Wiley, 2008, ISBN: 978-0- 471-72180-2.

2. Yifeng Zhu, “Embedded Systems with Arm Cortex-M Microcontrollers in Assembly Language and C” .

3. Embedded real time systems by K.V. K. K Prasad, Dreamtech publications, 2003

4. Embedded Systems by Rajkamal, 2nd Edition, McGraw hill Publications, 2010.

COURSE OUTCOME AND PROGRAM OUTCOME MAPPING																
Course Name:		ARM CORTEX M3 & EMBEDDED SYSTEM														
Course Code:		22EE542														
Sl. No.	**CO\PO**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**	**PSO3**
1	**CO1**	3				3	2						1	3		
2	**CO2**	3	3	3	2	3	2						1	3		
3	**CO3**	3				3	2						1	3		
4	**CO4**	3				3	2						1	3		
5	**CO5**	3	3	3		3	2						1	3		
	Average	3	1.2	1.2	0.4	3	2						1	3		

Course Title:	ELECTRICAL SAFETY		
	[As per NEP 2020, Outcome Based Education (OBE) and Choice Based Credit System (CBCS) Scheme]		
Course Code:	**22EE551**	**CIE Marks:**	50
Semester:	**5**	**SEE Marks:**	50
Course Type (Theory/Practical/Integrated):	Theory	**Total Marks:**	100
Teaching Hours/Week (L:T:P:S):	3:1:0:0	**Exam Hours:**	3
Total Hours of Pedagogy:	50 hours	**Credits:**	4

Course Objectives: This Course will enable the students to understand :

1. The objectives of safety,prevention and effect of shock.
2. The electrical safety in residential and commercial and agricultural installations.
3. The Electrical Safety during Installation, Testing and Commissioning, Operation and Maintenance.
4. The Electrical Safety in Hazardous Areas.
5. The various types of Fire Extinguishers:

Module-1 **10 hours L1, L2,L3**

Introduction To Electrical Safety, Shocks And Their Prevention: Terms and definitions, objectives of safety and security measures, Hazards associated with electric current and voltage, who is exposed, principles of electrical safety, Approaches to prevent Accidents, scope of subject electrical safety. Primary and secondary electrical shocks, possibilities of getting electrical shock and its severity, medical analysis of electric shocks and its effects, shocks due to flash/ Spark over's, prevention of shocks, safety precautions against contact shocks, flash shocks, burns in residential buildings and shop.

Module-2 **10 hours L1, L2,L3**

Electrical Safety in Residential, Commercial and Agricultural Installations: Wiring and fitting –Domestic appliances –water tap giving shock –shock from wet wall –fan firing shock –multi-storied building –Temporary installations –Agricultural pump installation –Do's and Don'ts for safety in the use of domestic electrical appliances.

Module-3 **10 hours L1, L2,L3**

Electrical Safety during Installation, Testing and Commissioning, Operation and Maintenance: Preliminary preparations –safe sequence –risk of plant and equipment –safety documentation –field quality and safety -personal protective equipment –safety clearance notice –safety precautions –safeguards for operators .

Module-4 **10 ours L1, L2,L3**

Electrical Safety in Hazardous Areas: Hazardous zones –class 0,1 and 2 –spark, flashovers and corona discharge and functional requirements –Specifications of electrical plants, equipment's for hazardous locations –Classification of equipment enclosure for various hazardous gases and vapours –classification of equipment/enclosure for hazardous locations. Earth fault protection-earthing standards-FRLS insulation-grounding-equipment grounding earth leakage circuit breaker.

Module-5 **10 hours L1, L2,L3**

Fire Extinguishers: Fundamentals of fire-initiation of fires, types; extinguishing techniques, prevention of fire, types of fire extinguishers, fire detection and alarm system; CO2 and Halogen gas schemes; foam schemes.

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

CO1: Describe electrical safety measures, analyze the causes of electric shock, and implement preventive techniques to ensure protection.

CO2: Compare electrical safety measures in residential, commercial, and agricultural installations, analyze potential hazards, and implement preventive strategies for safe operation.

CO3:Analyze electrical safety protocols during installation, testing, commissioning, operation, and maintenanc and apply preventive measures to ensure safe working .conditions.
CO4: Identify potential electrical hazards in hazardous areas, analyze associated risks, and implement safety measures to prevent accidents and ensure a secure working environment.
CO5: Examine different types of fire extinguishers, classify them based on their applications, and analyze their effectiveness in handling various fire hazards.
Question Paper Pattern:
SEE Assessment:
1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying 20 marks each.
3. There will be two full questions (with a maximum of four sub questions) from each module.
4. Each full question will have sub questions covering all the topics of the module.
5. Students have to answer any Five Full questions, choosing at least one full question from each module
CIE Assessment:
1. Two tests will be conducted each of 15 marks, average of the two tests will be considered
2. Session wise Assignment will be 25 Marks. Attendance carry 05 Marks and Library and Seminar will carry 05 Marks. In total this componenet carries 35 Marks all three together.
Text Books:
1. Rao, S. and Saluja, H.L., “Electrical Safety, Fire Safety Engineering and Safety Management”, Khanna Publishers, 1988.
Reference Books:
1. Cooper.W.F, “Electrical safety Engineering”, Newnes-Butterworth Company, 1978
2. John Codick, “Electrical safety hand book”, McGraw Hill Inc., New Delhi, 2000.
3. Nagrath, I.J. and Kothari, D.P., “Power System Engineering”, Tata McGraw Hill, 1998.
4. David A Bell, Electronic Instrumentation and Measurements, Oxford University, 3rd Edition, 2013.

COURSE OUTCOME AND PROGRAM OUTCOME MAPPING																
Course Name:		**ELECTRICAL SAFETY**														
Course Code:		**22EE551**														
Sl. No.	**CO\PO**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**	**PSO3**
1	**CO1**	3					3	2					2	3		
2	**CO2**	3					3	2					2	3		
3	**CO3**	3					3	2					2	3		
4	**CO4**	3					3	2					2	3		
5	**CO5**	3	3				3	2					2	3		
	Average	3	3				3	2					2	3		

Course Title:	**OPERATION AND MAINTENANCE OF SOLAR ELECTRIC SYSTEMS (Open Elective)** [As per NEP 2020, Outcome Based Education (OBE) and Choice Based Credit System (CBCS) Scheme]		
Course Code:	**22EE552**	**CIE Marks:**	50
Semester:	**5**	**SEE Marks:**	50
Course Type (Theory/Practical/Integrated):	Theory	**Total Marks:**	100
Teaching Hours/Week (L:T:P:S):	3:1:0:0	**Exam Hours:**	3
Total Hours of Pedagogy:	50 hours	**Credits:**	4

Course Objectives: This Course will enable the students to:
1. Understand the basics of solar resource data and PV technologies.
2. Understand inverters, system components, cabling and mounting systems.
3. Understand site assessment, design process and sizing of the grid connected system.
4. Understand installation, commissioning, operation and maintenance of PV systems.
5. Understand the types of financial incentives available and calculation of payback time.

Module-1	**10 hours L1, L2**

atmosphere on solar radiation, Sun geometry, Geometry for installing solar arrays.

PV Industry and Technology: Semiconductor devices, Mainstream technologies, Monocrystalline silicon ,Multi-crystalline /polycrystalline silicon, Thin film solar cells, Contacts, Buying solar modules, Standards, Certifications, Warranties, Emerging technologies, Dye-sensitized solar cells, Sliver cells, Hetero-junction with intrinsic thin layer (HIT) photovoltaic cells, III-V Semiconductors, Solar concentrators.

PV Cells, Modules and Arrays: Characteristics of PV cells, Graphic representations of PV cell performance, Connecting PV cells to create a module, Specification sheets, Creating a string of modules, Creating an array, Photovoltaic array performance, Irradiance, Temperature and Shading.

Module-2	**10 hours L1, L2**

Inverters and Other System Components: Introduction, Inverters, Battery inverters, Grid interactive inverters, Transformers, Mainstream inverter technologies, String inverters, Multi-string inverter, Central inverter, Modular inverters, Inverter protection systems, Self-protection, Grid protection, **Balance of system equipment**: System equipment excluding the PV array and inverter, Cabling, PV combiner box, Module junction box, Circuit breakers and fuses, PV main disconnects/isolators, Lightning and surge protection, System monitoring, Metering, Net metering, Gross metering.

Mounting Systems: Roof mounting systems, Pitched roof mounts, Pitched roof mounts for tiled roofs, Pitched roof mounts for metal roofs, Rack mounts, Direct mounts, Building-integrated systems, Ground mounting systems, Ground rack mounts, Pole mounts, Sun-tracking systems, Wind loading and Lightning protection.

Module-3	**10 hours L1, L2**

Site Assessment: Location of the PV array, Roof specifications, Is the site shade-free?, Solar Pathfinder, Solmetric Sun eye, HORI catcher, iPhone apps, Software packages, Available area, Portrait installation, Landscape installation, Energy efficiency initiatives, Health, safety and environment (HSE) risks, Local environment, Locating balance of system equipment, Site plan.
Designing Grid-connected PV Systems: Design brief, Existing system evaluation, choosing system components, Modules, Mounting structure, Inverters, Cabling, Voltage sizing, Current sizing, Monitoring, System protection, Over-current protection, Fault-current protection, Lightning and surge protection, Grounding/earthing, Mechanical protection, Array protection, Sub array protection, Extra low voltage (ELV) segmentation.
Sizing a PV System: Introduction, Matching voltage specifications, Calculating maximum voltage, Calculating minimum voltage, Calculating the minimum number of modules in a string, Calculating the maximum voltage, Calculating the maximum number of modules in a string, Calculating the minimum voltage, Calculating the minimum number of modules in a string, Matching current specifications, Matching modules to the inverter's power rating, Losses in utility-interactive PV systems, Temperature of the PV module, Dirt and soiling, Manufacturer's tolerance, Shading, Orientation and module tilt angle, Voltage drop, Inverter efficiency, Calculating system yield.

Module-4	**10 hours L1, L2**

Installing Grid-connected PV Systems: PV array installation, DC wiring, Cabling routes and required lengths, Cable sizing, PV combiner box, System grounding/earthing, Inverter installation, Installation checklist, Interconnection with the utility grid, Required information for installation, Safety.
System Commissioning: Introduction, Final inspection of system installation, Testing, Commissioning, System documentation.
System Operation and Maintenance: System maintenance, PV array maintenance, Inverter maintenance, System integrity, Troubleshooting, Identifying the problem, Troubleshooting PV arrays, Troubleshooting underperforming systems, Troubleshooting inverters, Other common problems.

Module-5	**10 hours L1, L2**

Marketing and Economics of Grid-connected PV Systems: Introduction, PV system costing, Valuing a PV system, Simple payback and financial incentives, Simple payback, Feed-in tariffs, Rebates, Tax incentives, Loans, Renewable portfolio standards and renewable energy certificates, Marketing, Insurance.
Case Studies: Case studies A to G.

Course Outcomes: At the end of the course the student will be able to:	
CO1: Describe the fundamentals of solar resource data, explain PV technology, and analyze the structure and function of PV cells, modules, and arrays.	
CO2: Describe the function of inverters, analyze various system components, and explain different mounting methods used in PV systems.	
CO3: Assess the site for PV system installation and design a grid connected system and compute its size.	
CO4: Analyze the procedures for installation and commissioning and apply maintenance practices for efficient performance of PV systems.	

CO5: Identify different types of financial incentives for PV systems and calculate the payback time to assess economic feasibility.			
Question Paper Pattern:			
SEE Assessment:			
1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to			
2. The question paper will have ten full questions carrying 20 marks each.			
3. There will be two full questions (with a maximum of four sub questions) from each module.			
4. Each full question will have sub questions covering all the topics of the module.			
5. Students have to answer any Five Full questions, choosing at least one full question from each module			
CIE Assessment:			
1. Two tests will be conducted each of 15 marks, average of the two tests will be considered.			
2. Remaining 35 Marks will be considered for other components like Assignment, Attendance, Library,			
Text Books:			
1. Grid-connected Solar Electric Systems, The Earthscan Expert Handbook for Planning, Design and			
Reference Books:			

COURSE OUTCOME AND PROGRAM OUTCOME MAPPING																
Course Name:		Operation and Mainenance of Solar Electric Systems														
Course Code:		22EE552														
Sl. No.	**CO\PO**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**	**PSO3**
1	**CO1**	3											1	3		
2	**CO2**	3		3		1	2	2					1	3		
3	**CO3**	3	3	2		1	2	2					1	3		
4	**CO4**	3											1	3		
5	**CO5**	3	1			2	2						1	3		
	Average	3	0.8	1		0.8	1.2	0.8					1	3		

Course Title:	SIGNALS AND SYSTEMS LABORATORY		
	[As per NEP 2020, Outcome Based Education (OBE) and Choice Based Credit System (CBCS) Scheme]		
Course Code:	**22EEL56**	**CIE Marks:**	50
Semester:	**5**	**SEE Marks:**	50
Course Type	Practical	**Total Marks:**	100
Teaching Hours/Week	0:0:2:0	**Exam Hours:**	3
Total Hours of Pedagogy:	24 hours	**Credits:**	1

Course Objectives: This Course will enable the students to:

1	exponential.
2	Understand Even and Odd components of a signal and Computation of Energy and Power of the signal.
3	Understand difference equations and computation of convolution.
4	Understand the Computation of DFT for a discrete signal,
5	Understand the Evaluation of Sampling theorem.

Sl. No	Experiments
1	Representation of basic signals impulse, unit step, unit ramp, sinusoidal, cosine and exponential.
2	Finding Energy and power of signals.
3	Finding Even and Odd components of the signal.
4	Write a program to perform Operations on signal time scaling, amplitude scaling.
5	Write a program to linear convolution of two sequences.
6	Find the Fourier transform, plot magnitude and phase.
7	Find the Inverse Fourier transform, plot magnitude and phase.
8	Find the solution of difference equation.
9	Evaluate Sampling Theorem.
10	Write a program to perform up sampling.
11	Write a program to perform down sampling.
12	Finding frequency response of LTI system.

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

CO1: Analyze and apply time scaling and amplitude scaling techniques to modify and interpret signals in continuous and discrete domains.

CO2: Perform convolution operations on given sequences to determine the response of linear time-invariant (LTI) systems.

CO3: Interpret and analyze signals using frequency domain representation to uncover their spectral characteristics.

CO4: Solve and analyze difference equations to evaluate the behavior and response of discrete-time systems.

CO5: Apply the principles of frequency domain sampling to reconstruct signals and avoid aliasing.

Practical Examination Conduction:

SEE Assessment:

1. Students will be given two experiments for their write-up.

2. Students need to conduct one of the two experiments given.

3. 15% of total marks are allotted for writeup, 70% of total marks are given to the conduction of experiment and remaining 15% of total marks will be given to Viva-Voce.
CIE Assessment:
1. One test will be conducted at the end of the semester of 15 marks out of total marks 50.
2. The remaining 35 marks are given to oveall conduction of an experiments by the students and also to the Observation/Assignment book.
Graduate Attributes (As per NBA)
Engineering Knowledge, Problem Analysis, Individual and Team work, Communication.
Conduct of Practical Examination:
1. Laboratory experiments are to be included for practical examination.
2. Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners.
3. Students can pick one experiment from the questions lot prepared by the examiners.
4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

3																
Course Name:		SIGNALS AND SYSTEMS LABORATORY														
Course Code:		22EEL56														
Sl. No.	**CO\PO**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**	**PSO3**
1	**CO1**	3	3	1	1	3				3	3		1		3	
2	**CO2**	3	3	1	1	3				3	3		1		3	
3	**CO3**	3	3	1	1	3				3	3		1		3	
4	**CO4**	3	3	1	1	1				3	3		1		3	
5	**CO5**	3	3	1	1	3				3	3		1		3	
	Average	3	3	1	1	2.6				3	3		1		3	

Course Title:	POWER ELECTRONICS LABORATORY		
	[As per NEP 2020, Outcome Based Education (OBE) and Choice Based Credit System (CBCS) Scheme]		
Course Code:	**22EEL57**	**CIE Marks:**	50
Semester:	**5**	**SEE Marks:**	50
Course Type	Practical	**Total Marks:**	100
Teaching Hours/Week	0:0:2:0	**Exam Hours:**	3
Total Hours of Pedagogy:	24 hours	**Credits:**	1

Course Objectives: This Course will enable the students to:

1	Conduct experiments on diode clipping,clamping and also to obtain the static characteristics of semiconductor devices .
2	Study different methods of triggering SCR
3	Study the performance of single phase controlled full wave rectifier and AC voltage controller with R and RL loads
4	Understand to control the speed of stepper motor.
5	Study single phase full wave bridge inverter connected to resistive load.

