PEOPLE'S UNIVERSITY, BHOPAL

Programme: **B. Tech. (Electrical Engineering)**

Semester: **VII**

Subject Title	Subject Code	Credits			Theory		
		L	T	P	Externals (70)	Internals (30)	Total (100)
Non Conventional Energy Sources	EET- 701	3	1	-		Min: Nil	Min: 40 (D Grade)

Duration of Theory (Externals): 3 Hours

Theory Internal - Max Marks: 30

Best of Two Mid Semester Test –Max Marks: 20

Assignment / Quiz – Max. Marks: 10

Unit	Contents (Theory)
I	Introduction: World energy situation, conventional and non-conventional energy sources, Indian energy scene. Tidal Energy: Introduction to tidal power. Components of tidal power plants, double basin arrangement. Power generation. Advantages and limitations of tidal power generation. Prospects of tidal energy in India.
II	**Solar Energy:** Solar radiation, solar radiation geometry, solar radiation on tilted surface. Solar energy collector. Flat- plate collector, concentrating collector – parabolidal and heliostat. Solar pond. Basic solar power plant. Solar cell, solar cell array, basic photo-voltaic power generating system
III	**Wind Energy:** Basic principle of wind energy conversion, efficiency of conversion, site selection. Electric power generation-basic components, horizontal axis and vertical axis wind turbines, towers, generators, control and monitoring components. Basic electric generation turbines, towers, generators, control and monitoring components. Basic electric generation schemes- constant speed constant frequency, variable speed constant frequency and variable speed variable frequency schemes. Applications of wind energy. **Geothermal Energy:** Geothermal fields, estimates of geothermal power. Basic geothermal steam power plant, binary fluid geothermal power plant and geothermal preheat hybrid power plant. Advantages and disadvantages of geothermal energy. Applications of geothermal energy. Geothermal energy in India.
IV	**Nuclear Fusion Energy:** Introduction, nuclear fission and nuclear fusion. Requirements for nuclear fusion. Plasma confinement - magnetic confinement and inertial confinement. Basic Tokamak reactor, laser fusion reactor. Advantages of nuclear fusion. Fusion hybrid and cold fusion.
V	**Biomass Energy:** Introduction, biomass categories, bio-fuels. Introduction to biomass conversion technologies. Biogas generation, basic biogas plants-fixed dome type, floating gasholder type, Deen Bandhu biogas plant, Pragati design biogas plant. Utilization of bio gas. Energy plantation. Pyrolysis scheme. Alternative liquid fuels –ethanol and methanol. Ethanol production.

REFERENCES:

1. J. B. Gupta, Dhanpat Rai Publications
2. G. D. Rai, Khanna Publications

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Semester: **VII**

Subject Title	Subject Code	Credits			Theory		
		L	**T**	**P**	**Externals (70)**	**Internals (30)**	**Total (100)**
Elective – I Computer Application to Power System	**EET- 7101**	3	1	0		Min: Nil	Min: 40 (D Grade)

Duration of Theory (Externals): 3 Hours

Theory Internal - Max Marks: 30

Average of Two Mid Semester Test –Max Marks: 20

Assignment / Quiz – Max. Marks: 10

Unit	Contents (Theory)
I	Models of power system components, network model using graph theory, formation of Z bus, Transmission line models, regulating transformer, line loadability, capability curves of alternator.
II	Control of load bus voltage using reactive power control variable, SVC & SVS, Regulated shunt compensation, series and shunt compensation, Uniform series and shunt compensation and effect of loadability of transmission lines.
III	Sensitivity analysis- General sensitivity relations, generation shift distribution factors, line outage distribution factors, compensated shift factors, sensitivity associated with voltage-VAR, sensitivities relating load bus voltage changes in terms of PV bus voltage changes, sensitivity relating changes in reactive power generation for changes in PV Bus Voltage.
IV	Power system security – Security functions, Security level, contingency analysis, security control, economic dispatch using LP formulation, pre-contingency and post- contingency, corrective rescheduling
V	Voltage stability - Difference between voltage and angle stability, PV Curve for voltage stability assessment, proximity and mechanism, modal analysis using reduced Jacobian, participation factor, effect of series and shunt compensation on voltage stability , effect of load models

REFERENCES:

1. Computer- Aided Design of Electrical Equipment- by Dr. M. Ramamoorthy-Affiliated East-West press Pvt. Ltd. New Delhi
2. Electrical Machine Design- by A.K. Sawhney, Dhanpat Rai & Sons
3. Principles of Electrical Machine Design with Computer Programmes by- S.K. Sen, Oxford & IBH Publishing Co.
4. Performance and Design of A.C. Machines-M.G. Say, Affiliated East West Press Pvt. Ltd., New Delhi.

