

Bachelor of Technology (Electrical Engineering)



Semester – V (w.e.f. session 2017-2018)

S. N.	Course No.	Course Title	Teaching Schedule				Allotment of Marks				Duration of Exam (Hrs.)
			L	T	P	Hrs/Wk	Theory	Sessional	Practical	Total	
1	EE-301N	Power Electronics-I	4	1		5	75	25		100	3
2	EE-303N	Electronic Instrumentation & Measurement	4	1		5	75	25		100	3
3	EE-305N	Non-Conventional Energy Resources	3			3	75	25		100	3
4	EE-307N	Control System	4	1		5	75	25		100	3
5	EE-309N	Power Transmission & Distribution	4	1		5	75	25		100	3
6*	EEN-311N	Field & Waves	4	1		5	75	25		100	3
7	EE-313N	Control System Lab			2	2		40	60	100	3
8	EE-315N	Power Electronics Lab			2	2		40	60	100	3
9	EE-317N	Electronic Instrumentation Lab			2	2		40	60	100	3
10	EE-319N	Industrial Training-I	1			1		100		100	
Total			24	5	6	35	450	370	180	1000	

Note: 1. * Subject Common with V Semester. B.Tech. [Electrical & Electronics Engg.] Scheme, K.U.K.

2. **Industrial Training** undergone by the students after IV sem is to be evaluated during V sem as **(EE-319N)** through submission of certified computerized report to the H.O.D. followed by conduct of viva-voce & seminar/presentation.

Code	Nomenclature of Subject	L	T	Int.	Ext.	Total	Time
EE-301N	POWER ELECTRONICS-I	4	1	25	75	100	3 Hr

Paper Setter Note: 8 questions of 15 marks each distributed in four sections are to be set taking two from each unit. The candidate is required to attempt five questions in all, taking at least one from each of the four sections.

UNIT-I

Power Diodes: depletion region, barrier potential, effect of forward & reverse bias, V-I characteristics, types of power diode, special features of power diode, power diode ratings, applications

Power Transistors: Introduction, Bipolar junction transistor, construction, transistor operations, BJT characteristics, load line, operating point, leakage currents, saturation and cut off mode of operations, applications of power BJT.

UNIT-II

Thyristor , Construction, principal of operation , characteristics of Thyristor: Thyristor turn on methods gate control, trigger voltage, trigger current, turn on process, conduction, turn off process ,turn on and turn off times Thyristor specifications and ratings, methods to improve di/dt and dv/dt ratings,

DIAC, TRIAC, UJT: Ratings, Construction, principle of operation. Characteristics & applications

UNIT-III

SCR Triggering Circuits: Resistance triggering, R-C triggering, UJT triggering, triac triggering, pulse transformer triggering Thyristor in series, in parallel, snubber circuit.

SCR Commutation: methods, commutating circuits, protection.

Thyristor family RCT, GTO, LASCR, MCT, PUT, SUS, SBS, SCS

UNIT-IV

Convertors (Rectifiers): One, two, three, six and twelve pulse converters, fully and half controlled converters, load voltage waveforms, output voltage equation, continuous and discontinuous modes of operation, input power factor of converter, reactive power demand effect of source inductance, introduction to four quadrant/ dual converter, power factor improvement techniques, forced commutated converter, MOSFET and transistor based converters.

TEXT BOOKS/REFERENCES:

1. Power Electronics: P.S Bhimra, Khanna Publication.
2. Power Electronics - Circuits, Devices and Applications, M. H . Rashid P.H .I. Publications.
3. Power Electronics: PC Sen; TMH.
4. Power Electronics by Dr. B. R. Gupta, Katson Publishers.

Code	Nomenclature of Subject	L	T	Int.	Ext.	Total	Time
EE-303N	Electronic Instrumentation & Measurement	4	1	25	75	100	3 Hr

Paper Setter Note: 8 questions of 15 marks each distributed in four sections are to be set taking two from each unit. The candidate is required to attempt five questions in all, taking at least one from each of the four sections.

