PEOPLE'S UNIVERSITY, BHOPAL

(Applicable for Admitted from Academic Session 2019-20 onwards)

Programme: **Master of Technology** **Specialization: Power Systems** **Semester –I**

Subject Code	Subject Title	Credit			Theory			Practical		
		L	T	P			Total (100)	External	Internal	Total
MT1101	Research Methodology & IPR	3	1	-	External (70)	Internal (30)	Min: 40 (D Grade)	Nil	Nil	Nil

Duration of Theory (Externals): 3 Hours

Theory Internal- Max Marks: 30	Best of Two Mid Semester Test – Max Marks: 15	Assignment/Quiz/Attendance Max. Marks: 15
Practical Internal Max Marks: Nil	Lab work & Sessional – Max Marks: Nil	Assignment / Quiz/attendance Max. Marks: Nil

Pre-Requisite	**Nil.**
Course Outcome	1. Students will be able to understand research problem formulation.
	2. Able to analyze research related information and follow research ethics.
	3. Understand the importance of IPR and its protection for further research work.

Unit	Contents (Theory)	Marks Weightage
I	**Research Methodology**: Meaning; Objective & its types; Research Approaches ; Significance of Research; Research Methods Vs. Methodology; Research Process; