

SWAMI VIVEKANAND SUBHARTI UNIVERSITY,
MEERUT



FACULTY OF ENGINEERING & TECHNOLOGY

ORDINANCE No. V-2 (B3)

**RELATING TO COURSE CURRICULUM & SYLLABUS
OF UG PROGRAM**

BACHELOR OF TECHNOLOGY (B.Tech.) EEE

(Effective from the Session – 2025-26)

Approved by the Academic Council of the Meeting held on 06 May 2025

Approved by the Executive Council of the Meeting held on 28 June 2025


(Pankaj Gautam)


(Er. Ravi)


(Mary Kapi)



FACULTY OF ENGINEERING AND TECHNOLOGY
SWAMI VIVEKANAND SUBHARTI UNIVERSITY, MEERUT
STUDY & EVALUATION SCHEME
(As per NEP 2020 and AICTE Guidelines)
B.Tech.2ndYear/3rdSemester (Electrical and Electronics Engineering)
w.e.f. academic Session 2026-27

SEMESTER III														
S. No.	Course Code	Course Name	Course Domain	Periods			CCA				ESE		Total	Credit
				L	T	P	CT	AT	Total	PS	TE	PE		
1	UOE-3**/ UAS-303	Science Based Open Elective/Engineering Mathematics-III	ES/BS	3	0	0	20	10	30	-	70	-	100	3
2	UHU-305/ UAS-304	Soft Skills*/ Environmental Science *	AEC	3	0	0	20	10	30	-	70	-	100	3
3	UEEE-301	Electrical Machines-I	ES	3	0	0	20	10	30	-	70	-	100	3
4	UEEE-302	Electrical Circuit Analysis	ES	3	0	0	20	10	30	-	70	-	100	3
5	UEEE-303	Electromagnetic Field Theory	ES	3	0	0	20	10	30	-	70	-	100	3
6	UEEE-351	Electrical Machines –ILab	SEC	0	0	4	-	-	-	15	-	35	50	2
7	UEEE-352	Electrical Circuit Analysis Lab	ES	0	0	2	-	-	-	15	-	35	50	1
8	UVA-301/ UVA-302	Introduction to MATLAB-I / Introduction to MATLAB-II	VAC-1/ VAC-2	0	0	4	-	-	-	15	-	35	50	2
9	UCC-351	Internship Assessment/Mini Project		-	-	-	-	-	-	100	-	-	100	2
10	UNC-301	Disaster Management & Preparedness	MC	1	0	2	20	10	30	-	70	-	100	0
Total													850	22

*May be offered through NPTEL

Abbreviation Used:

BS: Basic Science Course

ES: Engineering Science Course

HS: Humanities and Social Sciences, including Management Course

MC: Mandatory Course

SEC: Skill Enhancement Course

(Sanjay Gantam)

(Ravi)

(Ajay Kumar)



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B.Tech.2ndYear/4thSemester (Electrical and Electronics Engineering)
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SEMESTER IV														
S No.	Course Code	Course Name	Course Type	Periods			CCA				ESE		Total	Credit
				L	T	P	CT	AT	Total	PS	TE	PE		
1	UOE-4**/ UAS-403	Science-Based Open Elective/ Engineering Mathematics-III	ES/BS	3	0	0	20	10	30	-	70	-	100	3
2	UHU-405/ UAS-404	Soft Skills/ Environmental Science	AEC	3	0	0	20	10	30	-	70	-	100	3
3	UEEE-401	Analog & Digital Electronics	ES	3	0	0	20	10	30	-	70	-	100	3
4	UEEE-402	Electrical Machine-II	ES	3	0	0	20	10	30	-	70	-	100	3
5	UEEE-403	Signals and Systems	ES	3	0	0	20	10	30	-	70	-	100	3
6	UEEE-451	Analog & Digital Electronics Lab	ES	0	0	2	-	-	-	15	-	35	50	1
7	UEEE-452	Electrical Machine –IILab	ES	0	0	2	-	-	-	15	-	35	50	1
8	UEEE-453	Measurement & Instrumentation Lab	SEC	0	0	4	-	-	-	15	-	35	50	2
9	UVA-401/ UVA-402	Introduction to MATLAB-I / Introduction to MATLAB-II	VAC-3/ VAC-4	0	0	4	-	-	-	15	-	35	50	2
10	UHU-401	Universal Human Values-II: Understanding Harmony and Ethical Human Conduct	HS	3	0	0	20	10	30	-	70	-	100	3
Total													800	24

Summer Internship (4-6 weeks) during summer break after Semester-IV and same will be assessed/evaluated in the Semester-V

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YEAR II, SEMESTER-III SYALLBUS

UEEE-301	Electrical Machines-I	3L:0T:0P	3 credits
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Course Outcomes:

At the end of this course, students will demonstrate the ability to

CO-1: Analyze the various principles & concepts involved in Electromechanical Energy conversion.

CO-2: Demonstrate the constructional details of DC machines as well as transformers, and principle of operation of brushless DC motor, Stepper and DC Servo motors.

CO-3: Evaluate the performance and characteristics of DC Machine as motor and as well as generator.

CO-4: Evaluate the performance of transformers, individually and in parallel operation.

CO-5: Demonstrate and perform various connections of three phase transformers.

UNIT I

Pre- Requisites: Magnetic Materials, BH characteristics.

Principles of Electro-mechanical Energy Conversion: Introduction, Review of magnetic system, Energy in Magnetic system, Force and torque in magnetic field system, Energy balance equation, Energy conversion via electrical field, Energy in a singly excited system, Determination of the Force and Torque from energy and co-energy, Generation of EMF in Machines, Torque in machine with cylindrical air gap.

UNIT II

Pre- Requisites: Principle & Construction, Classification and circuit model, EMF equation of generator and torque equation of motor.

DC Machines: Armature winding (Concentrated and Distributed), Winding Factor, Armature reaction, Commutation, Interpoles and compensating windings, Performance characteristics of DC generators, Applications.

UNIT III

DC Machines (Contd.): Performance characteristics of DC motors, Starting of DC motors; 3 point and 4 point starters, Speed control of DC motors; Field control, Armature control and Voltage control (Ward Leonard method); Efficiency and Testing of DC machines (Hopkinson's and Swinburne's Test), Applications, Introduction to Brushless DC Motor, stepper motor and DC Servo motor and their applications.

UNIT IV

Pre- Requisites: Construction & Principle, Ideal and practical transformer, equivalent circuit & phasor diagram, losses in transformers.

Single Phase Transformer: Efficiency and voltage regulation, all day efficiency, Excitation phenomenon and harmonics in transformers. Testing of Transformers- O.C. and S.C. tests, Polarity test, Sumpner's test. Auto Transformer- Single phase and three phase autotransformers, Volt-amp relation, Copper saving in autotransformer Efficiency, Merits & demerits and applications.

UNIT V

Pre- Requisite: Three-phase connections – Star/Delta.

Three Phase Transformers: Construction, Three phase transformer, phasor groups and their connections, open delta connection, three phase to 2 phase and their applications, Three winding transformers. Parallel operation of single phase and three phase transformers and load sharing.

Text Books:

1. IJ Nagrath & D.P. Kothari, "Electrical Machines", Tata McGraw Hill
2. Rajendra Prasad, "Electrical Machines", PHI
3. PS Bimbhra, "Electrical Machinery", Khanna Publisher

Reference Books:

1. H. Cotton, "Electrical Technology", CBS Publication.
2. MG Say, "The Performance and Design of AC machines", Pit man& Sons.
3. PS Bimbhra, "Generalized Theory.

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UEEE-302	Electrical Circuit Analysis	3L:0T:0P	3 credits
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Course Outcomes:

At the end of this course, students will demonstrate the ability to

CO -1: Apply the knowledge of basic circuit law, nodal and mesh methods of circuit analysis, and simplify the network using the Graph Theory approach.

CO- 2: Analyze the AC and DC circuits using Kirchhoff's law and Network simplification theorems.

CO -3: Analyze steady-state responses and transient responses of DC and AC circuits using classical and Laplace transform methods.

CO- 4: Demonstrate the concept of complex frequency and analyze the structure and function of one and two-port networks. Also, evaluate and analyze two-port network parameters.

CO -5: Synthesize one port network and analyze different filters.

UNIT I

Mesh & Nodal analysis:

Node and mesh analysis, matrix approach of network containing voltage & current sources and reactances, source transformation and duality.

Unit II

AC Network Theorems (Applications to dependent & independent sources):

Network theorems: Superposition, reciprocity, Thevenin's, Norton's, Maximum power transfer, compensation and Tellegen's theorem as applied to A.C. circuits.

Unit III

Laplace Transform & Concept of Initial conditions:

Laplace transforms and properties: Partial fractions, singularity functions, waveform synthesis, analysis of RC, RL, and RLC networks with and without initial conditions with Laplace transforms evaluation of initial conditions.

Steady state response of a network to non-sinusoidal periodic inputs, Power factor, effective values.

Unit IV

Network Functions: Network function for one-port and two-port, calculation of network function for ladder and general networks, poles and zeros with restrictions for driving point functions and transform functions.

Two Port Networks:

Introduction, Parameters, and Condition for reciprocity and symmetry, Relation between port parameters, Interconnection of two ports networks.

Unit V

Sinusoidal response & Filters:

Sinusoidal response from pole-zero locations, convolution theorem, behaviour of series and parallel resonant circuits.

Introduction to band pass, low pass, high pass and band reject filters.

Text Books:

1. ME Van Valkenburg, "Network Analysis", Prentice Hall of India.
2. Alexander, Sadiku, "Fundamentals of Electric Circuits", McGraw Hill.
3. D. Roy Choudhary, "Networks and Systems", Wiley Eastern Ltd.

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UEEE-303	Electromagnetic Field Theory	3L:0T:0P	3 credits
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Course Outcomes: Upon the completion of the course, the student will be able to:

CO-1: Apply different coordinate systems and their application in electromagnetic field theory, establish a relation between any two systems and also understand the vector calculus.

CO-2: Understand the concept of static electric field. Understand the concept of current and properties of conductors. Establish boundary conditions and to calculate capacitances of different types of capacitors.

CO-3: Understand the concept of static magnetic field, magnetic scalar and vector potential.

CO-4: Understand the forces due to magnetic field, magnetization, magnetic boundary conditions, and inductors.

CO-5: Understand displacement current, time-varying fields, propagation, and reflection of EM waves and transmission lines.

UNIT 1: Review of Vector Calculus

Coordinate Systems and Transformation: Basics of Vectors: Addition, subtraction and multiplications; Cartesian, Cylindrical, Spherical transformation. Vector calculus: Differential length, area and volume, line surface and volume integrals, Del operator, Gradient, Divergence of a vector, Divergence theorem, Curl of a vector, Stokes's theorem, Laplacian of a scalar.

UNIT II Electrostatic fields: Coulombs law and field intensity, Electric field due to charge distribution, Electric flux density, Gauss's Law- Maxwell's equation, Electric dipole and flux line, Energy density in electrostatic fields, Electric field in material space: Properties of materials, convection and conduction currents, conductors, polarization in dielectrics, Dielectric-constants, Continuity equation and relaxation time, boundary conditions, Electrostatic boundary value problems: Poisson's and Laplace's equations., Methods of Images.

UNIT III Magneto statics: Magneto-static fields, Biot - Savart's Law, Ampere's circuit law, Maxwell's equation, Application of ampere's law, Magnetic flux density- Maxwell's equation, Maxwell's equation for static fields, magnetic scalar and vector potential.

UNIT IV Magnetic forces: Materials and devices, Forces due to magnetic field, Magnetic torque and moment, a magnetic dipole. Magnetization in materials, Magnetic boundary conditions, Inductors and inductances, Magnetic energy.

UNIT V Waves and Applications: Maxwell's equation, Faraday's Law, transformer and motional electromotive forces, Displacement current, Maxwell's equation in final form Electromagnetic wave propagation: Wave propagation in loss dielectrics, Plane waves in lossless dielectrics Plane wave in free space. Plain waves in good conductors, Power and the pointing vector, Reflection of a plain wave in a normal incidence. Transmission Lines and Smith Chart.

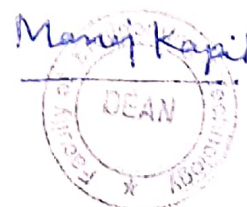
Text / References:

- M. N. O. Sadiku, "Elements of Electromagnetics", Oxford University Publication, 2014.
- Pramanik, "Electromagnetism - Theory and applications", PHI Learning Pvt. Ltd, New Delhi, 2009.
- Pramanik, "Electromagnetism-Problems with solution", Prentice Hall India, 2012.

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UEEE-351: Electrical Machines- I Laboratory (0:0:2 – 1 credit)

Course Outcome: At the end of this course, students will be able to:

CO-1: Perform various tests on DC machines and transformers and record experimental data accurately.

CO-2: Determine the performance characteristics, efficiency, voltage regulation, and losses of DC machines and transformers using experimental results.

CO-3: Analyze the operating characteristics of DC generators and DC motors under different loading conditions.

CO-4: Evaluate the equivalent circuit parameters of single-phase transformers through open-circuit and short-circuit tests.

CO-5: Demonstrate safe laboratory practices, proper use of measuring instruments, and prepare technical reports based on experimental observations and analysis.

1. To obtain magnetization characteristics of a DC shunt generator.
2. To obtain load characteristics of a DC shunt generator and compound generator (a) Cumulatively compounded (b) Differentially compounded.
3. To obtain efficiency of a dc shunt machine using Swinburn's test.
4. To perform Hopkinson's test and determine losses and efficiency of DC machine.
5. To obtain speed-torque characteristics of a DC shunt motor.
6. To obtain speed control of the DC shunt motor using (a) armature resistance control (b) field control.
7. To obtain speed control of DC separately excited motor using Conventional Ward-Leonard/ Static Ward-Leonard method.
8. To study polarity and ratio test of single-phase and 3-phase transformers.
9. To obtain equivalent circuit, efficiency, and voltage regulation of a single-phase transformer using C.C. and S.C. tests.
10. To obtain efficiency and voltage regulation of a single-phase transformer by Sumpner's test.
11. To obtain 3-phase to 2-phase conversion by Scott connection.
12. To determine the excitation phenomenon (B.H. loop) of a single-phase transformer using C.R.O.

UEEE-352: Electrical Circuit Analysis Laboratory (0:0:2 – 1 credit)

Course Outcome: At the end of this course, students will be able to:

CO -1 Understand the basics of electrical circuits with nodal and mesh analysis.

CO-2 Appreciate electrical network theorems.

CO-3 Analyse RLC circuits.

CO-4 Determine the stability of an electrical circuit.

CO-5 Design network filters.

List of Experiments:

Ten experiments to be performed:

1. Verification of Maximum power transfer theorem.
2. Verification of Tellegen's theorem.
3. Study of phenomenon of resonance in RLC series circuit and obtain resonant frequency.
4. Design and find the cut-off frequency of low-pass and high-pass filters.
5. Design and find the pass band frequencies of band-pass filters.
6. Design and find the stop band frequencies of band-reject filters.
7. Determination of two-port network Z and h parameters.

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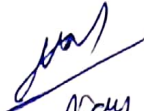


8. Verification of parameters properties in the interconnection of 2, two-port networks in series-series interconnection.
9. Verification of parameters properties in the interconnection of 2, two-port networks in parallel-parallel interconnection.
10. Determination of Z parameters of a T network and Computation of corresponding parameters to equivalent network.
11. To perform the transient response of the RL circuit.
12. Verification of parameters properties in the interconnection of 2, two-port networks in cascade interconnection.

Note: Any two experiments from the above list should also be performed by students in Virtual Lab.


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YEAR II, SEMESTER-IV SYALLBUS

UEEE-401	Analog & Digital Electronics	3L:0T:0P	3 credits
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Course Outcomes: At the end of this course, students will demonstrate the ability to

CO-1: Explain the operating principles and characteristics of semiconductor devices and analog electronic circuits.

CO-2: Analyze the performance of transistor amplifiers and electronic circuits under different operating conditions.

CO-3: Design and evaluate Op-Amp-based analog circuits for signal processing applications.

CO-4: Apply Boolean algebra and logic minimization techniques to design combinational digital circuits.

CO-5: Design and analyze sequential circuits, memory systems, ADCs, and DACs for digital electronic applications.

Unit-I: Semiconductor Devices and Diode Circuits: Energy bands in semiconductors , Intrinsic and extrinsic semiconductors, PN junction diode characteristics, Zener diode and voltage regulation, Rectifiers: Half-wave and Full-wave, Filters and power supply circuits, Clipping and clamping circuits.

Unit-II: Transistor and Analog Amplifiers:

- Bipolar Junction Transistor (BJT) operation
- CB, CE, and CC configurations
- Transistor biasing techniques
- Small-signal CE amplifier
- Frequency response of amplifiers
- Field Effect Transistor (FET) characteristics
- FET amplifiers

Unit-III: Operational Amplifiers and Applications:

- Differential amplifier
- Ideal and practical Op-Amp characteristics
- Inverting and Non-inverting amplifiers
- Summing, Subtracting, Integrator, and Differentiator circuits
- Comparator and Schmitt Trigger
- Active filters
- Oscillators using Op-Amps

Unit-IV: Digital Logic Fundamentals:

- Number systems and code conversions
- Boolean algebra and logic gates
- Universal gates
- Karnaugh Map (K-Map) simplification
- Combinational circuits:
 - Adders and Subtractors
 - Multiplexers and Demultiplexers
 - Encoders and Decoders

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- Logic families: TTL and CMOS

Unit-V: Sequential Circuits and Memories

- Latches and Flip-Flops (SR, JK, D, T)
- Registers and Shift Registers
- Counters (Asynchronous and Synchronous)
- Memory devices: RAM, ROM, EPROM, EEPROM
- Analog-to-Digital Converters (ADC)
- Digital-to-Analog Converters (DAC)
- Introduction to Programmable Logic Devices (PLDs)

Text Books:

1. Electronic Devices and Circuit Theory – Robert L. Boylestad & Louis Nashelsky, Pearson Education.
2. Integrated Electronics – McGraw-Hill Education.
3. Digital Principles and Applications – McGraw-Hill Education.
4. Digital Design – Pearson Education.

UEEE-402	Electrical Machines – II	3L:0T:0P	3 credits
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Course Outcomes: At the end of this course, students will demonstrate the ability to
CO-1: Explain the construction, operation, and performance characteristics of synchronous generators and determine voltage regulation.

CO-2: Analyze the operating characteristics and applications of synchronous motors and synchronous machines connected to an infinite bus.

CO-3: Evaluate the performance of three-phase induction motors using equivalent circuits, tests, and torque-slip characteristics.

CO-4: Analyze various starting methods, speed control techniques, and special features of three-phase induction motors.

CO-5: Explain the operation, characteristics, and applications of single-phase induction motors, repulsion motors, universal motors, and BLDC motors.

Unit – I: Synchronous Machine-I: Constructional features, Armature winding, EMF Equation, Winding coefficients, Equivalent circuit and phasor diagram, Armature reaction, O.C. & S.C. tests, Voltage regulation using Synchronous Impedance method, MMF method, Potier's Triangle method, Parallel operation of synchronous generators, Operation on infinite bus, Synchronizing power and torque coefficient.

Unit – II: Synchronous Machine-II: Two reaction theory, Power flow equations of cylindrical and salient pole machines, Operating characteristics. Synchronous Motor-Starting methods, Effect of varying field current at different loads, V- curves, Hunting & damping, Synchronous condenser.

Unit – III: Three-phase Induction Machine-I: Constructional features, Rotating magnetic field, Principle of operation, Phasor diagram, Equivalent circuit, Torque and power equations, Torque-slip characteristics, No-load & blocked rotor tests, Efficiency, Induction generator & its applications.