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Semester: **VII**

Subject Title	Subject Code	Credits			Theory		
		L	T	P	Externals (70)	Internals (30)	Total (100)
Elective – I Generalized Theory of Electrical Machines	**EET -7102**	3	1	0		Min: Nil	Min: 40 (D Grade)

Duration of Theory (Externals): 3 Hours

Theory Internal - Max Marks: 30

Best of Two Mid Semester Test –Max Marks: 20

Assignment / Quiz – Max. Marks: 10

Unit	Contents (Theory)
I	Review: Primitive machine, voltage and torque equation. Concept of transformation changes of variables & m/c variables and transform variables. Application to D.C. machine for steady state and transient analysis, and equation of cross field commutator machine.
II	Induction Machine : Voltage, torque equation for steady state operation, Equivalent circuit, Dynamic performance during sudden changes in load torque and three phase fault at the machine terminals. Voltage & torque equation for steady state operation of 1- induction motor & scharge motor
III	Synchronous Machine : Transformation equations for rotating three phase windings, Voltage and power equation for salient and non salient alternator, their phasor diagrams, Simplified equations of a synchronous machine with two damper coils.
IV	Operational Impedances and Time Constants of Synchronous Machines: Park's equations in operational form, operational impedances and G(P) for a synchronous machine with four Rotor Windings, Standard synchronous machine Reactances, time constants, Derived synchronous machine time constants, parameters from short circuit Characteristics.
V	Approximate Methods for Generator & System Analysis: The problem of power system analysis, Equivalent circuit & vector diagrams for approximate calculations, Analysis of line to line short circuit, Application of approximate method to power system analysis.

REFERENCES:

1. P.C.Krause, Analysis of Electric Machinery.
2. B.Adkins, The General theory of Electrical Machines.
3. B.Adkins & R.G. Harley, The General theory of AC Machines.
4. P.S.Bhimbra, Generalized theory of Electrical m/c
5. White & Woodson, Electro Mechanical Energy Conversion.

PEOPLE'S UNIVERSITY, BHOPAL

Programme: **B. Tech. (Electrical Engineering)**

Semester: **VII**

Subject Title	Subject Code	Credits			Theory		
		L	T	P	Externals (70)	Internals (30)	Total (100)
Elective - I Process Control	**EET-7103**	3	1	0		Min: Nil	Min: 40 (D Grade)

Duration of Theory (Externals): 3 Hours

Theory Internal - Max Marks: 30

Average of Two Mid Semester Test –Max Marks: 20

Assignment / Quiz – Max. Marks: 10

Unit	Contents (Theory)
I	Special characteristics of process systems large time constants, interaction, multistaging, pure lag; control loops for simple systems and their Dynamics & stability.
II	Generation of control action in electronic and pneumatic controllers. Control valves, valve positioners, relief and safety valves, relays, volume boosters, pneumatic transmitters for process variable. Tuning of controllers - Zeigler Nichols and other techniques
III	Different control techniques and interaction of process parameters e.g. feed forward, cascade, ratio, override controls Batch continuous process controls. Feed forward Control schemes.
IV	Various process schemes / unit operations and their control schemes e.g. distillation columns, absorbers, heat exchangers, furnaces, reactors, mineral processing industries, etc. Use of control schemes for process optimization.
V	Advanced control strategies with case studies. Use of DDC and PLC. Introduction to supervisory control. Conversion of existing control schemes in operating plants, data loggers

REFERENCES:

1. Dale Patrick, Stephen Fardo, "Industrial Process Control System". Shinskey F.G.,
2. "Process Control System", III Ed., McGraw Hill. Smith C.A. & A.B. Corripio,
3. "Principle & Practiced Automatic Process Control", J. Willey. Rao M & S.Qiv,
4. "Process Control Engg.", Gorden & Breach

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Programme: **B. Tech. (Electrical Engineering)**

Semester: **VII**

Subject Title	Subject Code	Credits			Theory			Practical		
		L	T	P	Externals (70)	Internals (30)	Total (100)	Externals (35)	Internals (15)	Total (50)
Electrical Drive	EET-703	3	1	2		Min: Nil	Min: 40 (D Grade)	Min: 14	Min: Nil	Min: 20 (D Grade)