UNIT - I

C.R.O: Introduction, basic specifications of CRO, Cathode Ray Tube (CRT), Electron Gun, Electrostatic Focussing, Electrostatic Deflection, limitation, Applications, sampling oscilloscope, analog and storage C.R.O, DSO, comparison between analog and digital storage oscilloscope.

Instruments for Signals Generation: Square wave and pulse wave circuits, multi-vibrators, function Generators, frequency synthesizer.

Elementary idea of Bio-medical Measurement: ECG, EEG, Blood pressure measurement.

UNIT-II

Signal Conditioning & Acquisition System: Signal conditioning, DC & AC signal conditioning A/D converter, D/A converter, basic components of analog and digital data acquisition system.

Transducer: Definition of transducer. Advantages of an electrical signal as out-put. Basic specifications of transducers, Primary and Secondary Transducers, Analog and digital types of transducers. Resistive, inductive, capacitive, piezoelectric, and photoelectric and Hall effect transducers.

Measurement of Displacement - Potentiometric resistance type transducers, inductive type transducers, differential transformer (L.V.D.T), capacitive transducers, Hall Effect devices, strain gauge transducers.

UNIT - III

Measurement of Velocity - Variable reluctance pick up, electromagnetic tachometers, photoelectric tachometer, toothed rotor tachometer generator.

Measurement of Flow: Venturi meter, electromagnetic flow meter.

Measurement of Pressure - Manometers, Force summing devices.

Measurement of Force - Strain-gauge load cells, pneumatic load cell, L.V.D.T. type force transducer.

UNIT - IV

Measurement of Torque - Torque meter, torsion meter, absorption dynamometers, inductive torque transducer and digital methods

Measurement of Temperature - Metallic resistance thermometers, semi-conductor resistance sensors(Thermistors), thermo-electric sensors, pyrometers.

Measurement of Liquid Level: Resistive Method, Inductive method, capacitive method.

Sound Measurement: Microphone, Types of Microphones.

Measurement of Humidity: Resistive, capacitive, aluminium oxide & crystal hygrometers.

Suggested Books:

1. B.C. Nakra, K.K. Chaudhry, "Instrumentation Measurement and Analysis," . Tata McGraw-Hill Publishing Company Limited, New Delhi.
2. Thomas G. Beckwith etc. all, "Mechanical Measurements (International Student Edition), Addison-Wesley Longman, Inc. England.
3. A.K. Sawhney, " A Course in Electrical and Electronic Measurements and Instrumentation," Dhanpat Rai & Sons, Delhi-6.
4. A.K. Sawhney, " A Course in Mechanical Measurements," Dhanpat Rai & Sons.

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Code	Nomenclature of Subject	L	T	Int.	Ext.	Total	Time
EE-305N	Non-Conventional Energy Resources	3		25	75	100	3 Hr

Paper Setter Note: 8 questions of 15 marks each distributed in four sections are to be set taking two from each unit. The candidate is required to attempt five questions in all, taking at least one from each of the four sections.

Unit I

SOLAR ENERGY: Introduction to Solar Radiation and its measurement. Solar Energy Collectors & Storage, Flat plate collectors, liquid and air type. Theory of flat plate collectors, advanced collectors, optical design of concentrators, solar water heating, solar dryers, solar stills, solar cooling and refrigeration. Thermal storage.

APPLICATIONS OF SOLAR ENERGY: Solar Thermal Electric Conversion, Thermal Electric Conversion Systems, Solar Electric power Generation, Solar Photo-Voltaics, Solar Cell Principle, Semiconductor Junctions, Conversion efficiency and power output, Basic Photo Voltaic System for Power Generation.

Unit II

WIND ENERGY: Characteristics of wind, wind data. Horizontal & Vertical axis wind Mills, Wind Energy Extraction, Wind Characteristics, Power Density Duration Curve, Design of Wind Turbine Rotor, Design of Regulating System for Rotor, Wind Power Generation Curve, Sub-systems of a Horizontal Axis Wind Turbine Generator, Modes of Wind Power Generation, Estimation of Wind Energy Potential, Selection of Optimum Wind Energy Generator (WEG), Grid Interfacing of a Wind Farm, Methods of Grid Connection, Grid System and Properties, Capacity of Wind Farms for Penetration into Grid, Control System for Wind Farms, Economics of Wind Farms.