Sl. No	Experiments
1	Study of Diode Clipping and Clamping circuits.
2	Single Phase Half wave and Full wave rectifier.
3	Static Characteristics of SCR.
4	Static Characteristic of TRIAC.
5	Static Characteristics of MOSFET.
6	Static Characteristics of IGBT.
7	SCR turn on circuit using synchronized UJT relaxation oscillator.
8	AC voltage controller using TRIAC and DIAC combination connected to R and RL loads.
9	Speed control of stepper motor.
10	Speed control of a separately excited D.C. Motor using an IGBT or MOSFET chopper.

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

CO1: Conduct experiments on semiconductor devices to obtain their static characteristics.

CO2: Conduct experiments for the triggering of SCR.

CO3: Perform experiments on single phase controlled full wave rectifier and AC voltage controller with R and RL loads.

CO4: Control the speed of a DC Motor and Stepper motors.

CO5: Perform experiment on single phase full bridge inverter connected to resistive load.

Practical Examination Conduction:

SEE Assessment:

1. Students will be given two experiments for their write-up.
2. Students need to conduct one of the two experiments given.
3. 15% of total marks are allotted for writeup, 70% of total marks are given to the conduction of experiment and remaining 15% of total marks will be given to Viva-Voce.

CIE Assessment:
1. One test will be conducted at the end of the semester of 15 marks out of total marks 50.
2. The remaining 35 marks are given to oveall conduction of an experiments by the students and also to the Observation/Assignment book.
Graduate Attributes (As per NBA)
Engineering Knowledge, Problem Analysis, Individual and Team work, Communication.
Conduct of Practical Examination:
1. Laboratory experiments are to be included for practical examination.
2. Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners.
3. Students can pick one experiment from the questions lot prepared by the examiners.
4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

COURSE OUTCOME AND PROGRAM OUTCOME MAPPING																
Course Name:		**POWER ELECTRONICS LABORATORY**														
Course Code:		**22EEL57**														
Sl. No.	**CO\PO**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**	**PSO3**
1	**CO1**	3	2				1			3	3		1		3	
2	**CO2**	3	2	2	2	1	1			3	3		1		3	
3	**CO3**	3	3	3	2	1	1			3	3		1		3	
4	**CO4**	3	3	3	2	1	1			3	3		1		3	
5	**CO5**	3	3	3	2	1	1			3	3		1		3	
	Average	3	2.6	2.6	2	1	1			3	3		1		3	

Course Title:	SWITCHGEAR AND PROTECTION LAB		
	[As per NEP 2020, Outcome Based Education (OBE) and Choice		
Course Code:	**22EEL581**	**CIE Marks:**	50
Semester:	**5**	**SEE Marks:**	50
Course Type	Practical	**Total Marks:**	100
Teaching Hours/Week	0:0:2:0	**Exam Hours:**	3
Total Hours of Pedagogy:	24 hours	**Credits:**	1

Course Objectives: This Course will enable the students to:	
1	Conduct an experiment to verify the characteristics of fuse.
2	Conduct experiments to verify the characteristics of various electromagnetic relays.
3	Conduct experiments to verify the characteristics of static relays.
4	Conduct experiments to verify the characteristics of microprocessor based over current, over voltage, under voltage relays.
5	Conduct experiments on transformer, motor and feeder protection.

Sl. No.	Experiments
1	Current-time characteristics offuse.
2	IDMT non-directional characteristics over current relay.
3	Directional over currentrelay
4	IDMT characteristics of over voltage relay.
5	IDMT characteristics of undervoltage relay.
6	Operation of negative sequencerelay.
7	Operating characteristics of microprocessor based (numeric) over –currentrelay.
8	Operating characteristics of microprocessor based (numeric) over/under voltagerelay.
9	To study the characteristics of the operation of Buchholzrelay
10	Feeder protection scheme-faultstudies.
11	Motor protection scheme-faultstudies.

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

CO1: Analyze and evaluate the operating characteristics of fuses under fault conditions.

CO2: Test and interpret the operating characteristics of electromagnetic relays to ensure proper fault detection and protection.

CO3: Examine and validate the characteristics and operational behavior of static relays under different fault scenarios.

CO4:Test and assess the performance of microprocessor-based relays for overcurrent, overvoltage, and undervoltage protection.

CO5: Conduct experiments to implement protection schemes for transformers, motors, and feeders under fault conditions.

Practical Examination Conduction:

SEE Assessment:

1. Students will be given two experiments for their write-up.
2. Students need to conduct one of the two experiments given.

3. 15% of total marks are allotted for writeup, 70% of total marks are given to the conduction of experiment and remaining 15% of total marks will be given to Viva-Voce.
CIE Assessment: 1. One test will be conducted at the end of the semester of 15 marks out of total marks 50. 2. The remaining 35 marks are given to oveall conduction of an experiments by the students and also to the Observation/Assignment book.
Graduate Attributes (As per NBA) Engineering Knowledge, Problem Analysis, Individual and Team work, Communication.
Conduct of Practical Examination: 1. Laboratory experiments are to be included for practical examination. 2. Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners. 3. Students can pick one experiment from the questions lot prepared by the examiners. 4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

COURSE OUTCOME AND PROGRAM OUTCOME MAPPING																
Course Name:		SWITCH GEAR AND PROTECTION LAB														
Course Code:		22EEL581														
Sl. No.	CO\PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1	CO1	3	1	1	1		1			3	3		1		3	
2	CO2	3	3	1	1		1			3	3		1		3	
3	CO3	3		1	1		1			3	3		1		3	
4	CO4	3		1	1	3	1			3	3		1		3	
5	CO5	3		1	1		1			3	3		1		3	
	Average	3	2	1	1	3	1			3	3		1		3	

Course Title:	ARM CORTEX M3 & EMBEDDED SYSTEM LAB			
	[As per NEP 2020, Outcome Based Education (OBE) and Choice Based Credit System (CBCS) Scheme]			
Course Code:	**22EEL582**	**CIE Marks:**	50	
Semester:	**5**	**SEE Marks:**	50	
Course Type (Theory/Practical/I	Practical	**Total Marks:**	100	
Teaching Hours/Week	0:0:2:0	**Exam Hours:**	3	
Total Hours of Peda	24 hours	**Credits:**	1	

Course Objectives: This Course will enable the students to:

1	Understand the instruction set of ARM Cortex M3, a 32 bit microcontroller and the software tool required for prograı
2	Understand to Program ARM Cortex M3 using the various instructions in assembly level language for different applications
3	Understand Interfacing external devices and I/O with ARM Cortex M3
4	Understand C language programs and library functions for embedded system applications.
5	Understand to control the speed of a DC motor using interfacing.

Sl. N	**Experiments**
	PART-A: Conduct the following Study experiments to learn ALP using ARM
	Cortex M3 Registers using an Evaluation board and the required software tool.
1	ALP to multiply two 16 bit binary numbers.
2	ALP to find the sum of first 10 integer numbers.
	PART-B: Conduct the following experiments on an ARM CORTEX M3 evaluation board using
	evaluation version of Embedded 'C' & Keil uVision-4 tool/compiler.
1	Display ―Hello World‖ message using Internal UART
2	Interface and Control a DC Motor.
3	Interface a Stepper motor and rotate it in clockwise and anti-clockwise direction.
4	Interface a DAC and generate Triangular and Square waveforms.
5	Interface a 4x4 keyboard and display the key code on an LCD.
6	Using the Internal PWM module of ARM controller generate PWM and vary its duty cycle.
7	Demonstrate the use of an external interrupt to toggle an LED On/Off.
8	Display the Hex digits 0 to F on a 7-segment LED interface, with an appropriate delay in between.
9	Interface a simple Switch and display its status through Relay, Buzzer and LED.
10	Measure Ambient temperature using a sensor and SPI ADC IC.

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

CO1: Develop programs for a 32 bit microcontroller and the software tool required for programming in Assembly and C language

CO2: Program ARM Cortex M3 using the various instructions in assembly level language for different applications

CO3: Interface external devices and I/O with ARM Cortex M3

CO4: Develop C language programs and library functions for embedded system applications.

COURSE OUTCOME AND PROGRAM OUTCOME MAPPING																
Course Name:		**ARM CORTEX AND EMBEDDED SYSTEMS LAB**														
Course Code:		**22EE582**														
Sl. No.	**CO\PO**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**	**PSO3**
1	**CO1**	3	1	3		3	2			3	3		1		3	
2	**CO2**	3	1	3		3	2			3	3		1		3	
3	**CO3**	3	1	3		3	2			3	3		1		3	
4	**CO4**	3	1	3		3	2			3	3		1		3	
5	**CO5**	3	1	3		3	2			3	3		1		3	
	Average	3	1	3		3	2			3	3		1		3	

Course Title:	PROJECT-IV		
	[As per NEP 2020, Outcome Based Education (OBE) and Choice Based Credit System (CBCS) Scheme]		
Course Code:	**22PRJ59**	**CIE Marks:**	50
Semester:	**4**	**SEE Marks:**	50
Course Type (Theory/Practical/Integrated):	Integrated	**Total Marks:**	100
Teaching Hours/Week (L:T:P:S):	0:1:1:0	**Exam Hours:**	3
Total Hours of Pedagogy:	24	**Credits:**	1

Course Objectives: The goal of the course Project III (22PRJ49)is to

1. Get exposure about the Electrical & Electronics hardware and various software tools.
2. Design the working model of the open ended problem.
3. Understand the Electrical and Electronics concepts.
4. Understand the latest technology trends in the electrcial system.
5. Prepare technical documentation of the project.

STUDENTS WILL BE GIVEN A OPEN ENDED PROBLEM OF THE SOCIETY AND ASKED TO SOLVE BY DESIGNING AND IMPLEMENTING THE SYSTEM IN A TEAM.

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

CO1: Apply the knowledge of electrical and electronics hardware and software components to solve the real time problems of the society

CO2: Analyze the various existing solutions available to solve the real time problem and propose the best solution

CO3: Design and implement the system to solve the real time problem of the society

CO4: Conduct investigations on the output and prepare the technical documentation of the designed /system in a team

CO5: Use the modern tool available like advanced hardware and software tools

Conduction of Assessment:

SEE and CIE Assessment

SEE Assessment: The SEE for the Project shall be evaluated by two examiners jointly and the evaluation shall be based on various components such as, Project work 50% of the maximum marks, Presentation 30 % of the maximum marks, and viva-voce 20% of the maximum marks.

CIE Assessment: Design and fabrication of the project -50% of the maximum marks, Evaluation of project report by the department-30% of the maximum marks , and Mock evaluation/ Presentation20% of the maximum marks.

COURSE OUTCOME AND PROGRAM OUTCOME MAPPING																
Course Name:		**PROJECT V**														
Course Code:		**22PRJ59**														
Sl. No.	**CO\PO**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**	**PSO3**
1	**CO1**	3											2	3	2	
2	**CO2**		3										2	3	3	
3	**CO3**			3			3						2	3	3	
4	**CO4**				3		3	3	3	3	3	3	3	3	3	
5	**CO5**					3							2			
	Average	3	3	3	3	3	3	3	3	3	3	3	2	3	3	

Course Title:	SIMULATION OF POWER ELECTRONICS (Abilility Enhacement Course) [As per NEP 2020, Outcome Based Education (OBE) and Choice Based Credit System (CBCS) Scheme]		
Course Code:	**22AECEE510A**	**CIE Marks:**	50
Semester:	**5**	**SEE Marks:**	50
Course Type	Practical	**Total Marks:**	100
Teaching Hours/Week	0:0:2:0	**Exam Hours:**	3
Total Hours of Pedagogy:	24 hours	**Credits:**	1

Course Objectives: This Course will enable the students to:

1. Understand the fundamental principles of power electronic circuits and their applications in various electrical systems.
2. Understand the simulation tools such as MATLAB/Simulink or SPICE or SCILAB for modeling and simulating power electronic circuits.
3. Understand the dynamic behavior and performance characteristics of different power electronic components and circuits.
4. Understand the design and optimizing power electronic circuits for specific applications, considering factors such as efficiency, stability and reliability.
5. Understand to interpret simulation results, identify design flaws and propose improvements to enhance the performance of power electronic systems.

Sl. No.	EXPERIMENTS
1	Uncontrolled 1-phase Half wave rectifier with R load.
2	Uncontrolled 1-phase Full wave rectifier with R load.
3	Uncontrolled 3-phase Half wave rectifier with R load.
4	Uncontrolled 3-phase Full wave rectifier with R load.
5	Single phase controlled half wave rectifier with R load.
6	Single phase controlled full wave rectifier with R load.
7	Three phase controlled half wave rectifier with R load.
8	Three phase controlled full wave rectifier with R load.
9	Step Down chopper with R load.
10	Step Up chopper with R load.

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

CO1: Simulate a power electronic circuits to obtain a single phase rectifier with R Load.

CO2: Simulate a power electronic circuits to obtain a three phase rectifier with R Load.

CO3: Simulate a power electronic circuits to obtain single phase controlled rectifier with R Load.

CO4: Simulate a power electronic circuits to obtain three phase controlled rectifier with R Load.

CO5: Simulate a power electronic circuits to obtain step down/ step up, chopper with R Load.

Question Paper Pattern:

SEE Assessment:

1	The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2	The question paper will have ten full questions carrying 20 marks each.
3	There will be two full questions (with a maximum of four sub questions) from each module.
4	Each full question will have sub questions covering all the topics of the module.
5	Students have to answer any Five Full questions, choosing at least one full question from each module
CIE Assessment:	
1	Three tests will be conducted each of 15 marks, average of best of two tests will be considered
2	Session wise Assignment will be 35 Marks

COURSE OUTCOME AND PROGRAM OUTCOME MAPPING																
Course Name:		SIMULATION OF POWER ELECTRONIC CIRCUITS														
Course Code:		22AECEE510A														
Sl. No.	**CO\PO**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**	**PSO3**
1	**CO1**	3	3			3	1			3	3		1		3	
2	**CO2**	3	3			3	1			3	3		1		3	
3	**CO3**	3	3	3	3	3	1			3	3		1		3	
4	**CO4**	3	3	3	3	3	1	3	3	3	3		1		3	
5	**CO5**	3	3		3	3	1	3	3	3	3		1		3	
	Average	3	3	3	3	3	1	3	3	3	3		1		3	

Course Title:	CIRCUIT DESIGN AND SIMULATION (Abilility Enhacement Course) [As per NEP 2020, Outcome Based Education (OBE) and Choice Based Credit System (CBCS) Scheme]		
Course Code:	**22AECEE510B**	**CIE Marks:**	50
Semester:	**5**	**SEE Marks:**	50
Course Type	Practical	**Total Marks:**	100
Teaching Hours/Week	0:0:2:0	**Exam Hours:**	3
Total Hours of Pedagogy:	24 hours	**Credits:**	1

Course Objectives: This Course will enable the students to:

1. Understand the simulation of a DC circuit and analyse using Nodal analysis .
2. Understand the simulation of a DC circuit and determine its Thevenin's equivalent circuit.
3. Understand the simulation of a RLC circuit and determine its transient analysis for various inputs.
4. Understand the simulation of a DC circuit and apply Maximum power transfer theorem and Reciprocity theorem.
5. Understand the simulation of a AC circuit.

Sl. No.	EXPERIMENTS
1	Simulation of nodal analysis for dc circuits
2	Simulation of d.c. circuit for determining thevinin's equivalent circuit.
3	Simulation of d.c. network with sub circuit
4	Simulation of transient analysis of series RLC circuit using step and pulse inputs
5	Simulation of transient analysis of series RLC circuit using sinusoidal input
6	Analysis of three phase circuit representing generator transmission line and load
7	Simulation of maximum power transfer theorem for dc circuits
8	Simulation of reciprocity theorem for dc circuits
9	Simulation of superposition theorem for dc circuits
10	Simulation of ac circuits.

