KAMLA NEHRU INSTITUTE OF TECHNOLOGY

SULTANPUR (U. P.)-228 118

(An Autonomous Institute under Dr. A. P. J. Abdul Kalam Technical University, Lucknow)

Evaluation Scheme B.Tech. II, III & IV Year
&
Syllabus B.Tech. IV Year

Choice Based Credit System
(Effective from the Session 2018-19)

KAMLA NEHRU INSTITUTE OF TECHNOLOGY, SULTANPUR

(An Autonomous Institute under Dr. A. P. J. Abdul Kalam Technical University, Lucknow)

ELECTRICAL ENGINEERING

SEMESTER –III

S. No.	Subject Category	Subject Code	Subject Name	Teaching Deptt.	L-T-P	Evaluation					Credit
						Sessional			ESE	Grand Total	
						CT	TA	Total			
	Theory										
01.	BAS/BAS		Engineering Maths-III/Environment & Ecology	APSH	3--1--0	30	10	40	60	100	4
02.	DC	EEC 301	Basic System Analysis	Core Deptt	3--1--0	30	10	40	60	100	4
03.	DC	EEC 302	Electrical Measurements and Measuring Instruments	Core Deptt	3--1--0	30	10	40	60	100	4
04.	DC	EEC 303	Analog and Digital Electronics	Core Deptt.	3--1--0	30	10	40	60	100	4
05.	DC	EEC 304	Electromagnetic Field Theory	Core Deptt	3--1--0	30	10	40	60	100	4
	Lab										
06.	DC	EEC 3L1	Numerical Technique Lab	Core Deptt	0--0--2	--	20	20	30	50	1
07.	DC	EEC 3L2	Electrical Measurement Lab	Core Deptt	0--0--2	--	20	20	30	50	1
08.	DC	EEC 3L3	Analog IC and Digital Electronics Lab	Core Deptt.	0--0--2	--	20	20	30	50	1
09.	DC	EEC 3L4	Electrical Workshop	Core Deptt	0--0--2	--	20	20	30	50	1
10.	GP		General Proficiency					**50**		**50**	
11.	MAC	MAB301/02	Mandatory Audit Course I-A/ Mandatory Audit Course II-B	APSH	2--0--2*	20	--	20	30	50	**3**
			Total							**700**	**24**

SEMESTER –IV

S. No.	Subject Category	Subject Code	Subject Name	Teaching Deptt.	L-T-P	Evaluation					Credit
						Sessional			ESE	Grand Total	
						CT	TA	Total			
	Theory										
01.	BAS/BAS		Environment & Ecology/Engineering Maths-III	APSH	3--1--0	30	10	40	60	100	4
02.	DC	EEC 401	Electromechanical Energy Conversion-I	Core Deptt	3--1--0	30	10	40	60	100	4
03.	DC	EEC 402	Network Analysis & Synthesis	Core Deptt	3--1--0	30	10	40	60	100	4
04.	DC	EEC 403	Microprocessors	Core Deptt.	3--1--0	30	10	40	60	100	4
05.	DC	EEC 404	Electrical & Electronics Engineering Materials	Core Deptt	3--1--0	30	10	40	60	100	4
	Lab										
06.	DC	EEC 4L1	Electro-mechanical Energy Conversion-I Lab	Core Deptt	0--0--2	--	20	20	30	50	1
07.	DC	EEC 4L2	Network & Synthesis Lab	Core Deptt	0--0--2	--	20	20	30	50	1
08.	DC	EEC 4L3	Microprocessor Lab	Core Deptt.	0--0--2	--	20	20	30	50	1
09.	DC	EEC 4L4	Electrical System Simulation Lab	Core Deptt	0--0--2	--	20	20	30	50	1
10.	GP		General Proficiency					**50**		**50**	
11.	MAC	MAB 401/02	Mandatory Audit Course I-B/ Mandatory Audit Course II-A	APSH	2--0--2*	20	--	20	30	50	**3**
			Total							**700**	**24**

SEMESTER –V

S. No.	Subject Category	Subject Code	Subject Name	Teaching Deptt.	L-T-P	Evaluation					Credit
						Sessional			ESE	Grand Total	
						CT	TA	Total			
	Theory										
01.	M/M		MANEGERIAL ECONOMICS/ INDUSTRIAL MANAGEMENT	APSH	3--1--0	30	10	40	60	100	4
02.	DC	EEC 501	Control System	Core Deptt	3--1--0	30	10	40	60	100	4
03.	DC	EEC 502	Element of Power System	Core Deptt	3--1--0	30	10	40	60	100	4
04.	DC	EEC 503	Power Station Practice	Core Deptt.	3--1--0	30	10	40	60	100	4
05.	DC	EEC 504	Electromechanical Energy Conversion-II	Core Deptt	3--1--0	30	10	40	60	100	4
	Lab										
06.	DC	EEC 5L1	Control Lab	Core Deptt	0--0--2	--	20	20	30	50	1
07.	DC	EEC 5L2	Power System Lab	Core Deptt	0--0--2	--	20	20	30	50	1
08.	DC	EEC 5L3	Renewable Energy lab	Core Deptt.	0--0--2	--	20	20	30	50	1
09.	DC/PST	EEC 5L4	Electromechanical Energy Conversion-II Lab	Core Deptt	0--0--2	--	20	20	30	50	1
10.	GP		General Proficiency					**50**		**50**	
			Total							**700**	**24**

SEMESTER –VI

S. No.	Subject Category	Subject Code	Subject Name	Teaching Deptt.	L-T-P	Evaluation					Credit
						Sessional			ESE	Grand Total	
						CT	TA	Total			
	Theory										
01.	M/M		INDUSTRIAL MANAGEMENT/ MANEGERIAL ECONOMICS	APSH	3--1--0	30	10	40	60	100	4
02.	DC	EEC 601	Power System Analysis	Core Deptt	3--1--0	30	10	40	60	100	4
03.	DC	EEC 602	Power Electronics	Core Deptt	3--1--0	30	10	40	60	100	4
04.	DC	EEC 603	Switch Gear & Protection	Core Deptt.	3--1--0	30	10	40	60	100	4
05.	DE	*	ELECTIVE DEPTT COURSE-1	Core Deptt	3—1—0	30	10	40	60	100	4
	Lab										
06.	DC	EEC 6L1	Power System-II	Core Deptt	0—0—2	--	20	20	30	50	1
07.	DC	EEC 6L2	Power Electronics Lab	Core Deptt	0—0—2	--	20	20	30	50	1
08.	DC/PST	EEP 601	Minor Project	Core Deptt.	0—0—2	--	20	20	30	50	1
09.	PST	EES 601	Seminar	Core Deptt	0—0—2	--	20	20	30	50	1
10.	GP		General Proficiency					**50**		**50**	
			Total							**700**	**24** **24**