Unit – IV: Three phase Induction Machine-II: Starting, Deep bar and double cage rotors, Cogging & Crawling, Speed control (with and without emf injection in rotor circuit).

Unit – V: Single phase Induction Motor: Double revolving field theory, Equivalent circuit, No-load and blocked rotor tests, Starting methods, Repulsion motor, Universal motor, Brushless DC Motors.

Text Books:

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1. D.P. Kothari & I.J. Nagrath, "Electric Machines", Tata Mc GrawHill
2. Fitzgerald, A.E., Kingsley and S.D. Umans, "Electric Machinery", McGraw Hill.
3. P.S. Bimbhra, "Electrical Machinery", Khanna Publisher

UEEE-403	Signals and Systems	3L:0T:0P	3 credits
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Course Outcomes: At the end of this course, students will demonstrate the ability to:

CO-1: Represent the various types of signals & systems and can perform mathematical operations on them.

CO-2: Analyze the response of LTI system to Fourier series and Fourier transform and to evaluate their applications to network analysis.

CO-3: Analyze the properties of continuous time signals and system using Laplace transform and determine the response of linear system to known inputs.

CO-4: Implement the concepts of Z transform to solve complex engineering problems using difference equations.

CO-5: Develop and analyze the concept of state-space models for SISO & MIMO system.

UNIT I

Introduction to Continuous Time Signals and Systems: Introduction to continuous time and discrete time signals, Classification of signals with their mathematical representation and characteristics. Transformation of independent variable, Introduction to various type of system, basic system properties.

Analogous System: Linear & Rotational mechanical elements, force-voltage and force-current analogy, modeling of mechanical and electro-mechanical systems: Analysis of first and second order linear systems by classical method.

UNIT II

Fourier Transform Analysis: Exponential form and Compact trigonometric form of Fourier series, Fourier symmetry, Fourier transform: Properties, application to network analysis. Definition of DTFS, and DTFT, Sampling Theorem.

UNIT III

Laplace Transform Analysis: Review of Laplace Transform, Properties of Laplace Transform, Initial & Final value Theorems, Inverse Laplace Transform, Convolution Theorem, Impulse response, Application of Laplace Transform to analysis of networks, waveform synthesis and Laplace Transform to complex waveforms

UNIT IV

State – Variable analysis: Introduction, State Space representation of linear systems, Transfer function and state Variables, State Transition Matrix, Solution of state equations for homogeneous and non-homogeneous systems, Applications of State – Variable technique to the analysis of linear systems.

UNIT V

Z – Transform Analysis: Concept of Z – Transform & ROC, Z – Transform of common functions,

Inverse Z – Transform, Initial & Final value Theorems, Applications to solution of difference equations, Properties of Z-transform.

Text Books:

1. Oppenheim, Wilsky, Nawab, "Signals & Systems", PHI
2. Anand Kumar, "Signals & Systems", PHI
3. Choudhary D. Roy, "Network & Systems", Wiley Eastern Ltd.

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UEEE-451: Analog & Digital Electronics Laboratory (0:0:2 – 1 credit)

Course Outcomes: Knowledge Level, KL Upon the completion of the course, the student will be able to:

- CO-1: Perform experiments on semiconductor devices and analyze their characteristics.
- CO-2: Design and test analog electronic circuits using diodes, transistors, and operational amplifiers.
- CO-3: Verify the operation of logic gates and combinational digital circuits.
- CO-4: Implement and analyze sequential circuits using flip-flops, counters, and registers.
- CO-5: Demonstrate proficiency in electronic circuit testing, measurement, and laboratory practices.

List of Experiments :-

1. Study of V-I characteristics of PN Junction Diode and determination of static and dynamic resistance.
2. Study of Zener diode characteristics and implementation of Zener voltage regulator.
3. Verification of Half-Wave and Full-Wave Rectifiers with and without filters.
4. Study of clipping and clamping circuits using diodes.
5. Study of BJT characteristics in Common Emitter (CE) configuration.
6. Design and analysis of single-stage CE transistor amplifier.
7. Verification of Op-Amp applications: Inverting and Non-Inverting Amplifiers.
8. Implementation of Op-Amp based Integrator and Differentiator circuits.
9. Verification of basic logic gates and universal gates (NAND and NOR).
10. Realization of combinational circuits using logic gates (Adder, Subtractor, Multiplexer, Decoder).
11. Verification of Flip-Flops (SR, JK, D, and T) and study of their characteristics.
12. Design and implementation of counters and shift registers using flip-flops.

UEEE-452: Electrical Machines-II Laboratory (0:0:2 – 1 credit)

Course Outcomes: At the end of this course, students will demonstrate the ability to

- CO-1: Characteristics of induction and synchronous machines are studied using direct and in direct methods.
- CO-2: Regulation of three phase alternator is predetermined using optimistic, pessimistic and accurate method are done.
- CO-3: Saliency nature of synchronous machine is studied.
- CO-4: Performance of single-phase induction motor is obtained.

List of Experiments :-

1. To perform no load and blocked rotor tests on a three phase squirrel cage induction motor and determine equivalent circuit.
2. To perform load test on a three phase induction motor and draw:
 - (i) Torque-speed characteristics
 - (ii) Power factor-line current characteristics
3. To perform no load and blocked rotor tests on a single phase induction motor and determine equivalent circuit.
4. To study speed control of three phase induction motor by Keeping V/f ratio constant

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5. To study speed control of three phase induction motor by varying supply voltage.
6. To perform open circuit and short circuit tests on a three phase alternator and determine voltage regulation at full load and at unity, 0.8 lagging and leading power factors by (i) EMF method (ii) MMF method.
7. To determine V-curves and inverted V-curves of a three phase synchronous motor.
8. To determine X_d and X_q of a three phase salient pole synchronous machine using the slip test and draw the power-angle curve.
9. To study synchronization of an alternator with the infinite bus by using:
 - (i) dark lamp method (ii) two bright and one dark lamp method

UEEE-453: Measurements and Instrumentation Laboratory (0:0:4 – 2 credit)

Course Outcomes: At the end of this course, students will demonstrate the ability to:

Upon the completion of the course, the student will be able to:

CO-1: Understand the importance of calibration of measuring instruments.

CO-2: Demonstrate the construction and working of different measuring instruments.

CO-3: Demonstrate the construction and working of different AC and DC bridges, along with their applications.

CO-4: Ability to measure electrical engineering parameters like voltage, current, power & phase difference in industry as well as in power generation, transmission and distribution sectors.

CO-5: Capability to analyze and solving the variety of problems in the field of electrical measurements.

List of Experiments :-

1. Calibration of AC voltmeter and AC ammeter.
2. Measurement of inductance using Maxwell's Bridge.
3. Measurement of capacitance using Schering Bridge.
4. Measurement of low resistance using Kelvin's Double Bridge.
5. Measurement of Power using CT and PT.
6. Measuring displacement using LVDT.
7. Measuring temperature using thermocouple.
8. Measuring pressure using piezoelectric pick up.
9. Measurement of speed of DC motor by photoelectric pick up.
10. Speed measurement using Hall Effect sensor.
11. PC based data logging of temperature sensor using LabVIEW/ MATLAB.
12. Signal conditioning of analog signal using LabVIEW/ MATLAB.

Note: Any two experiments from above list should also be performed by students on Virtual Lab

UVA-302	INTRODUCTION TO MATLAB-I	0L:0T:4P	2 Credits
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Course Outcomes: On completion of course the students are able:

CO-1: Apply MATLAB commands, matrix operations, and built-in functions to solve engineering problems.

CO-2: Develop MATLAB programs using scripts, functions, decision-making statements, and looping constructs.

CO-3: Design and implement user-defined functions and debug MATLAB programs for efficient problem-solving.

CO-4: Generate and customize 2D and 3D graphical representations of engineering data using MATLAB visualization tools.

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CO-5: Analyze and interpret engineering data through graphical techniques and present results effectively using MATLAB.

UNIT I: Introduction to MATLAB Environment

- Introduction to MATLAB and its applications in engineering
- MATLAB Desktop, Command Window, Workspace, Editor
- Variables, constants, and data types
- MATLAB operators and expressions
- Input/output commands
- Working with MATLAB files (.m files)
- Built-in mathematical functions

UNIT II: Matrix Operations and Numerical Computation

- Scalars, vectors, matrices, and arrays
- Matrix creation and initialization
- Matrix manipulation and indexing
- Matrix arithmetic operations
- Array operations
- Matrix functions and applications
- Solving systems of linear equations
- Numerical computations using MATLAB

UNIT III: MATLAB Programming Fundamentals

- Script files and function files
- Programming logic and algorithm development
- Decision-making statements: if, if-else, nested if, switch-case
- Looping constructs: for loop, while loop
- Break and continue statements
- User-defined functions
- Debugging and code documentation

UNIT IV: 2D Data Visualization and Graphics

- Introduction to graphical visualization
- 2D plotting using plot()
- Multiple plots and subplot()
- Semilog and log-log plots
- Graph formatting: Titles, Labels, Legends, Annotations
- Bar charts, Pie charts, Histograms
- Engineering data presentation techniques

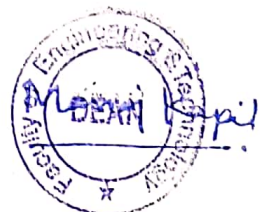
UNIT V: 3D Visualization and Engineering Applications

- 3D plotting concepts
- Mesh plots
- Surface (surf) plots
- Contour plots
- Advanced graphical visualization
- Visualization of engineering datasets

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- Data analysis and interpretation
- MATLAB applications in engineering

Mini-project based on engineering problem solving using MATLAB

UVA-402	INTRODUCTION TO MATLAB-II	0L:0T:4P	2 Credits
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Course Outcomes: On completion of course the students are able:

- CO1:** Apply MATLAB tools, commands, and matrix operations to solve engineering problems.
CO2: Develop MATLAB programs using scripts, functions, decision-making, and looping constructs.
CO3: Create and customize 2D and 3D visualizations for engineering data analysis.
CO4: Utilize numerical methods, optimization techniques, and statistical tools for engineering computations.
CO5: Model, simulate, and analyze engineering systems using MATLAB and Simulink.

UNIT I: Introduction to MATLAB Environment

- Introduction to MATLAB and its applications in engineering
- MATLAB Desktop, Command Window, Workspace, Editor
- Variables, constants, data types, operators
- Input/output commands
- Working with MATLAB files (.m files)
- Built-in mathematical functions

UNIT II: Matrix Operations and Numerical Computation

- Scalars, vectors, matrices, arrays
- Matrix creation and manipulation
- Matrix arithmetic operations
- Array operations
- Matrix functions and applications
- Solving systems of linear equations

UNIT III: MATLAB Programming and Visualization

- Script files and function files
- Decision-making statements and loops
- User-defined functions
- 2D plotting and graph formatting
- Bar charts, pie charts, histograms
- 3D plotting: mesh, surf, contour

UNIT IV: Numerical Computing and Engineering Applications

- Solution of algebraic equations
- Polynomial operations and curve fitting
- Numerical differentiation and integration
- Interpolation techniques
- Linear algebra applications
- Solving systems of equations
- Basic optimization concepts
- Statistical analysis: mean, median, standard deviation, regression analysis

UNIT V: Engineering Modeling, Simulation and Simulink

- Introduction to modeling and simulation
- Simulink environment
- Simulink blocks and libraries
- Model creation and execution
- Transfer function modeling

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- Signal generation and processing
- Engineering system simulation
- Data import/export
- Mini-project development using MATLAB/Simulink

UHV-401	UNIVERSAL HUMAN VALUES-II: UNDERSTANDING HARMONY AND ETHICAL HUMAN CONDUCT	3L:0T:0P	3 Credits
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Course Outcomes: On completion of course the students are able:

CO-1: Understand the significance of value inputs in a classroom, distinguish between values and skills, understand the need, basic guidelines, content and process of value education, explore the meaning of happiness and prosperity and do a correct appraisal of the current scenario in the society.

CO-2: Distinguish between the Self and the Body, understand the meaning of Harmony in the Self the Co-existence of Self and Body.

CO-3: Understand the value of harmonious relationship based on trust, respect and other naturally acceptable feelings in human-human relationships and explore their role in ensuring a harmonious society.

CO-4: Understand the harmony in nature and existence, and work out their mutually fulfilling participation in the nature.

CO-5: Distinguish between ethical and unethical practices, and start working out the strategy to actualize a harmonious environment wherever they work.

Module 1 – 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 – Harmony in the Human Being

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 – Harmony in the Family and Society

Lecture 13: Harmony in the Family – the Basic Unit of Human Interaction

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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
Tutorial 9: Practice Session PS9 Exploring Systems to fulfil Human Goal

Module 4 – Harmony in the Nature/Existence

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 – Implications of the Holistic Understanding – a Look at Professional Ethics

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

Text Books:

Text Book and Teachers Manual

1. The Textbook - A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93- 87034-47-1
2. The Teacher's Manual- Teachers' Manual for A Foundation Course in Human Values and Professional Ethics, RR Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53
3. Professional Ethics and Human Values, Premvir Kapoor, ISBN: 978-93-86173-652, Khanna Book Publishing Company, New Delhi, 2022.

(Ranjit Gaur)

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Dr. Ravi



Course Outcomes: On completion of course the students are able:

CO-1: Understand the concept of partial differential equation and to solve partial differential equations and analyze the concept of partial differential equations.

CO-2: Understand the concept of curve fitting. Correlation and regression.

CO-3: Understand the concept of probability to evaluate probability distributions and apply the concept of hypothesis testing.

CO-4: Understand the concept of transcendental and polynomial equations and interpolation.

CO-5: Analyze the concept the numerical differentiation and integration that are used in dealing with various engineering problems.

COURSE CONTENTS:

Content	Contact Hours
Unit-1: Partial Differential Equations	8
Formation of partial differential equations, Linear and Non-Linear Partial Equations of first order, Lagrange's linear PDE, solution of first order linear and non-linear PDEs by Charpit's method, Solution of homogenous and non-homogenous linear partial differential equations of second and higher orders with constant coefficients, Equations reducible to linear partial differential equations with constant coefficients.	
Unit-2: Statistical Techniques I	8
Measures of central tendency, Measures of dispersion, Curve Fitting, Method of least squares, Fitting of straight lines, Correlation and regression analysis.	
Unit-3: Statistical Techniques II	8
Probability and Distribution: Introduction, Addition and multiplication law of probability, Discrete and Continuous Probability distributions: Binomial, Poisson and Normal distributions. Sampling, Testing of Hypothesis: Introduction, Sampling Theory (Small and Large), Hypothesis, Null hypothesis, Alternative hypothesis, Level of significance, Confidence limits, Test of significance of difference of means, Student's t test and Chi-square test.	
Unit-4: Numerical Techniques - I	8
Zeros of transcendental and polynomial equations using Bisection method, Regula - Falsi method and Newton - Raphson method. Interpolation: Newton's forward and backward difference formulae, Lagrange's interpolation formula and Newton's divided difference formula for unequal intervals.	
Unit-5: Numerical Techniques - II	8
Numerical solution of system of linear equations by Jacobi method and Gauss- Seidel method. Numerical differentiation, Numerical integration by trapezoidal rule, Simpson's one-third and three-eight rules, Solution of ordinary differential equations (first order, second order and simultaneous) by Euler's and fourth-order Runge- Kutta methods.	

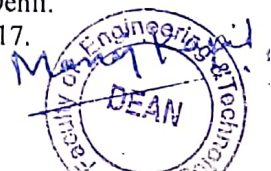
Reference Books:

1. Dr. B.S. Grewal, "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, New Dehli.
2. B. V. Ramana, Higher Engineering Mathematics, McGraw-Hill Publishing Company Ltd., 2017.

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Course Outcomes: On completion of course the students are able:

CO-1: To learn the concept of automation, its classification and terminology.

CO-2: To understand the concept of basic principles of Robots.

CO-3: To apply knowledge of basics of Robot Programming and robotic Applications.

CO-4: To understand and analyze the basic elements of Automation in manufacturing.

CO-5: Evaluate effectively about robotics engineering technologies, their workings and potential applications.

COURSE CONTENTS:

Content	Contact Hours
Unit-1: Introduction to Automation	8
Brief history of automation, Requirement of automation systems, classification & level of automation, Industrial Automation, benefits of Industrial Automation, closed loop & open loop system, role of automation in Industry 4.0.	
Unit-2: Introduction to Robotics	8
Overview: History, Definition and scope of robotics, laws of robotics, classification, advantages and disadvantages of Robot, applications of robots. Robot components: Joints, links, end-effectors, degrees of freedom, brief introduction to forward and inverse kinematics. Robot Ethics: Social impact of robots in society, ethical implications of robotics and automation.	
Unit-3: Industrial Automation Architecture	8
Input Devices: Transducers & sensors, Classification of sensors and applications. Controllers: Classification of controllers in Industrial Automation, principles of hard wire system and PLC, Types of PLC, I/O: Analog and Digital, Ladder programming for logic functions. Actuators: Basics of Hydraulic, Pneumatic and Electric actuators, merits and demerits.	
Unit-4: Automation in Manufacturing	8
Fundamentals of Computer Integrated Manufacturing, elements of a CIM system, benefits of CIM, types of automation in production system, fundamentals of Group Technology and Flexible Manufacturing System. Types and components of FMS.	
Unit-5: Industrial Applications	8
Industrial Applications of Automation and Robotics for material handling, welding, Spray painting, medical, mining, space, defence, security, domestic, entertainment.	

Text Books

1. Gary Dunning, "Introduction to Programmable Logic Controllers" Thomson Learning, 2001.
2. Patranabis D, "Sensors and Transducers", 2nd Edition, PHI, New Delhi, 2011.
3. Introduction to Robotics (Mechanics and control), Niku, Wiley 2013.
4. Introduction to Robotics by S K Saha, McGraw Hill Education
5. R K Mittal and I J Nagrath, "Robotics and Control", Tata McGraw Hill, New Delhi, 2003.

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UNC-301	Disaster Management and Preparedness	L: 2 T: 0 P: 0	0 Credit (Equivalent to 2 Credits as per NEP-2020)
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Course Objectives

The course aims to develop awareness, knowledge, and practical skills among students to understand disaster risks, enhance preparedness, respond effectively during emergencies, and contribute to disaster risk reduction at individual, institutional, and community levels in alignment with national and global frameworks.