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

CO1: Simulate a DC circuit and analyse using Nodal analysis .

CO2: Simulate a DC circuit and determine its Thevenin's equivalent circuit.

CO3: Simulate a RLC circuit and determine its transient analysis for various inputs.

CO4: Smulate of a DC circuit and apply Maximum power transfer theorem and Reciprocity theorem.

CO5: Simulate an AC circuit.

Question Paper Pattern:

SEE Assessment:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying 20 marks each.
3. There will be two full questions (with a maximum of four sub questions) from each module.

4	Each full question will have sub questions covering all the topics of the module.
5	Students have to answer any Five Full questions, choosing at least one full question from each module
CIE Assessment:	
1	Three tests will be conducted each of 15 marks, average of best of two tests will be considered
2	Session wise Assignment will be 35 Marks

COURSE OUTCOME AND PROGRAM OUTCOME MAPPING																
Course Name:		CIRCUIT DESIGN AND SIMULATION														
Course Code:		22AECEE510B														
Sl. No.	**CO\PO**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**	**PSO3**
1	**CO1**	3	3			3	1			3	3		1		3	
2	**CO2**	3	3			3	1			3	3		1		3	
3	**CO3**	3	3	3	3	3	1			3	3		1		3	
4	**CO4**	3	3	3	3	3	1	3	3	3	3		1		3	
5	**CO5**	3	3		3	3	1	3	3	3	3		1		3	
	Average	3	3	3	3	3	1	3	3	3	3		1		3	

Course Title:	MICROCONTROLLER & ITS APPLICATIONS [As per NEP 2020, Outcome Based Education (OBE) and Choice Based Credit System (CBCS) Scheme]		
Course Code:	**22EE61**	**CIE Marks:**	50
Semester:	**6**	**SEE Marks:**	50
Course Type	Theory	**Total Marks:**	100
Teaching Hours/Week	3:0:0:0	**Exam Hours:**	3
Total Hours of Pedagogy	40 hours	**Credits:**	3

Course Objectives: This Course will enable the students to:

1. Understand the basics of 8051 Microcontroller, Embedded systems and architecture of 8051 microcontroller.
2. Understand the instructions of 8051 microcontroller and also to write programs.
3. Understand the execution of 8051 C programming and also the usage of timers.
4. Understand the serial port and Interrupt programming in assembly and 8051 C.
5. Learn the interfacing of various devices with 8051 Microcontroller.

Module-1 **8 hours L1, L2, L3**

8051 Microcontroller Basics: Introduction to 8051, Microcontrollers versus Embedded Processors, 8051 Architecture- Oscillator and Clock, PSW and Flag Bits, 8051 Register Banks and Stack, Pins Of 8051, Internal Memory Organization of 8051, IO Port Usage in 8051, Types of Special Function Registers and their uses in 8051. Memory Address Decoding, 8031/51 Interfacing with External ROM And RAM.

Module-2 **8 hours L1, L2, L3**

Assembly Programming and Instruction Sets of 8051: Introduction to 8051 assembly programming, 8051 Addressing Modes, Assembling and running an 8051 program, Data types and Assembler directives, Data Transfer Instructions, Logical Instructions, Arithmetic Instructions, Jump Loop & Call Instruction, Assembly language programming using Jump, Loop, Call, Arithmetical and Logical Instructions, IO port programming.

Module-3 **8 hours L1, L2, L3**

8051 Programming in C: Data types and time delay in 8051C, IO programming in 8051C, Logic operations in 8051 C, Data conversion program in 8051 C, Accessing code ROM space in 8051C, Data serialization using 8051C.
8051 Timer Programming in C: Programming 8051 timers, Counter programming, Programming timers 0 and 1 in 8051 C.

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

8051 Serial Port Programming in C: Basics of serial communication, 8051 connection to RS232, 8051 serial port programming in assembly, serial port programming in 8051 C.
8051 Interrupt Programming in C: 8051 interrupts, Programming timer interrupts, Programming the external hardware, Programming the serial communication interrupt, Interrupt priority in 8051/52, Interrupt programming in C.

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

Interfacing: LCD interfacing, Keyboard interfacing.
ADC, DAC and Sensor Interfacing: ADC 0808 interfacing to 8051, Serial ADC Max1112 ADC interfacing to 8051, DAC interfacing.
Motor Control: Relay, PWM, DC and Stepper Motor: Relays and optisolators, stepper motor interfacing, DC motor interfacing and PWM.
8051 Interfacing with 8255: Programming the 8255, 8255 interfacing, C programming for 8255.

Course Outcomes: At the end of the course the student will be able to:
CO1: Understand and explain the architecture, instruction set, and basic operation of the 8051 Microcontroller.
CO2: Write, execute, and debug assembly language programs for the 8051 Microcontroller to perform specific tasks.

CO3:	Develop and implement programs for timers and counters using C programming for the 8051 Microcontroller.
CO4:	Design and implement programs to handle serial communication and interrupts using C programming for the 8051 Microcontroller.
CO5:	Interface peripheral devices (e.g., LEDs, LCDs, motors, sensors) with the 8051 Microcontroller to develop embedded system applications.

Question Paper Pattern:

SEE Assessment:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying 20 marks each.
3. There will be two full questions (with a maximum of four sub questions) from each module.
4. Each full question will have sub questions covering all the topics of the module.
5. Students have to answer any Five Full questions, choosing at least one full question from each module

CIE Assessment:

1. Three tests will be conducted each of 15 marks, average of best of two tests will be considered
2. Session wise Assignment will be 35 Marks

Text Books:

1. The 8051 Microcontroller and Embedded Systems Using Assembly and C, Muhammad Ali Mazadi Pearson 2 nd Edition,

Reference Books:

1. The 8051 Microcontroller, Kenneth Ayala Cengage Learning 3 rd Edition,2005.
2. The 8051 Microcontroller and Embedded Systems, Manish K Patel McGraw Hill2014.
3. Microcontrollers: Architecture, Programming, Interfacing and System Design, Raj Kamal Pearson 1 st Edition, 2012.

COURSE OUTCOME AND PROGRAM OUTCOME MAPPING																
Course Name:		MICROCONTROLLER & ITS APPLICATIONS														
Course Code:		22EE61														
Sl. No.	**CO\PO**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**	**PSO3**
1	**CO1**	3	2	1		3	2						2	3		
2	**CO2**	3	3	3	1	3	2						2	3		
3	**CO3**	3	3	3	1	3	2						2	3		
4	**CO4**	3	3	3	1	3	2						2	3		
5	**CO5**	3	3	3	3	3	2						2	3		
	Average	3	2.8	2.6	1.5	3	2						2	3		

Course Title:	POWER SYSTEM ANALYSIS-1		
	[As per NEP 2020, Outcome Based Education (OBE) and Choice Based Credit System (CBCS) Scheme]		
Course Code:	**22EE62**	**CIE Marks:**	50
Semester:	**6**	**SEE Marks:**	50
Course Type (Theory/Practical/Integrated):	Theory	**Total Marks:**	100
Teaching Hours/Week (L:T:P:S):	3:1:0:0	**Exam Hours:**	3
Total Hours of Pedagogy:	50 hours	**Credits:**	4

Course Objectives: This Course will enable the students to :

Understand the power system components and construction of per unit impedance diagram.

Understand various three phase symmetrical faults on power system.

Understand the various unsymmetrical faults on power system.

Understand computation of unbalanced phases in terms of sequence components and develop sequence networks.

Understand the dynamics of synchronous machine and determine the power system stability.

Module-1 **10 hours L1, L2**

Representation of Power System Components:

Introduction, Circuit models of power system components, One-Line diagram,Impedance and Reactance diagram, Per Unit (PU) System, Advantages of per unit computations, per unit Impedance and Reactance diagram.

Module-2 **10 hours L1, L2**

Symmetrical three phase faults:

Introduction, Transient on a Transmission Line due to short circuit, Symmetrical short circuit of a Synchronous generator, analysis of three phase symmetrical faults, Selection of Circuit Breakers,concept of short circuit capacity of a bus.

Module-3 **10 hours L1, L2,L3**

Symmetrical Components:

Introduction, resolution of unbalanced phasors into symmetrical components, expression for phase voltages in terms of syr components and vice versa, Complex power in terms of symmetrical components, sequence impedance of symmetrical and unsymmetrical circuits. Sequence impedances and networks of Synchronous generator, three phase transformer and transmission lines. Construction of sequence networks of a power system.

Module-4 **10 hours L1, L2,L3**

Unsymmetrical Fault Analysis:

Introduction, Fault calculations of synchronous generator, faults through impedance, unsymmetrical faults on power system, series type of faults.

Module-5 **10 hours L1, L2,L3**

Power System Stability:

Introduction, Dynamics of a Synchronous Machine, Power Angle Equations of Salient and Non – Salient pole Synchronous Machines, Steady State Stability, Transient Stability, Equal Area Criterion,Factors Affecting Transient Stabi

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

CO1: Model the power system components and construct per unit impedance diagram of power system.

CO2: Analyze three phase symmetrical faults on power system.

CO3: Compute unbalanced phases in terms of sequence components and develop sequence networks.

CO4: Analyze various unsymmetrical faults on power system.

CO5: Analyze the dynamics of synchronous machine and determine the power system stability.

Question Paper Pattern:

SEE Assessment:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying 20 marks each.
3. There will be two full questions (with a maximum of four sub questions) from each module.
4. Each full question will have sub questions covering all the topics of the module.
5. Students have to answer any Five Full questions, choosing at least one full question from each module

CIE Assessment:

1. Three tests will be conducted each of 15 marks, average of best of two tests will be considered
2. Session wise Assignment will be 25 Marks, Seminar & Library Work 5 Marks and Attendance 5 Marks

Text Books:

1. Elements of Power System, William D. Stevenson Jr, McGraw Hill, 4th Edition, 1982.

Reference Books:

1. Modern Power System, D. P. Kothari, McGraw Hill, 4th Edition, 2011.
2. Power System Analysis and Design, J. Duncan Glover et al, Cengage, 4th Edition, 2008.
3. Power System Analysis, Hadi Sadat, McGraw Hill, 1st Edition, 2002.

COURSE NAME		POWER SYSTEM ANLALYSIS-1														
COURSE CODE		22EE62														
SL NO	PO/ CO	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1	CO1	3	3	2	1								1	3		
2	CO2	3	3	3	1								1	3		
3	CO3	3	3	3	1								1	3		
4	CO4	3	3	3	1								1	3		
5	CO5	3	3	3	1								1	3		
	AVERAG	3	3	2.8	1								1	3		

Course Title:	ELECTRICAL MACHINE DESIGN (Core Elective) [As per NEP 2020, Outcome Based Education (OBE) and Choice Based Credit System (CBCS) Scheme]		
Course Code:	**22EE631**	**CIE Marks:**	50
Semester:	**6**	**SEE Marks:**	50
Course Type	Theory	**Total Marks:**	100
Teaching Hours/Week	3:0:0:0	**Exam Hours:**	3
Total Hours of Pedagogy	40 hours	**Credits:**	3

Course Objectives: This Course will enable the students to:

1	Understand the design factors and modern trends in design of electrical machine and also about conducting, Ferromagnetic and insulating materials used in the machine design.
2	Understand the design of field and armature of a DC machine
3	Understand the design of both single phase and three phase transformers.
4	Understand the design of three phase slip ring and squirrel cage induction motors.
5	Understand the design of Salient pole and non-salient pole types of Three Phase Synchronous Machines

Module-1 **8 hours L1, L2,L3**

Fundamental Aspects of Electrical Machine Design: Design of Machines, Design Factors, Limitations in design, Modern Trends in design, manufacturing Techniques.

Electrical Engineering Materials: Desirabilities of Conducting Materials, Comparison of Aluminium and Copper wires. Ferromagnetic Materials: Soft Magnetic materials – Solid Core Materials, Electrical Sheet and Strip, Cold Rolled Grain Oriented Steel. Insulating Materials: Desirable Properties, Temperature Rise and Insulating Materials, Classification of Insulating materials based on Thermal Consideration.

Module-2 **8 hours L1, L2,L3**

Design of DC Machines: Output Equation, Choice of Specific Loadings and Choice of Number of Poles, Main Dimensions of armature, Design of Armature Slot Dimensions, Commutator and Brushes. Estimation of Ampere Turns for the Magnetic Circuit. Dimensions of Yoke, Main Pole and Air Gap. Design of Shunt and Series Field Windings.

Module-3 **8 hours L1, L2,L3**

Design of Transformers: Output Equations of Single Phase and Three Phase Transformers, Choice of Specific Loadings, Expression for Volts/Turn, Determination of Main Dimensions of the Core, Estimation of Number of Turns and Conductor Cross Sectional area of Primary and Secondary Windings. Design of Tank and Cooling (Round and Rectangular) Tubes.

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

Design of Three Phase Induction Motors: Output Equation, Choice of Specific Loadings, Main Dimensions of Stator. Design of stator slots and Winding, Choice of Length of Air Gap, Estimation of Number of Slots for Squirrel Cage Rotor. Design of Rotor Bars and End Rings. Design of Slip Ring rotor. Estimation of No Load Current and Leakage Reactance.

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

Design of Three Phase Synchronous Machines: Output Equation, Choice of Specific Loadings, Short Circuit Ratio, Main Dimensions of Stator. Design of stator slots and Winding. Design of Salient and non- salient Pole Rotors. Magnetic Circuit and Field Winding.

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

CO1:	Explain the factors and modern trends in the design of an electrical machine and also about conducting,
CO2:	Design field and armature of a DC machine
CO3:	Design both single phase and three phase transformers.

CO4:	Design three phase slip ring and squirrel cage induction motors.
CO5:	Design Salient pole and non-salient pole types of Three Phase Synchronous Machines
Question Paper Pattern:	
SEE Assessment:	
1	The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2	The question paper will have ten full questions carrying 20 marks each.
3	There will be two full questions (with a maximum of four sub questions) from each module.
4	Each full question will have sub questions covering all the topics of the module.
5	Students have to answer any Five Full questions, choosing at least one full question from each module
CIE Assessment:	
1	Three tests will be conducted each of 15 marks, average of best of two tests will be considered
2	Session wise Assignment will be 35 Marks
Text Books:	
1	A course in Electrical Machine , A.K.Sawhney , DhanpatRai , 6th Edition, 2013.
Reference Books:	
1	Performance and Design of Alternating Current Machines, M.G. Say, CBS Publisher, 3rd Edition, 2002
2	Design Data Handbook, A. Sanmugasundaram Et al , New Age International, 1st Edition, 2011.

COURSE OUTCOME AND PROGRAM OUTCOME MAPPING																
Course Name:		ELECTRICAL MACHINE DESIGN														
Course Code:		22EE631														
Sl. No.	**CO\PO**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**	**PSO3**
1	**CO1**	3											2	3		
2	**CO2**	3	3	3	3								2	3		
3	**CO3**	3	3	3	3								2	3		
4	**CO4**	3	3	3	3								2	3		
5	**CO5**	3	3	3	3								2	3		
	Average	3	3	3	3								2	3		

Course Title:	LINEAR INTEGRATED CIRCUITS		
	[As per NEP 2020, Outcome Based Education (OBE) and Choice Based Credit System (CBCS) Scheme]		
Course Code:	**22EE632**	**CIE Marks:**	50
Semester:	**6**	**SEE Marks:**	50
Course Type (Theory/Practical/Integrated):	Theory	**Total Marks:**	100
Teaching Hours/Week (L:T:P:S):	3:0:0:0	**Exam Hours:**	3
Total Hours of Pedagogy:	40 hours	**Credits:**	3

Course Objectives: This Course will enable the students to understand:

1. The basics of Linear ICs such as Op-amp.
2. The design of various circuits using linear ICs.
3. The applications of linear ICs.
4. The concept of various types of converters.
5. The basics of PLL and Timer.

Module-1 **08 hours L1, L2,L3**

Operational Amplifiers: Introduction, Block diagram representation of a typical Op-amp, schematic symbol, characteristics of an Op-amp, ideal op-amp, equivalent circuit, ideal voltage transfer curve, open loop configuration, differential amplifier, inverting & non –inverting amplifier, Op-amp with negative feedback(excluding derivations).

General Linear Applications: A.C. amplifier, summing, scaling & averaging amplifier, inverting and non-inverting configuration, Instrumentation amplifier.

Module-2 **08 hours L1, L2,08**

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 & LM337 Integrated circuits regulators.

Module-3 **08 hours L1, L2,L3**

Signal Generators: Triangular / rectangular wave generator, phase shift oscillator, saw tooth oscillator.

Comparators & Converters: Basic comparator, zero crossing detector, inverting and 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.

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

Signal processing circuits: Precision half wave and full wave rectifiers.
A/D & D/A Converters: Basics, R–2R D/A Converter, Integrated circuit 8-bit D/A, successive approximation ADC, linear ramp ADC

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

Phase Locked Loop (PLL): Basic PLL, components, performance factors.

Timer: Internal architecture of 555 timer, Mono stable multivibrators and applications.

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

CO1: Analyze the characteristics of ideal and practical operational amplifier.
CO2: Design filters and signal generators using linear ICs.
CO3: Design and implement comparators and converters using Linear IC's.

CO4: Design and implement rectifiers, A/D and D/A converters.
CO5: Analyze the performance of PLL and various timers.
Question Paper Pattern:
SEE Assessment:
1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying 20 marks each.
3. There will be two full questions (with a maximum of four sub questions) from each module.
4. Each full question will have sub questions covering all the topics of the module.
5. Students have to answer any Five Full questions, choosing at least one full question from each module
CIE Assessment:
1. Three tests will be conducted each of 15 marks, average of best of two tests will be considered
2. Session wise Assignment will be 35 Marks.
Text Books:
1. Op-Amps and Linear Integrated Circuits by Ramakant A Gayakwad, Pearson, 4thEdition 2015.
Reference Books:
1. Operational Amplifiers and Linear ICs, David A. Bell, Oxford, 3rd Edition 2011.
2. Linear Integrated Circuits; Analysis, Design and applications, B. Somanthan Nair, Wiley India, 1st Edition, 2009.
3. Linear Integrated Circuits, S. Salivahanan, et al, McGraw Hill, 2nd Edition,2014.
4. Operational Amplifiers and Linear Integrated Circuits, K. Lal Kishore, Pearson, 1st Edition, 2012

COURSE OUTCOME AND PROGRAM OUTCOME MAPPING																
Course Name:		**LINEAR INTEGRATED CIRCUITS**														
Course Code:		**22EE632**														
Sl. No.	**CO\PO**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**	**PSO3**
1	**CO1**	3											1	3		
2	**CO2**	3	3	3			1						1	3		
3	**CO3**	3	3	3			1						1	3		
4	**CO4**	3	3	3			1						1	3		
5	**CO5**	3	2				1						1	3		
	Average	3	2.75	3			1						1	3		

Course Title:	DIGITAL SIGNAL PROCESSING		
	[As per NEP 2020, Outcome Based Education (OBE) and Choice Based Credit System (CBCS) Scheme]		
Course Code:	**22EE641**	**CIE Marks:**	50
Semester:	**6**	**SEE Marks:**	50
Course Type (Theory/Practical/Integrated):	Theory	**Total Marks:**	100
Teaching Hours/Week (L:T:P:S):	3:0:0:0	**Exam Hours:**	3
Total Hours of Pedagogy:	40 hours	**Credits:**	3

Course Objectives: This Course will enable the students to:

1. Understand the fundamentals of Discrete Fourier transform.
2. Understand the algorithms of fast Fourier transform.
3. Understand the design of analog Butterworth & Chebyshev IIR filters
4. Understand the design of digital IIR filters .
5. Understand the design of FIR filters and also implementation of Discrete time systems.

Module-1 **8 hours L1,L2,L3**

Discrete Fourier Transforms: Definitions, properties-linearity, shift, symmetry Properties- circular convolution – periodic convolution, use of tabular arrays, circular arrays, Stock ham's method, linear convolution – two finite duration sequence, one finite & one infinite duration, overlapadd and save methods.

Module-2 **8 hours L1, L2,L3**

Fast Fourier Transforms Algorithms: Introduction, decimation in time algorithm, first decomposition, number of computations, continuation of decomposition, number of multiplications, computational efficiency,decimation in frequency algorithms, Inverse radix – 2 algorithms.

Module-3 **8 hours L1, L2, L3**

Design of IIR Digital Filters: Introduction, impulse invariant transformation, bilinear transformations, All pole analog filters- Butterworth & Chebyshev filters, design of digital Butterworth filter by impulse invariant transformation and bilinear transformation, Frequencytransformations.

Module-4 **8 hours L1, L2, L6**

Design of IIR Digital Filters (Continued): Design of digital Chebyshev – type 1filter by impulse invariant transformation and bilinear transformation, Frequency transformations.

Realization of IIR digital systems: direct form, cascade form and parallel form, Ladder structuresforequal degree polynomial.

Module-5 **8 hours L1, L2, L6**

Design of FIR Digital Filters: Introduction, windowing, rectangular, modified rectangular. Hamming, Hanning, Blackman window, design of FIR digital filters by use of windows, Design of FIR digital filters- frequency sampling techniques.
Realization of FIR systems: direct form, cascade form, linear phase form

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

CO1: Understand and explain the fundamentals of the Discrete Fourier Transform (DFT) and its applications in signal analysis.

CO2: Analyze and implement Fast Fourier Transform (FFT) algorithms for efficient computation of the DFT.

CO3: Design and analyze analog Butterworth and Chebyshev IIR filters, and convert them into digital Butterworth filters for signal processing applications.

CO4: Design and implement digital Chebyshev IIR filters to meet specific frequency response requirements.

CO5: Design and realize FIR digital filters using windowing techniques and other advanced methods.

Question Paper Pattern:

SEE Assessment:
1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying 20 marks each.
3. There will be two full questions (with a maximum of four sub questions) from each module.
4. Each full question will have sub questions covering all the topics of the module.
5. Students have to answer any Five Full questions, choosing at least one full question from each module
CIE Assessment:
1. Three tests will be conducted each of 15 marks, average of best of two tests will be considered
2. Session wise Assignment will be 35 Marks
Text Books:
1.Introduction to Digital Signal Processing, Jhonny R. Jhonson, Pearson 1 st Edition, 2016.
2.Digital Signals Processing , Theory and Lab Practice , 2nd Edition , By Dr. D Ganesh Rao and Vineeta P Gejje.
Reference Books:
1.Digital Signal Processing – Principles, Algorithms, and Applications,Jhon G. Proakis Dimitris G. Manolakis,
2.Digital Signal Processing, A.NagoorKani, McGraw Hill, 2nd Edition, 2012.
3. Digital Signal Processing, Shaila D. Apte,Wiley, 2nd Edition, 2009.
4.Digital Signal Processing, Tarun Kumar Rawat, Oxford, 1st Edition, 2015.

COURSE OUTCOME AND PROGRAM OUTCOME MAPPING																
Course Name:		DIGITAL SIGNAL PROCESSING														
Course Code:		22EE641														
Sl. No.	**CO\PO**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**	**PSO3**
1	**CO1**	3	3	2	2	1	1						2	3		
2	**CO2**	3	3	2	2	1	1						2	3		
3	**CO3**	3	3	3	2	1	1						2	3		
4	**CO4**	3	3	3	2	1	1						2	3		
5	**CO5**	3	3	3	2	1	1						2	3		
	Average	3	3	2.6	2	1	1						2	3		

Course Title:	ENERGY AUDITING & DEMAND SIDE MANAGEMENT [As per NEP 2020, Outcome Based Education (OBE) and Choice Based Credit System (CBCS) Scheme]		
Course Code:	**22EE642**	**CIE Marks:**	50
Semester:	**6**	**SEE Marks:**	50
Course Type	Theory	**Total Marks:**	100
Teaching Hours/Week (L:T:P:S):	2:1:0:0	**Exam Hours:**	3
Total Hours of Pedagogy:	40 hours	**Credits:**	3

Course Objectives: This Course will enable the students to:	
1	Understand the current energy scenario and importance of energy conservation.
2	Understand the economic aspects related to energy and energy auditing.
3	Understand energy audit applied to new buidlings, elctricity and other commodities.
4	Understand optimization of electrical system and importance of power factor in electrical equipments .
5	Understand the scope of demand side management, its concept and implementation issues and strategies.

Module-1	**8 hours L1, L2**

INTRODUCTION: Energy situation – world and India, energy consumption, conservation, Codes,standards and Legislations.

Module-2	**8 hours L1, L2 ,L3**

ENERGY ECONOMIC ANALYSIS: The time value of money concept, developing cash flow models, payback analysis, depreciation, taxes and tax credit – numericals.

ENERGY AUDITING: Introduction, Elements of energy audits, energy use profiles, measurements in energy audits, presentation of energy audit results.

Module-3	**8 hours L1, L2**

ENERGY AUDIT APPLIED TO BUILDINGS: Energy – Saving Measures in New Buildings, Water Audit, Method of Audit, General Energy – Savings Tips Applicable to New as well as Existing Buildings.

ELECTRICITY vis-à-vis OTHER

COMMODITIES: Distinguishing features of electricity as a commodity, Four pillars of market design: Imbalance, Scheduling and Dispatch, Congestion Management, Ancillary Services. Framework of Indian power sector.

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

ELECTRICAL SYSTEM OPTIMIZATION: The power triangle, motor horsepower, power flow concept.

ELECTRICAL EQUIPMENT AND POWER FACTOR : Correction, improvement of power factor & location of capacitors, energy efficient motors, lighting basics, electrical tariff, Concept of ABT.

Module-5	**8 hours L1, L2**

DEMAND SIDE MANAGEMENT: Introduction to DSM, concept of DSM, benefits of DSM, different techniques of DSM - time of day pricing, multi-utility power exchange model, time of day models for planning, load management, load priority technique, peak clipping, peak shifting, valley filling, strategic conservation, energy efficient equipment. Management and Organization of Energy Conservation awareness Programs.

Course Outcomes: At the end of the course the student will be able to:	
CO1:	Analyze the energy scenario nationwide and worldwide , also outline Energy Conservation Act and its features.
CO2:	Analyze the economic aspects of energy and describe the methodology for conducting an effective energy audit.
CO3:	Describe the application of energy audits for new buildings, analyze electricity consumption and other commodities, and apply audit methodologies to enhance energy efficiency.

CO4:	Analyze the optimization of electrical systems and apply correction techniques to improve efficiency and reduce losses.
CO5:	Describe demand-side management strategies and energy consumption patterns and apply energy conservation techniques for improved efficiency and sustainability.

Question Paper Pattern:	
SEE Assessment:	
1	The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2	The question paper will have ten full questions carrying 20 marks each.
3	There will be two full questions (with a maximum of four sub questions) from each module.
4	Each full question will have sub questions covering all the topics of the module.
5	Students have to answer any Five Full questions, choosing at least one full question from each module
CIE Assessment:	
1	Three tests will be conducted each of 15 marks, average of best of two tests will be considered
2	Session wise Assignment will be 35 Marks

Text Books:	
1	Industrial Energy Management Systems, Arry C. White, Philip S. Schmidt, David R. Brown, Hemisphere Publishing
2	Energy Auditing and Demand Side Management by N G Ajjanna
3	Handbook of Energy Audit, Sonal Desai, McGraw Hill Education (India) Private Limited, Edition 2015.
4	Fundamentals of Energy Engineering - Albert Thumann, Prentice Hall Inc, Englewood Cliffs, New Jersey.
5	Electrical Power distribution, A S. Pabla, TMH, 5th edition, 2004
Reference Books:	
1	Recent Advances in Control and Management of Energy Systems, D.P.Sen, K.R.Padiyar, Indrane Sen, M.A.Pai, Interline
2	Energy Demand – Analysis, Management and Conservation, Ashok V. Desai, Wiley Eastern, 2005.
3	Demand Side Managementm, Jyothi Prakash, TMH Publishers.
4	Energy Management Handbook, W.C. Turner, John Wiley, and Sons.
5	Hand book on energy auditing - TERI (Tata Energy Research Institute)

COURSE OUTCOME AND PROGRAM OUTCOME MAPPING																
Course Name:		ENERGY AUDITING & DEMAND SIDE MANAGEMENT														
Course Code:		22EE642														
Sl. No.	**CO\PO**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**	**PSO3**
1	**CO1**	2	2	2			3						2	3		
2	**CO2**	3	3	2			3						2	3		
3	**CO3**	3	3	3			3						2	3		
4	**CO4**	3	3	3			3						2	3		
5	**CO5**	3	3	3			3						2	3		
	Average	2.8	2.8	3			3						2	3		

Course Title:	INTRODUCTION TO ELECTRIC VEHICLES		
	[As per NEP 2020, Outcome Based Education (OBE) and Choice Based Credit		
Course Code:	**22EE651**	**CIE Marks:**	50
Semester:	**6**	**SEE Marks:**	50
Course Type (Theory/Practical/Integrated):	Theory	**Total Marks:**	100
Teaching Hours/Week (L:T:P:S):	3:1:0:0	**Exam Hours:**	3
Total Hours of Pedagogy:	50 hours	**Credits:**	4
Course Objectives: This Course will enable the students to:			
1. Understand the basics of Electric Vehicles (EVs).			
2. Understand the battery systems of Electric Vehicles.			
3. Understand battery charging methods of electric vehicles.			
4. Understand different motors and their control methods.			
5. Understand the basics of hybrid electric vehicles.			
Module-1			**10 hours L1, L2**
Introduction to Electric Vehicles: History and need of electric vehicles, major components of electric vehicles and their description, working of Electric vehicles, advantages and disadvantages of electric vehicles, classification of Electric vehicles, Electric vehicle scenario in India and world, Indian Electric Vehicles			
Module-2			**10 hours L1, L2**
Electric Vehicle Battery Systems : Introduction to electric vehicle batteries, requirements of EV batteries, different types of batteries used in EVs (Lead acid, Nickel Metal hydride, lithium ion, sodium, VRLA batteries and its types), effect of excessive heat on battery, battery management system, ultra capacitors fly wheels, fuel cell technology.			
Module-3			**10 hours L1, L2**
Electric vehicle battery charging: charger, need of charging, charging time, types of Electric vehicle chargers, charging methods of batteries, ways/types of charging EVs batteries (conductive coupling and inductive charging), battery swapping and its features. Power Electronic Converter for Battery Charging: The Z-Converter. Isolated bidirectional DC-DC converter, High frequency transformer based isolated charger topology.			
Module-4			**10 hours L1, L2,L3**
Motors and Control Systems: factors considered for selecting motor for EVs, requirements of EV motors, basic concepts of induction motor, DC motor, brushless DC motor, permanent magnet synchronous motor, switched reluctance motor, comparison of motors used in EVs in terms of power density, motor efficiency, reliability, cost of controller and motor, regenerative braking, control system, sensor.			
Module-5			**10 hours L1, L2**
Hybrid Electric Vehicles: Introduction, components and working of Hybrid electric vehicles, advantages and disadvantages, types of Hybrid electric vehicles- Series, Parallel and Series -Parallel Configuration.			
Course Outcomes: At the end of the course the student will be able to:			
CO1: Identify and describe the major components of an electric vehicle and their functions.			
CO2: Compare and contrast different types of batteries used in EVs and analyze the effect of excessive heat on battery performance and its impact on efficiency, lifespan, and safety.			
CO3: Analyze and Compare different charging methods used for EV batteries and also different Power Electronic Converters for Battery Charging Systems .			

CO4: Analyze the various performance of motors in terms of Power desnsity, efficiency , reliability , braking etc.
CO5: Analyze the fundamentals of Hybrid Electric Vehicles (HEVs) of different configurations.
Question Paper Pattern:
SEE Assessment:
1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying 20 marks each.
3. There will be two full questions (with a maximum of four sub questions) from each module.
4. Each full question will have sub questions covering all the topics of the module.
5. Students have to answer any Five Full questions, choosing at least one full question from each module
CIE Assessment:
1. Two tests will be conducted each of 15 marks, average of best of two tests will be considered
2. Session wise Assignment will be 25 Marks, Seminar & Library Work 5 Marks and Attendance 5 Marks
Text/Reference Books:
1.Tom Denton, “Electric and hybrid vehicles.
2.Sandeep Dhaneja, “Electric Vehicle Battery systems”
3.A K Babu, “Electric and Hybrid Vehicles”, Khanna Book Publishers Co.(P) Ltd.