***EEE 101/02/03**

SEMESTER –VII

S. No.	Subject Category	Subject Code	Subject Name	Teaching Deptt.	L-T-P	Evaluation					Credit
						Sessional			ESE	Grand Total	
						CT	TA	Total			
	Theory										
01.	OE		OPEN ELECTIVE COURSE -1	Other Deptt.	3--1--0	30	10	40	60	100	4
02.	DE	**	ELECTIVE DEPTT COURSE-2	Core Deptt	3--1--0	30	10	40	60	100	4
03.	DE	***	ELECTIVE DEPTT COURSE-3	Core Deptt	3—1—0	30	10	40	60	100	4
04.	DC	EEC 701	Electric Drives	Core Deptt.	3—1—0	30	10	40	60	100	4
05.	DC	EEC 702	Power System Operation & Control	Core Deptt	3—1—0	30	10	40	60	100	4
	Lab										
06.	DC	EEC 7L1	Electric Drives lab	Core Deptt	0—0—2	--	20	20	30	50	1
07.	PST	EET 701	INDUSTRIAL TRAINING	Core Deptt	0—0—2	--	50	50	--	50	1
08.	PST	EEP 701	PROJECT-1	Core Deptt.	0—0—4	--	100	100	--	100	2
09.	GP		General Proficiency					**50**		**50**	
			Total							**700**	**24**

**** EEE 201/02/03**
*****EEE 301/02/03**

SEMESTER –VIII

S. No.	Subject Category	Subject Code	Subject Name	Teaching Deptt.	L-T-P	Evaluation					Credit
						Sessional			ESE	Grand Total	
						CT	TA	Total			
	Theory										
01.	OE		OPEN ELECTIVE COURSE -2	Other Deptt.	3--1--0	30	10	40	60	100	4
02.	DE	#	ELECTIVE DEPTT COURSE-4	Core Deptt	3--1--0	30	10	40	60	100	4
03.	DE	##	ELECTIVE DEPTT COURSE-5	Core Deptt	3—1—0	30	10	40	60	100	4
04.	DC	EEC 801	Instrumentation & Process Control	Core Deptt.	3—1—0	30	10	40	60	100	4
	Lab										
05.	DC	EEC 8L1	Instrumentation & Process Control Lab	Core Deptt	0—0—2	--	20	20	30	50	1
06.	PST	EEP 801	PROJECT-2	Core Deptt	0—0—14	--	150	150	100	250	7
07.	GP		General Proficiency					**50**		**50**	
			Total							**700**	**24**

 # EEE 401/02/03/04
EEE 501/02/03

ELECTIVE DEPTT COURSE-1

01 Electrical Machine Design
02 Utilization of Electrical Energy and Traction
03 Advanced Power Semiconductor Devices
04 Advanced Control System

ELECTIVE DEPTT COURSE-2

01 Non-Conventional Energy Resources
02 Distributed generation and Micro grid
03 Power System Reliability

ELECTIVE DEPTT COURSE-3

01 High Voltage Engineering
02 Power Quality
03 Power System Security

ELECTIVE DEPTT COURSE-4

01 ANN & Fuzzy System
02 Computer Aided Power System Analysis
03 Special Electrical Machine

ELECTIVE DEPTT COURSE-5

01 Power Converters Applications
02 Bio Instrumentation
03 EHV AC & DC Transmission Systems

OPEN ELECTIVE COURSE-1

01 Non-Conventional Energy Resources
02 Artificial Neural Networks and Fuzzy system

SEMESTER VII

CODE	EEC 701	L	T	P	Credit
	ELECTRIC DRIVE	3	1	0	4

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. **08**

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. **08**

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. **08**

Unit-IV:

Power Electronic Control of DC Drives: Introduction, 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, Power factor improvement, Chopper control of separately excited dc motor and dc series motor. **08**

Unit-V:

Power Electronic Control of AC Drives:

Three Phase induction Motor Drive: Introduction, 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, DC and AC motor drives in transportation system and traction. **08**

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:

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

CODE	EEC 702	L	T	P	Credit
	POWER SYSTEM OPERATION AND CONTROL	3	1	0	4

UNIT-I:

Introduction : Structure of power systems, Power system control center and real time computer control, SCADA system, Level decomposition in power system, Power system security, Various operational stages of power system, Power system voltage stability, frequency stability, and rotor angle stability. **08**

UNIT-II:

Economic Operation: Concept and problems of unit commitment Input-output characteristics of thermal and hydro-plants System constraints, Optimal operation of thermal units without and with transmission losses, Penalty factor, incremental transmission loss, transmission loss formula (without derivation) Hydrothermal scheduling long and short terms, Concept of optimal power flow. **08**

UNIT-III:

Load Frequency Control: Concept of load frequency control, Load frequency control of single area system: Turbine speed governing system and modeling, block diagram representation of single area system, steady state analysis, dynamic response, control area concept, P-I control, load frequency control and economic dispatch control. Load frequency control of two area system: Tie line power modeling, block diagram representation of two area system, static and dynamic Response. **08**

UNIT-IV:

Automatic Voltage Control: Schematic diagram and block diagram representation, different types of EEE Excitation systems &their controllers and mathematical modeling.

Voltage and Reactive Power control: Concept of voltage control, methods of voltage control-control by tap changing transformer. Shunt Compensation, series compensation, phase angle compensation, concept of bank of capacitors, and bank of inductors. **08**

UNIT-V:

State Estimation: Detection and identification, Linear and non-linear models.

Flexible AC Transmission Systems: Concept, objectives, applications, limitations, and mathematical modeling: FACTs controllers: Structures & Characteristics of following FACTs Controllers, TCR,FC-TCR, TSC, SVC, STATCOM, TSSC, TCSC, SSSC, TC-PAR, UPFC, HPFC, BESS, SMES, IEEE-FACTS controllers. **08**

Text Books:

1. D. P. Kothari & I. J. Nagrath, "Modern Power System Analysis", Tata McGraw Hill, 3rdEdition.
2. P. S. R. Murty, "Operation and control in Power Systems", B. S. Publications.
3. N. G. Hingorani & L. Gyugyi, "Understanding FACTs", Concepts and Technology of Flexible AC Transmission Systems", Standard Publishers Distributors.
4. J. Wood & B.F. Wollenburg, "Power Generation, Operation and Control", John Wiley & Sons.

Reference Books:

5. O. I. Elgerd, "Electric Energy System Theory" Tata McGraw Hill.
6. P. Kundur, "Power System Stability and Control McGraw Hill.
7. M.H. Rashid, "Power Electronics: Circuits, devices and Applications" Prentice Hall of India, 3rd Edition.
8. T. K. Nagsarkar & M. S. Sukhiza,' Power System Analysis' Oxford University Press.