Unit III (Qualitative analysis only)

GEOTHERMAL ENERGY: Structure of the Earth's Interior, Plate Tectonic Theory, Geothermal Sites, Geothermal Field, Geothermal Gradients, Geothermal Resources, Geothermal Power Generation, Geothermal Electric Power Plant, Geothermal-Preheat Hybrid with Conventional Plant.

OCEAN ENERGY: Development of a Tidal Power Scheme, Grid Interfacing of Tidal Power, Wave Energy, Mathematical Analysis of Wave Energy, Empirical Formulae on Wave Energy, Wave Energy Conversion, Principle of Wave Energy plant, Wave Energy Conversion Machines.

FUEL CELLS: Principle of Operation of Fuel Cell, Fuel Processor, Fuel Cell Types, Energy Output of a Fuel Cell, Efficiency, and EMF of a Fuel Cell, Operating Characteristics of Fuel Cells, Thermal Efficiency of a Fuel Cell.

Unit IV (Qualitative analysis only)

BIOMASS ENERGY: Introduction to biomass, biofuels & their heat content, Brief overview about biomass conversion technologies, Biochemical conversion and Biogas technologies. Factors affecting biogas production, biogas plants- types & description. Utilization of biogas - Gasifiers, direct thermal application of Gasifiers. Advantages & problems in development of Gasifiers, use in I.C. engines, Energy plantation. Pyrolysis scheme. Alternative liquid fuels –ethanol and methanol.

HYBRID ENERGY SYSTEMS: Hybrid Systems and its types. Concept of Electric and Hybrid Electric Vehicles.

References:

1. Kothari, Singal and Ranjan , Renewable Energy Sources and Emerging Technologies, 2nd ed, Prentice Hall (India).
2. G.D. Rai, Non-Conventional Sources of Energy, Khanna Publishers.
3. B H Khan, Non-Conventional Energy Resources, McGraw Hill Education.
4. Bansal N.K., M. Kleemann, M. Heliss, Renewable energy sources and conversion technology, TMGH 1990.
5. Abbasi SA, Abbasi N, Renewable energy sources and their environmental impact, PHI, 2001
6. Mittal KM, Renewable energy Systems, Wheeler Publishing, New Delhi, 1997.
7. Mukherjee D, Renewable energy Systems, New Age International, New Delhi, 2004
8. Renewable Energy Resources: John Twidell and Tony Weir.

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Code	Nomenclature of Subject	L	T	Int.	Ext.	Total	Time
EE-307N	Control System	4	1	25	75	100	3 Hr

Paper Setter Note: 8 questions of 15 marks each distributed in four sections are to be set taking two from each unit. The candidate is required to attempt five questions in all, taking at least one from each of the four sections.

UNIT I

Control Systems: Basics & Components: Introduction to basic terms, classifications & types of Control Systems, block diagrams & signal flow graphs, Mathematical Models of Physical System, Differential equation of physical systems & electrical systems with analogy. Transfer function, determination of transfer function using block diagram reduction techniques and Mason's Gain formula. Error detectors, Signal conditioners, Modulators, Demodulators, Servo amplifiers voltage and power, Actuators including servomotors, Techogenerators, Stepper motor.

UNIT II

Time-Domain Analysis :Time domain analysis, transient response of first & second order systems ,steady state error and static error constants in unity feedback control systems, response with P, PI and PID controllers, limitations of time domain analysis.

UNIT III

Frequency Domain Analysis and Stability : Concept of stability, graphic and numeric techniques of stability analysis, Routh Hurwitz, Nyquist, Bode plot, Root locii and polar plots, frequency domain specifications and performance of LTI systems, Gain and phase margins, relative stability. Correlation with time domain performance closed loop frequency responses from open loop response. Limitations of frequency domain analysis.

UNIT IV

State Space & Compensation Techniques: State space characteristics of control systems. Concepts of state variable, Transfer Function controllability and observability. Concepts of compensation, series/parallel/ series-parallel/feedback compensation, Lag/Lead/Lag-Lead networks for compensation.