COURSE OUTCOME AND PROGRAM OUTCOME MAPPING																
Course Name:		INTRODUCTION OF ELECTRIC VEHICLES														
Course Code:		22EE651														
Sl. No.	**CO\PO**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**	**PSO3**
1	**CO1**	2	1				1	1				1	1	3		
2	**CO2**	2	1				1	1				1	1	3		
3	**CO3**	2	1				1	1				1	1	3		
4	**CO4**	2	1				1	1				1	1	3		
5	**CO5**	2	1				1	1				1	1	3		
	Average	2	1				1	1				1	1	3		

Course Title:	TESTING AND COMMISSIONING OF POWER SYSTEM APPARATUS [As per NEP 2020, Outcome Based Education (OBE) and Choice Based Credit System (CBCS) Scheme]		
Course Code:	**22EE652**	**CIE Marks:**	50
Semester:	**6**	**SEE Marks:**	50
Course Type (Theory/Practical/Integrated):	Theory	**Total Marks:**	100
Teaching Hours/Week (L:T:P:S):	3:1:0:0	**Exam Hours:**	3
Total Hours of Pedagogy:	50 hours	**Credits:**	4

Course Objectives: This Course will enable the students to understand:

1. The process to plan, control and implement commissioning of electrical equipment.
2. The performance specifications of transformer and induction motor.
3. The routine tests for synchronous machine, induction motor, transformer and switchgears.
4. The corrective and preventive maintenance of electrical equipment.
5. The routine tests to be conducted on switchger and protective devices.

Module-1	**10 hours L1, L2**

Electrical Tools, accessories: Tools, Accessories and Instruments required for Installation, Maintenance and Repair Work, India Electricity Rules, Safety Codes, Causes and Prevention of Accidents, Artificial Respiration, Workmen's Safety Devices.
Transformers: Installation, Site Selection, Foundation Details, Code of Practice for Terminal Plates, Polarity and Phase Sequence, Oil Tanks, Drying of Windings and General Inspection. Commissioning Tests As Per National and International Standards - Volts Ratio,Earth Resistance, Oil Strength, Insulation Tests, Impulse Tests, Polarizing Index, Load Temperature Rise Tests. Specific Tests for Determination of Performance Curves like Efficiencies, Regulation Etc., Determination Mechanical Stress Under Normal and Abnormal Conditions.

Module-2	**10 hours L1, L2,L3**

Synchronous Machines: Specifications as per BIS Standards. Installation - Physical Inspection, Foundation Details, Alignments, Excitation Systems, Cooling and Control Gear, Drying Out.
Commissioning Tests - Insulation, Resistance Measurement of Armature and Field Windings, Wave Form and Telephone Interference Tests, Line Charging Capacitance. Performance Tests -Various Tests to Estimate the Performance of Generator Operations, Slip Test, Maximum Lagging Current, Maximum Reluctance Power Tests, Sudden Short Circuit Tests, Transient Sub Transient Parameters, Measurement of Sequence Impedances, Capacitive Reactance, and Separation Of Losses, Temperature Rise Test, and Retardation Tests. Factory Tests -Gap Length, Magnetic Eccentricity, Balancing Vibrations, Bearing Performance.

Module-3	**10 hours L1, L2,L3**

Induction Motor: Specifications. Installation- Location of Motors and its Control Apparatus, Shaft Alignment for Various Coupling, Fitting of Pulleys and Coupling, Drying of Windings. Commissioning Tests -Mechanical Tests For Alignment, Air Gap Symmetry, Tests for Bearings, Vibrations and Balancing. Specific Tests -Performance and Temperature Raise Tests, Stray Load Losses, Shaft Alignment, Re-Writing and Special Duty Capability, Site Test.

Module-4	**10 hours L1, L2,L3**

Laying of Underground Cables: Inspection, Storage, Transportation and Handling of Cables, Cable Handing Equipment, Cable Laying Depths and Clearances from other Services such as Water Sewerage, Gas, Heating and other Mains, Series of Power and Telecommunication Cables and Coordination with these Services, Excavation of Trenches, Cable Jointing and Terminations Testing and Commissioning. Location of Faults using Megger, Effect of Open or Loose Neutral Connections, Provision of Proper Fuses on Service Lines and Their Effect on System, Causes and Dim and Flickering Lights.

Module-5	**10 hours L1, L2,L3**

Switchgear and Protective Devices: Standards, Types, Specification, Installation, Commissioning Tests, Maintenance Schedule, Type and Routine Tests. **Domestic Installation:** Introduction, Testing of Electrical Installation of a Building, Testing of Insulation Resistance to Earth, Testing of Insulation and Resistance between Conductors Continuity or Open Circuit Test, Short Circuit Test, Testing of Earthing Continuity, Location of Faults, IE Rules for Domestic Installation.
Course Outcomes: At the end of the course the student will be able to:
CO1: Describe the process to plan, control and implement commissioning of electrical equipment.
CO2: Conduct routine tests on synchronous machine to obtain the performnace.
CO3: Conduct various tests for the installation of induction motor.
CO4: Analyze the location of the underground cables and apply the knowledge during installation and commision.
CO5: Conduct tests on electrical installation of a building such as insulation resitance to earth and earthing continuity .
Question Paper Pattern:
SEE Assessment:
1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying 20 marks each.
3. There will be two full questions (with a maximum of four sub questions) from each module.
4. Each full question will have sub questions covering all the topics of the module.
5. Students have to answer any Five Full questions, choosing at least one full question from each module
CIE Assessment:
1. Three tests will be conducted each of 15 marks, average of best of two tests will be considered
2. Session wise Assignment will be 25 Marks. Attendance carry 05 Marks and Library and Seminar will carry 05 Marks. In
Text Books:
1. Testing and Commissioning of Electrical Equipment by R.L.Chakrasali,Prism Books Pvt Ltd,1st Edition,2014
Reference Books:
1. Testing, Commissioning, Operation and Maintenance of Electrical Equipment by S. Rao,Khanna Publishers ,6th Edition,
2. Preventive Maintenance of Electrical Apparatus by S.K.Sharotri,Katson Publishing House,1st Edition, 1980
3. Handbook of Switchgears,BHEL,McGraw Hill,1st Edition, 2005
4. Transformers,BHEL,McGraw Hill,1st Edition, 2003
5.TheJ&P Transformer Book,Martin J. Heathcote,Newnes,12th Edition, 1998

COURSE OUTCOME AND PROGRAM OUTCOME MAPPING																
Course Name:		**TESTING AND COMMISSIONING OF POWER SYSTEM APPARATUS**														
Course Code:		**22EE652**														
Sl. No.	**CO\PO**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**	**PSO3**
1	**CO1**	3	1				2	1	1				2	3		
2	**CO2**	3	3				2	1	1				2	3		
3	**CO3**	3			3		2	1	1				2	3		
4	**CO4**	3	3				2	1	1				2	3		
5	**CO5**	3	3		3		2	1	1				2	3		
	Average	3	2.5		3		2	1	1				2	3		

Course Title:	MICROCONTROLLER LABORATORY [As per NEP 2020, Outcome Based Education (OBE) and Choice Based Credit System (CBCS) Scheme]		
Course Code:	**22EEL66**	**CIE Marks:**	50
Semester:	**6**	**SEE Marks:**	50
Course Type	LAB	**Total Marks:**	100
Teaching Hours/Week	0:0:2:0	**Exam Hours:**	3
Total Hours of Pedagogy:	24 hours	**Credits:**	1

Course Objectives: This Course will enable the students to:

1. Understand assembly language programming for data transfer, arithmetic, Boolean and logical instructions
2. Understand assembly language programming for code conversions
3. Understand assembly language programming using subroutines for generation of delays, counters, configuration of SFRs for serial communication and timers.
4. Understand to perform interfacing of stepper motor and DC motor for controlling the speed. .
5. Understand the generation of different waveforms using DAC interface. .

Sl. No	Experiments
1	Data transfer – Program for block data movement, sorting, exchanging, finding largest element inan array.
2	Arithmetic instructions: Addition, subtraction, multiplication and division. Square and cubeoperations for counters
3	Boolean and logical instructions (bit manipulation).
4	Conditional call and return instructions.
5	Code conversion programs – BCD to ASCII, ASCII to BCD, ASCII to decimal, Decimal toASCII, Hexa.
6	Program to generate delay and program to using serial port and on-chip timer/counters Note: Single chip solution for interfacing 8051 is to be with C Programs for the following experiments.
7	Stepper motor interface.
8	DC motor interface for direction and speed control using PWM.
9	Alphanumerical LCD panel interface.
10	Generate different waveforms: Sine, Square, Triangular, Ramp using DAC interface.
11	External ADC and Temperature control interface..

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

CO1: Write and execute assembly language programs for data transfer, arithmetic and logical operations.

CO2: Write and execute assembly language programs for code conversions.

CO3: Write and execute assembly language programs using subroutines.

CO4: Perform interfacing of stepper motor and DC motor to control the speed.

CO5: Generate different waveforms using DAC interface. .

Practical Examination Conduction:

SEE Assessment:

1. Students will be given two experiments for their write-up.
2. Students need to conduct one of the two experiments given.
3. 15% of total marks are allotted for writeup, 70% of total marks are given to the conduction of experiment and remaining 15% of total marks will be given to Viva-Voce.

CIE Assessment:

1. One test will be conducted at the end of the semester of 15 marks out of total marks 50.

2. The remaining 35 marks are given to oveall conduction of an experiments by the students and also to the Observation/Assignment book.

Graduate Attributes (As per NBA)

Engineering Knowledge, Problem Analysis, Individual and Team work, Communication.

Conduct of Practical Examination:

1. Laboratory experiments are to be included for practical examination.
2. Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the
3. Students can pick one experiment from the questions lot prepared by the examiners.
4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

COURSE OUTCOME AND PROGRAM OUTCOME MAPPING																
Course Name:		MICROCONTROLLER LAB														
Course Code:		22EEL66														
Sl. No	**CO\PO**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**	**PSO3**
1	**CO1**	3	2	1		3	2			3	3		2		3	
2	**CO2**	3	2	1		3	2			3	3		2		3	
3	**CO3**	3	2	1		3	2			3	3		2		3	
4	**CO4**	3	2	1	2	3	2			3	3		2		3	
5	**CO5**	3	2	1	2	3	2			3	3		2		3	
	Average	3	2	1	2	3	2			3	3		2		3	

Course Title:	ELECTRICAL DRAWING LAB [As per NEP 2020, Outcome Based Education (OBE) and Choice Based		
Course Code:	**22EEL671**	**CIE Marks:**	50
Semester:	**6**	**SEE Marks:**	50
Course Type (Theory/Practical/Integrated):	LAB	**Total Marks:**	100
Teaching Hours/Week (L:T:P:S):	2:0:0:0	**Exam Hours:**	3
Total Hours of Pedagogy:	24 hours	**Credits:**	1

Course Objectives: This Course will enable the students to:

1. Understand the AC and DC armature winding.
2. Understand sectional views of single and three phase core and shell type transformer.
3. Understand the different sectional views of DC machine and its parts.
4. Understand the different sectional views of AC machine and its parts.
5. Understand the substation equipment, their location in a substation and development of a layout for substation.

Experiments

1. Develop single layer Lap and Wave winding diagrams of DC machines
2. Develop double layer Lap and Wave winding diagrams of DC machines

a) Three phase lap winding b) Three phase wave winding

4. Draw sectional view of single phase core and shell type transformers.
5. Draw sectional view of three phase core and shell type transformers.
6. Draw sectional view of DC machine yoke with poles.
7. Draw sectional view of alternator Stator.
8. Draw sectional view of alternator Rotor.
9. Draw single line diagram of a Substation.
10. Draw single line diagram of a Generating Station.

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

CO1: Develop armature winding diagram for DC machines.

CO2: Develop armature winding diagram for AC machines.

CO3: Construct sectional views of core and shell type transformer using design data.

CO4: Construct sectional views of assembled DC and AC machines and their parts using design data.

CO5: Develop single line diagram of generating station and substation using the standard symbols.

Graduate Attributes (As per NBA)

Engineering knowledge, Problem Analysis, Individual Team work, Communication.

Conduct of Practical Examination:

1. Laboratory experiments are to be included for practical examination.
2. Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners.
3. Students can pick one experiment from the questions lot prepared by the examiners.
4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

COURSE OUTCOME AND PROGRAM OUTCOME MAPPING																
Course Name:		ELECTRICAL DRAWING LAB														
Course Code:		22EEL671														
Sl. No.	**CO\PO**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**	**PSO3**
1	**CO1**	3	2	3		3				3	3		1		3	
2	**CO2**	3	2	3		3				3	3		1		3	
3	**CO3**	3	2	3		3				3	3		1		3	
4	**CO4**	3	2	3		3				3	3		1		3	
5	**CO5**	3	2	3		3				3	3		1		3	
	Average	3	2	3		3				3	3		1		3	

Course Title:	OP- AMP AND LINEAR ICS LABORATORY		
	[As per NEP 2020, Outcome Based Education (OBE) and Choice Based Credit System		
Course Code:	**22EEL672**	**CIE Marks:**	50
Semester:	**6**	**SEE Marks:**	50
Course Type	LAB	**Total Marks:**	100
Teaching Hours/Week	0:0:2:0	**Exam Hours:**	3
Total Hours of Pedagogy:	24 hours	**Credits:**	1

Course Objectives: This Course will enable the students to:	
1	Study the performance of precision full wave rectifier.
2	Study the performance of an op-amp under inverting and non-inverting configurations and also RC phase shift oscillator.
3	Understand the design of a Schmiit Trigger circuit, Voltage comparator circuit and zero crossing detector using an op-amp.
4	Study the frequency response characteristic of various Filters.
5	Understand the realization of R-2R ladder DAC and two bit Flash ADC.

Sl. No	**Experiments**
1	Design and verify a precision full wave rectifier. Determine the performance parameters.
2	Design and realize to analyse the frequency response of an op – amp under inverting and non - inverting configurations for a given gain.
3	Design and verify the output waveform of an op – amp RC phase shift oscillator for a desired frequency.
4	Design and realize Schmitt trigger circuit using an op – amp for desired upper trip point (UTP) andlower trip point (LTP).
5	Verify the operation of an op – amp as (a) voltage comparator circuit and (b) zero crossing detector.
6	Design and verify the operation of op – amp as an (a) adder (b) subtractor (c) integrator and (d) differentiator.
7	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.
8	Design and realize an op – amp based function generator to generate sine, square and triangular waveforms of desired frequency.
9	Design and realize a R-2R ladder DAC.
10	Realization of Two bit Flash ADC.

Course Outcomes: At the end of the course the student will be able to:	
CO1:	Design and verify the performance of precision full wave rectifier.
CO2:	Design and realize to analyze an op-amp under inverting and non-inverting configurations and also RC phase shift oscillator.
CO3:	Design and realize the Schmiit Trigger circuit, Voltage comparator circuit and zero crossing detector using an op-amp.
CO4:	Analyse the frequency response characteristic of various Filters.
CO5:	Design and realize R-2R ladder DAC and realise two bit Flash ADC.

Practical Examination Conduction:
SEE Assessment:
1. Students will be given two experiments for their write-up.
2. Students need to conduct one of the two experiments given.

3. 15% of total marks are allotted for writeup, 70% of total marks are given to the conduction of experiment and remaining 15% of total marks will be given to Viva-Voce.
CIE Assessment:
1. One test will be conducted at the end of the semester of 15 marks out of total marks 50.
2. The remaining 35 marks are given to oveall conduction of an experiments by the students and also to the Observation/Assignment book.
Graduate Attributes (As per NBA)
Engineering Knowledge, Problem Analysis, Individual and Team work, Communication.
Conduct of Practical Examination:
1. Laboratory experiments are to be included for practical examination.
2. Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners.
3. Students can pick one experiment from the questions lot prepared by the examiners.
4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

COURSE OUTCOME AND PROGRAM OUTCOME MAPPING																
Course Name:		OP- AMP AND LINEAR ICS LABORATORY														
Course Code:		22EEL672														
Sl. No.	**CO\PO**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**	**PSO3**
1	**CO1**	3								3	3		1		3	
2	**CO2**	3	3	3						3	3		1		3	
3	**CO3**	3	3	3						3	3		1		3	
4	**CO4**	3	3	3						3	3		1		3	
5	**CO5**	3	3	3						3	3		1		3	
	Average	3	3	3						3	3		1		3	

Course Title:	**DIGITAL SIGNAL PROCESSING LABORATORY** [As per NEP 2020, Outcome Based Education (OBE) and Choice Based Credit		
Course Code:	**22EEL681**	**CIE Marks:**	50
Semester:	**6**	**SEE Marks:**	50
Course Type	LAB	**Total Marks:**	100
Teaching Hours/Week	0:0:2:0	**Exam Hours:**	3
Total Hours of Pedagogy:	24 hours	**Credits:**	1

Course Objectives: This Course will enable the students to:

1. Understand the use of matlab software in evaluating DFT and IDFT of given sequence.
2. Understand the convolution property of a DFT.
3. Understand the design and implementation of IIR filters for a given frequency .
4. Understand the design and implementation of FIR filters for a given frequency .
5. Understand the Realization of IIR and FIR filters.