CODE	EEC-8L1	L	T	P	Credit
	ELECTRIC DRIVE LAB	0	0	2	1

a) Hardware Based Experiments:

1. To study speed control of separately excited dc motor by varying armature voltage using single-phase fully controlled bridge converter.
2. To study speed control of separately excited dc motor by varying armature voltage using single-phase half controlled bridge converter.
3. To study speed control of separately excited dc motor using single-phase dual converter (Static Ward-Leonard Control)
4. To study speed control of separately excited dc motor using MOSFET/IGBT chopper
5. To study closed loop control of separately excited dc motor
6. To study speed control of single-phase induction motor using single phase ac voltage controller.
7. To study speed control of three-phase induction motor using three-phase ac voltage controller
8. To study speed control of three-phase induction motor using three-phase current source inverter
9. To study speed control of three-phase induction motor using three-phase voltage source inverter
10. To study speed control of three-phase slip ring induction motor using static rotor resistance control using rectifier and chopper
11. To study speed control of three-phase slip ring induction motor using static scherbius slip power recovery control scheme.

b) Simulation Based Experiments (using MATLAB or any other software):

12. To study starting transient response of separately excited dc motor
13. To study speed control of separately excited dc motor using single phase fully-half controlled bridge converter in discontinuous and continuous current modes.
14. To study speed control of separately excited dc motor using chopper control in motoring and braking modes.
15. To study starting transient response of three-phase induction motor
16. To study speed control of three phase induction motor using (a) constant V/F control (b) Constant Voltage and frequency control.

SEMESTER VIII

CODE	EEC 801	L	T	P	Credit
	INSTRUMENTATION AND PROCESS CONTROL	3	1	0	4

UNIT-I:
Transducer-I: Definition, advantages of electrical transducers, classification, characteristics, factors affecting the choice of transducers, Potentiometers, Strain guages, Resistance thermometer, Thermistors, Thermocouples, LVDT, RVDT. **08**

UNIT-II:
Transducer-II: Capacitive, Piezoelectric Hall effect and opto electronic transducers. Measurement of Motion, Force pressure, temperature, flow and liquid level. **08**

UNIT-III:
Telemetry: General telemetry system, land line & radio frequency telemetering system, transmission channels and media, receiver & transmitter. Data
Acquisition System: Analog data acquisition system, Digital data acquisition system, Modern digital data acquisition system. **08**

UNIT-IV:
Display Devices and Recorders: Display devices, storage oscilloscope, spectrum analyzer, strip chart & x-y recorders, magnetic tape &digital tape recorders.
Recent Developments: Computer aided measurements, fibre optic transducers, microsessors, smart sensors, smart transmitters. **08**

UNIT-V:
Process Control: Principle, elements of process control system, process characteristics, proportional (P), integral (I), Derivative (D), PI, PD and PID control modes. Electronic, Pneumatic & digital controllers. **08**

Text Books:

1. A. K. Sawhney, "Advanced Measurements & Instrumentation", Dhanpat Rai & Sons
2. B. C. Nakra & K. Chaudhry, "Instrumentation, Measurement and Analysis", Tata McGraw Hill 2nd Edition.
3. Curtis Johns, "Process Control Instrumentation Technology", Prentice Hall

Reference Books:

4. E.O. Decblin, "Measurement System – Application & design", McGraw Hill.
5. W. D. Cooper and A.P. Beltried, "Electronics Instrumentation and Measurement Techniques", Prentice Hall International.
6. Rajendra Prasad, "Electronic Measurement and Instrumentation", Khanna Publisher.
7. M. M. S. Anand, "Electronic Instruments and Instrumentation Technology", PHI Learning.

CODE	EEC 8L1	L	T	P	Credit
	INTRUMENTATION AND PROCESS CONTROL LAB	0	0	2	1

1. To study the performance of electromagnetic transducer as a speed measurement device
2. Study of P, PI and PID controllers
3. Measurement of displacement using LVDT and RVDT
4. Measurement of load using strain gauge based load cell.
5. Measurement of temperature by RTD.
6. Measurement of temperature by thermocouple
7. Experiment based Virtual Instrumentation
   a. program which consists of a knob and waveform chart.
   b. VI program which consist of dial and a thermometer.
   c. VI program to compare a thermometer with a set point and if it exceeds the limit, an indicator is on.
   d. Build a VI that displays two random plots on a waveform chart in sweep update mode. The plots should be a random plot and a running average of the last four points.

ELECTIVE COURSES

ELECTIVE DEPTT COURSE-1

CODE	EEE-101	L	T	P	Credit
	ELECTRICAL MACHINE DESIGN	3	1	0	4

UNIT-I:

Basic design principles and approaches, specification, Magnetic and electric loading, out put equations and output coefficients, Main dimensions. Ratings, Heating cooling and temperature rise. **08**

UNIT-II:

Transformer: Magnetic circuit, core construction and design, winding types, insulation, Loss allocation and estimation, Reactance, Temperature rise. **08**

UNIT-III:

D C Machine: No. of poles and main dimensions, armature, windings, Magnetic circuit and Magnetisation curve, Commutator and brushes. **08**

UNIT-IV:

Induction Machine-3 phase: Rating specifications, standard frame sizes, Main dimensions specific loadings, Design of stator windings, Rotor design-slots and windings, calculations of equivalent circuit parameters. **10**

UNIT-V:

Computer assisted design of above machines. **06**

Text Book:

1. A K Sawhney; A Course in Electrical Machine Design; Dhanpat Rai & Co.
2. Clayton A E & Hancock N N : The Performance and Design of Direct Current Machines ; CBS Publishers and Distributors
3. M G Say: The Performance and Design of Alternating Current Machines; CBS Publishers and Distributors.
4. S K Sen: Principles of Electrical Machine Design with Computer Programs; Oxford & IBH Pub. Co. Norton, Machine design, Pearson Education.

CODE	EEE-102	L	T	P	Credit
	UTILIZATION OF ELECTRICAL ENERGY AND TRACTION	3	1	0	4

Unit-I:

Electric Heating: Advantages and methods of electric heating, Resistance heating, Electric arc heating, Induction heating, Dielectric heating **08**

Unit-II:

Electric Welding: Electric Arc Welding, Electric Resistance welding, Electronic welding control

Electrolyte Process: Principles of electro deposition, Laws of electrolysis, applications of electrolysis **08**

Unit-III

Illumination: Various definitions, Laws of illumination, requirements of good lighting, Design of in door lighting and outdoor lighting systems

Refrigeration and Air Conditioning: Refrigeration systems, domestic refrigerator, water cooler

Types of air conditioning, Window air conditioner **08**

Unit-IV:

Electric Traction-I: Types of electric traction, systems of track electrification Traction mechanics- types of services, speed time curve and its simplification, average and schedule speeds Tractive effort, specific energy consumption, mechanics of train movement, coefficient of adhesion and its influence **08**

Unit-V:

Electric Traction-II: Salient features of traction drives, Series – parallel control of dc traction drives (bridge transition) and energy saving, Power Electronic control of dc and ac traction drives Diesel electric traction. **08**

Text Books:

1. H. Partab, "Art and Science of Electrical Energy", Dhanpat Rai & Sons.
2. H. Partab, "Modern Electric Traction", Dhanpat Rai & Sons.