References :

1. Control System Engg. By Nagrath and Gopal.
2. Control System Engg. By K.Ogata.
3. Liner Control System by R.S. Chauhan, (Umesh Publications)
4. Feedback control system Analysis and Synthesis by D'Azzo and Houpias.
5. Control System by B.C. Kuo.

Code	Nomenclature of Subject	L	T	Int.	Ext.	Total	Time
EE-309N	Power Transmission & Distribution	4	1	25	75	100	3 Hr

Paper Setter Note: 8 questions of 15 marks each distributed in four sections are to be set taking two from each unit. The candidate is required to attempt five questions in all, taking at least one from each of the four sections.

UNIT- I

Transmission of Power by A.C. & D.C. system: Typical power system, Modern trends in power system transmission . Underground and overhead system, Effects of increase in Voltage on transmission line efficiency

Distribution of Power: General consideration, Radial and ring main system. Different types of distributors; Relative copper consumption in various systems. Conductor size and Kelvin's Law, Tariffs and power factor improvement.

UNIT- II

Resistance of transmission lines, skin effects, Proximity effect,

Inductance of a single phase & two phase line, Composite conductor lines, Three phase lines with symmetrical and unsymmetrical spacing, Bundled conductors

Capacitance of two-wire line, three phase line with symmetrical and unsymmetrical spacing, Effect of earth capacitance.

UNIT- III

PERFORMANCE OF LINES Short, medium and long lines – their representation, Performance calculation, determination of ABCD parameters, Ferranti effect, Surge impedance Loading of transmission lines, Calculation of synchronous phase modifier capacity.

Corona loss & radio interference Factors affecting corona, advantages and disadvantages of corona, disruptive critical voltage, visual critical voltage, corona power loss, methods of reducing corona effects, advantages & disadvantages of corona, interference of power lines with neighboring communication lines.

UNIT IV

Underground cables, Cables for A.C & D.C systems, Insulation resistance and capacitance, capacitance measurement, cable loss, Power factor in cable. Heating of cables Thermal characteristics, Use of inter sheaths, Capacitance grading.

Mechanical Considerations Types of Insulators, Methods of equalizing voltage distribution, Line supports, various types of conductor material, Sag calculations, Effect of wind, Ice and temperature on sag, Conditions at erection.

Text Books/References:

1. Power System analysis and Stability by S.S. Vadhera
2. Electrical Power System by C.L. Wadhwa
3. Electrical Power System by Ashfaq Hussain
4. Elements of Power System Analysis by W.D. Stevenson
5. Electric Power System by B.M. Weddy
6. The transmission and Distribution of Electric energy by H. Cotton
7. Modern Power System Analysis by I.J. Nagrath and D.P. Kothari
8. A Course in Electrical Power by Soni, Gupta and Bhatnagar

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Code	Nomenclature of Subject	L	T	Int.	Ext.	Total	Time
EEN-311N	Field & Waves	4	1	25	75	100	3 Hr

Paper Setter Note: 8 questions of 15 marks each distributed in four sections are to be set taking two from each unit. The candidate is required to attempt five questions in all, taking at least one from each of the four sections.

UNIT – 1

Review of vector algebra, the three orthogonal co-ordinate systems and their inter-relation, review of vector calculus in all the three coordinate systems: Line, surface & volume integrals, gradient, divergence & curl of vector & their physical significance, Divergence theorem, Stokes theorem, concept of solenoidal and irrotational fields.

Gauss Law in electrostatics & its applications, uniform line, surface & volume charge distributions, concept of electric field & electric potentials, electric field & potential due to a linear dipole, Spherical & cylindrical capacitor, energy density in electric field, method of images.

UNIT-II

Magnetostatics: Magnetic flux density and magnetizing field intensity, Biot Savart's law, Amperes circuital law & its applications. Magnetic vector potentials, Magnetic field energy, boundary conditions for both the electric & magnetic fields at the interface of various types of media. Laplace, Poisson's equation & continuity equation, displacement current density, conduction current density, Maxwell's equation in differential & integral forms, time harmonic cases & their physical significance, retarded potentials.