Sl. No.	Experiments
1	Verification of Sampling Theorem both in time and frequency domains.
2	Evaluation of impulse response of a system.
3	Verification of Linearity property, circular time shift property & circular frequency shift property of DFT.
4	To perform linear convolution and circular convolution of given sequences.
5	Computation of circular convolution of two given sequences and verification of commutative,distributive and associative property of convolution.
6	Computation of N-point DFT and plot the magnitude and phase spectrum.
7	Linear and circular convolution by DFT and IDFT method.
8	Solution of a given difference equation.
9	Calculation of DFT and IDFT by FFT.
10	Design and implementation of IIR filters to meet given specification (Low pass, high pass, band pass and band reject filters).
11	Design and implementation of FIR filters to meet given specification (Low pass, high pass, band pass and band reject filters) using different window functions.
12	Realization of IIR and FIR filters.

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

CO1: Simulate DFT and IDFT of a given sequence.
CO2: Verify the convolution property of a DFT.
CO3: Design and implement IIR filters.
CO4: Design and implement FIR filters using window function.
CO5: Design and implement FIR filters using frequency sampling technique.

Practical Examination Conduction:

SEE Assessment:

1. Students will be given two experiments for their write-up.
2. Students need to conduct one of the two experiments given.
3. 15% of total marks are allotted for writeup, 70% of total marks are given to the conduction of experiment and

CIE Assessment:

1. One test will be conducted at the end of the semester of 15 marks out of total marks 50.
2. The remaining 35 marks are given to oveall conduction of an experiments by the students and also to the

Graduate Attributes (As per NBA) Engineering Knowledge, Problem Analysis, Individual and Team work, Communication.
Conduct of Practical Examination:
1. Laboratory experiments are to be included for practical examination. 2. Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the 3. Students can pick one experiment from the questions lot prepared by the examiners. 4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

COURSE OUTCOME AND PROGRAM OUTCOME MAPPING																
Course Name:		DIGITAL SIGNAL PROCESSING LAB														
Course Code:		22EEL681														
Sl. No.	**CO\PO**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**	**PSO3**
1	**CO1**	3	3	3	2	3	1			3	3		1		3	
2	**CO2**	3	3	3	2	3	1			3	3		1		3	
3	**CO3**	3	3	3	2	3	1			2	3		1		3	
4	**CO4**	3	3	3	2	3	1			2	3		1		3	
5	**CO5**	3	3	3	2	3	1			2	3		1		3	
	Average	3	3	3	2	3	1			2.5	3		1		3	

Course Title:	PROJECT-VI		
	[As per NEP 2020, Outcome Based Education (OBE) and Choice Based Credit		
Course Code:	**22PRJ69**	**CIE Marks:**	50
Semester:	**6**	**SEE Marks:**	50
Course Type (Theory/Practical/Integrated):	Integrated	**Total Marks:**	100
Teaching Hours/Week (L:T:P:S):	0:1:1:0	**Exam Hours:**	3
Total Hours of Pedagogy:	24	**Credits:**	1

Course Objectives: The goal of the course Project III (22PRJ49)is to

1. Get exposure about the Electrical & Electronics hardware and various software tools.
2. Design the working model of the open ended problem.
3. Understand the Electrical and Electronics concepts.
4. Understand the latest technology trends in the electrcial system.
5. Prepare technical documentation of the project.

STUDENTS WILL BE GIVEN A OPEN ENDED PROBLEM OF THE SOCIETY AND ASKED TO SOLVE BY DESIGNING AND IMPLEMENTING THE SYSTEM IN A TEAM.

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

CO1: Apply the knowledge of electrical and electronics hardware and software components to solve the real time problems of the society

CO2: Analyze the various existing solutions available to solve the real time problem and propose the best solution

CO3: Design and implement the system to solve the real time problem of the society

CO4: Conduct investigations on the output and prepare the technical documentation of the designed /system in a team

CO5: Use the modern tool available like advanced hardware and software tools

Conduction of Assessment:

SEE and CIE Assessment

SEE Assessment: The SEE for the Project shall be evaluated by two examiners jointly and the evaluation shall be based

CIE Assessment: Design and fabrication of the project -50% of the maximum marks, Evaluation of project report by the

COURSE OUTCOME AND PROGRAM OUTCOME MAPPING																
Course Name:		**PROJECT VI**														
Course Code:		**22PRJ69**														
Sl. No.	**CO\PO**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**	**PSO3**
1	**CO1**	3											2	3	2	
2	**CO2**	3	3										2	3	3	
3	**CO3**			3			3						2	3	3	
4	**CO4**				3		3	3	3	3	3	3	3	3	3	
5	**CO5**					3							2			
	Average	3	3	3	3	3	3	3	3	3	3	3	2	3	3	

Course Title:	BASICS OF C++		
	[As per NEP 2020, Outcome Based Education (OBE) and Choice Based		
Course Code:	**22AEE611A**	**CIE Marks:**	50
Semester:	**6**	**SEE Marks:**	50
Course Type	LAB	**Total Marks:**	100
Teaching Hours/Week	0:0:2:0	**Exam Hours:**	3
Total Hours of Pedagogy:	24 hours	**Credits:**	1

Course Objectives: This Course will enable the students to:

1. Understand object-oriented programming concepts using the C++ language.
2. Understand the principles of data abstraction, inheritance and polymorphism.
3. Understand the principles of virtual functions and polymorphism .
4. Understand handling formatted I/O and unformatted I/O .
5. Understand to create an array of pointers.

Sl. No.	Experiments
1	Write a C++ Program to display Names, Roll No., and grades of 3 students who have appeared in the examination. Declare the class of name, Roll No. and grade. Create an array of class objects. Read and display the contents of the array.
2	Write a C++ program to declare Struct. Initialize and display contents of member variables.
3	Write a C++ program to declare a class. Declare pointer to class. Initialize and display the contents of the class member.
4	Given that an EMPLOYEE class contains following members: data members: Employee number, Employee name, Basic, DA, IT, Net Salary and print data
5	Write a C++ program to read the data of N employee and compute Net salary of each employee (DA=52% of Basic and Income Tax (IT) =30% of the gross salary).
6	Write a C++ to illustrate the concepts of console I/O operations.
7	Write a C++ program to use scope resolution operator. Display the various values of the same variables declared at different scope levels.
8	Write a C++ program to allocate memory using new operator.
9	Write a C++ program to create multilevel inheritance. (Hint: Classes A1, A2, A3)
10	Write a C++ program to create an array of pointers. Invoke functions using array objects.
11	Write a C++ program to use pointer for both base and derived classes and call the member function. Use Virtual keyword.

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

- **CO1:** Develop a program to declare students results from a structered student data.
- **CO2**: Develop a program to allocate memory.
- **CO3:** Develop a program to create multilevel inheritance and also array of pointers.
- **CO4:** Develop a program to use scope resolution operator.
- **CO5**: Develop an employee database

Practical Examination Conduction:

SEE Assessment:

1. Students will be given two experiments for their write-up.
2. Students need to conduct one of the two experiments given.
3. 15% of total marks are allotted for writeup, 70% of total marks are given to the conduction of experiment and remaining 15% of total marks will be given to Viva-Voce.

CIE Assessment:

1. One test will be conducted at the end of the semester of 15 marks out of total marks 50.

2. The remaining 35 marks are given to oveall conduction of an experiments by the students and also to the Observation/Assignment book.

Graduate Attributes (As per NBA)

Engineering Knowledge, Problem Analysis, Individual and Team work, Communication.

Conduct of Practical Examination:

1. Laboratory experiments are to be included for practical examination.
2. Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners.
3. Students can pick one experiment from the questions lot prepared by the examiners.
4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be

COURSE OUTCOME AND PROGRAM OUTCOME MAPPING																
Course Name:		Basics of C++														
Course Code:		22AEE611A														
Sl. No.	CO\PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1	CO1	3	3	3		3				3	3		2		3	
2	CO2	3	3	3		3				3	3		2		3	
3	CO3	3	3	3		3				3	3		2		3	
4	CO4	3	3	3		3				3	3		2		3	
5	CO5	3	3	3		3				3	3		2		3	
	Average	3	3	3		3				3	3		2		3	

	DIGITAL SYSTEM DESIGN		
	[As per NEP 2020, Outcome Based Education (OBE) and Choice Based Credit		
Course Code:	**22AEE611B**	**CIE Marks:**	50
Semester:	**6**	**SEE Marks:**	50
Course Type	LAB	**Total Marks:**	100
Teaching Hours/Week	0:0:2:0	**Exam Hours:**	3
Total Hours of Pedagogy:	24 hours	**Credits:**	1

Course Objectives: This Course will enable the students to:

1. Understand simulation software such as scilab,matlab etc
2. Understand to design parity generator and parity checker
3. Understand to design gray to binary and binary to gray code conversion
4. Understand to design and simulate of SR ,JK,D and T flip flops
5. Understand to design encoder and decoder

Sl. No.	Experiments
1	Design and simulation of 4-bit parity generator
2	Design and simulation of 4- bit parity checker
3	Design and simulation of 1-bit magnitude comparator
4	Design and simulation of gray to binary code converter
5	Design and simulation of binary to gray code converter
6	Design and simulation of priority encoder
7	Design and simulation of demultiplexer
8	Design and simulation of decoder
9	Design and simulation of i) SR flip flop ii) D flip flop iii) JK flip flop iv)T flip flop
10	Design and simulation of ripple counter

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

CO1: Design and realize parity generator and parity checker.

CO2: Design and realize binary to gray and gray to binary code conversion.

CO3: Design and realize decoder and encoders.

CO4: Design and realize JK ,T, SR and D Flip-Flops .

CO5: Design and realize counters

Practical Examination Conduction:

SEE Assessment:

1. Students will be given two experiments for their write-up.
2. Students need to conduct one of the two experiments given.
3. 15% of total marks are allotted for writeup, 70% of total marks are given to the conduction of experiment and remaining 15% of total marks will be given to Viva-Voce.

CIE Assessment:

1. One test will be conducted at the end of the semester of 15 marks out of total marks 50.
2. The remaining 35 marks are given to oveall conduction of an experiments by the students and also to the Observation/Assignment book.

Graduate Attributes (As per NBA)

Engineering Knowledge, Problem Analysis, Individual and Team work, Communication.

Conduct of Practical Examination:

1. Laboratory experiments are to be included for practical examination.

2. Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners. 3. Students can pick one experiment from the questions lot prepared by the examiners. 4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

COURSE OUTCOME AND PROGRAM OUTCOME MAPPING																
Course Name:		**DIGITAL SYSTEM DESIGN**														
Course Code:		**22AEE611B**														
Sl. No.	**CO\PO**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**	**PSO3**
1	**CO1**	3	3	3		3				3			1		3	
2	**CO2**	3	3	2		3				3			1		3	
3	**CO3**	3	3	3		3				3			1		3	
4	**CO4**	3	3	3		3				3			1		3	
5	**CO5**	3	3	3		3				3			1		3	
	Average	3	3	2.6		3				3			1		3	

Course Title:	POWER SYSTEM ANALYSIS – 2		
	[As per NEP 2020, Outcome Based Education (OBE) and Choice Based Credit System		
Course Code:	**22EE71**	**CIE Marks:**	50
Semester:	**7**	**SEE Marks:**	50
(Theory/Practical/Integrated):	Theory	**Total Marks:**	100
Teaching Hours/Week (L:T:P:S):	2:1:0:0	**Exam Hours:**	3
Total Hours of Pedagogy:	40 hours	**Credits:**	3

Course Objectives: This Course will enable the students to understand:

1	The formulation of network models and bus admittance matrix for solving load flow problems.
2	The optimal operation of generators on a bus bar and optimum generation scheduling.
3	Symmetrical fault analysis and development of an algorithm for short circuit studies.
4	Formulation of bus impedance matrix for the use in short circuit studies.
5	Numerical solution of swing equation using various methods.

Module-1 **8 hours L1, L2,L3**

Network Topology: Introduction and basic definitions of Elementary graph theory Tree, cut-set, loop analysis. Formation of Incidence Matrices. Primitive network- Impedance form and admittance form, Formation of Y Bus by Singular Transformation. Y bus by Inspection Method.

Module-2 **8 hours L1, L2 ,L3**

Load Flow Studies: Introduction, Classification of buses. Power flow equation, Operating Constraints, Data for Load flow, Gauss Seidal iterative method.

Module-3 **8 hours L1, L2,L3**

Load Flow Studies (continued) Newton-Raphson method derivation in Polar form, Fast decoupled load flow method, Flow charts of LFS methods. Comparison of Load Flow Methods.

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

Economic Operation of Power System: Introduction and Performance curves ,Economic generation scheduling neglecting losses and generator limits,Economic generation scheduling including generator limits and neglecting losses, Economic dispatch including transmission losses, Derivation of transmission loss formula.

Unit Commitment: Introduction, Constraints and unit commitment solution by prior list method and dynamic forward DP

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

Symmetrical Fault Analysis: Z Bus Formulation by Step by step building algorithm without mutual coupling between the

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

CO1:	Formulate network matrices and models for solving load flow problems.
CO2:	Perform steady state power flow analysis of power systems using numerical iterative techniques.
CO3:	Analyze various load flow methods.
CO4:	Analyze short circuit faults in power system networks using bus impedance matrix.
CO5:	Obtain numerical solution of swing equation using various methods.

Question Paper Pattern:

SEE Assessment:

1	The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2	The question paper will have ten full questions carrying 20 marks each.
3	There will be two full questions (with a maximum of four sub questions) from each module.
4	Each full question will have sub questions covering all the topics of the module.
5	Students have to answer any Five Full questions, choosing at least one full question from each module

CIE Assessment:

1	Three tests will be conducted each of 15 marks, average of best of two tests will be considered
2	Session wise Assignment will be 35 Marks

Text Books:

1	Modern Power System Analysis D. P. Kothari McGraw Hill 4 th Edition, 2011
2	Computer Methods in Power Systems Analysis Glenn W. Stagg Ahmed H Ei - Abiad Scientific International Pvt. Ltd. 1 st
3	Power Generation Operation and Control Allen J Wood etal Wiley 2 nd Edition,2016
Reference Books:	
1	Computer Methods in Power Systems Analysis Glenn W Stagg Ahmed H Ei - Abiad McGraw Hill 1stEdition, 1968
2	Computer Techniques in Power System Analysis M.A. Pai McGraw Hill 2ndEdition, 2006
3	Power System Analysis Hadi Saadat McGraw Hill 2ndEdition, 2002

COURSE OUTCOME AND PROGRAM OUTCOME MAPPING																
Course Name:		Power System Analysis -2														
Course Code:		22EE71														
Sl. No.	**CO\PO**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**	**PSO3**
1	**CO1**	3	3	2									1	3		
2	**CO2**	3	3	2									1	3		
3	**CO3**	3	3	2									1	3		
4	**CO4**	3	3	2									1	3		
5	**CO5**	3	3	2									1	3		
	Average	3	3	2									1	3		

Course Title:	Electric Vehicle Technologies		
	[As per NEP 2020, Outcome Based Education (OBE) and Choice Based Credit System (CBCS) Scheme]		
Course Code:	**22EE72**	**CIE Marks:**	50
Semester:	**7**	**SEE Marks:**	50
Course Type	Theory	**Total Marks:**	100
Teaching Hours/Week	3:0:0:0	**Exam Hours:**	3
Total Hours of Pedagogy:		**Credits:**	3

Course Objectives: This Course will enable the students to:

1	Understand the working of Electric Vehicles and recent trends.
2	Understand concept of design of Hybrid Electric Drive Train.
3	Understand different types of batteries used in electric vehicle.
4	Understand the motors and drives and also control methods used in electric vehicles.
5	Understand energy management principles and strategies used in electric vehicles.