Reference Books:

3. G. K. Dubey, "Fundamentals of Electric Drives", Narosa Publishing House
4. C. L. Wadhwa, "Generation, Distribution and Utilization of Electrical Energy", New Age International Publications.

CODE	EEE-103	L	T	P	Credit
	ADVANCED POWER SEMICONDUCTOR DEVICES	3	1	0	4

Unit-I:

Introduction: General overview of power semiconductor devices and their desirable characteristics, Comparison of power semiconductor devices.

Power Diodes: General purpose diode, Fast recovery diode, Schottky diode, Diode snubbers. **08**

Unit-II:

Power Bipolar Junction Transistors: Physical structure and device operation, Static V-I and switching characteristics, Secondary breakdown and safe operating area, Snubber circuits, Base drive control.

Power MOSFETS: Physical structure and device operation, Static V-I and switching characteristics, Operating limitations and safe operating area, Gate drive and snubber circuits. **08**

Unit-III:

Thyristors: Physical structure and device operation, Two-transistor analogy, Static V-I and switching characteristics, Gate characteristics, Firing circuits, Snubber circuits, Series and parallel operation.

TRIAC: Physical structure and device operation, Static V-I characteristics and applications. **08**

Unit-IV:

GTO (Gate Turn Off) Thyristors: Physical structure and device operation, Static V-I and switching characteristics, Drive and snubber circuits.

Insulated Gated Bipolar Transistors: Physical structure and device operation, Static V-I and switching characteristics, Safe operating area, Drive and snubber circuits. **08**

Unit-V:

Special Power Devices: Physical structure, Device operation and static V-I characteristics of reverse conducting thyristor, Field controlled thyristor, MOS controlled thyristor. **08**

Text Books:

1. B. Jayant Baliga, “Modern Power Devices”, John Wiley & Sons, 1987.
2. N. Mohan, T. M. Undeland and W. P. Robbins, “Power Electronics Converters, Applications and Design”, Johan Wiley & Sons, 1995.
3. M. H. Rashid, “Power Electronics: Circuit, Devices and Applications”, Prentice Hall of India, 1996.
4. G. K. Dubey et al, “Thyristorised Power Controllers”, Wiley Eastern Limited 1987.
5. M. D. Singh and K.B. Khanchandani, “Power Electroncs”, Tata McGraw Hill, 2001.
6. John G. K. Kassakian, Martin F. Schlecht and G. C. Verghese, “Principles of Power Electronics”, Addison-Wesley Publishing Co., 1991.

CODE	EEE-104	L	T	P	Credit
	ADVANCED CONTROL SYSTEM	3	1	0	4

UNIT-I:

State Space Analysis of Continuous System: Review of state variable representation of continuous system, conversion of state variable models to transfer function and vice-versa, solution of state equations and state transition matrix, controllability and observability, design of state observer and controller. **08**

UNIT-II:

Analysis of Discrete System: Discrete system and discrete time signals, state variable model and transfer function model of discrete system, conversion of state variable model to transfer function model and vice-versa, modeling of sample hold circuit, solution of state difference equations, steady state accuracy, stability on the z-plane and Jury stability criterion, bilinear transformation, Routh-Hurwitz criterion on rth planes. **08**

UNIT-III:

Stability: Lyapunov's stability theorems for continuous and discrete systems, methods for generating Lyapunovfunction for continuous and discrete system, Popov's criterion.

Non-linear System: Types of non linearities, phenomena related to non - linear systems. Analysis of non- linear systems-Linearization method, second order non-linear system on the phase plane, types of phase portraits, singular points, system analysis by phase-plane method, describing function and its application to system analysis. **08**

UNIT-IV:

Optimal Control: Introduction, formation of optimal control problem, calculus of variations minimization of functions, constrained optimization.Pontryagin's Minimum Maximum Principle, Linear Quadratic Problem-Hamilton Jacobi equation, Riccati equation and its solution. **08**

UNIT-V:

Adaptive Control: Introduction, modal reference adaptive control systems, controller structure, self tuning regulators. Introduction to neural network, fuzzy logic and genetic algorithms. **08**

Text Books:

1. M. Gopal, "Digital Control and State variable Methods", Tata Mc Graw Hill
2. Ajit K. Madal, "Introduction to Control Engineering: Modeling, Analysis and Design", New Age International.
3. D. Landau, "Adaptive Control", Marcel Dekker Inc.
4. S. Rajasekaran & G. A. Vjayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Alogorithms: Synthesis and Applications", Prentice Hall of India.

Reference Book:

5. Donald E. Kiv, "Optimal Control Theory: An Introduction", Prentice Hall
6. B. C. Kuo, "Digital Control Systems", Sounders College Publishing
7. C. H. Houpis and G. B. Lamont, "Digital Control Systems: Theory, Hardware, Software", Mc Graw Hill.

ELECTIVE DEPTT COURSE-2

CODE	EEE-201	L	T	P	Credit
	NON-CONVENTIONAL ENERGY RESOURCES	3	1	0	4

UNIT-I:

Introduction: Various non-conventional energy resources-Introduction, availability, classification, relative merits and demerits.

Solar Cells: Theory of solar cells. solar cell materials, solar cell array, solar cell power plant, limitations. **08**

UNIT-II:

Solar Thermal Energy: Solar radiation, flat plate collectors and their materials, applications and performance, focussing of collectors and their materials, applications and performance; solar thermal power plants, thermal energy storage for solar heating and cooling, limitations. **08**

UNIT-III:

Geothermal Energy: Resources of geothermal energy, thermodynamics of geo-thermal energy conversion-electrical conversion, non-electrical conversion, environmental consideration **Magneto-hydrodynamics (MHD):** Principle of working of MHD Power plant, performance and limitations.

Fuel Cells: Principle of working of various types of fuel cells and their working, performance and limitations. 0**8**

UNIT-IV:

Thermo-electrical and thermionic Conversions: Principle of working, performance and limitations.

Wind Energy: Wind power and its sources, site selection, criterion, momentum theory, classification of rotors, concentrations and augments, wind characteristics. performance and limitations of energy conversion systems. **08**

UNIT-V:

Bio-mass: Availability of bio-mass and its conversion theory.

Ocean Thermal Energy Conversion (OTEC): Availability, theory and working principle, performance and limitations.

Wave and Tidal Wave: Principle of working, performance and limitations. Waste Recycling Plants. **08**

Text Books:

1. D. S. Chauhan and S. K. Srivastava, "Non-conventional Energy Resources", New Age International.
2. M. V. R. Koteswara Rao, "Energy Resources: Conventional & Non-Conventional", BSP Publications, 2006.

Reference Books:

3. Raja et. al., "Introduction to Non-Conventional Energy Resources", Scitech Publications.
4. John Twideu and Tony Weir, "Renewal Energy Resources", BSP Publications, 2006.
5. Peter Auer, "Advances in Energy System and Technology", Vol. 1 & II Edited by Academic Press.