Duration of Theory (Externals): 3 Hours

Theory Internal - Max Marks: 30

Best of Two Mid Semester Test –Max Marks: 20
Assignment / Quiz – Max. Marks: 10

Practical Internal - Max Marks: 15

Lab work & Sessional –Max Marks: 10
Assignment / Quiz – Max. Marks: 05

Unit	Contents (Theory)
I	**Dynamics of Electric Drives:** Fundamental torque equations, speed-torque conventions and multiquardant operation, equivalent values of drive parameters, nature and classification of load torques, steady state stability, load equalization, close loop configurations of drives.
II	**DC Drives:** Speed torque curves, torque and power limitation in armature voltage and field control, Starting, **Braking-**Regenerative Braking, dynamic braking and plugging. **Speed Control-**Controlled Rectifier fed DC drives, Chopper Controlled DC drives.
III	**Induction Motor Drives-I:** Starting, **Braking-**Regenerative braking, plugging and dynamic braking. **Speed Control-**Stator voltage control, variable frequency control from voltage source, Voltage Source Inverter (VSI) Control.
IV	**Induction Motor Drives-II:** Variable frequency control from current source, Current Source Inverter (CSI) Control, Cycloconverter Control, Static rotor resistance control, Slip Power Recovery- Stator Scherbius drive, Static Kramer drive.
V	**Synchronous Motor Drive**: Control of Synchronous Motor-Separately Controlled and VSI fed Self-Controlled Synchronous Motor Drives. Dynamic and Regenerative Braking of Synchronous Motor with VSI. Control of Synchronous Motor Using Current Source Inverter(CSI)

REFERENCES:

1. Pillai S. K. "A first course on Electrical Drives", Second edition, Wiley Eastern.
2. Dubey G. K., "Power Semiconductor Controlled Drives", Prentice-Hall, Englewood Cliffs! .
3. Dubey G. K. , "Fundamentals of Electrical Drives". Narosa Publishing House.
4. Bose B. K., "Power Electronics and AC Drives", Prentice-Hall.
5. Murphy M. D., and Tumbuli F., "Power Electronic Control of AC Motors", Pergamon
6. Press, Oxford University Press.
7. P.V. Rao, "Power semiconductor Drives", BS Publications

PEOPLE'S UNIVERSITY, BHOPAL

Programme: **B. Tech. (Electrical Engineering)**

PRACTICALS:

1. Study the starting and running characteristics of converter fed DC traction motor.
2. To study the energy recovery systems and braking of a DC drive.
3. To study the braking Methods of a three-phase induction motor.
4. To study the performance of VSI fed three-phase induction motor using PWM technique.
5. To control the speed of a three phase slip ring Induction motor using rotor impedance control.
6. To study the performance of Vector Controlled three phase Induction motor drive.
7. To Study frequency Controlled Synchronous motor drive.
8. To study the control & performance Characteristics of switched Reluctance motor.
9. To study the performance & control of a Stepper motor.
10. To Study the Performance of a permanent magnet Brushless dc motor

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Semester: **VII**

Subject Title	Subject Code	Credits			Theory			Practical		
		L	T	P	Externals (70)	Internals (30)	Total (100)	Externals (35)	Internals (15)	Total (50)
Protection of Power Systems	EET-704	3	1	2		Min: Nil	Min: 40 (D Grade)	Min: 14	Min: Nil	Min: 20 (D Grade)

Duration of Theory (Externals): 3 Hours

Theory Internal - Max Marks: 30

Best of Two Mid Semester Test –Max Marks: 20

Assignment / Quiz – Max. Marks: 10

Practical Internal - Max Marks: 15

Lab work & Sessional –Max Marks: 10

Assignment / Quiz – Max. Marks: 05

Unit	Contents (Theory)
I	**Causes and consequences of dangerous currents:** Faults, overloads and switching over currents. Introduction to protection, trip circuit of a circuit breaker. Functional characteristics of a relay, zone of protection, primary and backup protection. CTs & PTs: Current transformer construction, measurement and protective CTs. Type of potential transformers. Steady state ratio and phase angle errors in CTs and PTs. Transient errors in CT and CVT (Capacitive Voltage Transformer).
II	**Overcurrent Protection:** HRC fuse and thermal relay. Over current (OC) relays– instantaneous, definite time, inverse time and inverse definite minimum time over current relays, time and current grading. Induction disc type relay. Directional over current relay, 30◦, 60◦ and 90◦ connections. Earth fault relay. Brief description of over current protective schemes for a feeder, parallel feeders and ring mains.
III	**Generator Protection:** Stator protection– differential and percentage differential protection, protection against stator inter-turn faults, stator overheating protection. Rotor protection, protection against excitation and prime mover failure, field earth fault and unbalanced stator currents (negative sequence current protection).
IV	**Transformer Protection:** Percentage differential protection, magnetizing inrush current, percentage differential relay with harmonic restraint. Buchholz relay. Differential protection of generator transfer unit. Busbar Protection: Differential protection of busbars, high impedance relay scheme, frames leakage protection.
V	**Transmission Line Protection:** Introduction to distance protection. Construction, operating principle and characteristics of an electromagnetic impedance relay. Effect of arc resistance. Induction cup type reactance and mho relays. Comparison between impedance, reactance and mho relays. Three stepped distance protection of transmission line. Induction Motor Protection: Introduction to various faults and abnormal operating conditions, unbalance supply voltage and single phasing. Introduction to protection of induction motors- HRC fuse and