Course Outcomes:

On completion of course the students are able:

CO	CO Statement	Bloom's Level
CO1	Identify hazards, vulnerabilities, capacities, and disaster risks at various levels.	K1, K2
CO2	Understand disaster management cycles and legal-institutional frameworks in India and globally.	K1, K2
CO3	Apply preparedness, mitigation, and response strategies during disasters.	K3
CO4	Demonstrate basic life-saving, first-aid, and emergency response skills.	K3
CO5	Prepare simple disaster management plans and participate in community-based DRR activities.	K6

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

COURSE CONTENTS:

Content	Contact Hours
Unit-1: Understanding Disaster Management and Disaster Risk Reduction	L: 4 Hrs P: 4 Hrs
- Basic concepts and terminology: Hazard, Vulnerability, Capacity, Exposure, Disaster, Risk - Disaster Management vs Disaster Risk Reduction - Hazard profile of India (regional perspective) - Disaster Management Cycle: mitigation, preparedness, response, relief, recovery, rehabilitation - Policy and legal frameworks: - Disaster Management Act, 2005 - National Disaster Management Policy - State Disaster Management Acts - International frameworks: Sendai Framework, SDGs, Paris Agreement - Role of institutions (overview): NDMA, NIDM, IMD, CWC, GSI, ISRO, SDMA, DDMA, NDRF - Case studies of major disasters in India (minimum two)	
Unit-2: Preparedness, Mitigation and Response Planning	L: 4 Hrs P: 8 Hrs
- Framework for developing Disaster Management Plans - Hazard, Vulnerability, Capacity and Risk (HVCR) assessment tools: - Hazard mapping - Transect walk - Problem tree	

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Ravi
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Ajay

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○ Chapatti diagram • Preparedness planning: evacuation plans, mock drills, tabletop exercises • Disaster-specific mitigation measures • Basics of Incident Response System (IRS) • Role of emergency responders: NDRF, SDRF, police, fire services, armed forces, NCC, NSS • Planning for vulnerable groups • Emerging technologies in DRR: ○ Drones, mobile apps (SAFAR, Meghdoot, UMAN, Sachet) ○ Flood and weather alerts ○ Social media for disaster communication • Basics of safe construction and structural & non-structural safety audits	
Unit-3: Life-Saving Skills and Public Health Preparedness	L: 4 Hrs P: 10 Hrs
• First aid in disasters: ○ Golden hour concept ○ CPR ○ Burns, fractures, choking ○ Animal bites (snake/dog/rabies) ○ Heat-related illnesses ○ Triage and stampede management • Household and personal preparedness: ○ 72-hour emergency kit ○ Safe food storage ○ Water purification ○ ORS usage ○ WASH and IPC practices • Search and rescue basics • Fire safety and electrical/LPG safety (fire extinguisher demonstration) • Disaster-specific response: floods, earthquakes, landslides, cyclones, heatwaves, cold waves, pandemics, CBRN emergencies • Psychosocial support and psychological first aid • Public health impacts of disasters and prevention of post-disaster diseases	
Unit-4: Field Exposure and Community Engagement	L: 3 Hrs P: 8 Hrs
• Field visits (physical/virtual): ○ Emergency Operations Centres ○ Disaster-prone communities ○ Fire stations / SDRF / NDRF units • Practical exposure: ○ Mock drills and simulations (multi-hazard evacuation) ○ Interaction with responders and officials • Community engagement activities: ○ Awareness campaigns ○ Street plays (nukkad natak) ○ DRR clubs ○ IEC material development (posters, videos, podcasts) • Project/Assignment: ○ Household or institutional disaster management plan ○ Community-based DRR project ○ Field report / reflective report	

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Books/Handbooks

1. Sphere Handbook for humanitarian response standards. Link: <https://spherestandards.org/handbook/>
2. Health emergency and disaster risk management framework (Health EDM), WHO. Link: <https://www.who.int/publications/i/item/9789241516181NDMA Booklets>
3. AAPDA MITRA: A prime example of community-based disaster management: <https://ndma.gov.in/sites/default/files/IEC/Booklets/AAPDA%20MITRA%20A5%20BOOK%20Final.pdf>
4. DISABILITY INCLUSIVE DRR: Transformative journey towards a disability-inclusive society: <https://ndma.gov.in/sites/default/files/IEC/Booklets/Disability%20inclusive%20DRR.pdf>
5. BEATING THE HEAT: How India successfully reduces mortality due to heat waves: <https://ndma.gov.in/sites/default/files/IEC/Booklets/HeatWave%20A5%20BOOK%20Final.pdf>
6. PSYCHOSOCIAL CARE: Mitigating impact of disasters on mental health: <https://ndma.gov.in/sites/default/files/IEC/Booklets/Psychosocial%20A5%20Book.pdf>
7. REACHING OUT TO SAVE LIVES: How social media transformed India's readiness towards disasters: <https://ndma.gov.in/sites/default/files/IEC/Booklets/Social%20Media%20A5%20BOOK.pdf>
8. THUNDERSTORM AND LIGHTNING: Tackling weather hazards: <https://ndma.gov.in/sites/default/files/IEC/Booklets/Thunderstorm%20Lightning%20NDMA%20A5%20BOOK%20New.pdf>

Online courses

1. Comprehensive Disaster Risk Management Framework (CDRMF): https://elearning.nidm.gov.in/enrol/blpayment/course_overview.php?id=193
 2. Gender Aspects of Disaster Recovery and Reconstruction: https://elearning.nidm.gov.in/enrol/blpayment/course_overview.php?id=187
 3. Risk Sensitive Land Use Planning: https://elearning.nidm.gov.in/enrol/blpayment/course_overview.php?id=191
 4. Safe cities: https://elearning.nidm.gov.in/enrol/blpayment/course_overview.php?id=197
 5. Community- Based Disaster Risk Management: https://elearning.nidm.gov.in/enrol/blpayment/course_overview.php?id=217
 6. Climate Change and Disaster Risk: https://elearning.nidm.gov.in/enrol/blpayment/course_overview.php?id=216
- SWAYAM and NPTEL MOOCs:
1. Disaster Recovery and Build Back Better (BBB): https://onlinecourses.nptel.ac.in/noc22_ar05/preview12
 2. Climate Change and Disaster Risk Management https://onlinecourses.swayam2.ac.in/ntr25_ed113/preview
 3. Disaster Management: https://onlinecourses.swayam2.ac.in/ntr25_ed102/preview
 4. Disaster Management: https://onlinecourses.swayam2.ac.in/cec25_hs135/preview
 5. Disaster Risk Reduction and Management: https://onlinecourses.swayam2.ac.in/ini25_hs32/preview

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Course Outcomes:

On completion of course the students are able:

CO	CO Statement	Bloom's Level
CO1	To understand the importance of soft skills in personal and professional contexts	K1, K2
CO2	To apply effective communication skills in diverse situations	K3
CO3	To create strong professional vocabulary for its application at different platforms and through numerous modes as Comprehension, reading and writing.	K4, K6
CO4	To deliver engaging presentations with confidence at work place and maintain positive relationships with peers and colleagues	K3, K5
CO5	To build up personal and professional traits that will make the transition from institution to workplace smoother and help them to excel in their jobs.	K6

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

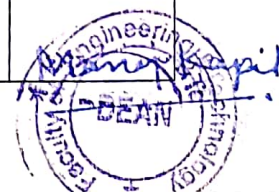
COURSE CONTENTS:

Content	Contact Hours
Unit-1: Introduction to Soft Skills	8
- Meaning and Aspects of Soft Skills - Soft skills and Personality Development - Effective Communication Skills - Telephonic Communication Skills - Positive Thinking - Listening Skills, Types of Listening	
Unit-2: Negotiation vs. Communication Skills	8
- Meaning and definition of Negotiation Skill - Culture as Communication - Classification of Communication - Communicating without Words : Paralanguage, Proxemics, Haptics - Meta-communication - Organizational Communication - Communication Breakdown - Group Communication Skills	
Unit-3: Advanced Writing Skills	8
- Principles of Business Writing - Business Letters: Format and Style, Types of Business Letter - Writing Reports, Types of Report, Strategies for Report Writing, - Evaluation and Organization of Data	
Unit-4: Advanced Presentation Skills	8
- Oral Presentation: Planning & Preparation - Speeches & Debates, Combating Nervousness - Patterns & Methods of Presentation - Making Effective Presentations - Speeches for Various Occasions	

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Unit-5: Work- place skills	8
• Interviews, Planning & Preparing: • Drafting Effective Résumé • Facing Job Interviews • Emotional Intelligence & Critical Thinking	

Course Objectives:

1. To understand the aspects of soft skills for personal and professional world
2. To cultivate leadership qualities and teamwork abilities in the organization.
3. To develop effective communication skills, including verbal, non-verbal, and written communication.
4. To refine presentation and public speaking skills.
5. To develop work place skills for seeking good job opportunities.

Books and references

1. Butterfield, Jeff. Soft Skills for Everyone. New Delhi: Cengage Learning. 2010.
2. Chauhan, G.S. and Sangeeta Sharma. Soft Skills. New Delhi: Wiley. 2016.
3. Goleman, Daniel. Working with Emotional Intelligence. London: Banton Books. 1998.
4. Hall, Calvin S. et al. Theories of Personality. New Delhi: Wiley. rpt. 2011.
5. Holtz, Shel. Corporate Conversations. New Delhi: PHI. 2007.
6. Kumar, Sanajy and Pushp Lata. Communication Skills. New Delhi: OUP. 2011.
7. Lucas, Stephen E. The Art of Public Speaking. McGraw-Hill Book Co. International Edition, 11th Ed. 2014.

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FACULTY OF ENGINEERING AND TECHNOLOGY
SWAMI VIVEKANAND SUBHARTI UNIVERSITY, MEERUT
STUDY & EVALUATION SCHEME
B. Tech. 3rd Year/5th Semester (EEE branch)
w.e.f. academic Session 2025-26

SEMESTER V														
S. No.	Course Code	Course Name	Course Type	Periods			CCA				ESE		Total	Credit
				L	T	P	CT	AT	Total	PS	TE	PE		
1	KEEE-501	Power System - I	PC	3	1	0	20	10	30	-	70	-	100	4
2	KEEE-502	Control System	PC	3	1	0	20	10	30	-	70	-	100	4
3	KEEE-503	Power Quality and Facts	PC	3	1	0	20	10	30	-	70	-	100	4
4	KEEE-511-S to KEEE-514-S	Departmental Elective-I*	PE	3	0	0	20	10	30	-	70	-	100	3
5	KEEE-521 to KEEE-539	Departmental Elective-II	PE	3	0	0	20	10	30	-	70	-	100	3
6	KEEE-551	Power System-I Lab	PC	0	0	2	-	-	-	15	-	35	50	1
7	KEEE-552	Control System Lab	PC	0	0	2	-	-	-	15	-	35	50	1
8	KEEE-553	Electronics Design Lab	PC	0	0	2	-	-	-	15	-	35	50	1
9	KCC-551	Mini Project or Internship Assessment#		-	-	-	-	-	-	100	-	-	100	1
10	KNC501/ KNC502	Constitution of India / Essence of Indian Traditional Knowledge	MC	2	0	0	20	10	30	-	70	-	100	0
Total													850	22
#The Mini Project and internship (4 weeks) conducted during summer break after IV semester and will be assessed during V semester.														
* Will be offered through SWAYAM-NPTEL.														

Abbreviation Used:

PC: Professional Core Course

PE: Professional Elective Course

MC: Mandatory Course

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FACULTY OF ENGINEERING AND TECHNOLOGY
SWAMI VIVEKANAND SUBHARTI UNIVERSITY, MEERUT
STUDY & EVALUATION SCHEME
B. Tech. 3rd Year/6th Semester (EEE branch)
w.e.f. academic Session 2025-26

SEMESTER VI														
S No.	Course Code	Course Name	Course Type	Periods			CCA				ESE		Total	Credit
				L	T	P	CT	AT	Total	PS	TE	PE		
1	KEEE-601	Power System-II	PC	3	1	0	20	10	30	-	70	-	100	4
2	KEEE-602	Microprocessors	PC	3	1	0	20	10	30	-	70	-	100	3
3	KEEE-603	Power Electronics	PC	3	1	0	20	10	30	-	70	-	100	3
4	KEEE-611-S To KEEE-614-S	Departmental Elective- III*	PE	3	0	0	20	10	30	-	70	-	100	3
5	KOE-6**	Open Elective-I	OE	3	0	0	20	10	30	-	70	-	100	3
6	KEEE-651	Power System-II Lab	PC	0	0	2	-	-	-	15	-	35	50	1
7	KEEE-652	Microprocessor Lab	PC	0	0	2	-	-	-	15	-	35	50	1
8	KEEE-653	Power Electronics Lab	PC	0	0	2	-	-	-	15	-	35	50	1
9	KNC-601/ KNC-602	Constitution of India / Essence of Indian Traditional Knowledge	MC	2	0	0	20	10	30	-	70	-	100	0
10	KEEE-654	Project-I	PROJ	0	0	4	-	-	-	50	-	100	150	2
Total													900	21

* Will be offered through SWAYAM-NPTEL.

Abbreviation Used:

PC: Professional Core Course

PE: Professional Elective Course

OE: Open Elective Course

MC: Mandatory Course

The Mini Project/Internship (4 weeks) will be done during summer break after 6th Semester and will be assessed during VII semester.

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Departmental Elective-I

* A bucket of four (04) courses should be prepared based on the courses offered by SWAYAM in the respective session.

Departmental Elective-II

S. No.	Course Code	Course Title
1	KEEE-521	Wind and Solar Energy Systems
2	KEEE-522	Line Commutated and Active Rectifiers
3	KEEE-523	Electrical Drives
4	KEEE-524	Electrical and Hybrid Vehicles
5	KEEE-525	Electrical Machine Design
6	KEEE-526	Power System Protection
7	KEEE-527	HVDC Transmission Systems
8	KEEE-528	High Voltage Engineering
9	KEEE-529	Electrical Energy Conservation and Auditing
10	KEEE-530	Industrial Electrical Systems
11	KEEE-531	Power System Dynamics and Control
12	KEEE-532	Digital Control Systems
13	KEEE-533	Digital Signal Processing
14	KEEE-534	Computer Architecture
15	KEEE-535	Electromagnetic Waves
16	KEEE-536	Computational Electromagnetics
17	KEEE-537	Control Systems Design
18	KEEE-538	Advanced Electric Drives

Departmental Elective-III

* A bucket of four (04) courses should be prepared based on the courses offered by SWAYAM in the respective session.

Open Elective-I

Separate list is attached (common to all branches)

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Faculty of Engineering & Technology

Syllabus:

Vth Semester

KEEE-501: POWER SYSTEM-I

Pre-requisites of the course: Basic Electrical Engineering, Networks Analysis and Synthesis, Electromagnetic Field Theory.

Course Outcome		Knowledge Level, KL
Upon the completion of the course, the student will be able to:		
CO1	Describe the working principle and basic components of conventional power plants as well as the other aspects of power generation.	K2
CO2	Recognize elements of power system and their functions, as well as compare the different types of supply systems. Illustrate different types of conductors, transmission lines and various performance parameters of transmission line for short, medium and long transmission line.	K3
CO3	Calculate sag and tension in overhead lines with and without wind and ice loading. Classify different type of insulators, determine potential distribution over a string of insulator, string efficiency and its improvement.	K3
CO4	Compute the inductance and capacitance of single phase, three phase lines with symmetrical and unsymmetrical spacing, Composite conductors-transposition, bundled conductors, and understand the effect of earth on capacitance of transmission lines.	K3
CO5	Elucidate different types of cables and assess the Resistance and capacitance parameters of cables, grading of cables and compare overhead lines and cables.	K3

KL- Bloom's Knowledge Level (K1, K2, K3, K4, K5, K6)

K1 – Remember K2 – Understand K3 – Apply K4 – Analyze K5 – Evaluate K6 – Create

Detailed Syllabus:

UNIT-I (Power Generation):

Introduction: Basic structure of power system, sources of electric energy: conventional and non- conventional; Layout of Hydro-electric, Thermal and Nuclear power plants, Concept of cogeneration, combined heat and power, and captive power plants, SPV generation at household level.

Basic Structure of Smart Grid, Communication and IT components in power system.

Load curve, load duration curve, Concept of Connected Load, Maximum Demand, Average load, Demand Factor, Load factor, Diversity Factor, Capacity Factor, Utilization factor, Plant use factor, Installed capacity, Reserves, role of load diversity in power system economy. Load Sharing between Base load and Peak Load

UNIT-II (Transmission & Distribution of Electric Power- I):

Single line diagram of Power system, choice of transmission voltage, One-line diagram, Impedance and reactance diagram, per unit system changing the base of per unit quantities, advantages of per unit system Different kinds of supply system and their comparison.

Configurations of transmission lines: Types of conductors, Bundled Conductors, resistance of line, skin effect, Kelvin's law, Proximity effect,

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Corona Effect, factors affecting the Corona, Corona Power Loss, Advantages and Disadvantages.

Performance of Lines: Representation of lines, short transmission lines, medium length lines, nominal T and π -representations, long transmission lines. The equivalent circuit representation of a long Line, A, B, C, D constants, Ferranti Effect.

UNIT-III (Transmission & Distribution of Electric Power- II):

Mechanical Design of Over Headlines: Catenary curve, calculation of sag & tension, effects of wind and ice loading, sag template, vibration dampers

Overhead line Insulators: Type of insulators and their applications, potential distribution over a string of insulators, methods of equalizing the potential, string efficiency

UNIT-IV (Transmission Line Parameters):

Inductance and Capacitance Calculations of Transmission Lines: Line conductors, inductance and capacitance of single phase and three phase lines with symmetrical and unsymmetrical spacing, Composite conductors-transposition, bundled conductors, and effect of earth on capacitance.

UNIT-V (Insulated Cables):

Insulated Cables: Introduction, insulation, insulating materials, Extra high voltage cables, grading of cables, insulation resistance of a cable, Capacitance of a single core and three core cables, Overhead lines versus underground cables, types of cables

Textbooks:

1. Kothari & Nagrath, "Power System Engineering", McGraw-Hill Education
2. B.R. Gupta, "Generation of Electrical Energy", S. Chand Publication.
3. Chakrabarti A., Soni M.L., Gupta P.V., and Bhatnagar U.S., 'A textbook on Power Systems Engg.', Dhanpat Rai and Sons, New Delhi.
4. JB Gupta, 'A Course in Power Systems', S.K. Kataria and Sons.
5. C.L. Wadhwa, "Electrical Power System", New Age International Ltd. Third Edition.
6. Arun Ingle, "Power Transmission and Distribution", Pearson Education, 2018
7. A. J. Wood & B.F. Wollenburg, "Power Generation, Operation and Control "John Wiley & Sons.

Reference Books:

1. Wadhwa, C.L., 'Generation Distribution and Utilization of Electrical Energy', New Age International publishers.
2. Deshpande M.V, 'Elements of Electrical Power systems Design', Pitman, New Delhi, PHI Learning Private Limited,
3. S.N. Singh, "Electric Power Generation, Transmission & Distribution", PHI Learning.

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KEEE-502: CONTROL SYSTEM

Pre-requisites of course: Basic signal systems

Course Outcome		Knowledge Level, KL
Upon the completion of the course, the student will be able to:		
CO 1	Obtain transfer functions to predict the correct operation of open loop and closed loop control systems and identify the basic elements, structures and the characteristics of feedback control systems.	K3
CO 2	Measure and evaluate the performance of basic control systems in time domain. Design specification for different control action.	K4
CO 3	Analyze the stability of linear time-invariant systems in time domain using Routh-Hurwitz criterion and root locus technique.	K4
CO 4	Determine the stability of linear time-invariant systems in frequency domain using Nyquist criterion and Bode plot.	K4
CO 5	Design different type of compensators to achieve the desired performance of control system by root locus and Bode plot method. Develop and analyze the intermediate states of the system using state space analysis.	K4

KL- Bloom's Knowledge Level (K1, K2, K3, K4, K5, K6)

K1 – Remember K2 – Understand K3 – Apply K4 – Analyze K5 – Evaluate K6 – Create

Detailed Syllabus:

Unit-I:

Control System Concepts: Elements of control systems, concept of open loop and closed loop systems, Examples and application of open loop and closed loop systems, Mathematical Modelling of Physical Systems (Electro Mechanical), Determination of transfer function by block diagram reduction techniques and signal flow method using Mason's gain formula, Basic Characteristics of negative feedback control systems.

Control System Components: Constructional and working concept of AC & DC servomotor, synchro's, stepper motor and tachometer.

Unit-II:

Time Response Analysis: Standard test signals, time response analysis of first and second order systems time response specifications of second order system for unit step input, location of roots of characteristics equation and corresponding time response, steady state errors and error constants.

Basic modes of feedback control: Proportional, Derivative, Integral and PID controllers, controller design using Ziegler Nichols.

Unit-III:

Stability and Algebraic Criteria: Concept of stability and its necessary conditions, Routh-Hurwitz criteria and its limitations.

Root Locus Technique: Salient features of root locus plot, Procedure for plotting root locus, root contours.

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Unit-IV:

Frequency Response Analysis: Frequency Response analysis from transfer function model, Construction of polar and inverse polar plots.

Stability in Frequency Domain: Nyquist stability criterion, Determination of gain and phase margin from Bode & Nyquist Plots, Correlation between time and Frequency Responses.

Unit-V

Introduction to Design: The design problems and preliminary considerations of lead, lag and lead-lag compensation networks, design of closed loop systems using compensation techniques in time and frequency domains.

State Space Technique: Concept of single input and multiple input and multiple output system, State-space model of physical system, conversion of state-space to transfer function model and vice-versa, State transition matrix, Concept of controllability and observability and their testing.

Text Book:

1. I. J. Nagrath & M. Gopal, "Control System Engineering", 6th Ed. New Age International Publishers, 4th Edition 2018
2. M. Gopal, "Control System Principles and Design", McGraw Hill 4th Edition
3. Ogata, "Modern Control Engineering, 5th Edition", Pearson Education, 2015
4. B.C. Kuo & Farid Golnaraghi, "Automatic Control Systems", 10th Edition, McGraw Hill
5. D. Roy Choudhary, "Modern Control Engineering", Prentice Hall of India.
6. A.K. Jairath, "Problems and solutions of Control System with Essential Theory", CBS Publishers

Reference Books:

1. (Schaums Outlines Series) Joseph J. Distefano III, Allen R. Stubberud, Ivan J. Williams, "Control Systems", 3rd Edition, McGraw Hill, Special Indian Edition, 2010.
2. Norman S. Mise, Control System Engineering, Wiley Publishing Co.
3. Ajit K Mandal, "Introduction to Control Engineering" New Age International.
4. R.T. Stefani, B.Shahian, C.J.Savant and G.H. Hostetter, "Design of Feedback Control Systems" Oxford University Press.
5. Samarjit Ghosh, "Control Systems theory and Applications", Pearson Education.

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KEEE-503: POWER QUALITY AND FACTS

Pre-requisites of course: Basics Electrical Engg.

Course Outcome		Knowledge Level, KL
Upon the completion of the course, the student will be able to:		
CO 1	Understand the characteristics of ac transmission and the effect of shunt and series reactive compensation.	K3
CO 2	Understand the working principles of FACTS devices and their operating Characteristics.	K4
CO 3	Understand the basic concepts of power quality.	K4
CO 4	Understand the working principles of devices to improve power quality.	K4

KL- Bloom's Knowledge Level (K1, K2, K3, K4, K5, K6)

K1 – Remember K2 – Understand K3 – Apply K4 – Analyze K5 – Evaluate K6 – Create

Detailed Syllabus:

UNIT 1: Transmission Lines and Series/Shunt Reactive Power Compensation (4 hours)

Basics of AC Transmission. Analysis of uncompensated AC transmission lines. Passive Reactive Power Compensation. Shunt and series compensation at the mid-point of an AC line. Comparison of Series and Shunt Compensation.

UNIT 2: Thyristor-based Flexible AC Transmission Controllers (FACTS) (6 hours)

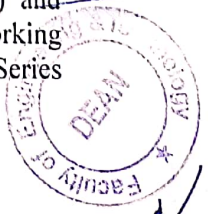
Description and Characteristics of Thyristor-based FACTS devices: Static VAR Compensator (SVC), Thyristor Controlled Series Capacitor (TCSC), Thyristor Controlled Braking Resistor and Single Pole Single Throw (SPST) Switch. Configurations/Modes of Operation, Harmonics and control of SVC and TCSC. Fault Current Limiter.

UNIT 3: Voltage Source Converter based (FACTS) controllers (8 hours)

Voltage Source Converters (VSC): Six Pulse VSC, Multi-pulse and Multi-level Converters, Pulse-Width Modulation for VSCs. Selective Harmonic Elimination, Sinusoidal PWM and Space Vector Modulation. STATCOM: Principle of Operation, Reactive Power Control. Type I and Type II controllers, Static Synchronous Series Compensator (SSSC) and Unified Power Flow Controller (UPFC): Principle of Operation and Control. Working principle of Interphase Power Flow Controller. Other Devices: GTO Controlled Series Compensator. Fault Current Limiter.

UNIT 4: Application of FACTS (4 hours)

Application of FACTS devices for power-flow control and stability improvement. Simulation example of power swing damping in a single-machine infinite bus system using

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a TCSC. Simulation example of voltage regulation of transmission mid-point voltage using aSTATCOM.

UNIT 5: Power Quality Problems in Distribution Systems (4 hours)

Power Quality problems in distribution systems: Transient and Steady state variations in voltage and frequency. Unbalance, Sags, Swells, Interruptions, Wave-form Distortions: harmonics, noise, notching, dc-offsets, fluctuations. Flicker and its measurement. Tolerance of Equipment: CBEMA curve.

UNIT 6: DSTATCOM (8 hours)

Reactive Power Compensation, Harmonics and Unbalance mitigation in Distribution Systems using DSTATCOM and Shunt Active Filters. Synchronous Reference Frame Extraction of Reference Currents. Current Control Techniques in for DSTATCOM.

UNIT 6: Dynamic Voltage Restorer and Unified Power Quality Conditioner (6 hours)

Voltage Sag/Swell mitigation: Dynamic Voltage Restorer – Working Principle and Control

Strategies. Series Active Filtering. Unified Power Quality Conditioner (UPQC): Working Principle. Capabilities and Control Strategies.

Text/References

- N. G. Hingorani and L. Gyugyi, "Understanding FACTS: Concepts and Technology of FACTS Systems", Wiley-IEEE Press, 1999.
- K. R. Padiyar, "FACTS Controllers in Power Transmission and Distribution", New Age International (P) Ltd. 2007.
- T. J. E. Miller, "Reactive Power Control in Electric Systems", John Wiley and Sons, New York, 1983.
- R. C. Dugan, "Electrical Power Systems Quality", McGraw Hill Education, 2012.
- G. T. Heydt, "Electric Power Quality", Stars in a Circle Publications, 1991

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BEEE-551: Power Systems-I Laboratory (0:0:2 – 1 credit)

Course Outcome: At the end of the session students will be able to:

- Understand practical application of MATLAB in switchgear system.
- Understand practical aspects of the working of various types of relays.

Note: - At least 10 experiments should be performed out of which 3 should be simulation based.

Hardware Based:

1. To determine direct axis reactance (x_d) and quadrature axis reactance (x_q) of a salient pole alternator.
2. To determine negative and zero sequence reactances of an alternator.
3. To determine sub transient direct axis reactance (x_d) and sub transient quadrature axis reactance (x_q) of an alternator
4. To determine location of fault in a cable using cable fault locator
5. To study ferranti effect and voltage distribution in H.V. long transmission line using transmission line model.
6. To study the suspension type insulator.
7. To study and design the string type insulator for 11 KV transmission line.
8. To study operation of oil testing set.

Simulation Based Experiments (using MATLAB or any other software)

9. To determine transmission line performance.
10. To obtain steady state, transient and sub-transient short circuit currents in an alternator.

Additional power system experiments:

1. To determine fault current for L-G, L-L, L-L-G and L-L-L faults at the terminals of an alternator at very low excitation.
2. To study the IDMT over current relay and determine the time current characteristics.
3. To study percentage differential relay.
4. To study Impedance, MHO and Reactance type distance relays.
5. To obtain formation of Y-bus and perform load flow analysis.
6. To perform symmetrical fault analysis in a power system.
7. To perform unsymmetrical fault analysis in a power system.

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BEEE-552: Control Systems Laboratory (0:0:2 – 1 credit)

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

- Various Control techniques in electrical engineering.
- Transducers for error detectors.
- Analysis of synchros device (Transmitter and Receiver)
- PID Controllers algorithms analysis.
- Analysis Stability methods (Polar, Nyquist, Bode plot, Root Locus etc.) using MATLAB.

Note: The minimum of 10 experiments are to be performed from the following, out of which at least three should be software based.

1. To determine response of first order and second order systems for step input for various values of constant 'K' using linear simulator unit and compare theoretical and practical results.
2. To study P,PI and PID temperature controller for an oven and compare their performance.
3. To study and calibrate temperature using resistance temperature detector (RTD)
4. To design Lag, Lead and Lag-Lead compensators using Bode plot.
5. To study DC position control system
6. To study synchro-transmitter and receiver and obtain output V/ S input characteristics
7. To determine speed-torque characteristics of an ac servo motor.
8. To study performance of servo voltage stabilizer at various loads using load bank.
9. To study behavior of separately excited dc motor in open loop and closed loop conditions at various loads.
10. To study PID Controller for simulation proves like transportation lag.

Software based experiments (Use MATLAB software)

11. To determine time domain response of a second order system for step input and obtains performance parameters.
12. To draw a Polar plot of an open loop transfer functions and examines the stability of the closed loop system.
13. To plot root locus diagram of an open loop transfer function and determine range of gain 'k' for stability.
14. To plot a Bode diagram of an open loop transfer function.
15. To draw a Nyquist plot of an open loop transfer functions and examines the stability of the closed loop system.

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KEEE-553: Electronics Design Laboratory (1:0:4-3 credits)

Course Outcomes: At the end of the course, students will demonstrate the ability to

- Understand the practical issues related to practical implementation of applications using electronic circuits.
- Choose appropriate components, software and hardware platforms.
- Design a Printed Circuit Board, get it made and populate/solder it with components.
- Work as a team with other students to implement an application.
- Basic concepts on measurements; Noise in electronic systems; Sensors and signal conditioning circuits; Introduction to electronic instrumentation and PC based data acquisition; Electronic system design, Analog system design, Interfacing of analog and digital systems, Embedded systems, Electronic system design employing microcontrollers, CPLDs, and FPGAs, PCB design and layout; System assembly considerations. Group projects involving electronic hardware (Analog, Digital, mixed signal) leading to implementation of an application.

Text/Reference Books

- S. Sedra and K. C. Smith, "Microelectronic circuits", Oxford University Press, 2007.
- P. Horowitz and W. Hill, "The Art of Electronics", Cambridge University Press, 1997.
- H.W.Ott, "Noise Reduction Techniques in Electronic Systems", Wiley, 1989.
- W.C. Bosshart, "Printed Circuit Boards: Design and Technology", Tata McGraw Hill, 1983.
- G.L. Ginsberg, "Printed Circuit Design", McGraw Hill, 1991.

KCC-551: Mini Project or Internship Assessment (1 credits)

Course Outcomes: At the end of the course, students will demonstrate the ability to

- Enhance practical skills and apply theoretical knowledge to real-world scenarios.
- encourage students to identify, analyze, and find solutions to complex issues.
- Students are encouraged to think outside the box, develop new ideas, and implement innovative solutions.
- gain hands-on experience with various tools, techniques, and technologies relevant to their field.
- Provide students with hands-on experience, fostering creativity, problem-solving abilities, and teamwork skills.
- Working on projects in teams fosters communication, coordination, and the ability to collaborate effectively.

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VIth Semester

KEEE-601: POWER SYSTEMS-II

Pre-requisites of course: Basic Electrical Engineering, Networks Analysis and Synthesis, Electromagnetic Field Theory, Power System-I, Electrical Machines-II

Course Outcomes:		Knowledge Level, KL
Upon the completion of the course, the student will be able to:		
CO1	Identify power system components on one line diagram of power system and its representation including the behaviour of the constituent components and sub systems and Analyse a network under both balanced and unbalanced fault conditions and design the rating of circuit breakers.	K4
CO2	Perform load flow analysis of an electrical power network and interpret the results of the analysis.	K4
CO3	Describe the concept of travelling waves in transmission lines and use the travelling wave theory to determine the over voltage caused by surge propagation in transmission networks.	K4
CO4	Assess the steady state and transient stability of the power system under various conditions.	K4
CO5	Describe Operating Principle of a relay and classify them according to applications. Explain working principle of Circuit breaker and phenomenon of arc production and quenching.	K3

KL- Bloom's Knowledge Level (K1, K2, K3, K4, K5, K6)

K1 – Remember K2 – Understand K3 – Apply K4 – Analyze K5 – Evaluate K6 – Create

Detailed Syllabus:

UNIT-I (Fault Analysis in Power System):

Symmetrical Components: Significance of positive, negative and zero sequence components, Average 3-phase power in terms of symmetrical components, sequence impedances and sequence networks.

Fault Calculations: Fault calculations, sequence network equations, single line to ground fault, line to line fault, double line to ground fault, three phase faults, faults on power systems, and faults with fault impedance, reactors and their location, short circuit capacity of a bus

UNIT-II (Load Flow Analysis):

Introduction, Need for load flow, load dispatch centers and operating strategies, Formation of Z_{BUS} and Y_{BUS} , development of load flow equations, load flow solution using Gauss Siedel and Newton-Raphson method, Comparison of Gauss Siedel and Newton Raphson Method, approximation to N-R method, fast decoupled method, introduction to forward backward sweep load flow for radial network

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UNIT-III (Travelling Waves in Power System):

Travelling Waves on Transmission Lines: Production of travelling waves, open circuited line, short circuited line, line terminated through a resistance, line connected to a cable, reflection and refraction at T-junction line terminated through a capacitance, capacitor connection at a T-junction, Attenuation of travelling waves, Bewley's Lattice diagram.

UNIT-IV (Stability in Power System):

Power flow through a transmission line, Stability and Stability limit, Steady state stability study, derivation of Swing equation, transient stability studies by equal area criterion. Factors affecting steady state and transient stability and methods of improvement.

UNIT-V (Introduction to Power System Protection):

Relays: Operating Principle of a general relay,

Basic Terminology: Relay, Energizing Quantity, setting, Pickup, drop out, Flag, fault clearing time, Relay time, Breaker time, Overreach, Underreach; Classification of Relays according to applications, according to time. Over current Relay, Distance Protection, Differential Protection.

Circuit Breakers: Arc Phenomenon, Arc Extinction and its Methods, Restriking Voltage & Recovery Voltage, Circuit Breaker Rating.

Text Books:

1. D.P. Kothari & I.J. Nagrath, "Modern Power System Analysis" McGraw Hill, 3rd Edition.
2. P.S.R. Murthy, "Operation and control in Power Systems" B.S. Publications.
3. W. D. Stevenson, "Elements of Power System Analysis", McGraw Hill
4. J. Wood & B.F. Wollenburg, "Power Generation, Operation and Control" John Wiley & Sons.
5. S. S. Rao, "Switchgear and Protection", Khanna Publishers.
6. B. Ravindranath and M. Chander, Power system Protection and Switchgear, Wiley Eastern Ltd.
7. Arun Ingole, "Power Transmission and Distribution", Pearson Education, 2018
8. Jegatheesan & Vijaykumar, "Modern Power System Analysis with MATLAB Applications", Pearson Education, 2020

Reference Books:

1. O.I. Elgerd, "Electric Energy System Theory" McGraw Hill.
2. P. Kundur, "Power System Stability and Control McGraw Hill.
3. T. K. Nagsarkar & M.S. Sukhija, 'Power System Analysis' Oxford University Press.
4. Hadi Sadat, "Power System Analysis", McGraw Hill.
5. B. Ram and D. N. Vishwakarma, "Power System Protection and Switchgear", McGraw Hill

KEEE-602: MICROPROCESSORS

Pre-requisites of course: Digital Electronics, Computer Basics

Course Outcomes:		Knowledge Level, KL
Upon the completion of the course, the student will be able to:		
CO 1	Demonstrate the general architecture of 8085 & explain its operations the basic programming instructions of 8085 microprocessor	K2

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CO2	Demonstrate the internal architecture of 8085 explain the instruction sets of 8085	K2
CO3	Demonstrate the general architecture of 8086 explain the instruction sets of 8086	K2
CO4	Explain the basic programming instructions of 8085 microprocessor and write assembly level programs	K3
CO5	Interface different external peripheral devices with 8085 microprocessor	K2

KL- Bloom's Knowledge Level (K₁, K₂, K₃, K₄, K₅, K₆)

K₁ – Remember K₂ – Understand K₃ – Apply K₄ – Analyze K₅ – Evaluate K₆ – Create

Detailed Syllabus:

Unit-I: Introduction to Microprocessor:

Introduction to Microprocessor and its applications, Microprocessor Evolution Tree, Microprocessor Architecture (Harvard & Princeton), General Architecture of the Microprocessor and its operations, Component of Microprocessor system: Processor, Buses, Memory, Inputs-outputs (I/Os) and other Interfacing devices.

Unit-II: 8-bit Microprocessor: Intel 8085 microprocessor:

Pin Diagram, Internal architecture: ALU, Registers, Timing and control unit, interrupt:
Instruction Set of 8085:

Instruction format, op-codes, mnemonics, no. of bytes computation of the instruction, Machine cycles and T- states and Execution time computation of an instruction. Classification of instruction with their examples. Writing of assembly Language programs.

Unit-III: 16-bit Microprocessor:

Architecture of Intel 8086:

Pin Diagram, Bus Interface Unit, Execution unit, Register organization, Memory addressing, Memory Segmentation, Pipelining, Min & Max operating Modes
8086 Instruction set:

Format, Addressing Modes, Instruction Set Groups: Data transfer, Arithmetic, Logic, String, Branch control transfer and Processor control.

Interrupts: Hardware and software interrupts.

Unit-IV: Fundamental of Programming:

Program structure for microprocessors, Flowcharts of series, parallel, and controls structures.

Assembler Level Programming:

Memory space allocation for monitor and user program. Assembly language program using Debug or MASM assembler.

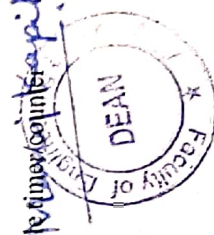
Unit-V: Peripheral Interfacing:

Programmed I/O, Memory Mapped I/O, Interrupt Driven I/O, DMA I/O interface, Serial and Parallel communications.

Peripheral Devices:

DMA controller (Intel 8237), Programmable peripheral interface (Intel 8255), Programmable timer/counter.

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Text Books:

- ### Reference Books:

- ## KEEE-603: POWER ELECTRONICS

Course Outcomes:

KL- Bloom's Knowledge Level ($K_1, K_2, K_3, K_4, K_5, K_6$)

Detailed Syllabus:

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Power semiconductor switches and their characteristics: Power Diode, Power BJT, Power MOSFET, IGBT, SCR, TRIAC, GTO.

Unit-II:

Thyristor: Rating & protection, Methods of SCR commutation, Gate Drive Circuit, Series and Parallel operation.

DC-DC Converters: Introduction, Control Strategies, Buck converter, Boost Converter, Buck-Boost converter, Analysis of buck converter, introduction to Switched Mode power Supply (SMPS).

Unit-III: Phase Controlled Converters:

Single phase half wave controlled rectifier with various loads, Effect of freewheeling diode, Single phase fully controlled and half controlled bridge converters with various loads. Performance Parameters of single phase uncontrolled and controlled converters, three phase half wave converters, Three phase fully controlled and half controlled bridge converters, Effect of source impedance on Single phase converters.

Unit-IV: AC Voltage Controllers:

Principle of On-Off and phase controls, Single phase ac voltage controller with resistive and inductive loads, sequence control, Introduction to Matrix converter.

Cyclo Converters: Basic principle of operation, single phase to single phase, three phase to single phase output voltage equation. **Unit-V: Inverters:**

Single phase and Three phase bridge inverters, voltage source inverters, current source inverters, Voltage control of single phase inverters, Pulse width modulation, Introduction to Multi level inverter.

Text Books:

1. M.H. Rashid, "Power Electronics: Circuits, Devices & Applications", Pearson Education.
2. Ned Mohan, T.M. Undeland and W.P. Robbins, "Power Electronics: Converters, Applications and Design", Wiley India Ltd, 2008
3. P.C. Sen, "Power Electronics", McGraw Hill Education (India) Pvt. Ltd.
4. P.S. Bhimbra, "Power Electronics", Khanna Publishers:

Reference Books:

1. M.S. Jamil Asghar, "Power Electronics" Prentice Hall of India Ltd., 2004
2. Chakrabarti & Rai, "Fundamentals of Power Electronics & Drives" Dhanpat Rai & Sons.
3. V.R. Moorthy, "Power Electronics: Devices, Circuits and Industrial Applications" Oxford University Press, 2007
4. S.N. Singh, "A Text Book of Power Electronics" Dhanpat Rai & Sons

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KEEE-651: Power Systems-II Laboratory (0:0:2 – 1 credit)

Course Outcome: At the end of the session students will be able to:

- Understand practical application of MATLAB in switchgear system.
- Understand practical aspects of the working of various types of relays.