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

Electric and Hybrid Electric Vehicles: History of Electric Vehicles, Hybrid Electric Vehicles, Fuel Cell Vehicles. Performance of EVs - Traction Motor Characteristics, Tractive Effort and Transmission Requirement, Vehicle performance, Energy Consumption in Hybrid Electric Vehicles, Concept of Hybrid Electric Drive Trains, Architectures of Hybrid Electric Drive Trains.

Module-2 **10 hours L1, L2, L6**

Design Principle of Series and parallel Hybrid Electric Drive Train

Operation Patterns, Control Strategies-Max. SOC-of-Peak Power Source (PPS) and Engine On–Off.

Series Hybrid Electric Drive Train Design of Electrical Coupling Device, Power Rating Design of the Traction Motor, Power Rating Design of the Engine/Generator, Design of PPS, Power Capacity of PPS, Energy Capacity of PPS.

Parallel Hybrid Electric Drive Train Design

Drive Train Configuration and Design Objectives, Control Strategies, Max. SOC-of-PPS Control Strategy Engine On–Off (Thermostat) Control Strategy, Constrained Engine On–Off Control

Module-3 **8 hours L1, L2, L3**

Batteries in Electric and Hybrid vehicles: Basics of Battery-Battery cell Structure and Chemical reactions. Battery Parameters -Battery capacity, Open circuit voltage, Terminal voltage, Practical capacity, Discharge rate, State of charge, Battery energy, Battery power, Specific power

Module-4 **12 hours L1, L2, L3**

Electric Vehicle Motors: Motors (DC, Induction, BLDC) – Types, Principle, Construction, Control. Electric Drive Trains (EDT) – Series HEDT (Electrical Coupling) – Power Rating Design, Peak Power Source (PPS); Parallel HEDT (Mechanical Coupling) – Torque Coupling and Speed Coupling. Switched Reluctance Motors (SRM) Drives – Basic structure, Drive Convertor, Design.

Sensor-less control in EV: Sensor less – Control methods- Phase Flux Linkage-Based Method, Phase Inductance Based, Modulated Signal Injection, Mutually Induced Voltage-Based, Observer-Based.

Module-5 **4 hours L1, L2**

Introduction to Energy Management Overview of electric vehicles (EVs) - Introduction to energy management in EVs - Importance of energy management; Key objectives of energy management in EVs. Electric vehicle components and systems- Battery systems; Power electronics and motor drive systems; Regenerative braking systems; Energy storage and management systems.

Course Outcomes: At the end of the course the student will be able to:	
CO1:	Explain the working of Electric Vehicles and recent trends.
CO2:	Design Hybrid Electric Drive Train.
CO3:	Explain different types of batteries used in electric vehicle.
CO4:	Explain the motors and drives and also control methods used in electric vehicles.
CO5:	Explain energy management principles and strategies used in electric vehicles.

Question Paper Pattern:	
SEE Assessment:	
1	The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2	The question paper will have ten full questions carrying 20 marks each.
3	There will be two full questions (with a maximum of four sub questions) from each module.
4	Each full question will have sub questions covering all the topics of the module.
5	Students have to answer any Five Full questions, choosing at least one full question from each module
CIE Assessment:	
1	Three tests will be conducted each of 15 marks, average of best of two tests will be considered
2	Session wise Assignment will be 35 Marks
Text Books:	
1	Mehrdad Ehsani, Yimin Gao, sebastien E. Gay and Ali Emadi, “Modern Electric,
2	Electric and Hybrid Vehicles: Design Fundamentals by Iqbal Husain, CRC Press, 2003
3	Electric Vehicle Energy Management System for Efficiency Optimization" by
Reference Books:	
1	Advanced Electric Drive Vehicles" edited by Ali Emadi
2	Electric Vehicle Technology Explained" by James Larminie and John Lowry

COURSE OUTCOME AND PROGRAM OUTCOME MAPPING																
Course Name:		Electric Vehicle Technology														
Course Code:		22EE72														
Sl. No.	**CO\PO**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**	**PSO3**
1	**CO1**	3					1	1					1			
2	**CO2**	3	3	3			2	2					1	2	2	
3	**CO3**	3	2				2	1					1	2	2	
4	**CO4**	3	2				2	1					1	2	2	
5	**CO5**	3	2		1		2	2					1	2	1	
	Average	3	1.4		0.2		1.8	1.4					1	2	1.2	

Course Title:	**HIGH VOLTAGE ENGINEERING** [As per NEP 2020, Outcome Based Education (OBE) and Choice Based Credit System (CBCS) Scheme]		
Course Code:	**22EE73**	**CIE Marks:**	50
Semester:	**7**	**SEE Marks:**	50
(Theory/Practical/Integrated):	Theory	**Total Marks:**	100
(L:T:P:S):	2:1:0:0	**Exam Hours:**	3
Total Hours of Pedagogy:	40 hours	**Credits:**	3

Course Objectives: This Course will enable the students to understand:	
1	Conduction and breakdown in gases, liquid dielectrics and solid dielectrics.
2	Generation of high voltages and currents.
3	Measurements of high voltages and currents.
4	Overvoltage phenomenon and insulation coordination.
5	Non-destructive testing of materials.

Module-1	**8 hours L1, L2,L3**

Conduction and Breakdown in Gases: Gases as Insulating Media, Collision Process, Ionization Processes, Townsend's Current Growth Equation, Current Growth in the Presence of Secondary Processes, Townsend's Criterion for Breakdown, Experimental Determination of Coefficients α and γ, Time Lags for Breakdown, Streamer Theory of Breakdown in Gases, Paschen's Law, Breakdown in Non-Uniform Fields and Corona Discharges.
Conduction and Breakdown in Liquid Dielectrics: Liquids as Insulators, Pure Liquids and Commercial Liquids, Conduction and Breakdown in Commercial Liquids.
Breakdown in Solid Dielectrics: Introduction, Intrinsic Breakdown, Electromechanical Breakdown, Thermal Breakdown,Problems.

Module-2	**8 hours L1, L2 ,L3**

Generation of High Voltages and Currents: Generation of High Direct Current Voltages, Generation of High Alternating Voltages, Multistage Impulse Generator-Marx Circuit, Generation of Rectangular Current Pulses, Tripping and Control of Impulse Generators,Problems.

Module-3	**8 hours L1, L2,L3**

Measurement of High Voltages and Currents: Generating Voltmeters, Electrostatics Voltmeters, Sphere Gap Measurements, Factors Influencing the Sparkover Voltage of sphere Gaps, Potential Dividers for Impulse Voltage measurements, Potential Dividers used for High-Voltage Impulse measurements, Capacitance voltage dividers, Mixed R-C Potential dividers, Measurement of High Impulse currents, Cathode Ray Oscillographs for Impulse Measurements, Problems.

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

Overvoltage Phenomenon and Insulation Coordination in Electric Power Systems: Charge Formation in the Clouds, Classification of Transmission Lines, Successive Reflections and Lattices Diagrams, Protection of transmission lines against overvoltages, Principles of Insulation Coordination on High Voltage and Extra High Voltage Power Systems. Problems.	
Module-5	**8 hours L1, L2**
Non-Destructive Testing of Materials and Electrical Apparatus: Introduction, Measurement of Dielectric Constant and	
Course Outcomes: At the end of the course the student will be able to:	
CO1:	Explain the conduction and breakdown phenomenon in gases, liquid and solid dielectrics.
CO2:	Explain the generation of high voltages and currents.
CO3:	Explain the measurement techniques for high voltages and currents.
CO4:	Explain overvoltage phenomenon and insulation coordination in electric power systems.
CO5:	Explain non-destructive testing of materials and electrical apparatus and high-voltage testing of electrical apparatus.
Question Paper Pattern:	
SEE Assessment:	
1	The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2	The question paper will have ten full questions carrying 20 marks each.
3	There will be two full questions (with a maximum of four sub questions) from each module.
4	Each full question will have sub questions covering all the topics of the module.
5	Students have to answer any Five Full questions, choosing at least one full question from each module
CIE Assessment:	
1	Three tests will be conducted each of 15 marks, average of best of two tests will be considered
2	Session wise Assignment will be 35 Marks
Text Books:	
1	High Voltage Engineering M.S. Naidu, V.Kamaraju McGraw Hill 5 th Edition, 2013.
Reference Books:	
1	High Voltage Engineering Fundamentals E. Kuffel, W.S. Zaengl, J. KuffelNewnes 2 nd Edition, 2000.
2	High Voltage Engineering Wadhwa C.L. New Age International 3 rd Edition, 2012.
3	High-Voltage Test and Measuring Techniques Wolfgang Hauschild , Eberhard Lemke Springer 1 st Edition2014.
4	High Voltage Engineering Farouk A.M. Rizk CRC Press 1 st Edition2014.

COURSE OUTCOME AND PROGRAM OUTCOME MAPPING																
Course Name:		HIGH VOLTAGE ENGINEERING														
Course Code:		22EE73														
Sl. No.	**CO\PO**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**	**PSO3**
1	**CO1**	3	2				2	1					1	3		
2	**CO2**	3	2				2	1					1	3		
3	**CO3**	3	2				2	1					1	3		
4	**CO4**	3	2				2	1					1	3		
5	**CO5**	3	2				2	1					1	3		
	Average	3	2				2	1					1	3		

Course Title:	RENEWABLE ENERGY SOURCES [As per NEP 2020, Outcome Based Education (OBE) and Choice Based Credit System (CBCS) Scheme]		
Course Code:	**22EE751**	**CIE Marks:**	50
Semester:	**7**	**SEE Marks:**	50
Course Type (Theory/Practical/Integrated):	Theory	**Total Marks:**	100
Teaching Hours/Week (L:T:P:S):	4:0:0:0	**Exam Hours:**	3
Total Hours of Pedagogy:	50	**Credits:**	4

Course Objectives: This Course will enable the students to:

1	Understand causes of energy scarcity and its solution, energy resources and availability of renewable energy, need of solar cell, components of a solar cell system and applications.
2	Understand types of solar collectors and their applications, solar energy reaching the Earth's surface and solar thermal energy applications.
3	Understand the benefits of hydrogen energy, usage of hydrogen energy, its advantages and disadvantages, wind turbines, wind resources, site selection for wind turbine.
4	Understand biomass production, types of biomass gasifiers, properties of producer gas, tidal energy resources, energy availability, power generation.
5	Understand the principles of ocean thermal energy conversion and production of electricity.

Module-1 **10 hours L1, L2, L3**

Introduction: Causes of Energy Scarcity, Solution to Energy Scarcity, Factors Affecting Energy Resource Development, Energy Resources and Classification, Renewable Energy – Worldwide Renewable Energy Availability, Renewable Energy in India.
Solar Cells: Need for Solar Cells, Components of Solar Cell System, Elements of Silicon Solar Cell, Efficiency of Solar Cells, Photovoltaic Panels, Applications of Solar Cell Systems.

Module-2 **10 hours L1, L2, L3**

Solar Thermal Energy Collectors: Types of Solar Collectors, Material Aspects of Solar Collectors, Parabolic Dish – Stirling Engine System, Working of Stirling or Brayton Heat Engine, Solar Collector Systems into Building Services, Solar Water Heating Systems, Passive Solar Water Heating Systems, Applications of Solar Water Heating Systems, Solar Dryers, Solar Cookers, Solar ponds.

Module-3 **10 hours L1, L2, L3**

Hydrogen Energy: Benefits of Hydrogen Energy, Use of Hydrogen Energy, Advantages and Disadvantages of Hydrogen Energy, Problems associated with Hydrogen Energy.
Wind Energy: Windmills, Wind Turbines, Wind Resources, Considerations and guidelines for Wind Site Selection.
Geothermal Energy: Geothermal Systems, Classifications, Geothermal based Electric Power Generation, associated problems, environmental Effects.

Module-4 **10 hours L1, L2, L3**

Biomass Energy: Biomass Production, Energy Plantation, Gasification, Gasifiers and Their Classifications, Chemistry of Reaction Process in Gasification, Updraft, Downdraft and Cross-draft Gasifier, Fluidized Bed Gasification, Applications of Biomass Gasifier.
Tidal Energy: Introduction, Tidal Energy Resource, Tidal Energy Availability, Tidal Power Generation in India, Tidal Power Basin, Advantages and Disadvantages of Tidal Power, Problems Faced in Exploiting Tidal Energy.

Module-5 **10 hours L1, L2, L3**

Sea Wave Energy: Introduction, Motion in the sea Waves, Devices for Harnessing Wave Energy, Advantages and Disadvantages of Wave Power. **Ocean Thermal Energy:** Introduction, Principles of Ocean Thermal Energy Conversion (OTEC), Ocean Thermal Energy Conversion plants, Basic Rankine Cycle and its Working, Closed Cycle, Open Cycle and Hybrid Cycle, Applications of OTEC in addition to Production of Electricity, Advantages, Disadvantages of OTEC.	
Course Outcomes: At the end of the course the student will be able to:	
CO1:	Explain the causes of energy scarcity and its solution, energy resources and availability of
CO2:	Explain types of solar collectors, their configurations, solar cell system, its characteristics and
CO3:	Explain generation of energy from hydrogen, wind and geothermal systems.
CO4:	Explain production of energy from biomass.
CO5:	Explain power generation from sea wave energy and ocean thermal energy.
Question Paper Pattern:	
SEE Assessment:	
1	The SEE question paper will be set for 100 marks and the marks scored will be proportionately redu
2	The question paper will have ten full questions carrying 20 marks each.
3	There will be two full questions (with a maximum of four sub questions) from each module.
4	Each full question will have sub questions covering all the topics of the module.
5	Students have to answer any Five Full questions, choosing at least one full question from each modu
CIE Assessment:	
1	Three tests will be conducted each of 15 marks, average of best of two tests will be considered
2	Session wise Assignment will be 35 Marks
Text Books:	
1	Nonconventional Energy Resources. Shobh Nath Singh, Pearson, 1st Edition, 2015 .
Reference Books:	
1	Nonconventional Energy Resources , B.H. Khan McGraw Hill, 3rd Edition
2	Renewable Energy Power for a sustainable Future, Godfrey Boyle , Oxford, 3rd Edition, 2012
3	Renewable Energy Sources Their Impact on global Warming and Pollution ,TasneemAbbasi , S.A.

COURSE OUTCOME AND PROGRAM OUTCOME MAPPING																
Course Name:		RENEWABLE ENERGY SOURCES														
Course Code:		22EE751														
Sl. No.	**CO\PO**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**	**PSO3**
1	**CO1**	3	2	1			2	1					2	3	2	
2	**CO2**	3	2	1			2	1					2	3	2	
3	**CO3**	3	2	1			2	1					2	3	2	
4	**CO4**	3	2	1			2	1					2	3	2	
5	**CO5**	3	2	1			2	1					2	3	2	
	Average	3	2	1			2	1					2	3	2	

Course Title:	**HYBRID ELECTRIC VECHICLES** [As per NEP 2020, Outcome Based Education (OBE) and		
Course Code:	**22EE752**	**CIE Marks:**	50
Semester:	**7**	**SEE Marks:**	50
Course Type	Theory	**Total Marks:**	100
Teaching Hours/Week	2:1:0:0	**Exam Hours:**	3
Total Hours of Pedagogy:	40 hours	**Credits:**	3

Course Objectives: This Course will enable the stude

1	Understand Energy consumption Concept of Hybrid Electric Drive Trains
2	Understand types of batteries for Hybrid Electric Vehicles (HEV).
3	Understand Configuration and control of Drives for Electric Vehicles.
4	Understand the design configuration of HEV.
5	Understand the converter for battery charging.

Module-1 **8 hours L1, L2,L3**

Electric and Hybrid Electric Vehicles: Configuration of Electric Vehicles, Performance of Electric Vehicles, Traction motor characteristics, Tractive effort and Transmission requirement, Vehicle performance, Tractive effort in normal driving, Energy consumption Concept of Hybrid Electric Drive Trains, Architecture of Hybrid Electric Drive Trains, Series Hybrid Electric Drive Trains, Parallel hybrid electric drive trains.