CODE	EEE-202	L	T	P	Credit
	DISTRIBUTED GENERATION AND MICRO-GRID	3	1	0	4

UNIT-1:

Introduction:

Conventional power generation: advantages and disadvantages, Energy crises, Non-conventional energy (NCE) resources: review of Solar PV, Wind Energy systems, Fuel Cells, micro-turbines, biomass and tidal sources. 08

UNIT-2:

Distributed Generations (DG):

Concept of distributed generations, topologies, selection of sources, regulatory standards/ framework, Standards for interconnecting Distributed resources to electric power systems: IEEE 1547. DG installation classes, security issues in DG implementations. Energy storage elements: Batteries, ultra-capacitors, flywheels. Captive power plants. 08

UNIT-3:

Impact of Grid Integration:

Requirements for grid interconnection, limits on operational parameters,: voltage, frequency, THD, response to grid abnormal operating conditions, islanding issues. Impact of grid integration with NCE sources on existing power system: reliability, stability and power quality issues. 08

UNIT-4:

Microgrids:

Concept and definition of microgrid, microgrid drivers and benefits, review of sources of microgrids, typical structure and configuration of a microgrid, AC and DC microgrids, Power Electronics interfaces in DC and AC microgrids, communication infrastructure, modes of operation and control of microgrid: grid connected and islanded mode, Active and reactive power control, protection issues, anti-islanding schemes: passive, active and communication based techniques. 08

UNIT-5:

Power Quality Issues in Microgrids:

Power quality issues in microgrids-Modelling and Stability analysis of Microgrid, regulatory standards, Microgrid economics, Introduction to smart microgrids. 08

References:

1. Amirnaser Yezdani, and Reza Iravani, “Voltage Source Converters in Power Systems: Modeling, Control and Applications”, IEEE John Wiley Publications, 2009.
2. Dorin Neacsu, “Power Switching Converters: Medium and High Power”, CRC Press, Taylor & Francis, 2006.
3. Chetan Singh Solanki, “Solar Photo Voltaics”, PHI learning Pvt. Ltd., New Delhi, 2009.
4. J. F. Manwell, “Wind Energy Explained, theory design and applications,” J. G. McGowan Wiley publication, 2002.
5. D. D. Hall and R. P. Grover, “Biomass Regenerable Energy”, John Wiley, New York, 1987.
6. John Twidell and Tony Weir, “Renewable Energy Resources”, Taylor and Francis Publications, 2005.
7.

CODE	EEE-203	L	T	P	Credit
	POWER SYSTEM RELIABILITY	3	1	0	4

UNIT-1:

Review of probability theory, probability laws, binomial, Poisson's, Normal Exponential, Gamma and Weibull distributions.

Markov processes (discrete state and continuous time), State transition matrix and state transition diagram. **08**

UNIT-2:

Reliability definition, Hazard rate, General reliability function, Mean time to failure, mortality curve, reliability evaluation using state enumeration, tie set and cut set methods, reliability indices from state transition matrix and state transition diagram. 08

UNIT-3:

Models for generation system reliability evaluation, capacity outage probability, recursive algorithm, loss of load indices, load forecast uncertainty, loss of energy indices, frequency and duration methods, system risk indices. **08**

UNIT-4:

Spinning capacity evaluation, load forecast uncertainty, derated capacity levels. Reliability evaluation of two area interconnected system. Conditional probability approach for evaluation reliability of a generation- transmission system. 08

UNIT-5:

Transmission system reliability evaluation using average interruption rate method and frequency and duration methods, Stormy and normal weather effects, Markov processes approach. Interruption indices for distribution systems and their evaluation for radial distribution systems. Introduction to protective system reliability evaluation. **08**

References:

1. M. L. Shooman, "Probabilistic Reliability-An engineering approach", RK Pub. Co., Florida.
2. C. O. Smith, "Introduction to reliability in design", McGraw Hill, Tokyo.
3. R. Billinton, R. J Ringlee and A. J Wood, "Power System Reliability Calculations", MIT Press, Cambridge.
4. J. Eudrenyl, "Reliability modeling in electric power systems", John Wiley, NY.
5. C. Singh & R. Billinton, "System Reliability modeling and evaluation", Hutchisn London.
6. R. L Sullivan, "Power System Planning", McGraw Hill New York.

ELECTIVE DEPTT COURSE-3

CODE	EEE-301	L	T	P	Credit
	HIGH VOLTAGE ENGINEERING	3	1	0	4

UNIT-I:

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, breakdown in vacuum.

Break Down in Liquid Dielectrics: Classification of liquid dielectric, characteristic of liquid dielectric, breakdown in pure liquid and commercial liquid.

Break Down in Solid Dielectrics: Intrinsic breakdown, electromechanical breakdown, breakdown of solid, dielectric in practice, breakdown in composite dielectrics. **10**

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. **08**

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. **08**

UNIT-IV:

Non-Destructive Testing: Measurement of direct current resistively, measurement of dielectric constant and loss factor, partial discharge measurements. **06**

UNIT-V:

High Voltage Testing & Insulation Coordination: High voltage testing of electrical power apparatus-Power frequency, impulse voltage and DC testing-International and Indian standards-Insulation Coordination. **08**

Text Book:

1. M. S. Naidu and V. Kamaraju, "High Voltage Engineering", Tata Mc-Graw Hill.

Reference Books:

2. E. Kuffel and W. S. Zacngal, "High Voltage Engineering", Pergamon Press.
3. M. P. Chaurasia , "High Voltage Engineering", Khanna Publishers
4. R. S. Jha, "High Voltage Engineering", Dhanpat Rai & sons
5. C. L. Wadhwa, "High Voltage Engineering", Wiley Eastern Ltd.
6. M. Khalifa, "High Voltage Engineering Theory and Practice", Marcel Dekker.
7. Subir Ray, "An Introduction to High Voltage Engineering", Prentice Hall of India

CODE	EEE-302	L	T	P	Credit
	POWER QUALITY	3	1	0	4

Unit-I:

Power Quality Terms and Definitions: Introduction, transients, Short Duration Voltage Variations: interruption, Sag, Swell; Long Duration Voltage Variations: under Voltage, over Voltage and Sustained Interruptions**;** Voltage and Phase Imbalance; waveform distortion; voltage fluctuation; power frequency variations**,** Harmonics, Frequency deviation monitoring.