Note: - At least 10 experiments should be performed out of which 3 should be simulation based.

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Hardware / Simulation Based:

1. To determine fault current for L-G fault at the terminals of an alternator at very low excitation.
2. To determine fault current for L-L fault at the terminals of an alternator at very low excitation.
3. To determine fault current for L-L-G fault at the terminals of an alternator at very low excitation.
4. To determine fault current for L-L-L fault at the terminals of an alternator at very low excitation.
5. To study the IDMT over current relay and determine the time current characteristics
6. To study percentage differential relay
7. To study Impedance, MHO and Reactance type distance relays.
8. To obtain formation of Y-bus and perform load flow analysis by Newton-Raphson method.
9. To obtain formation of Y-bus and perform load flow analysis by fast decoupled method.
10. To obtain formation of Y-bus and perform load flow analysis by Gauss Seidel method.
11. To perform symmetrical fault analysis in a power system
12. To perform unsymmetrical fault analysis in a power system

KEEE-652: Microprocessor Laboratory (0:0:2 – 1 credit)

Course Outcome: At the end of this course, students will be able to:

- Execution of different programs for 8086 in Assembly Level Language using MASM
- Interfacing various I/O Devices like stepper motor, key board, ADC AND DAC TO 8086.
- 3.Execution of different programs in 8051 etc they will learn assembly language programming and interfacing various peripherals to processor and controller with this knowledge they can design diff microprocessor based mini & main project.

A. Study Experiments:

1. To study 8085 based microprocessor system
2. To study 8086 and 8086A based microprocessor system
3. To study Pentium Processor

B. Programming based Experiments (any four)



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4. To develop and run a program for finding out the largest/smallest number from a given set of numbers.
5. To develop and run a program for arranging in ascending/descending order of a set of numbers
6. To perform multiplication/division of given numbers
7. To perform conversion of temperature from 0F to 0C and vice-versa
8. To perform computation of square root of a given number
9. To perform floating point mathematical operations (addition, subtraction, multiplication and division)

C. Interfacing based Experiments (any four)

10. To obtain interfacing of RAM chip to 8085/8086 based system
11. To obtain interfacing of keyboard controller
12. To obtain interfacing of DMA controller
13. To obtain interfacing of PPI
14. To obtain interfacing of UART/USART
15. To perform microprocessor based stepper motor operation through 8085 kit
16. To perform microprocessor based traffic light control
17. To perform microprocessor based temperature control of hot water.

KEEE-653: Power Electronics Laboratory (0:0:2 – 1 credit)

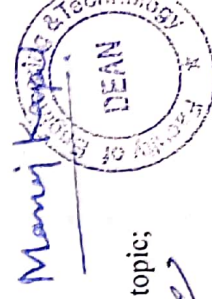
Project/Internship

KEEE-654: Project –I (0:0:4 – 2 credit)

The object of Project Work I is to enable the student to take up investigative study in the broad field of Electronics & Communication Engineering, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or two/three students in a group, under the guidance of a Supervisor. This is expected to provide a good initiation for the student(s) in R&D work. The assignment to normally include:

- Survey and study of published literature on the assigned topic;
- Working out a preliminary Approach to the Problem relating to the assigned topic;

Conducting preliminary Analysis/Modeling/Simulation/Experiment/Design/Feasibility;



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- Preparing a Written Report on the Study conducted for presentation to the Department;
- Final Seminar, as oral Presentation before a departmental committee.

LIST OF MANDATORY COURSES (NON-CREDIT)

KNC-601/ KNC-602: Constitution of India

The Constitution of India is the supreme law of India. Parliament of India cannot make any law which violates the Fundamental Rights enumerated under the Part III of the Constitution. The Parliament of India has been empowered to amend the Constitution under Article 368, however, it cannot use this power to change the “basic structure” of the constitution, which has been ruled and explained by the Supreme Court of India in its historical judgments. The Constitution of India reflects the idea of “Constitutionalism” – a modern and progressive concept historically developed by the thinkers of “liberalism” – an ideology which has been recognized as one of the most popular political ideology and result of historical struggles against arbitrary use of sovereign power by state. The historic revolutions in France, England, America and particularly European Renaissance and Reformation movement have resulted into progressive legal reforms in the form of “constitutionalism” in many countries. The Constitution of India was made by borrowing models and principles from many countries including United Kingdom and America.

The Constitution of India is not only a legal document but it also reflects social, political and economic perspectives of the Indian Society. It reflects India's legacy of "diversity". It has been said that Indian constitution reflects ideals of its freedom movement, however, few critics have argued that it does not truly incorporate our own ancient legal heritage and cultural values. No law can be "static" and therefore the Constitution of India has also been amended more than one hundred times. These amendments reflect political, social and economic developments since the year 1950. The Indian judiciary and particularly the Supreme Court of India has played an historic role as the guardian of people. It has been protecting not only basic ideals of the Constitution but also strengthened the same through progressive interpretations of the text of the Constitution. The judicial activism of the Supreme Court of India and its historic contributions has been recognized throughout the world and it gradually made it "as one of the strongest court in the world".

Course content

- Meaning of the constitution law and constitutionalism
- Historical perspective of the Constitution of India
- Salient features and characteristics of the Constitution of India
- Scheme of the fundamental rights
- The scheme of the Fundamental Duties and its legal status
- The Directive Principles of State Policy – Its importance and implementation
- Federal structure and distribution of legislative and financial powers between the Union and the States
- Parliamentary Form of Government in India – The constitution powers and status of the President of India
- Amendment of the Constitutional Powers and Procedure

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- The historical perspectives of the constitutional amendments in India
- Emergency Provisions : National Emergency, President Rule, Financial Emergency
- Local Self Government – Constitutional Scheme in India
- Scheme of the Fundamental Right to Equality
- Scheme of the Fundamental Right to certain Freedom under Article 19
- Scope of the Right to Life and Personal Liberty under Article 21.

KNC-601/ KNC-602: Essence of Indian Knowledge Tradition:

Essence of Indian Knowledge Tradition Pt-I

भारतीयविवासर - 1

Course objective

The course aims at imparting basic principles of thought process, reasoning and inferencing. Sustainability is at the core of Indian Traditional knowledge Systems connecting society and nature. Holistic life style of yogic science and wisdom capsules in Sanskrit literature are also important in modern society with rapid technological advancements and societal disruptions. Part-I focuses on introduction to Indian Knowledge Systems, Indian perspective of modern scientific world-view, and basic principles of Yoga and holistic health care system.

Course Contents

- Basic structure of Indian Knowledge System:
- अ ादशिव ा -श्वेद, षउपवेद (आयुर्वेद, धनुर्वेद,
- ग ववेद, थाप आिद) श्वेदांग (िश ा, क , िन , ाकरण, ोितष, छंद) ष उपाङ्ग (धम शा , मीमांसा, पुराण, तक शा)
- Modern Science and Indian Knowledge System Yoga and Holistic Health care
- Case studies

References

- V. Sivaramakrishnan (Ed.), *Cultural Heritage of India-course material*, Bharatiya Vidya Bhavan, Mumbai. 5th Edition, 2014
- Swami Jitatanand, *Modern Physics and Vedant*, Bharatiya Vidya Bhavan Swami Jitatanand, *Holistic Science and Vedant*, Bharatiya Vidya Bhavan Fritzof Capra, *Tao of Physics*
- Fritzof Capra, *The Wave of life*
- VN Jha (Eng. Trans.), *Tarkasangraha of Annam Bhatta*, International Chinmay Foundation, Velliarnad, Arnakulam
- *Yoga Sutra of Patanjali*, Ramakrishna Mission, Kolkata
- GN Jha (Eng. Trans.), Ed. RN Jha, *Yoga-darshanam with Vyasa Bhashya*, Vidyaniidhi Prakashan, Delhi 2016
- RN Jha, *Science of Consciousness Psychotherapy and Yoga Practices*, Vidyaniidhi Prakashan, Delhi 2016
- P B Sharma (English translation), *Shodhashang Hridayan*

Pedagogy: Problem based learning, group discussions, collaborative mini projects.

Outcome: Ability to understand, connect up and explain basics of Indian traditional knowledge in modern scientific perspective.



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Essence of Indian Knowledge Tradition-Pt-2

भारतीयविवासर - 2

Course objective

The course aims at imparting basic principles of thought process, reasoning and inferencing. Sustainability is at the core of Indian Traditional Knowledge Systems connecting society and nature. Holistic life style of yogic science and wisdom capsules in Sanskrit literature are also important in modern society with rapid technological advancements and societal disruptions. Part-2 focuses on Indian philosophical traditions, Indian linguistic Tradition, and Indian artistic tradition.

Course Contents

- Philosophical Tradition (सवदशन)- ाय, वैशेषिक, सां, योग, मीमांसा, वेदांत, चावाक, जैन, बौ
- Indian Linguistic Tradition (Phonology, morphology, syntax and semantics)
- Indian Artistic Tradition - िच कला, मूर्तिकला, वा ुकला, थाप, संगीत, नृ एवंसाहित्य
- Case studies

References

- V. Sivaramakrishnan (Ed.), *Cultural Heritage of India-course material*, Bharatiya Vidya Bhavan, Mumbai. 5th Edition, 2014
- S.C. Chatterjee & D.M. Datta, *An Introduction to Indian Philosophy*, University of Calcutta, 1984
- K.S. Subrahmanialyer, *Vakyapadiya of Bhartrihari*, (Brahma Kanda), Deccan College Pune 1965
- *Panini Shiksha*, MotilalBanarasidas
- V.N. Jha, *Language, Thought and Reality*,
- वासुदेवशरण अ वाल, कलाएवंसं ूित, साहि भवन, इलाहाबाद, 1952
- Pramod Chandra, *India Arts*, Howard Univ. Press, 1983
- Krishna Chaitanya, *Arts of India*, Abhinav Publications, 1987
- R. Nagaswamy, *Foundations of Indian Art*, Tamil Arts Academy, 2002

Pedagogy: Problem based learning, group discussions, collaborative mini projects.

Outcome: Ability to understand, connect up and explain basics of Indian traditional knowledge in modern scientific perspective.

DEPARTMENTAL ELECTIVE –II

KEEE-521: Wind and Solar Energy Systems (3L:0T:0P-03 credits)

Course Outcomes: At the end of this course, students will demonstrate the ability to

- Understand the energy scenario and the consequent growth of the power generation from renewable energy sources.
- Understand the basic physics of wind and solar power generation.
- Understand the power electronic interfaces for wind and solar generation.
- Understand the issues related to the grid-integration of solar and wind energy systems.

UNIT 1: Physics of Wind Power: (5 Hours)

History of wind power, Indian and Global statistics, Wind physics, Betz limit, Tip speed ratio, stall and pitch control, Wind speed statistics-probability distributions, Wind speed and power-cumulative distribution functions.

UNIT 2: Wind generator topologies: (12 Hours)

Review of modern wind turbine technologies, Fixed and Variable speed wind turbines, Induction Generators, Doubly-Fed Induction Generators and their characteristics, Permanent-Magnet Synchronous Generators, Power electronics converters. Generator-Converter configurations, Converter Control.

UNIT 3: The Solar Resource: (3 Hours)

Introduction, solar radiation spectra, solar geometry, Earth Sun angles, observer Sun angles, solar day length, Estimation of solar energy availability.

UNIT 4: Solar photovoltaic: (8 Hours)

Technologies-Amorphous, monocrystalline, polycrystalline; V-I characteristics of a PV cell, PV UNIT, array, Power Electronic Converters for Solar Systems, Maximum Power Point Tracking (MPPT) algorithms. Converter Control.

UNIT 5: Network Integration Issues: (8 Hours)

Overview of grid code technical requirements. Fault ride-through for wind farms - real and reactive power regulation, voltage and frequency operating limits, solar PV and wind farm behavior during grid disturbances. Power quality issues. Power system interconnection experiences in the world. Hybrid and isolated operations of solar PV and wind systems.

UNIT 6: Solar thermal power generation: (3 Hours)

Technologies, Parabolic trough, central receivers, parabolic dish, Fresnel, solar pond, elementary analysis.

Text / References:

- T. Ackermann, "Wind Power in Power Systems", John Wiley and Sons Ltd., 2005.
- G. M. Masters, "Renewable and Efficient Electric Power Systems", John Wiley and Sons, 2004.
- S. P. Sukhatme, "Solar Energy: Principles of Thermal Collection and Storage", McGraw Hill, 1984.
- H. Siegfried and R. Waddington, "Grid integration of wind energy conversion systems" John Wiley and Sons Ltd., 2006.
- G. N. Tiwari and M. K. Ghosal, "Renewable Energy Applications", Narosa Publications, 2004.
- J. A. Duffie and W. A. Beckman, "Solar Engineering of Thermal Processes", John Wiley & Sons, 1991.



KEEE-522: Line-Commutated and Active PWM Rectifiers (3L:0T:0P-03 credits)

Course Outcomes: At the end of this course, students will demonstrate the ability to

- Analyze controlled rectifier circuits.
- Understand the operation of line-commutated rectifiers – 6 pulse and multi-pulse configurations.
- Understand the operation of PWM rectifiers – operation in rectification and regeneration modes and lagging, leading and unity power factor mode.

UNIT 1: Diode rectifiers with passive filtering (6 Hours) *Pass (Participation)*

Half-wave diode rectifier with RL and RC loads; 1-phase full-wave diode rectifier with L, C and LC filter; 3-phase diode rectifier with L, C and LC filter; continuous and discontinuous conduction, input current waveshape, effect of source inductance; commutation overlap.

UNIT 2: Thyristor rectifiers with passive filtering (6 Hours)

Half-wave thyristor rectifier with RL and RC loads; 1-phase thyristor rectifier with L and LC filter; 3-phase thyristor rectifier with L and LC filter; continuous and discontinuous conduction, input current waveshape.

UNIT 3: Multi-Pulse converter (6 Lectures)

Review of transformer phase shifting, generation of 6-phase ac voltage from 3-phase ac, 6-pulse converter and 12-pulse converters with inductive loads, steady state analysis, commutation overlap, notches during commutation.

UNIT 4: Single-phase ac-dc single-switch boost converter (6 Hours)

Review of dc-dc boost converter, power circuit of single-switch ac-dc converter, steady state analysis, unity power factor operation, closed-loop control structure.

UNIT 5: Ac-dc bidirectional boost converter (6 Hours)

Review of 1-phase inverter and 3-phase inverter, power circuits of 1-phase and 3-phase ac-dc boost converter, steady state analysis, operation at leading, lagging and unity power factors. Rectification and regenerating modes. Phasor diagrams, closed-loop control structure.

UNIT 6: Isolated single-phase ac-dc flyback converter (10 Hours)

Dc-dc flyback converter, output voltage as a function of duty ratio and transformer turns ratio. Power circuit of ac-dc flyback converter, steady state analysis, unity power factor operation, closed loop control structure.

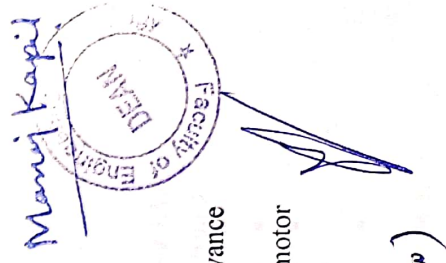
Text / References:

- G. De, "Principles of Thyristorised Converters", Oxford & IBH Publishing Co, 1988.
- J.G. Kassakian, M. F. Schlecht and G. C. Verghese, "Principles of Power Electronics", Addison-Wesley, 1991.
- L. Umanand, "Power Electronics: Essentials and Applications", Wiley India, 2009.
- N. Mohan and T. M. Undeland, "Power Electronics: Converters, Applications and Design", John Wiley & Sons, 2007.

KEEE-523: Electrical Drives (3L:0T:0P-03 credits)

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Know the basic idea of operating principle, control and application of advance electrical machines.
2. Understand power electronic converters and their application in electrical motor drives
3. Understand common load models for electrical motor drives
4. learn control principles for electrical motor drives

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Kavi (Sankaragadhu)

UNIT-I: Fundamentals of Electric Drive: Electric Drives and its parts, advantages of electric drives, Classification of electric drives, Speed-torque conventions and multi-quadrant operations Constant torque and constant power operation, Types of load, Load torque: components, nature and classification.

UNIT-II: Dynamics of Electric Drive: Dynamics of motor-load combination Steady state stability of Electric Drive Transient stability of electric Drive Selection of Motor Power rating: Thermal model of motor for heating and cooling, classes of motor duty, determination of motor power rating for continuous duty, short time duty and intermittent duty. Load equalization.

UNIT-III: Electric Braking: Purpose and types of electric braking, braking of dc, three phase induction and synchronous motors.

Dynamics During Starting and Braking: Calculation of acceleration time and energy loss during starting of dc shunt and three phase induction motors, methods of reducing energy loss during starting. Energy relations during braking, dynamics during braking.

UNIT-IV: Power Electronic Control of DC Drives: Single phase and three phase controlled converter fed separately excited dc motor drives (continuous conduction only), dual converter fed separately excited dc motor drive, rectifier control of dc series motor. Supply harmonics, power factor and ripples in motor current Chopper control of separately excited dc motor and dc series motor.

UNIT-V: Power Electronic Control of AC Drives: Three Phase induction Motor Drive:

Static Voltage control scheme, static frequency control scheme (VSI, CSI, and cyclo - converter based) static rotor resistance and slip power recovery control schemes.

Three Phase Synchronous motor: Self controlled scheme. **Special Drives:** Switched Reluctance motor, Brushless dc motor. Selection of motor for particular applications.

Text Books:

1. G.K. Dubey, "Fundamentals of Electric Drives", Narosa publishing House.
2. S.K.Pillai, "A First Course on Electric Drives", New Age International.

Reference Books:

- 1 M.Chilkin, "Electric Drives", Mir Publishers, Moscow.
- 2 Mohammed A. El-Sharkawi, "Fundamentals of Electric Drives", Thomson Asia, Pvt. Ltd. Singapore.
- 3 N.K. De and Prashant K.Sen, "Electric Drives", Prentice Hall of India Ltd.
- 4 V.Subrahmanyam, "Electric Drives: Concepts and Applications", Tata McGraw Hill.

KEEE-524: Electrical and Hybrid Vehicles (3L:0T:0P-03 credits)

Course Outcomes: At the end of this course, students will demonstrate the ability to

- Understand the models to describe hybrid vehicles and their performance.
- Understand the different possible ways of energy storage.
- Understand the different strategies related to energy storage systems.

UNIT 1: Introduction (10 hours)

Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, and mathematical models to describe vehicle performance. Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.

UNIT 3: Electric Trains (10 hours)

Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis. Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.

UNIT 4: Energy Storage (10 hours)

Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices. Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems

UNIT 5: Energy Management Strategies (9 hours)

Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies Case Studies: Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV).

Text / References:

- C. Mi, M. A. Masrur and D. W. Gao, "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", John Wiley & Sons, 2011.
- S. Onori, L. Serrao and G. Rizzoni, "Hybrid Electric Vehicles: Energy Management Strategies", Springer, 2015.
- M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design", CRC Press, 2004.
- T. Denton, "Electric and Hybrid Vehicles", Routledge, 2016.

KEEE-525: Electrical Machine Design (3L:0T:0P-03 credits)

Course Outcomes: At the end of this course, students will demonstrate the ability to

- Understand the construction and performance characteristics of electrical machines.
- Understand the various factors which influence the design: electrical, magnetic and thermal loading of electrical machines
- Understand the principles of electrical machine design and carry out a basic design of an ac machine.
- Use software tools to do design calculations.

UNIT 1: Introduction

Major considerations in electrical machine design, electrical engineering materials, space factor, choice of specific electrical and magnetic loadings, thermal considerations, heat flow, temperature rise, rating of machines.

UNIT 2: Transformers

Sizing of a transformer, main dimensions, kVA output for single- and three-phase transformers, window space factor, overall dimensions, operating characteristics, regulation, no load current, temperature rise in transformers, design of cooling tank, methods for cooling of transformers.

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UNIT 3: Induction Motors

Sizing of an induction motor, main dimensions, length of air gap, rules for selecting rotor slots of squirrel cage machines, design of rotor bars & slots, design of end rings, design of wound rotor, magnetic leakage calculations, leakage reactance of polyphase machines, magnetizing current, short circuit current, circle diagram, operating characteristics.

UNIT 4: Synchronous Machines

Sizing of a synchronous machine, main dimensions, design of salient pole machines, short circuit ratio, shape of pole face, armature design, armature parameters, estimation of air gap length, design of rotor, design of damper winding, determination of full load field mmf, design of field winding, design of turbo alternators, rotor design.

UNIT 5: Computer aided Design (CAD):

Limitations (assumptions) of traditional designs, need for CAD analysis, synthesis and hybrid methods, design optimization methods, variables, constraints and objective function, problem formulation. Introduction to FEM based machine design. Introduction to complex structures of modern machines-PMSMs, BLDCs, SRM and claw-pole machines.

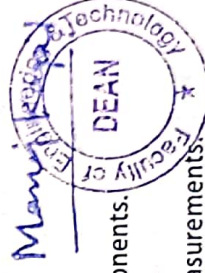
Text / References:

- A. K. Sawhney, "A Course in Electrical Machine Design", Dhanpat Rai and Sons, 1970.
- M.G. Say, "Theory & Performance & Design of A.C. Machines", ELBS London.
- S. K. Sen, "Principles of Electrical Machine Design with computer programmes", Oxford and IBH Publishing, 2006.
- K. L. Narang, "A Text Book of Electrical Engineering Drawings", SatyaPrakashan, 1969.
- A. Shanmugasundaram, G. Gangadharan and R. Palani, "Electrical Machine Design Data Book", New Age International, 1979.
- K. M. V. Murthy, "Computer Aided Design of Electrical Machines", B.S. Publications, 2008.
- Electrical machines and equipment design exercise examples using Ansoft's Maxwell 2D machine design package.

KEEE-526: Power System Protection (3L:0T:0P-03 credits)

Course Outcomes: At the end of this course, students will demonstrate the ability to

- Understand the different components of a protection system.
- Evaluate fault current due to different types of fault in a network.
- Understand the protection schemes for different power system components.
- Understand the basic principles of digital protection.
- Understand system protection schemes, and the use of wide-area measurements.



UNIT 1: Introduction and Components of a Protection System (4 hours) Principles of Power System Protection, Relays, Instrument transformers, Circuit Breakers

UNIT 2: Faults and Over-Current Protection (8 hours)

Review of Fault Analysis, Sequence Networks. Introduction to Overcurrent Protection and overcurrent relay co-ordination.

UNIT 3: Equipment Protection Schemes(8 hours)

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Directional, Distance, Differential protection. Transformer and Generator protection. Bus bar Protection, Bus Bar arrangement schemes.

UNIT 4: Digital Protection (8 hours)

Computer-aided protection, Fourier analysis and estimation of Phasors from DFT. Sampling, aliasing issues.

UNIT 5: Modeling and Simulation of Protection Schemes (8 hours)

CT/PT modeling and standards, Simulation of transients using Electro-Magnetic Transients (EMT) programs. Relay Testing.

UNIT 6: System Protection (4 hours)

Effect of Power Swings on Distance Relaying. System Protection Schemes. Under-frequency, under-voltage and df/dt relays, Out-of-step protection, Synchro-phasors, Phasor Measurement Units and Wide-Area Measurement Systems (WAMS). Application of WAMS for improving protection systems.

Text/References

- J. L. Blackburn, "Protective Relaying: Principles and Applications", Marcel Dekker, New York, 1987.
- Y. G. Paithankar and S. R. Bhide, "Fundamentals of power system protection", Prentice Hall, India, 2010.
- G. Phadke and J. S. Thorp, "Computer Relaying for Power Systems", John Wiley & Sons, 1988.
- G. Phadke and J. S. Thorp, "Synchronized Phasor Measurements and their Applications", Springer, 2008.
- D. Reimert, "Protective Relaying for Power Generation Systems", Taylor and Francis, 2006.

KEEE-527: HVDC Transmission Systems (3L:0T:0P-03 credits)

Course Outcomes: At the end of this course, students will demonstrate the ability to

- Understand the advantages of dc transmission over ac transmission.
- Understand the operation of Line Commutated Converters and Voltage Source Converters.
- Understand the control strategies used in HVDC transmission system.
- Understand the improvement of power system stability using an HVDC system.

UNIT 1: DC Transmission Technology (4 hours)

Comparison of AC and DC Transmission (Economics, Technical Performance and Reliability). Application of DC Transmission. Types of HVDC Systems. Components of a HVDC system. Line Commutated Converter and Voltage Source Converter based systems.

UNIT 2: Analysis of Line Commutated and Voltage Source Converters (10 hours)

Line Commutated Converters (LCCs): Six pulse converter, Analysis neglecting commutation overlap, harmonics, Twelve Pulse Converters. Inverter Operation. Effect of Commutation Overlap. Expressions for average dc voltage, AC current and reactive power absorbed by the converters. Effect of Commutation Failure, Misfire and Current Extinction in LCC links.

Voltage Source Converters (VSCs): Two and Three-level VSCs, PWM schemes: Selective Harmonic Elimination, Sinusoidal Pulse Width Modulation. Analysis of a six pulse converter. Equations in the rotating frame. Real and Reactive power control using a VSC.

UNIT 3: Control of HVdc Converters: (10 hours)

Principles of Link Control in a LCCHVdc system. Control Hierarchy, Firing Angle Controls—Phase-Locked Loop, Current and Extinction Angle Control, Starting and Stopping of a Link. Higher level Controllers Power control, Frequency Control, Stability Controllers. Reactive Power Control. Principles of Link Control in a VSC HVdc system: Power flow and dc Voltage Control. Reactive Power Control/AC voltage regulation.

UNIT 3: Components of HVdc systems: (8 hours)

Smoothing Reactors, Reactive Power Sources and Filters in LCC HVdc systems DC line: Corona Effects. Insulators, Transient Over-voltages. dc line faults in LCC systems. dc line faults in VSC systems. dc breakers. Monopolar Operation. Ground Electrodes.

UNIT 4: Stability Enhancement using HVdc Control (4 hours)

Basic Concepts: Power System Angular, Voltage and Frequency Stability Power Modulation: basic principles – synchronous and asynchronous links. Voltage Stability Problem in AC/dc systems.

UNIT 5: MTdc Links (4 hours)

Multi-Terminal and Multi-Infeed Systems. Series and Parallel MTdc systems using LCCs. MTdc systems using VSCs. Modern Trends in HVdc Technology. Introduction to Modular Multi-level Converters.

Text/References:

- K. R. Padiyar, "HVDC Power Transmission Systems", New Age International Publishers, 2011.
- J. Arrillaga, "High Voltage Direct Current Transmission", Peter Peregrinus Ltd., 1983.
- E. W. Kimbark, "Direct Current Transmission", Vol.1, Wiley-Interscience, 1971.

KEEE-528: High Voltage Engineering (3L:0T:0P-03 credits)

Course outcomes: At the end of the course, the student will demonstrate

- Understand the basic physics related to various breakdown processes in solid, liquid and gaseous insulating materials.
- Knowledge of generation and measurement of D. C., A.C., & Impulse voltages. Knowledge of tests on H. V. equipment and on insulating materials, as per the standards.
- Knowledge of how over-voltages arise in a power system, and protection against these over-voltages.

UNIT-I: Electrostatic Field and Field Stress Control: Electric field stresses, Numerical methods for Electric field computation, Finite Element Method, Charge simulation method.

Conduction and Break Down in Gases:

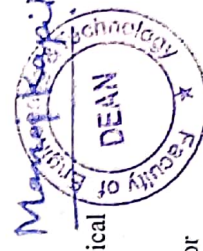
Ionization processes, Townsend's criterion, breakdown in electronegative gases, time lags for breakdown, streamer theory, Paschen's law, break down in non-uniform field, and corona discharge.

Break Down in Liquid Dielectrics:

Conduction and breakdown in pure liquid and commercial liquid.

Break Down in Solid Dielectrics:

Intrinsic breakdown, electromechanical breakdown, breakdown of solid, dielectric and composite dielectrics.



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UNIT-II: Generation of High Voltages and Currents:

Generation of high direct current voltages, generation of high alternating voltages, generation of impulse voltages, generation of impulse currents, tripping and control of impulse generators.

UNIT -III: Measurement of High Voltages and Currents:

Measurement of high direct current voltages, measurement of high alternating and impulse voltages, measurement of high direct, alternating and impulse currents, Cathode Ray Oscillographs for impulse voltage and current measurements.
Insulation Coordination in Electric Power Systems:
Principle of Isolation Coordination in High-Voltage & Extra-High Voltage Power System.

UNIT-IV: Non-Destructive Testing:

Measurement of direct current resistively, measurement of dielectric constant and loss factor, partial discharge measurements

High Voltage Testing:

Testing of insulators and bushings, testing of isolators and circuit breakers, testing of cables, testing of transformers, testing of surge arresters, radio interference measurements.

Text Books:

1. M. S. Naidu and V. Kamaraju, "High Voltage Engineering, Tata Mc-Graw Hill.
2. C. L. Wadhwa, "High Voltage Engineering", Wiley Eastern Ltd.

Reference Books:

3. E. Kuffel and W. S. Zaengal, High Voltage Engineering", Pergamon Press.
4. M. P. Chaurasia, "High Voltage Engineering", Khanna Publishers
5. R. S. Jha, "High Voltage Engineering", DhanpatRai & sons
6. M. Khalifa, 'High Voltage Engineering Theory and Practice,' Marcel Dekker.
7. Subir Ray, 'An Introduction to High Voltage Engineering' Prentice Hall of India

Subir Ray
(Subir Ray)

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KEEE-529: Electrical Energy Conservation and Auditing (3L:0T:0P-03 credits)

Course Outcomes: At the end of this course, students will demonstrate the ability to

- Understand the current energy scenario and importance of energy conservation.
- Understand the concepts of energy management.
- Understand the methods of improving energy efficiency in different electrical systems.
- Understand the concepts of different energy efficient devices.

UNIT 1: Energy Scenario (6 Hours)

Commercial and Non-commercial energy, primary energy resources, commercial energy production, final energy consumption, energy needs of growing economy, long term energy scenario, energy pricing, energy sector reforms, energy and environment, energy security, energy conservation and its importance, restructuring of the energy supply sector, energy strategy for the future, air pollution, climate change. Energy Conservation Act-2001 and its features.

UNIT 2: Basics of Energy and its various forms (7 Hours)

Electricity tariff, load management and maximum demand control, power factor improvement, selection & location of capacitors, Thermal Basics-fuels, thermal energy contents of fuel, temperature & pressure, heat capacity, sensible and latent heat, evaporation, condensation. steam, moist air and humidity & heat transfer, units and conversion.

UNIT 3: Energy Management & Audit (6 Hours)

Definition, energy audit, need, types of energy audit. Energy management (audit) approach- understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel energy substitution, energy audit instruments. Material and Energy balance: Facility as an energy system, methods for preparing process flow, material and energy balance diagrams.

UNIT 4: Energy Efficiency in Electrical Systems (7 Hours)

Electrical system: Electricity billing, electrical load management and maximum demand control, power factor improvement and its benefit, selection and location of capacitors, performance assessment of PF capacitors, distribution and transformer losses. Electric motors: Types, losses in induction motors, motor efficiency, factors affecting motor performance, rewinding and motor replacement issues, energy saving opportunities with energy efficient motors.

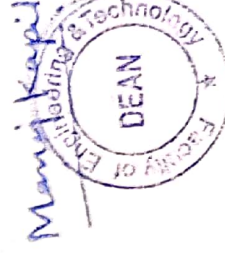
UNIT 5: Energy Efficiency in Industrial Systems (8 Hours)

Compressed Air System: Types of air compressors, compressor efficiency, efficient compressor operation, Compressed air system components, capacity assessment, leakage test, factors affecting the performance and savings opportunities in HVAC, Fans and blowers: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities. Pumps and Pumping System: Types, performance evaluation,

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efficient system operation, flow control strategies and energy conservation opportunities. Cooling Tower: Types and performance evaluation, efficient system operation, flow control strategies and energy saving opportunities, assessment of cooling towers.

UNIT 6: Energy Efficient Technologies in Electrical Systems (8Hours)

Maximum demand controllers, automatic power factor controllers, energy efficient motors, soft starters with energy saver, variable speed drives, energy efficient transformers, electronic ballast, occupancy sensors, energy efficient lighting controls, energy saving potential of each technology.

Text/Reference Books

- Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-1, General Aspects (available online)
- Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-3, Electrical Utilities (available online)
- S. C. Tripathy, "Utilization of Electrical Energy and Conservation", McGraw Hill, 1991.
- Success stories of Energy Conservation by BEE, New Delhi (www.bee-india.org)

KEEE-530: Industrial Electrical Systems (3L:0T:0P-03 credits)

Course Outcomes: At the end of this course, students will demonstrate the ability to

- Understand the electrical wiring systems for residential, commercial and industrial consumers, representing the systems with standard symbols and drawings, SLD.
- Understand various components of industrial electrical systems.
- Analyze and select the proper size of various electrical system components.

UNIT 1: Electrical System Components (8 Hours)

LT system wiring components, selection of cables, wires, switches, distribution box, metering system, Tariff structure, protection components- Fuse, MCB, MCCB, ELCB, inverse current characteristics, symbols, single line diagram (SLD) of a wiring system, Contactor, Isolator, Relays, MPCB, Electric shock and Electrical safety practices

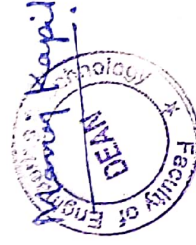
UNIT 2: Residential and Commercial Electrical Systems (8 Hours)

Types of residential and commercial wiring systems, general rules and guidelines for installation, load calculation and sizing of wire, rating of main switch, distribution board and protection devices, earthing system calculations, requirements of commercial installation, deciding lighting scheme and number of lamps, earthing of commercial installation, selection and sizing of components.

UNIT 3: Illumination Systems (6 Hours)

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Understanding various terms regarding light, lumen, intensity, candle power, lamp efficiency, specific consumption, glare, space to height ratio, waste light factor, depreciation factor, various illumination schemes, Incandescent lamps and modern luminaries like CFL, LED and their operation, energy saving in illumination systems, design of a lighting scheme for a residential and commercial premises, flood lighting.

UNIT 4: Industrial Electrical Systems I (8 Hours)

HT connection, industrial substation, Transformer selection, Industrial loads, motors, starting of motors, SLD, Cable and Switchgear selection, Lightning Protection, Earthing design, Power factor correction – kVAR calculations, type of compensation, Introduction to PCC, MCC panels. Specifications of LT Breakers, MCB and other LT panel components.

UNIT 5: Industrial Electrical Systems II (6 Hours)

DG Systems, UPS System, Electrical Systems for the elevators, Battery banks, Sizing the DG, UPS and Battery Banks, Selection of UPS and Battery Banks.

UNIT 6: Industrial Electrical System Automation (6 Hours)

Study of basic PLC, Role of in automation, advantages of process automation, PLC based control system design, Panel Metering and Introduction to SCADA system for distribution automation.

Text/Reference Books

- S. L. Uppal and G. C. Garg, "Electrical Wiring, Estimating & Costing", Khanna publishers, 2008.
- K. B. Raina, "Electrical Design, Estimating & Costing", New age International, 2007.
- S. Singh and R. D. Singh, "Electrical estimating and costing", Dhanpat Rai and Co., 1997.
- Web site for IS Standards.
- H. Joshi, "Residential Commercial and Industrial Systems", McGraw Hill Education, 2008.

KEEE-531: Power System Dynamics and Control (3L:0T:0P-03 credits)

Course Outcomes: At the end of this course, students will demonstrate the ability to

- Understand the problem of power system stability and its impact on the system.
- Analyze linear dynamical systems and use of numerical integration methods.
- Model different power system components for the study of stability.

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Understand the methods to improve stability.

UNIT 1: Introduction to Power System Operations (3 hours)

Introduction to power system stability. Power System Operations and Control. Stability problems in Power System. Impact on Power System Operations and control.

UNIT 2 : Analysis of Linear Dynamical System and Numerical Methods (5 hours)

Analysis of dynamical System, Concept of Equilibrium, Small and Large Disturbance Stability. Modal Analysis of Linear System. Analysising Numerical Integration Techniques. Issues in Modeling: Slow and Fast Transients, Stiff System.

UNIT 3 : Modeling of Synchronous Machines and Associated Controllers (12 hours)

Modeling of synchronous machine: Physical Characteristics. Rotor position dependent model. D-Q Transformation. Model with Standard Parameters. Steady State Analysis of Synchronous Machine. Short Circuit Transient Analysis of a Synchronous Machine. Synchronization of Synchronous Machine to an Infinite Bus. Modeling of Excitation and Prime Mover Systems. Physical Characteristics and Models. Excitation System Control. Automatic Voltage Regulator. Prime Mover Control Systems. Speed Governors.

UNIT 4 : Modeling of other Power System Components (10 hours)

Modeling of Transmission Lines and Loads. Transmission Line Physical Characteristics. Transmission Line Modeling. Load Models - induction machine model. Frequency and Voltage Dependence of Loads. Other Subsystems – HVDC and FACTS controllers, Wind Energy Systems.

UNIT 5 : Stability Analysis (11 hours)

Angular stability analysis in Single Machine Infinite Bus System. Angular Stability in multi-machine systems – Intra-plant, Local and Inter-area modes. Frequency Stability: Centre of Inertia Motion. Load Sharing: Governor droop. Single Machine Load Bus System: Voltage Stability. Introduction to Torsional Oscillations and the SSR phenomenon. Stability Analysis Tools: Transient Stability Programs, Small Signal Analysis Programs.

UNIT 6 : Enhancing System Stability (4 hours)

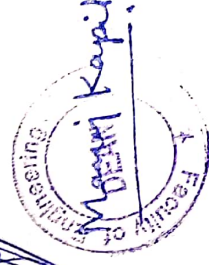
Planning Measures. Stabilizing Controllers (Power System Stabilizers). Operational Measures- Preventive Control. Emergency Control.

Text/Reference Books

- K.R. Padiyar, "Power System Dynamics, Stability and Control", B. S. Publications, 2002.

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- P. Kundur, "Power System Stability and Control", McGraw Hill, 1995.
- P. Sauer and M. A. Pai, "Power System Dynamics and Stability", Prentice Hall, 1997.

KEEF-532: Digital Control Systems (3L:0T:0P-03 credits)

Course Outcomes: At the end of this course, students will demonstrate the ability to

- Obtain discrete representation of LTI systems.
- Analyze stability of open loop and closed loop discrete-time systems. Design and analyze digital controllers.
- Design state feedback and output feedback controllers.

UNIT 1: Discrete Representation of Continuous Systems (6 hours)

Basics of Digital Control Systems. Discrete representation of continuous systems. Sample and hold circuit. Mathematical Modelling of sample and hold circuit. Effects of Sampling and Quantization. Choice of sampling frequency. ZOH equivalent.

UNIT 2: Discrete System Analysis (6 hours)

Z-Transform and Inverse Z Transform for analyzing discrete time systems. Pulse Transfer function. Pulse transfer function of closed loop systems. Mapping from s-plane to z plane. Solution of Discrete time systems. Time response of discrete time system.

UNIT 3: Stability of Discrete Time System (4 hours)

Stability analysis by Jury test. Stability analysis using bilinear transformation. Design of digital control system with dead beat response. Practical issues with dead beat response design.

UNIT 4: State Space Approach for discrete time systems (10 hours)

State space models of discrete systems, State space analysis. Lyapunov Stability. Controllability, reach-ability, Reconstructibility and observability analysis. Effect of pole zero cancellation on the controllability & observability.

UNIT 5: Design of Digital Control System(8 hours)

Design of Discrete PID Controller, Design of discrete state feedback controller. Design of set point tracker. Design of Discrete Observer for LTI System. Design of Discrete compensator.

UNIT 6: Discrete output feedback control (8 hours)

Design of discrete output feedback control. Fast output sampling (FOS) and periodic output feedback controller design for discrete time systems.

Text Books :

- K. Ogata, "Digital Control Engineering", Prentice Hall, Englewood Cliffs, 1995.
- M. Gopal, "Digital Control Engineering", Wiley Eastern, 1988.
- G. F. Franklin, J. D. Powell and M. L. Workman, "Digital Control of Dynamic Systems",

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Addison-Wesley, 1998.

- B.C. Kuo, "Digital Control System", Holt, Rinehart and Winston, 1980.

KEEE-533: Digital Signal Processing (3L:0T:0P-03 credits)

Course Outcomes: At the end of this course, students will demonstrate the ability to

- Represent signals mathematically in continuous and discrete-time, and in the frequency domain.
- Analyze discrete-time systems using z-transform.
- Understand the Discrete-Fourier Transform (DFT) and the FFT algorithms. Design digital filters for various applications.
- Apply digital signal processing for the analysis of real-life signals.

Unit-I: Discrete-Time Signals and Systems:

Sequences, discrete time systems, LTI systems, frequency domain representation of discrete time signals and systems, discrete time signals and frequency domain representation, Fourier Transform.

Implementation of discrete time systems:

Structure for FIR system, Structure for IIR systems

Unit-II: Sampling of Continuous Time Signals:

Sampling and reconstruction of signals, frequency domain representation of sampling, discrete time processing of continuous time signals, continuous time processing of discrete time signals, changing the sampling rate using discrete time processing, multi rate signal processing, digital processing of analog signals, over sampling and noise shaping in A/D and D/A conversion

Unit-III: Transform Analysis of LTI Systems:

Frequency response of LTI systems, system functions, frequency response for rational system functions, magnitude-phase relationship, all pass systems, minimum phase systems, and linear systems with generalized linear phase

Discrete Fourier Transform:

Discrete Fourier Transform, properties, linear convolution and circular convolution,

Unit-IV: Filter Design Techniques:

Design of IIR filters using Impulse Invariant Response method and Bilinear Transformation method. Butterworth filters and chebyshev Filter's response, Design of FIR filters by windowing, Kaiser Window method, optimum approximations of FIR filters,

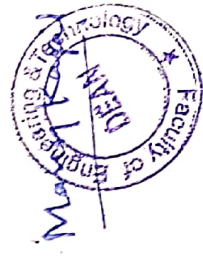
Unit-V: Efficient computation of the DFT:

FFT algorithms- decimation in time and decimation in frequency, Goertzel algorithm, Implementation of the DFT using convolution,

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Introduction to wavelet transform:

Wavelet comparison with Fourier transforms, Applications of Wavelet cosine transform, Discrete cosine transform (DCT).

Text Books:

1. S. Salivahanan, "Digital Signal Processing", McGraw Hill Education (India) Private Limited.
2. Oppenheim A.V., Schaffer, Ronald W. & Buck, John R. "Discrete Time Signal processing", Pearson Education .

Reference Books:

3. Proakis, J.G. & Manolakis, D.G., "Digital Signal Processing: Principles Algorithms and Applications", Prentice Hall of India.
4. Rabiner, L.R. and Gold B., "Theory and applications of DSP", Prentice Hall of India.
5. Oppenheim, Alan V. & Willsky, Alan S., "Signals and Systems", Prentice Hall of India, 2nd Edition
6. Johnson, J.R., "Introduction to Digital Signal Processing", Prentice Hall of India.

KEEE-534: Computer Architecture (3L:0T:0P-03 credits)

Course Outcomes: At the end of this course, students will demonstrate the ability to

- Understand the concepts of microprocessors, their principles and practices.
- Write efficient programs in assembly language of the 8086 family of microprocessors. Organize a modern computer system and be able to relate it to real examples.
- Develop the programs in assembly language for 80286, 80386 and MIPS processors in real and protected modes.
- Implement embedded applications using ATOM processor.

UNIT 1: Introduction to computer organization (6 hours)

Architecture and function of general computer system, CISC Vs RISC, Data types, Integer Arithmetic - Multiplication, Division, Fixed and Floating point representation and arithmetic, Control unit operation, Hardware implementation of CPU with Micro instruction, microprogramming, System buses, Multi-bus organization.

UNIT 2: Memory organization (6 hours)

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(Ranjay Surtani)

Ravi
(Ravi)

Manoj Kapi



System memory, Cache memory - types and organization, Virtual memory and its implementation, Memory management unit, Magnetic Hard disks, Optical Disks.

UNIT 3: Input – output Organization (8 hours)

Accessing I/O devices, Direct Memory Access and DMA controller, Interrupts and Interrupt Controllers, Arbitration, Multilevel Bus Architecture, Interface circuits - Parallel and serial port. Features of PCI and PCI Express bus.

UNIT 4: 16 and 32 microprocessors (8 hours)

80x86 Architecture, IA – 32 and IA – 64, Programming model, Concurrent operation of EU and BIU, Real mode addressing, Segmentation, Addressing modes of 80x86, Instruction set of 80x86, I/O addressing in 80x86

UNIT 5: Pipelining(8 hours)

Introduction to pipelining, Instruction level pipelining (ILP), compiler techniques for ILP, Data hazards, Dynamic scheduling, Dependability, Branch cost, Branch Prediction, Influence on instruction set.

UNIT 6: Different Architectures (8 hours)

VLIW Architecture, DSP Architecture, SoC architecture, MIPS Processor and programming
Text/Reference Books

- V. Carl, G. Zvonko and S. G. Zaky, "Computer organization", McGraw Hill, 1978.
- B. Brey and C. R. Sarma, "The Intel microprocessors", Pearson Education, 2000.
- J. L. Hennessy and D. A. Patterson, "Computer Architecture A Quantitative Approach", Morgan Kaufman, 2011.
- W. Stallings, "Computer organization", PHI, 1987.
- P. Barry and P. Crowley, "Modern Embedded Computing", Morgan Kaufmann, 2012.
- N. Mathivanan, "Microprocessors, PC Hardware and Interfacing", Prentice Hall, 2004.
- Y. C. Liu and G. A. Gibson, "Microcomputer Systems: The 8086/8088 Family", Prentice Hall India, 1986.
- J. Uffenbeck, "The 8086/8088 Design, Programming, Interfacing", Prentice Hall, 1987.
- B. Govindarajalu, "IBM PC and Clones", Tata McGraw Hill, 1991.
- P. Able, "8086 Assembly Language Programming", Prentice Hall India.

KEEE-535: Electromagnetic waves (3L:0T:0P-03 credits)

(Paulraj Garg)

Ravi
(Ravi)

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Course Outcomes: At the end of this course, students will demonstrate the ability to

- Analyse transmission lines and estimate voltage and current at any point on transmission line for different load conditions.
- Provide solution to real life plane wave problems for various boundary conditions. Analyse the field equations for the wave propagation in special cases such as lossy and low loss dielectric media.
- Visualize TE and TM mode patterns of field distributions in a rectangular wave-guide. Understand and analyse radiation by antennas.

Syllabus:

UNIT 1: Transmission Lines (6 hours)

Introduction, Concept of distributed elements, Equations of voltage and current, Standing waves and impedance transformation, Lossless and low-loss transmission lines, Power transfer on a transmission line, Analysis of transmission line in terms of admittances, Transmission line calculations with the help of Smith chart, Applications of transmission line, Impedance matching using transmission lines.

UNIT 2: Maxwell's Equations (6 hours)

Basic quantities of Electromagnetics, Basic laws of Electromagnetics: Gauss's law, Ampere's Circuital law, Faraday's law of Electromagnetic induction. Maxwell's equations, Surface charge and surface current, Boundary conditions at media interface.

UNIT 3: Uniform Plane Wave (7 hours)

Homogeneous unbound medium, Wave equation for time harmonic fields, Solution of the wave equation, Uniform plane wave, Wave polarization, Wave propagation in conducting medium, Phase velocity of a wave, Power flow and Poynting vector.

UNIT 4: Plane Waves at Media Interface (7 hours)

Plane wave in arbitrary direction, Plane wave at dielectric interface, Reflection and refraction of waves at dielectric interface, Total internal reflection, Wave polarization at media interface, Brewster angle, Fields and power flow at media interface, Lossy media interface, Reflection from conducting boundary.

UNIT 5: Waveguides (7 hours)

Parallel plane waveguide: Transverse Electric (TE) mode, transverse Magnetic (TM) mode, Cut-off frequency, Phase velocity and dispersion. Transverse Electromagnetic (TEM) mode, Analysis of waveguide-general approach, Rectangular waveguides.

UNIT 6: Antennas (7 hours)

(Paulraj Epitau) *Ravi* *(Ravi)* *Manoj Kapi*


Radiation parameters of antenna, Potential functions, Solution for potential functions, Radiations from Hertz dipole, Near field, Far field, Total power radiated by a dipole, Radiation resistance and radiation pattern of Hertz dipole, Hertz dipole in receiving mode.

Text/Reference Books

- R. K. Shevgaonkar, "Electromagnetic Waves", Tata McGraw Hill, 2005.
- D. K. Cheng, "Field and Wave Electromagnetics", Addison-Wesley, 1989.
- M. N.O. Sadiku, "Elements of Electromagnetics", Oxford University Press, 2007.
- C. A. Balanis, "Advanced Engineering Electromagnetics", John Wiley & Sons, 2012.
- C. A. Balanis, "Antenna Theory: Analysis and Design", John Wiley & Sons, 2005.

KEEE-536: Computational Electromagnetics (3L:0T:0P-03 credits)

Course Outcomes: At the end of this course, students will demonstrate the ability to

- Understand the basic concepts of electromagnetics.
- Understand computational techniques for computing fields.
- Apply the techniques to simple real-life problems.

UNIT 1: Introduction (6 hours)

Conventional design methodology, Computer aided design aspects – Advantages. Review of basic fundamentals of Electrostatics and Electromagnetics. Development of Helmholtz equation, energy transformer vectors- Poynting and Stepan, magnetic Diffusion-transients and time-harmonic.

UNIT 2: Analytical Methods (6 hours)

Analytical methods of solving field equations, method of separation of variables, Roth's method, integral methods- Green's function, method of images.

UNIT 3: Finite Difference Method (FDM) (7 hours)

Finite Difference schemes, treatment of irregular boundaries, accuracy and stability of FD solutions, Finite-Difference Time-Domain (FDTD) method- Uniqueness and convergence.

UNIT 4: Finite Element Method (FEM) (7 hours)

(Paulkay Gantun) *Kari* *(Ravi)*



Overview of FEM, Variational and Galerkin Methods, shape functions, lower and higher order elements, vector elements, 2D and 3D finite elements, efficient finite element computations.

UNIT 5: Special Topics (7 hours)

{Background of experimental methods-electrolytic tank, R-C network solution, Field plotting (graphical method)}, hybrid methods, coupled circuit - field computations, electromagnetic - thermal and electromagnetic - structural coupled computations, solution of equations, method of moments, Poisson's fields.

UNIT 6: Applications (7 hours)

Low frequency electrical devices, static / time-harmonic / transient problems in transformers, rotating machines, actuators. CAD packages.

Text/Reference Books

- P. P. Silvester and R. L. Ferrari "Finite Element for Electrical Engineers", Cambridge University press, 1996.
- M. N. O. Sadiku, "Numerical Techniques in Electromagnetics", CRC press, 2001.

KEEE-537: Control Systems Design (3L:0T:0P-03 credits)

Course Outcomes: At the end of this course, students will demonstrate the ability to

- Understand various design specifications.
- Design controllers to satisfy the desired design specifications using simple controller structures (P, PI, PID, compensators).
- Design controllers using the state-space approach.

UNIT 1: Design Specifications (6 hours)

Introduction to design problem and philosophy. Introduction to time domain and frequency domain design specification and its physical relevance. Effect of gain on transient and steady state response. Effect of addition of pole on system performance. Effect of addition of zero on system response.

UNIT 2: Design of Classical Control System in the time domain (8 hours)

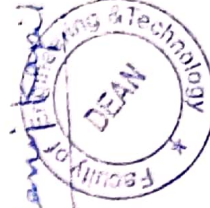
Introduction to compensator. Design of Lag, lead lag-lead compensator in time domain. Feedback and Feed forward compensator design. Feedback compensation. Realization of compensators.

UNIT 3: Design of Classical Control System in frequency domain (8 hours)

Compensator design in frequency domain to improve steady state and transient response.

Feedback and Feed forward compensator design using bode diagram.

Praveen *Ravi* *Mani*
(Praveen) (Ravi) (Mani)



UNIT 4: Design of PID controllers (6 hours)

Design of P, PI, PD and PID controllers in time domain and frequency domain for first, second and third order systems. Control loop with auxiliary feedback – Feed forward control.

UNIT 5: Control System Design in state space (8 hours)

Review of state space representation. Concept of controllability & observability, effect of pole zero cancellation on the controllability & observability of the system, pole placement design through state feedback. Ackerman's Formula for feedback gain design. Design of Observer. Reduced order observer. Separation Principle.

UNIT 6: Nonlinearities and its effect on system performance (3 hours)

Various types of non-linearities. Effect of various non-linearities on system performance. Singular points. Phase plot analysis.

Text and Reference Books :

- N. Nise, "Control system Engineering", John Wiley, 2000.
- J. Nagrath and M. Gopal, "Control system engineering", Wiley, 2000.
- M. Gopal, "Digital Control Engineering", Wiley Eastern, 1988.
- K. Ogata, "Modern Control Engineering", Prentice Hall, 2010.
- B. C. Kuo, "Automatic Control system", Prentice Hall, 1995.
- J. J. D'Azzo and C. H. Houpis, "Linear control system analysis and design (conventional and modern)", McGraw Hill, 1995.
- R. T. Stefani and G. H. Hostetter, "Design of feedback Control Systems", Saunders College Pub, 1994.

KEEE-538: Advanced Electric Drives (3L:0T:0P-03 credits)

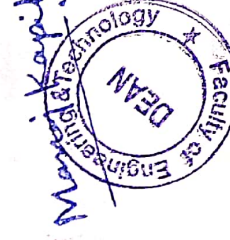
Course Outcomes: At the end of this course, students will demonstrate the ability to

- Understand the operation of power electronic converters and their control strategies.
- Understand the vector control strategies for ac motor drives
- Understand the implementation of the control strategies using digital signal processors.

UNIT 1: Power Converters for AC drives (10 hours)

PWM control of inverter, selected harmonic elimination, space vector modulation, current control of VSI, three level inverter, Different topologies, SVM for 3 level inverter, Diode rectifier with boost chopper, PWM converter as line side rectifier, current fed inverters with self-commutated devices. Control of CSI, H bridge as a 4-Q drive.

Dr. P. S. Ravi
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Dr. P. S. Ravi
(Ravi)



UNIT 2: Induction motor drives (10 hours)

Different transformations and reference frame theory, modeling of induction machines, voltage fed inverter control-v/f control, vector control, direct torque and flux control(DTC).

UNIT 3: Synchronous motor drives (6 hours)

Modeling of synchronous machines, open loop v/f control, vector control, direct torque control, CSI fed synchronous motor drives.

UNIT 4: Permanent magnet motor drives (6 hours)

Introduction to various PM motors, BLDC and PMSM drive configuration, comparison, block diagrams, Speed and torque control in BLDC and PMSM.

UNIT 5: Switched reluctance motor drives (6 hours)

Evolution of switched reluctance motors, various topologies for SRM drives, comparison, Closed loop speed and torque control of SRM.

UNIT 6: DSP based motion control (6 hours)

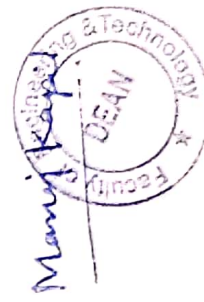
Use of DSPs in motion control, various DSPs available, realization of some basic blocks in DSP for implementation of DSP based motion control.

Text / References:

- B. K. Bose, "Modern Power Electronics and AC Drives", Pearson Education, Asia, 2003.
- P. C. Krause, O. Wasynczuk and S. D. Sudhoff, "Analysis of Electric Machinery and Drive Systems", John Wiley & Sons, 2013.
- H. A. Taliyat and S. G. Campbell, "DSP based Electromechanical Motion Control", CRC press, 2003.
- R. Krishnan, "Permanent Magnet Synchronous and Brushless DC motor Drives", CRC Press.

- R. Steffen and D. Maksimovic, "Fundamentals of Power Electronics", Springer

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FACULTY OF ENGINEERING AND TECHNOLOGY
SWAMI VIVEKANAND SUBHARTI UNIVERSITY, MEERUT
STUDY & EVALUATION SCHEME
B.Tech. 4thYear/7th Semester (Electrical and Electronics Engineering)
w.e.f. academic Session 2026-27

SEMESTER VII														
S. No	Course Code	Course Title	Course Type	Periods			CCA				ESE		Total	Credit
				L	T	P	CT	AT	Total	PS	TE	PE		
1	KEEE-701	Power Plant Engineering	PCC	3	0	0	20	10	30	-	70	-	100	3
2	KEEE-711- KEEE-715	Departmental Elective-IV	PEC-4	3	0	0	20	10	30	-	70	-	100	3
3	KOE-7**	Open Elective-II	OEC-2	3	0	0	20	10	30	-	70	-	100	3
4	KEEE-751	Power system Protection Lab	OEC-4	0	0	2			15	-	35	-	50	1
5	KEEE-752	Mini project/Summer Internship	PROJ	0	0	4	-	-	-	100	-	-	100	2
6	KEEE-753	Project -I	PROJ	0	0	10	-	-	-	50	-	100	150	5
TOTAL													600	17
#The Mini Project or Internship (5-6 weeks) conducted during summer break after VI semester and will be assessed during VII semester.														