Module-2 **8 hours L1, L2 ,L3**

Energy storage for EV and HEV: Energy storage requirements, Battery parameters, Types of Batteries, Modelling of Battery, Fuel Cell basic principle and operation, Types of Fuel Cells, PEMFC and its operation, Modelling of PEMFC, Supercapacitors.

Module-3 **8 hours L1, L2,L3**

Electric Propulsion: EV consideration, DC motor drives and speed control, Induction motor drives, Permanent Magnet Motor Drives, Switched Reluctance Motor Drive for Electric Vehicles, Configuration and control of Drives.

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

Design of Electric and Hybrid Electric Vehicles:
Series Hybrid Electric Drive Train Design: Operating patterns, control strategies, Sizing of major components, power rating of traction motor, power rating of engine/generator, design of PPS Parallel Hybrid Electric Drive Train ,Control strategies of parallel hybrid drive train, design of engine power capacity, design of electric motor drive capacity, transmission design, energy storage design.

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

Power Electronic Converter for Battery Charging: Charging methods for battery, Termination methods, charging from grid, The Z-converter, Isolated bidirectional DC-DC converter, Design of Z- converter for battery charging, High-frequency transformer based isolated charger topology, Transformer less topology.

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

CO1:	Explain the working of electric vehicles and recent trends.
CO2:	Analyze different power converter topologies used for electric vehicle applications.
CO3:	Develop the electric propulsion and its control unit for application of electric vehicles.
CO4:	Design configuration of Hybrid Electric Vehicles.
CO5:	Design converters for battery charging and explain transformer less topology.

Question Paper Pattern:

SEE Assessment:

1	The SEE question paper will be set for 100 marks and the marks scored will be proport
2	The question paper will have ten full questions carrying 20 marks each.
3	There will be two full questions (with a maximum of four sub questions) from each mo
4	Each full question will have sub questions covering all the topics of the module.
5	Students have to answer any Five Full questions, choosing at least one full question fro
CIE Assessment:	
1	Two tests will be conducted each of 15 marks, average of best of two tests will be consi
2	Session wise Assignment will be 35 Marks
Text Books:	
1 Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design	
Reference Books:	
1	Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles Sheldon S. Williamson Springer 2013.
2	Modern Electric Vehicle Technology C.C. Chan and K.T. Chau Oxford University
3	Hybrid Electric Vehicles Principles And Applications With Practical Perspectives

COURSE OUTCOME AND PROGRAM OUTCOME MAPPING																
Course Name:		HYBRID ELECTRIC VEHICLES														
Course Code:		22EE752														
Sl. No.	**CO\PO**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**	**PSO3**
1	**CO1**	3														
2	**CO2**	3	3				2	1					1			
3	**CO3**	3	3	3			2	1					1			
4	**CO4**	3	3	3			2	1					1			
5	**CO5**	3	3	3			2	1					1			
	Average	3	2.4	1.2			1.6	0.8					1			

Course Title:	**POWER SYSTEM SIMULATION LABORATORY**		
	[As per NEP 2020, Outcome Based Education (OBE) and Choice Based		
Course Code:	**22EEL76**	**CIE Marks:**	50
Semester:	**7**	**SEE Marks:**	50
(Theory/Practical/Integrated):	LAB	**Total Marks:**	100
(L:T:P:S):	0:0:2:0	**Exam Hours:**	3
Total Hours of Pedagogy:	24 hours	**Credits:**	1

Course Objectives: This Course will enable the students to:

1	Understand the performance of short and medium transmission lines.
2	Obtain the admittance and impedance matrices of interconnected power systems.
3	Understand the analysis of power flow problem for simple power systems.
4	Understand optimal generation scheduling problems for thermal power plants.
5	Understand fault analysis of a given network.

Sl. No	**Experiments**
1	Determination of voltage regulation and efficiency of a short transmission line,
2	Determination of voltage regulation and efficiency of medium transmission line (nominal π-network,
3	Formation of Y-Bus for Power Systems without Mutual Coupling, by Singular Transformation
4	Formation of Y-Bus for Power Systems by Inspection Method.
5	Formation of Z Bus(without mutual coupling) using Z-Bus Building Algorithm.
6	To obtain Swing Curve and to Determine Critical Clearing Time, Regulation, Inertia Constant/Line Time/Pre-Fault Electrical Output for a Single Machine connected to Infinite Bus
7	Load Flow Analysis using Gauss Siedel Method .
8	Load Flow Analysis using Newton Raphson Method .
9	Economic dispatch in power system , neglecting losses.
10	Optimal Generation Scheduling for Thermal power plants.
11	Symmetrical Fault analysis to find out fault current, post-fault voltage and line flow of a given
12	Unsymmetrical fault analysis to find out the fault current of a given network.

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

CO1: Analyze the performance of short and medium transmission lines.

CO2: Determine bus admittance, bus impedance matrices .

CO3: Perform load flow analysis using Gauss siedel method and Newton Raphson method

CO4: Obtain Economic dispatch in power system ,neglecting losses and Optimal Generation Scheduling for Thermal power plants.

CO5: Analyze Symmetrical Faults to find out fault current, post-fault voltage and line flow of a given network.

Practical Examination Conduction:

SEE Assessment:

1. Students will be given two experiments for their write-up.
2. Students need to conduct one of the two experiments given.
3. 15% of total marks are allotted for writeup, 70% of total marks are given to the conduction of experiment and remaining 15% of total marks will be given to Viva-Voce.

CIE Assessment:

1. One test will be conducted at the end of the semester of 15 marks out of total marks 50.
2. The remaining 35 marks are given to oveall conduction of an experiments by the students and also to the Observation/Assignment book.

Graduate Attributes (As per NBA)
Engineering Knowledge, Problem Analysis, Individual and Team work, Communication.
Conduct of Practical Examination:
1. Laboratory experiments are to be included for practical examination. 2. Breakup of marks and the instructions printed on the cover page of answer script to be 3. Students can pick one experiment from the questions lot prepared by the examiners. 4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to

COURSE OUTCOME AND PROGRAM OUTCOME MAPPING																
Course Name:		POWER SYSTEM SIMULATION LABORATORY														
Course Code:		22EEL76														
Sl. No.	CO\PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1	CO1	3	2				1			3	3		1	3	1	
2	CO2	3	2				1			3	3		1	3	1	
3	CO3	3	2				1			3	3		1	3	1	
4	CO4	3	2				1			3	3		1	3	1	
5	CO5	3	2				1			3	3		1	3	1	
	Average	3	2				1			3	3		1	3	1	

Course Title:	**HIGH VOLTAGE ENGINEERING LABORATORY**		
	[As per NEP 2020, Outcome Based Education (OBE) and Choice Based		
Course Code:	**22EEL77**	**CIE Marks:**	50
Semester:	**7**	**SEE Marks:**	50
Course Type	LAB	**Total Marks:**	100
Teaching Hours/Week	0:0:2:0	**Exam Hours:**	3
Total Hours of Pedagogy:	24 hours	**Credits:**	1

Course Objectives: This Course will enable the students to:

1	Conduct experiments to study the spark over characteristics for both uniform and non-uniform configurations using High AC and DC voltage.
2	Conduct experiment to measure the breakdown strength of transformer oil.
3	Conduct experiment to measure the capacitance of different electrode configuration models using Electrolytic Tank.
4	Conduct experiment to determine Surface Flashover on the surface of insulating materials.
5	Conduct experiment to determine audible and visible corona inception and extinction voltage under the non- uniform field.

Sl. No.	**Experiments**
1	Measurement of Breakdown Strength of Transformer Oil.
2	Field Mapping using Electrolytic test kit.
3	Measurement of HVAC using sphere gap equipment.
4	Measurement of HVDC using sphere gap equipment.
5	Finding of flash over voltages of uniform and non-uniform field electrodes subjected to HVAC.
6	Finding of flash over voltages of uniform and non-uniform field electrodes subjected to HVDC.
7	To perform experiment on the horn gap arrestor and understand the arc quenching phenomenon.
8	Surface Flashover on the surface of polymer insulating materials.
9	Surface Flashover on corrugated porcelain insulating materials.
10	To understand the basic principle of corona and obtain audible and visible corona inception and

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

CO1:	Determine the spark over characteristics for both uniform and non-uniform configurations using High AC and DC voltage.
CO2:	Determine the breakdown strength of transformer oil.
CO3:	Determine the capacitance of different electrode configuration models using Electrolytic Tank.
CO4:	determine Surface Flashover on the surface of insulating materials.
CO5:	Determine audible and visible corona inception and extinction voltage under non- uniform field.

Practical Examination Conduction:

SEE Assessment:

1. Students will be given two experiments for their write-up.
2. Students need to conduct one of the two experiments given.
3. 15% of total marks are allotted for writeup, 70% of total marks are given to the conduction of experiment and

CIE Assessment:

1. One test will be conducted at the end of the semester of 15 marks out of total marks 50.
2. The remaining 35 marks are given to oveall conduction of an experiments by the students and also to the

Graduate Attributes (As per NBA)

Engineering Knowledge, Problem Analysis, Individual and Team work, Communication.

Conduct of Practical Examination:

1. Laboratory experiments are to be included for practical examination.
2. Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners.
3. Students can pick one experiment from the questions lot prepared by the examiners.
4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

COURSE OUTCOME AND PROGRAM OUTCOME MAPPING																
Course Name:		**HIGH VOLTAGE ENGINEERING LABORATORY**														
Course Code:		22EEL77														
Sl. No.	**CO\PO**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**	**PSO3**
1	**CO1**	3	2				2			3	3		1	3	3	
2	**CO2**	3	2				2			3	3		1	3	3	
3	**CO3**	3	2				2			3	3		1	3	3	
4	**CO4**	3	2				2			3	3		1	3	3	
5	**CO5**	3	2				2			3	3		1	3	3	
	Average	3	2				2			3	3		1	3	3	

Course Title:	**PROJECT-VII**		
	[As per NEP 2020, Outcome Based Education (OBE) and Choice Based		
Course Code:	**22PRJ79**	**CIE Marks:**	50
Semester:	**7**	**SEE Marks:**	50
Course Type (Theory/Practical/Integrated):	Integrated	**Total Marks:**	100
Teaching Hours/Week (L:T:P:S):	0:1:1:0	**Exam Hours:**	3
Total Hours of Pedagogy:	24	**Credits:**	1

Course Objectives: The goal of the course Project III (21PRJ79) is to

1. Get exposure about the Electrical & Electronics hardware and various software tools.
2. Design the working model of the open ended problem.
3. Understand the Electrical and Electronics concepts.
4. Understand the latest technology trends in the electrcial system.
5. Prepare technical documentation of the project.

STUDENTS WILL BE GIVEN A OPEN ENDED PROBLEM OF THE SOCIETY AND ASKED TO SOLVE BY DESIGNING AND IMPLEMENTING THE SYSTEM IN A TEAM.

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

CO1: Apply the knowledge of electrical and electronics hardware and software components to solve the real time problems of the society

CO2: Analyze the various existing solutions available to solve the real time problem and propose the best solution

CO3: Design and implement the system to solve the real time problem of the society

CO4: Conduct investigations on the output and prepare the technical documentation of the designed /system in a team

CO5: Use the modern tool available like advanced hardware and software tools

Conduction of Assessment:

SEE and CIE Assessment

SEE Assessment: The SEE for the Project shall be evaluated by two examiners jointly and the evaluation

CIE Assessment: Design and fabrication of the project -50% of the maximum marks, Evaluation of project

COURSE OUTCOME AND PROGRAM OUTCOME MAPPING																
Course Name:		PROJECT VII														
Course Code:		22PRJ79														
Sl. No.	**CO\PO**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**	**PSO3**
1	**CO1**	3											2	3	2	
2	**CO2**		3										2	3	3	
3	**CO3**			3			3						2	3	3	
4	**CO4**				3		3	3	3	3	3	3	3	3	3	
5	**CO5**					3							2			
	Average	3	3	3	3	3	3	3	3	3	3	3	2	3	3	

PROJECT - VIII
[As per Choice Based Credit System (CBCS) Scheme]
SEMESTER - VIII

Subject Code	22PRJ81	**CIE Marks**	50
No. of Practical Hours/Week	16	**SEE Marks**	50
		Exam Hours	3

CREDITS - 08

Course Objectives:
This Course will enable the students to:

- Independent Learning.
- Selection and Utilization of adequate information.
- Organization and presentation of information.
- Learn to work with team members.
- Expand one's intellectual capability and decision making.
- Meeting the deadlines

Project - VIII
Students in consultation with the guide take up an updated topic on the subjects taught in eighth semester and search and collect the relative literature and then study. Students in a team should come with an idea as a result of literature studies and build a prototype to demonstrate the implementation of the idea.

Course Outcome:
At end of the course, students will be able to:
CO1: Exhibit a thorough understanding of the selected project topic, showcasing sound technical expertise and domain-specific knowledge.
CO2: Identify, formulate, and analyze engineering problems systematically to derive precise and actionable problem statements.
CO3: Develop and design innovative engineering solutions to address identified problems effectively and efficiently.
CO4: Implement and execute the project successfully, adhering to engineering standards, timelines, and resource constraints.
CO5: Effectively communicate project outcomes and solutions through professional presentations and reports to academic peers, industry professionals, and the broader society.

Graduate Attributes:
Engineering knowledge, Problem Analysis, Individual and teamwork, Communication.

Examinations:

Continuous Internal Evaluation:
CIE marks for the project is 50 marks.

1. Report 25 marks
2. Presentation 25 marks

Marks shall be awarded by a guide with one examiner (senior most faculty within the department) selected by the head of the department based on his/her performance.

Semester End Examination:
SEE marks for the project is 50 marks.

1. Report 15 marks
2. Presentation 15 marks
3. Viva-Voce 20 marks.

Marks shall be awarded by two examiners (one internal and one external) constituted by the head of the department/dean.

Sl.No.	PO / CO	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1	CO1	3								3	3	3				
2	CO2	3	3							3	3	3				
3	CO3	3	3	3	3	3				3	3	3		3	3	
4	CO4	3	3		3	3				3	3	3	3	3	3	
5	CO5						3	2	1	3	3	3	3			3
	AVERAGE	3	3	3	3	3	3	2	1	3	3	3	3	3	3	3

INTERNSHIP

[As per Outcome Based Education (OBE) and Choice Based Credit System (CBCS) Scheme]
SEMESTER-IV

Subject Code	22EEI82	CIE Marks	50
Total No. of implementation/training weeks	12P	SEE Marks	50
		Exam Hours	03

CREDITS-06

Course Objectives: Students will be taught to:

1. Learn to appreciate work and its function in the economy.
2. Develop work habits and attitudes necessary for job success.
3. Develop communication, interpersonal and other critical skills in the job interview process.
4. Build a record of work experience.
5. Acquire employment contacts leading directly to a full-time job following graduation from college.

Students has to carry out the internship OF 12 weeks in the industry.

Course outcomes: After studying this course, students will be able to:

CO1. Apply the knowledge of electronics hardware and software components to solve the real time problems of the society.

CO2. Analyze the various existing solutions available to solve the real time problem and propose the best solution.

CO3. Design and implement the system to solve the real time problem of the society.

CO4.Conduct investigations on the output and prepare the technical documentation of the designed system in a team.

CO5.Use the modern tool available like advanced hardware and software tools.

COURSE OUTCOME AND PROGRAMME OUTCOME MAPPING (1/2/3):

Note: 1-Low, 2-Medium, 3-High

CO/PO	PO.1	PO.2	PO.3	PO.4	PO.5	PO.6	PO.7	PO.8	PO.9	PO.10	PO.11	PO.12	PSO.1	PSO.2	PSO.3
CO1	3	-	-	-	3	3	2	-	-	-	-	3	-	3	-
CO2	2	3	2	2	-	2	2	-	-	-	-	3	-	3	-

CO3	**2**	**2**	**3**	**2**	**-**	**2**	**2**	**-**	**-**	**-**	**-**	**3**	**-**	**3**	**-**
CO4	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**3**	**2**	**3**	**-**	**3**	**-**
CO5	**-**	**-**	**-**	**-**	**3**	**-**	**-**	**2**	-	-	-	**3**	**-**	**3**	**-**