Power Quality Problems: Poor load power factor, load containing harmonics, notching in load voltage, DC offset in loads, Unbalanced loads, disturbance in supply voltage. **08**

Unit-II:

Voltage Sag: Sources of voltage sag: motor starting, arc furnace, fault clearing etc; estimating voltage sag performance and principle of its protection; solutions at end user level- Isolation Transformer, Voltage Regulator, Static UPS, Rotary UPS, Active Series Compensator. **08**

Unit-III:

Electrical Transients: Sources of Transient Over voltages-Atmospheric and switching transients-motor starting transients, power factor correction capacitor switching transients, ups switching transients, neutral voltage swing etc; devices for over voltage protection. **06**

Unit-IV:

Harmonics: Causes of harmonics; current and voltage harmonics: measurement of harmonics; effects of harmonics on-Transformers, AC Motors, Capacitor Banks, Cables, and Protection Devices, Energy Metering, Communication Lines etc. harmonic mitigation techniques. **08**

Unit-V:

Wiring and Grounding: Reasons for grounding, typical wiring and grounding problems, solutions to wiring and grounding problems.

Monitoring Power Quality: Power quality related standards, standard test waveforms, and detailed power quality monitoring, Power quality measurement devices: Harmonic Analyzer, Transient Disturbance Analyzer, wiring and grounding tester, Flicker Meter, Oscilloscope, multimeter etc.

Custom Power Devices: Utility customer interface, Network Reconfiguration devices; Load compensation and voltage regulation using D-STATCOM; protecting sensitive loads using Dynamic Voltage Restorer (DVR); Unified power Quality Conditioner (UPQC). **10**

Text Books:

1. Roger C. Dugan, McGrahan, Santoso & Beaty, “Electrical Power System Quality”, McGraw Hill
2. Arindum Ghosh & Gerard Ledwich, “Power Quality Enhancement Using Custom Power Devices”, Kluwer Academic Publishers
3. C. Sankaran, “Power Quality”, CRC Press.

Reference Books:

4. G. W. Heydt, “Electric Power Quality”, Stars in a Circle Publications, 1991.
5. G. J. Parter and J. A. V. Sciver, “Power Quality Salutations: Case Study for Troubleshooters”, Fairmont Press.

CODE	EEE-303	L	T	P	Credit
	POWER SYSTEM SECURITY	3	1	0	4

UNIT-1:

Introduction:

Basic concepts and definitions of Rotor angle stability, Voltage stability or voltage collapse and Mid-term and long-term stability, Classification of stability. **08**

UNIT-2:

Basic Concepts:

Power system-security-observability and reliability, factors affecting power system security, decomposition and multilevel approach, system monitoring, security assessment, static and dynamic – online and offline, security enhancement. **08**

UNIT-3:

Power System State Estimation: DC and AC network, orthogonal decomposition algorithm, detection identification of bad measurements, network observability and pseudo measurements, application of power system state estimation, introduction to supervisory control and data acquisition. **08**

UNIT-4:

Power System Security Assessment: contingency analysis, network sensitivity factors, contingency selection, performance indices, security constrained optimization, SCOPF, basis of evolutionary optimization techniques, preventive, emergency and restorative controls though non-linear programming (NLP) and linear programming (LP) methods. **08**

UNIT-5:

Security in Deregulated Environment: Need and conditions for deregulation, electricity sector structure model, power wheeling transactions, congestion management methods, available transfer capability (ATC), system security in deregulation. **08**

References:

1. Wood and Wollenberg, “Power generation, operation and control”, John Wiley & Sons, 2000.
2. K. Bhattacharya, M. H. J Bollen and J. E. Daaider, “Operation of restructured power system”, Kluwer Power Electronics and Power System series (2001)
3. N. S. Rau, “Optimization Principles: Practical Applications to the operation and Markets of the Electric Power Industry”.
4. Sally Hunt, “Making competition work in Electricity”, John Wiley, 2002

ELECTIVE DEPTT COURSE-4

CODE	EEE-401	L	T	P	Credit
	ARTIFICIAL NEURAL NETWORKS AND FUZZY SYSTEM	3	1	0	4

UNIT-I:

Neural Networks-1(Introduction & Architecture): Neuron, Nerve structure and synapse, Artificial Neuron and its model, activation functions, Neural network architecture: single layer and multilayer feed forward networks, recurrent networks. Various learning techniques; perception and convergence rule, Auto-associative and hetro-associative memory. **08**

UNIT-II:

Neural Networks-II (Back propogation networks): Architecture: perceptron model, solution, single layer artificial neural network, multilayer perception model; back propogation learning methods, effect of learning rule co-efficient ;back propagation algorithm, factors affecting backpropagation training, applications. **08**

UNIT-III

Fuzzy Logic-I (Introduction): Basic concepts of fuzzy logic, Fuzzy sets and Crisp sets, Fuzzy set theory and operations, Properties of fuzzy sets, Fuzzy and Crisp relations, Fuzzy to Crisp conversion. **08**

UNIT-IV

Fuzzy Logic –II (Fuzzy Membership, Rules): Membership functions, interference in fuzzy logic, fuzzy if-then rules, Fuzzy implications and Fuzzy algorithms, Fuzzyfications & Defuzzificataions, Fuzzy Controller, Industrial applications. **08**

UNIT-V

Fuzzy Neural Networks: L-R Type fuzzy numbers, fuzzy neutron, fuzzy back propogation (BP), architecture, learning in fuzzy BP, inference by fuzzy BP, applications. **08**

Text Books:

1. Kumar Satish, “Neural Networks”, Tata Mc Graw Hill
2. S. Rajsekaran & G. A. Vijayalakshmi Pai, “Neural Networks, Fuzzy Logic and Genetic Algorithm:Synthesis and Applications”, Prentice Hall of India.

Reference Books:

3. Siman Haykin, ”Neural Netowrks”, Prentice Hall of India
4. Timothy J. Ross, “Fuzzy Logic with Engineering Applications”, Wiley Indi
5. S N Shivanandan, S Sumathi and S N Deepa, “Introduction to Neural Networks Using Matlab 6.0”, Tata McGraw-Hill Education, 2006

CODE	EEE-402	L	T	P	Credit
	COMPUTER AIDED POWER SYSTEM ANALYSIS	**3**	**1**	**0**	**4**

UNIT-I:

Network Matrices: Evaluation of bus admittance matrix (YBUS), Bus impedance matrix (ZBUS), Branch impedance matrix (ZBT) and loop Impedance matrix (ZLOOP) by singular and non singular transformations. **08**

UNIT-II:

Short Circuit Studies: Formulation of ZBUS for single phase and three phase networks, Transformation of network matrices using symmetrical components; Short circuit studies using ZBUS, YBUS and ZLOOP. **06**

UNIT-III:

Load Flow Studies: Representation of off-load, on-load tap changing and phase shifting transformers, DC link, Decoupled and fast decoupled methods, Sparsity technique; Introduction to load flow of integrated AC/DC system. **08**

UNIT-IV:

Stability Studies: Network formulation for stability studies for different types of loads (constant impedance, constant current and constant power loads), Digital computer solution of swing equation for single and multi-machine cases using Runge-Kutta and predictor corrector methods, Effects of exciter and governor on transient stability. **08**

UNIT-V:

Voltage Stability and Small –Signal Stability: Voltage Stability Transmission system characteristics, Generator characteristics, Load characteristics. Introduction of reactive compensating devices. Classification of voltage Stability, voltage stability Analysis, voltage collapse and its Prevention. Small-Signal Stability –Concept of stability of Dynamic System, Eigen-properties of the State Matrix, Single-machine Infinite Bus System, Power System Stabilizer. **10**

Reference Books:

1. Prabha Kundur, “Power System Stability and Control”, Tata McGraw Hill, New Delhi, 2006.
2. G. W. Stagg and A.H.EI-Abiad, “Computer Methods in Power System Analysis”, McGraw Hill, 1971.
3. G. I. Kusic, “Computer Sided Power System Analysis”, Prentice Hall International, 1986.
4. L. P. Singh, “Advanced Power System Analysis and Dynamics”, Wiley Eastern.