Abbreviation Used:

PC: Professional Core Course
PE: Professional Elective Course
OE: Open Elective Course

(Pankaj Gupta)

Ravi
(Ravi)

(Ajay)

Manoj Kapi



FACULTY OF ENGINEERING AND TECHNOLOGY
SWAMI VIVEKANAND SUBHARTI UNIVERSITY, MEERUT
STUDY & EVALUATION SCHEME
B.Tech.4thYear/8th Semester (Electrical and Electronics Engineering)
w.e.f. academic Session 2026-27

SEMESTER VIII														
S. No.	Course Code	Course Title	Course Type	Periods			CCA				ESE		Total	Credit
				L	T	P	CT	AT	Total	PS	TE	PE		
1	KOE-S**	Open Elective-III	OEC-5	3	0	0	20	10	30	-	70	-	100	3
2	KOE-S**	Open Elective-IV	OEC-6	3	0	0	20	10	30	-	70	-	100	3
3	KEEE-851	Project -II	PROJ	0	0	20	-	-	-	100	-	350	450	10
TOTAL													650	16

Abbreviation Used:

PC: Professional Core Course
PE: Professional Elective Course
OE: Open Elective Course
MC: Mandatory Course

Departmental Elective-IV

1. KEEE-711 – Energy Conservation and Management
2. KEEE-712 – Smart Grid Technology
3. KEEE-713 – IOT For Smart Energy Systems
4. KEEE-714 – Artificial Intelligence in Electrical & Electronics Engineering

Open Elective-II

Separate list is attached (common to all branches)

Open Elective-III

Separate list is attached (common to all branches)

Open Elective-IV

Separate list is attached (common to all branches)

B.Tech. (Electrical and Electronics Engg.) TOTAL CREDITS – 165

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DEPARTMENT ELECTIVE-IV

Code	Subject
KEEE-711	ENERGY CONSERVATION AND MANAGEMENT
KEEE-712	SMART GRID TECHNOLOGY
KEEE-713	IOT FOR SMART ENERGY SYSTEMS
KEEE-714	ARTIFICIAL INTELLIGENCE IN ELECTRICAL & ELECTRONICS ENGINEERING

OPEN ELECTIVE-II

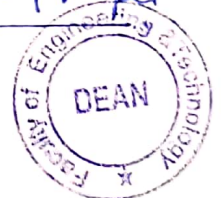
Code	Subject
KOE-701	INTRODUCTION TO PLC & SCADA
KOE-702	FILTER DESIGN
KOE-703	BIOECONOMICS
KOE-704	MACHINE LEARNING
KOE-705	RENEWABLE ENERGY RESOURCES
KOE-706	OPERATIONS RESEARCH
KOE-707	VISION FOR HUMANE SOCIETY
KOE-708	DESIGN THINKING
KOE-709	SOIL AND WATER CONSERVATION ENGINEERING
KOE-710	INTRODUCTION TO WOMEN'S AND GENDER STUDIES
KOE-711	SMART MANUFACTURING FOR INDUSTRY 4.0


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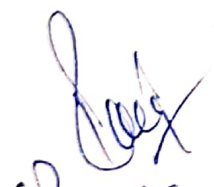


OPEN ELECTIVE –III

Code	Subject
KOE-801	FUNDAMENTALS OF DRONE TECHNOLOGY
KOE-802	CLOUD COMPUTING
KOE-803	BIO MEDICAL SIGNAL PROCESSING
KOE-804	ENTREPRENEURSHIP DEVELOPMENT
KOE-805	INTRODUCTION TO SMART GRID
KOE-806	QUALITY MANAGEMENT
KOE-807	INDUSTRIAL OPTIMIZATION TECHNIQUES
KOE-808	VIROLOGY
KOE-809	NATURAL LANGUAGE PROCESSING
KOE-810	HUMAN VALUES IN MADHYASTH DARSHAN
KOE-811	BIM FOR SUSTAINABLE BUILDING PLANNING

OPEN ELECTIVE –IV

Code	Subject
KOE-812	ELECTRIC VEHICLES
KOE-813	PROJECT MANAGEMENT
KOE-814	COMPUTERIZED PROCESS CONTROL
KOE-815	DATA WAREHOUSING & DATA MINING
KOE-816	DIGITAL AND SOCIAL MEDIA MARKETING
KOE-817	MODELING OF FIELD-EFFECT NANO DEVICES
KOE-818	MODELLING AND SIMULATION OF DYNAMIC SYSTEMS
KOE-819	BIG DATA
KOE-820	HUMAN VALUES IN BUDDHA AND JAIN DARSHAN
KOE-821	HUMAN VALUES IN VEDIC DARSANA
KOE-822	BUILDING SERVICES INSTALLATION, SAFETY & PRACTICES


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SEMESTER-VII SYALLBUS

KEEE-701	POWER PLANT ENGINEERING	3L:0T:0P	3 CREDITS
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COURSE OUTCOMES: Students who complete this course will be able to:

CO-1: Understand the hydro-electric power plant construction and operation.

CO-2: Describe the different element of thermal power plant and its operations.

CO-3: Design and development of nuclear power plants.

CO-4: Understand renewable resources and power plant operations in combinations.

SYLLABUS:

UNIT I Hydro-electric power plants – selection of site, elements of power plant, classification, water turbines, governor action, hydro-electric generator, plant layout, pumped storage plants.

UNIT II Thermal Steam power plants – selection of site, elements and operational circuits of the power plant, turbo-alternators, plant layout, steam turbines, controls and auxiliaries.

UNIT III Nuclear power plants – selection of site, nuclear reaction – fission process and chain reaction, constituents of power plant and layout, nuclear reactor – working, classification, control, shielding and waste disposal.

UNIT IV Renewable power plants – Solar power generation – Photo-voltaic and solar thermal generation – solar concentrators, Wind power generation – types of wind mills, wind generators, tidal, biomass, geothermal and magneto-hydro dynamic power generation, microhydel power plants, fuel cells and diesel and gas power plants.

UNIT V Combined operation of power plants – plant selection, choice of size and number of generator units, interconnected systems, real and reactive power exchange among interconnected systems. Power plant economics: load curve, different terms and definitions, cost of electrical energy, tariffs methods of electrical energy, performance & operating characteristics of power plants, Economic Load Sharing.

Text Books:

1. Chakrabarti A., Soni M.L., Gupta P.V., and Bhatnagar U.S., 'A text book on Power Systems Engg.', Dhanpat Rai and Sons, New Delhi, 2nd revised edition, 2010.
2. JB Gupta, 'A course in Power Systems', S.K. Kataria and sons, reprint 2010-2011.

Reference Books:

1. Wadhwa, C.L., 'Generation Distribution and Utilization of Electrical Energy', New Age International publishers, 3rd edition, 2010.
2. Deshpande M.V., 'Elements of Electrical Power systems Design', Pitman, New Delhi, PHI Learning Private Limited, 1st edition, 2009.

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DEPARTMENTAL ELECTIVE-IV:

KEEE-711	ENERGY CONSERVATION AND MANAGEMENT	3L:0T:0P	3 CREDITS
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COURSE OUTCOMES: Students who complete this course will be able to:

CO-1: Understand energy resources, energy conservation principles, and the importance of efficient energy utilization in various sectors.

CO-2: Conduct energy audits, analyze energy consumption patterns, and recommend suitable energy management strategies.

CO-3: Evaluate the performance of electrical systems and identify energy-saving opportunities in motors, transformers, lighting, and industrial loads.

CO-4: Apply energy management techniques for industries and buildings to improve energy efficiency and reduce operating costs.

CO-5: Assess renewable energy integration, sustainable energy practices, and energy management standards for achieving energy conservation goals.

SYLLABUS:

UNIT-I: Fundamentals of Energy Conservation: Energy Scenario: Global and Indian Perspectives, Energy Resources and Energy Consumption Patterns, Need for Energy Conservation, Energy Conservation Act and Policies, Energy Efficiency and Energy Intensity, Energy Flow and Energy Balance, Energy Demand and Supply Management, Role of Energy Managers and Energy Auditors, Sustainable Energy Development.

UNIT-II: Energy Auditing and Management: Principles of Energy Management, Energy Audit Methodologies (Preliminary and Detailed), Energy Accounting and Monitoring, Energy Performance Indicators (EnPIs), Energy Cost Analysis, Energy Management Information Systems (EMIS), Energy Audit Instruments and Measurements, and Energy Audit Report Preparation.

UNIT-III: Energy Efficiency in Electrical Systems: Energy Conservation in Transformers, Motors, Pumps, Fans and Blowers, Variable Frequency Drives (VFDs), Power Factor Improvement, Demand Side Management (DSM), Energy-Efficient Lighting Systems (LEDs and Smart Controls), and Electrical Energy Saving Opportunities.

UNIT-IV: Energy Management in Industries and Buildings: Energy Conservation in Industries, Compressed Air Systems, Steam and Boiler Efficiency, HVAC Energy Management, Building Energy Management Systems (BEMS), Green Buildings, Energy Benchmarking, Waste Heat Recovery, and Cogeneration/CHP Systems.

UNIT-V: Renewable Energy and Sustainable Energy Management: Renewable Energy Sources, Solar, Wind and Biomass Energy Systems, Energy Storage Technologies, Smart Energy Management Systems, Carbon Footprint Assessment, ISO 50001 Standards, Energy Economics and Financial Analysis, and Future Trends in Sustainable Energy Management.

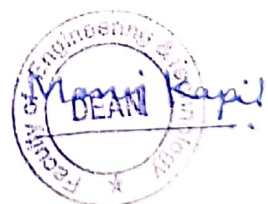
Suggested Text Books

1. Energy Management Handbook by Wayne C. Turner.
2. Guide to Energy Management by Barney L. Capehart, Wayne C. Turner, and William J. Kennedy.
3. Bureau of Energy Efficiency Energy Manager and Energy Auditor Study Material.

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KEEE-712	SMART GRID TECHNOLOGY	3L:0T:0P	3 CREDITS
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COURSE OUTCOMES: Students who complete this course will be able to:

CO-1: To understand the concept, architecture, and components of smart grids.

CO-2: To study advanced communication and automation technologies used in modern power systems.

CO-3: To analyze smart metering, demand response, and energy management techniques.

CO-4: To understand the integration of renewable energy resources and electric vehicles into smart grids.

CO-5: To explore smart grid applications, standards, and future developments.

SYLLABUS:

UNIT-I: Introduction to Smart Grid: Evolution of Conventional Grid to Smart Grid, Need for Smart Grid, Characteristics and Features of Smart Grid, Smart Grid Architecture and Components, Functions of Smart Grid, Smart Grid Drivers and Benefits, Challenges in Smart Grid Implementation, National and International Smart Grid Initiatives.

UNIT-II: Smart Grid Communication and Automation: Communication Requirements in Smart Grids, Communication Technologies: Wired Communication, Wireless Communication, Fiber Optic Communication. Advanced Metering Infrastructure (AMI), Supervisory Control and Data Acquisition (SCADA), Distribution Management Systems (DMS), Wide Area Measurement Systems (WAMS), Phasor Measurement Units (PMUs), Smart Grid Communication Protocols.

UNIT-III: Smart Metering and Demand Side Management: Smart Meters and Their Features, Automatic Meter Reading (AMR), Advanced Metering Infrastructure (AMI), Home Area Network (HAN), Building Area Network (BAN), Neighbourhood Area Network (NAN), Demand Response Programs, Demand Side Management (DSM), Energy Efficiency and Conservation, Consumer Participation in Smart Grids.

UNIT-IV: Renewable Energy Integration and Electric Vehicles:

Distributed Energy Resources (DERs), Integration of Solar and Wind Energy Systems, Microgrids and Nano grids, Energy Storage Systems, Battery Energy Storage Systems (BESS), Electric Vehicles and Charging Infrastructure, Vehicle-to-Grid (V2G) Technology, Grid Stability Issues with Renewable Integration, Smart Energy Management Systems.

UNIT-V: Smart Grid Applications, Security and Future Trends: Smart Grid Cyber Security, Data Analytics in Smart Grids, Artificial Intelligence Applications in Smart Grids, Internet of Things (IoT) in Smart Grid, Cloud Computing for Energy Systems, Blockchain Applications in Energy Trading, Smart Cities and Smart Energy Systems, Smart Grid Standards: IEC 61850, IEEE 1547, IEC 62351. Future Trends and Challenges in Smart Grid Development.

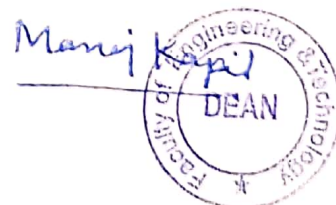
Suggested Text Books:

1. Smart Grid: Fundamentals of Design and Analysis by James Momoh.
2. Integration of Green and Renewable Energy in Electric Power Systems by Ali Keyhani.
3. The Smart Grid: Enabling Energy Efficiency and Demand Response by Clark W. Gellings.

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KEEE-713	IOT FOR SMART ENERGY SYSTEMS	3L:0T:0P	3 CREDITS
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Course Outcomes (CO): At the end of course, the student will be able to understand:

CO-1: Demonstrate basic concepts, principles and challenges in IoT.

CO-2: Illustrate functioning of hardware devices and sensors used for IoT.

CO-3: Analyze network communication aspects and protocols used in IoT.

CO-4: Apply IoT for developing real life applications using Arduino programming.

CP-5: To develop IoT infrastructure for popular applications.

SYLLABUS:

Unit-I: Internet of Things (IoT): Vision, Definition, Conceptual Framework, Architectural view, technology behind IoT, Sources of the IoT, M2M Communication, IoT Examples. Design Principles for Connected Devices: IoT/M2M systems layers and design standardization, communication technologies, data enrichment and consolidation, ease of designing and Affordability.

Unit-II: Hardware for IoT: Sensors, Digital sensors, actuators, radio frequency identification (RFID) technology, wireless sensor networks, participatory sensing technology. Embedded Platforms for IoT: Embedded computing basics, Overview of IOT supported Hardware platforms such as Arduino, Net Arduino, Raspberry pi, Beagle Bone, Intel Galileo boards and ARM cortex.

Unit-III: Network & Communication aspects in IoT: Wireless Medium access issues, MAC protocols survey, Survey routing protocols, Sensor deployment & Node discovery, Data aggregation & dissemination.

Unit-IV: Programming the Arduino: Arduino Platform Boards Anatomy, Arduino IDE, coding, using emulator, using libraries, additions in arduino, programming the arduino for IoT.

Unit-V: Challenges in IoT Design challenges: Development Challenges, Security Challenges, Other challenges IoT Applications: Smart Metering, E-health, City Automation, Automotive Applications, home automation, smart cards, communicating data with H/W units, mobiles, tablets, Designing of smart street lights in smart city.

Text books:

1. Olivier Hersent, David Boswarthick, Omar Elloumi "The Internet of Things key applications and protocols", Wiley, 2012.
2. Jeeva Jose, "Internet of Things", Khanna Publishing House, 2018.
3. Michael Miller "The Internet of Things" by Pearson, 2015.
4. Raj Kamal, "Internet of Things: Architecture and Design Principles", McGraw-Hill, 2nd Edition, 2017.

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KEEE-714	ARTIFICIAL INTELLIGENCE IN ELECTRICAL & ELECTRONICS ENGINEERING	3L:0T:0P	3 CREDITS
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Course Objectives (COs): At the end of the course, students will be able to-

CO-1: Understand the concepts of Artificial Intelligence.

CO-2: Demonstrate understanding about ANN and fuzzy logic.

CO-3: Select appropriate AI technique for applications related to electrical engineering.

CO-4: Apply meta-heuristic technique for solving optimization problems.

CO-5: Implement AI techniques for electrical engineering applications.

Syllabus:

Unit-I Introduction

Overview and historical perspective, advantages and disadvantages of AI, need for human intervention, data analytics and present trends.

Unit-II Artificial Neural Network

Introduction to artificial neural networks, basic models and activation functions, learning in neural networks, single layer and multi-layer feed-forward and feedback neural networks, Back-propagation algorithm, factors affecting the performance of artificial neural network.

Unit-III Fuzzy Logic

Introduction, fuzzy Sets, operations and properties of fuzzy sets, membership functions, fuzzy relations, fuzzy logic and rule-based system, defuzzification methods, fuzzy logic modelling and controller design.

Unit-IV Meta-heuristic Techniques

Genetic Algorithm (GA) - Introduction, fitness function, reproduction, crossover, mutation, Particle Swarm Optimization (PSO) - Introduction, principle, velocity updating, parameter selection, binary version, recent techniques.

Unit-V AI Applications in Electrical Engineering

Forecasting, economic load dispatch, fault identification and classification, fault diagnosis, load frequency control, reactive power control, MPPT algorithms, motor drive applications, power quality improvement devices, design optimization of electrical machines, condition monitoring etc.

Suggested Readings/ References:

1. S. Rajasekaran and G.A.V. Pai, Neural Networks, Fuzzy logic, Genetic Algorithm: Synthesis and applications, PHI Publication.
2. N.P. Padhy, Artificial Intelligence and Intelligent System, Oxford University Press.
3. D K Chaturvedi, Soft Computing Techniques and its Applications in Electrical Engineering, Springer
4. S. Chakraverty, D.M. Sahoo, N. R. Mahato, Concepts of Soft Computing: Fuzzy and ANN with Programming, Springer
5. B Kosko. Neural Networks and Fuzzy Systems; Prentice-Hall

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KEEE-751	POWER SYSTEM PROTECTION LAB	0L:0T:2P	1 CREDIT
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COURSE OUTCOMES: Students who complete this course will be able to:

CO-1: Test and analyze the characteristics of protective relays.

CO-2: Apply transformer and transmission line protection schemes.

CO-3: Evaluate relay coordination and fault-clearing performance.

CO-4: Configure numerical relays for practical protection applications.

List of 10 Experiments

1. Study and testing of Over Current Relay (OCR) and determination of its operating characteristics.
2. Study and testing of Earth Fault Relay (EFR) and determination of relay settings.
3. Determination of operating characteristics of Over Voltage and Under Voltage Relays.
4. Study of Differential Protection of Transformer using percentage differential relay.
5. Study of Buchholz Relay Operation for transformer protection.
6. Determination of Distance Relay Characteristics (Impedance, Reactance, and Mho Relay).
7. Simulation of Transmission Line Faults (LG, LL, LLG, and LLL faults) and analysis of relay operation.
8. Study of Protective Relay Coordination and time-current grading characteristics.
9. Study and Configuration of Numerical Relays for power system protection applications.
10. Modeling and Simulation of Power System Protection Schemes using MATLAB/Simulink or ETAP.

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KEEE-752	MINI PROJECT/SUMMER INTERNSHIP	0L:0T:4P	2 CREDITS
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Minimum of six weeks in an Industry in the area of Electrical Engineering. The summer internship should give exposure to the practical aspects of the discipline. In addition, the student may also work on a specified task or project which may be assigned to him/her. The outcome of the internship should be presented in the form of a report.

KEEE-753	PROJECT-I	0L:0T:10P	5CREDITS
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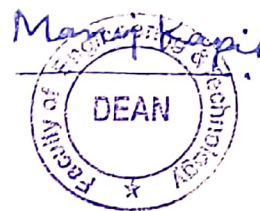
The object of Project Work I is to enable the student to take up investigative study in the broad field of Electronics & Communication Engineering, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or two/three students in a group, under the guidance of a supervisor. This is expected to provide a good initiation for the student(s) in R&D work. The assignment to normally include:

- Survey and study of published literature on the assigned topic;
- Working out a preliminary Approach to the Problem relating to the assigned topic;
- Conducting preliminary Analysis/Modeling/Simulation/Experiment/Design/Feasibility;
- Preparing a Written Report on the Study conducted for presentation to the Department;
- Final Seminar, as oral Presentation before a departmental committee.

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SEMESTER-VIII SYALLBUS

KEEE-851	PROJECT-II	0L:0T:20P	10 CREDITS
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The object of Project Work II & Dissertation is to enable the student to extend further the investigative study taken up under EC P1, either fully theoretical/practical or involving both theoretical and practical work, under the guidance of a Supervisor from the Department alone or jointly with a Supervisor drawn from R&D laboratory/Industry. This is expected to provide a good training for the student(s) in R&D work and technical leadership. The assignment to normally include:

- In depth study of the topic assigned in the light of the Report prepared under EEP1;
- Review and finalization of the Approach to the Problem relating to the assigned topic;
- Preparing an Action Plan for conducting the investigation, including team work;
- Detailed Analysis/Modeling/Simulation/Design/Problem Solving/Experiment as needed;
- Final development of product/process, testing, results, conclusions and future directions;
- Preparing a paper for Conference presentation/Publication in Journals, if possible;
- Preparing a Dissertation in the standard format for being evaluated by the Department.
- Final Seminar Presentation before a Departmental Committee.


(Pankaj Gantam)


(Ravi)


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