UNIT- III

UPW: Plane waves & uniform plane waves and their properties, wave equations in various media, Polarization & its types, intrinsic impedance, propagation constant, reflection & refraction of uniform plane waves at the interface of conductor- dielectric & dielectric-dielectric (both normal and oblique incidence). Relaxation time, skin effect, skin depth & surface impedance, Poynting vector theorem and its physical significance.

UNIT- IV

Transmission lines: Distributed parameters, circuit parameters, concepts of voltage & current flow on a transmission line, line equations, characteristics impedance. Reflection of transmission line, maxima & minima, standing wave ratio of a transmission line, impedance matching, Smith's chart & its applications, co-axial type transmission line.

Wave Guides: Brief idea of Wave Guides, types of Wave Guides. TE, TM and TEM modes in rectangular wave guides.

Reference Books:

1. Field & Waves Electromagnetic by D.K. Cheng. (Pearson Education)
2. Electromagnetic Fields & Wave by Sadiku (Oxford Univ. Press)
3. Electromagnetic by J.D. Kraus, MGH.

Code	Nomenclature of Lab	P	Int.	Ext.	Total	Time
EE-313N	Control System Lab	2	40	60	100	3 Hr

LIST OF EXPERIMENTS:

1. Experiment to study linear system simulator.
2. To study the stroboscope & measure the shaft speed
2. Experiment to study light intensity control using P & PI controller with provision for and transient speed control.
3. Experiment to study D.C motor speed control.
4. Experiment to study the stepper motor characteristics and its control through microprocessor kit.
5. Experiment to study Temperature control system.
6. Experiment to study Compensation design.
7. Experiment to study Digital control system.
8. Experiment to study synchros.
10. Experiment to study AC Position control system.
11. Experiment to study Potential Metric Error detector.

NOTE: 10 experiments are to be performed with at least 8 from above list; the remaining may either be performed or designed & set by concerned Institution as per the scope.

Code	Nomenclature of Lab	P	Int.	Ext.	Total	Time
EE-315N	Power Electronics Lab	2	40	60	100	3 Hr

LIST OF EXPERIMENTS:

1. Experiment to study characteristics of diode, Thyristor and Triac.
2. Experiment to study characteristics of Transistor and MOSFET.
3. Experiment to study R and R-C firing circuits
4. Experiment to study UJT firing circuit.
5. Experiment to study complementary voltage commutation using a lamp flasher.
6. Experiment to study Thyristorised D.C circuit breaker.
7. Experiment to study Thyristorised A.C phase control.
8. Experiment to study full wave converter.
9. Experiment to study series inverter.
10. Experiment to study DC chopper.
11. Experiment to study of bridge inverter.
12. Experiment to study of single phase cycloconverter.

NOTE: At least 10 experiments are to be performed with 8 from above list; the remaining may either be performed or designed & set by concerned Institution as per the scope

Code	Nomenclature of Lab	P	Int.	Ext.	Total	Time
EE-317N	Electronic Instrumentation Lab	2	40	60	100	3 Hr

LIST OF EXPERIMENTS:

1. To Measure Temperature using RTD.
2. To Measure Displacement using L.V.D.T.
3. To Measure Load using Load Cell.
5. To Light intensity Measurement using LDR & Photo Cell.
6. To Measure Angular Displacement using Capacitive Transducer.
7. To Measure the Variation in Water Level using Capacitive Transducer
- 8 Experiment to measure temperature coefficient of material using thermo couple
- 9 Experiment to measure pressure using strain gauge
- 10 Experiment to study Op-Amp as instrumentation amplifier.
- 11 Experiment to study Op-Amp as AD/DA converter
- 12 Experiment to measure the speed of D.C motor using magnetic pick-up.
- 13 Experiment to measure the speed of D.C motor using Photo-electric pick-up.
- 14 To study Q-meter for measurement of resistance, inductance and capacitance.

NOTE: At least 10 experiments are to be performed with 8 from above list, the remaining may either be performed or designed & set by concerned Institution as per the scope.