CODE	EEE-403	L	T	P	Credit
	SPECIAL ELECTRICAL MACHINES	**3**	**1**	**0**	**4**

UNIT-I:

Poly-phase AC Machines: Construction and performance of double cage and deep bar three phase induction motors; e.m.f. injection in rotor circuit of slip ring induction motor, concept of constant torque and constant power controls, static slip power recovery control schemes (constant torque and constant power). **08**

UNIT-II:

Single phase Induction Motors: Construction, starting characteristics and applications of split phase, capacitor start, capacitor run, capacitor start capacitor-run and shaded pole motors.

Two Phase AC Servomotors: Construction, torque-speed characteristics, performance and applications. **08**

UNIT-III:

Stepper Motors: Principle of operation, variable reluctance, permanent magnet and hybrid stepper motors, characteristics, drive circuits and applications.

Switched Reluctance Motors: Construction; principle of operation; torque production, modes of operation, drive circuits. **08**

UNIT-IV:

Permanent Magnet Machines: Types of permanent magnets and their magnetization characteristics, demagnetizing effect, permanent magnet Dc motors, sinusoidal PM ac motors, brushless dc motors and their important features and applications, PCB Motors.

Single phase synchronous motor; construction, operating principle and characteristics of reluctance and hysteresis motors; introduction to permanent magnet generators. **08**

UNIT-V:

Single Phase Commutator Motors: Construction, principle of operation, characteristics of universal and repulsion motors; Linear Induction. Motors. Construction, principle of operation, Linear force, and applications. **08**

Text Books:

1. P. S. Bimbhra, "Generalized Theory of Electrical Machines", Khanna Publishers.
2. P. C. Sen "Principles of Electrical Machines and Power Electronics", John willey & Sons, 2001

Reference Books:

3. G. K. Dubey "Fundamentals of Electric Drives", Narosa Publishing House, 2001
4. Cyril G. Veinott "Fractional and Sub-fractional horse power electric motors", McGraw Hill International, 1987
5. M. G. Say, "Alternating current Machines", Pitman & Sons.

ELECTIVE DEPTT COURSE-5

CODE	EEE-501	L	T	P	Credit
	POWER CONVERTER APPLICATIONS	**3**	**1**	**0**	**4**

UNIT-I:

Industrial Applications: Electric heating, Advantages & disadvantages, Concept of resistance and induction heating, AC voltage controllers for resistance heating, High frequency inverters for induction heating, Illumination control, High frequency fluorescent lighting system. **08**

UNIT-II:

Application in High Voltage DC Transmission: Introduction to HVDC transmission, Basic layout for HVDC transmission system, Types of HVDC links, Twelve pulse converters, Control of HVDC converters, Control characteristics, Converter faults and protection, Harmonic filters and power factor correction capacitors. **08**

UNIT-III:

Applications in Static VAR Control: Concept of static VAR control, Thyristor controlled VAR compensation techniques, Series compensation, Synchronous link converter based VAR compensation, Unified power flow controller (UPFC). **08**

UNIT-IV:

Applications in Power Supplies: Classification and sources of power line disturbances, Need of uninterruptible power supply (UPS) system, Static UPS systems – short break & no break UPS systems, Components of UPS systems, Introduction to SMPS, Configurations-flyback converter, two transistor / MOSFET flyback converter, paralleling flyback converter, forward converter, push-pull converter, half-bridge converter, full-bridge SMPS, Advantages & disadvantages. **08**

UNIT-V:

Applications in Grid Interconnected Renewable Energy Systems: Single-phase and three-phase photovoltaic array interconnection, Maximum power point tracking (MPPT), Wind / fuel cell and small hydro interconnections with utility grid.

Other Applications: DC circuit breaker, single-phase and three-phase AC switches Static excitation control of synchronous generators. **08**

Text Books:

1. N. Mohan, T. M. Undeland and W. P. Robbins, “Power Electronics Converters, Applications and Design”, John Wiley & Sons, 1995.
2. H. Rashid, “Power Electronics: Circuits, Devices and Applications”, Prentice Hall of India, 1996.

Reference Books:

3. E. W. Kimbark, “Direct Current Transmission”, Vol-I, Wiley Interscience, 1971.
4. T. J. Miller, “Reactive Power Control in Electric System”, Wiley Interscience, 1982.
5. K. R. Padiyar, “HVDC Power Transmission: Technology and System Reactions”, New Age International.

CODE	EEE-502	L	T	P	Credit
	BIO-INSTRUMENTATION	**3**	**1**	**0**	**4**

UNIT-I:

Basic physiological system of the body: Problems encountered in measuring living systems, bioelectric potentials, biomaterials

Basic Transducer Principles: Active and passive transducers, Transducers for biomedical applications. Generation, propagation and distribution of bioelectric potentials (ECG, EEG and EMG). **08**

UNIT-II:

Bio-potential electrodes: Basic types (micro, skin surface and needle electrodes) biochemical transducers. (PH, blood, gas and specific ions electrodes).

The cardiovascular system and measurements: Heart and cardiovascular system and circulation block diagram, blood pressure and measurement, characteristics of blood flow and heart sounds. Electrocardiography, ECG lead configurations, ECG recording and their types. **08**

UNIT-III:

The Nervous System: The anatomy of nervous system, Neuronal communication, EPSP & IPSP
Organization of the brain, Measurements from the nervous system

Systemic Body & Skin Temperature Measurement: Temperature measurements, Brief idea about ultrasonic measurements. **08**

UNIT-IV:

Patient care monitoring: Elements of intensive care, Organization of the Hospital for patient-care monitoring, Pace-makers-types, systems, modes and generators, Defibrillators-types. Bio telemetry & applications of telemetry in patient care. **08**

UNIT-V:

Automation of chemical tests, Instrumentation for diagnostic X-Rays, Interfacing computer with medical instrumentation and other equipments, biomedical computer applications. Shock hazards from electrical equipments, methods of accident prevention. **08**

Text Book:

1. T. Cromwell, F. J. Weibell & F. A. Pfieffer, “Biomedical Instrumentation & Measurements”, Prentice Hall International

Reference Books:

2. R. S. Khanpur, “Handbook of Biomedical Instrumentation”, Tata Mc Graw Hill
3. H. E. Thomas, “Handbook of Biomedical Instrumentation and Measurement”, Restone Publishing Company
4. J. G. Webester, “Medical Instrumentation”, Houghton Mifflin.

CODE	EEE-503	L	T	P	Credit
	EHV AC & DC TRANSMISSION SYSTEM	**3**	**1**	**0**	**4**

UNIT-I:

Introduction: Need of EHV transmission, standard transmission voltage, comparison of EHV ac & dc transmission systems and their applications & limitations, surface voltage gradients in conductor, distribution of voltage gradients on sub-conductors, mechanical considerations of transmission lines, modern trends in EHV AC and DC transmission **08**

UNIT-II:

EHV AC Transmission: Corona loss formulas, corona current, audible noise – generation and characteristics corona pulses their generation and properties, radio interference (RI) effects, over voltage due to switching, ferroresonance, reduction of switching surges on EHV system, principle of half wave transmission. **08**

UNIT-III:

Extra High Voltage Testing: Characteristics and generation of impulse voltage, generation of high Ac and Dc voltages, measurement of high voltage by spheregaps and potential dividers.

Consideration for Design of EHV Lines: Design factors under steady state limits, EHV line insulation design based upon transient over voltages. Effects of pollution on performance of EHV lines. **08**

UNIT-IV:

EHV DC Transmission-I: Types of dc links, converter station, choice of converter configuration and pulse number, effect of source inductance on operation of converters. Principle of dc link control, converter controls characteristics, firing angle control, current and Excitation angle control, power control, starting and stopping of dc link. **08**

UNIT-V:

EHV DC Transmission-II: Converter faults, protection against over currents and over voltages, smoothing reactors, Generation of harmonics, ac and dc filters, Multi Terminal DC systems (MTDC): Types, control, protection and applications. **08**

Text Books:

1. R. D. Begamudre, “Extra High Voltage AC Transmission Engineering”, Wiley Eastern.
2. K. R. Padiyar, “HVDC Power Transmission Systems: Technology and System Reactions”, New Age International.
3. J. Arrillaga, “High Voltage Direct current Transmission”, IEEE Power Engineering Series 6, Peter Peregrinus Ltd, London.

Reference Books:

4. M. S. Naidu & V. Kamaraju, “High Voltage Engineering”, Tata McGraw Hill.
5. M. H. Rashid , “Power Electronics: Circuits, Devices and Applications”, Prentice Hall of India.
6. S. Rao, “EHV AC and HVDC Transmission Engineering and Practice”, Khanna Publisher.
7. “EPRI, Transmission Line Reference Book, 345 KV and above” Electric Power Research Institute. Palo Alto, California, 1982.

OPEN ELECTIVE COURSE -1

CODE	OEE-101	L	T	P	Credit
	NON-CONVENTIONAL ENERGY RESOURCES	3	1	0	4

UNIT-I:

Introduction: Various non-conventional energy resources-Introduction, availability, classification, relative merits and demerits.

Solar Cells: Theory of solar cells. solar cell materials, solar cell array, solar cell power plant, limitations. **08**

UNIT-II:

Solar Thermal Energy: Solar radiation, flat plate collectors and their materials, applications and performance, focussing of collectors and their materials, applications and performance; solar thermal power plants, thermal energy storage for solar heating and cooling, limitations. **08**

UNIT-III:

Geothermal Energy: Resources of geothermal energy, thermodynamics of geo-thermal energy conversion-electrical conversion, non-electrical conversion, environmental consideration **Magneto-hydrodynamics (MHD):** Principle of working of MHD Power plant, performance and limitations.

Fuel Cells: Principle of working of various types of fuel cells and their working, performance and limitations. **08**

UNIT-IV:

Thermo-electrical and thermionic Conversions: Principle of working, performance and limitations.

Wind Energy: Wind power and its sources, site selection, criterion, momentum theory, classification of rotors, concentrations and augments, wind characteristics. performance and limitations of energy conversion systems. **08**

UNIT-V:

Bio-mass: Availability of bio-mass and its conversion theory.

Ocean Thermal Energy Conversion (OTEC): Availability, theory and working principle, performance and limitations.

Wave and Tidal Wave: Principle of working, performance and limitations. Waste Recycling Plants. **08**

Text Books:

1. D. S. Chauhan and S. K. Srivastava, "Non-conventional Energy Resources", New Age International.
2. M. V. R. Koteswara Rao, "Energy Resources: Conventional & Non-Conventional", BSP Publications, 2006.

Reference Books:

3. Raja et. al., "Introduction to Non-Conventional Energy Resources", Scitech Publications.
4. John Twideu and Tony Weir, "Renewal Energy Resources", BSP Publications, 2006.
5. Peter Auer, "Advances in Energy System and Technology", Vol. 1 & II Edited by Academic Press.

CODE	OEE-102	L	T	P	Credit
	ARTIFICIAL NEURAL NETWORKS AND FUZZY SYSTEM	3	1	0	4

UNIT-I:

Neural Networks-1(Introduction & Architecture): Neuron, Nerve structure and synapse, Artificial Neuron and its model, activation functions, Neural network architecture: single layer and multilayer feed forward networks, recurrent networks. Various learning techniques; perception and convergence rule, Auto-associative and hetro-associative memory. **08**

UNIT-II:

Neural Networks-II (Back propogation networks): Architecture: perceptron model, solution, single layer artificial neural network, multilayer perception model; back propogation learning methods, effect of learning rule co-efficient ;back propagation algorithm, factors affecting backpropagation training, applications. **08**

UNIT-III

Fuzzy Logic-I (Introduction): Basic concepts of fuzzy logic, Fuzzy sets and Crisp sets, Fuzzy set theory and operations, Properties of fuzzy sets, Fuzzy and Crisp relations, Fuzzy to Crisp conversion. **08**

UNIT-IV

Fuzzy Logic –II (Fuzzy Membership, Rules): Membership functions, interference in fuzzy logic, fuzzy if-then rules, Fuzzy implications and Fuzzy algorithms, Fuzzyfications & Defuzzificataions, Fuzzy Controller, Industrial applications. **08**

UNIT-V

Fuzzy Neural Networks: L-R Type fuzzy numbers, fuzzy neutron, fuzzy back propogation (BP), architecture, learning in fuzzy BP, inference by fuzzy BP, applications. **08**

Text Books:

1. Kumar Satish, “Neural Networks”, Tata Mc Graw Hill
2. S. Rajsekaran & G. A. Vijayalakshmi Pai, “Neural Networks, Fuzzy Logic and Genetic Algorithm:Synthesis and Applications”, Prentice Hall of India.

Reference Books:

3. Siman Haykin, ”Neural Netowrks”, Prentice Hall of India
4. Timothy J. Ross, “Fuzzy Logic with Engineering Applications”, Wiley Indi
5. S N Shivanandan, S Sumathi and S N Deepa, “Introduction to Neural Networks Using Matlab 6.0”, Tata McGraw-Hill Education, 2006