REFERENCES:

1. The Art And Science Of Protective Relaying, by C.R.Mason, John Wiley
2. Protective Relays – Their theory And Practice Vol-I & II, by A.R.Van. C. Warrington, john Willey
3. Power System Protection, by S.P.Patra, S.K.Basu & S.Choudhuri, Oxfort & IBH
4. Power System Protection & Switchgear, by B.Ravindranath & M.Chander, Willey Eastern
5. Switchgear & Protection, by S. S. Rao, Khanna Publishers.

6. Power System Protection, Vols.I, II & III, by Electricity Council, Macdonald & Co.
7. The J & P Switchgear Book, Johnson & Philips Ltd. Newness Butterworths.
8. Power System Protection, Vols.I, II, III & IV, by The Electricity Training Association, IEE

PRACTICALS:

1. To study the operation of definite time over current relay.
2. To plot the characteristics of single pole over current or earth fault using static IDMT Relays
3. To study the operation of static over voltage relay
4. To plot the characteristics of electromagnetic IDMT relay
5. To study directional over current relay

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Semester: **VII**

Subject Title	Subject Code	Credits			Practical		
		L	T	P	External	Internal	Total (50)
Electrical Machine Design CAD Based	**EET-705**	-	-	2	**(Nil)**	**(50)**	Min: 20 (D Grade)

Practical Internal - Max Marks: 50

Lab work & Sessional – Max Marks: 45
Assignment / Quiz – Max. Marks: 05

Unit	Contents (Practical)
I	**Introduction:**Factors and limitations in design, standard specifications, general problems in machine design such as insulation problem current carrying capacity of conductor, flux density, saturation, heat dissipation and temperature rise
II	**Magnetic Circuit:**Magnetization curves, calculation of m.m.f of magnetic circuit for a D.C. Machine (air gap irregularities, M.M.F. of tooth section etc.)Amp turns calculations for induction machine and synchronous machines
III	**Design of Transforms**:Choice of flux density for yoke and core, window space factors etc. Determination of the main dimensioned of the magnetic frame ,design of low and high voltage winding, insulation details, calculation of resistance and leakage reactance ,design of cooling system tank radiators and tubes
IV	**Design of D.C. Machines:**Output equation, calculation of main dimensions, design of armature and field system, effect of commutation, design of communtator, brush and inter pole, losses and efficiency.
V	**Computer Aided Design:** Flow chart for design of magnetic circuit ,design of transformer and design of DC Machine.

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Subject Title	Subject Code	Credits			Practical		
		L	**T**	**P**	**Externals (105)**	**Internals (45)**	**Total (150)**
Major Project-I	**EET-706**	-	-	6		Min: Nil	Min: 60 (D Grade)

Duration of Theory (Externals): 3 Hours

Practical Internal - Max Marks: 45

Lab work & Sessional –Max Marks: 40
Assignment / Quiz – Max. Marks: 05

Contents (Practical)
The Major Project Work provides students an opportunity to do something on their own and under the supervision of a guide. Each student shall work on an approved project, which should be selected from some real life problem as far as possible, which may involve fabrication, design or investigation of a technical problem. The project work involves sufficient work so that students get acquainted with different aspects of manufacturing, design or analysis. The student also have to keep in mind that in final semester they would be required to implement whatever has been planned in the major project in this semester. It is possible that a work, which involves greater efforts and time, may be taken up at this stage and finally completed in final semester, but partial completion report should be submitted in this semester and also evaluated internally. At the end of semester, all students are required to submit a synopsis.

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Semester: **VII**

Subject Title	Subject Code	Credits			Practical		
Industrial Training II	**EET- 707**	L	T	P	Externals (70)	Internals (30)	Total (100)
		-	-	4	Min: Nil	Min: Nil	Min: 40

Practical Internal - Max Marks: 30

Lab work & Sessional –Max Marks: 25

Assignment / Quiz – Max. Marks: 05

Contents (Practical)
Industrial Training II

OBJECTIVE OF INDUSTRIAL TRAINING

The objective of undertaking industrial training is to provide work experience so that student's engineering knowledge is enhanced and employment prospects are improved. The student should take this course as a window to the real World of Work and should try to learn as much as possible from real life experiences by involving and interacting with industry staff. Industrial training also provides an opportunity to students to select an engineering problem and possibly an industry guide for their Major Project in final Year.

Industrial training of the students is essential to bridge the wide gap between the classroom and industrial environment. This will enrich their practical learning and they will be better equipped to integrate the practical experiences with the classroom learning process.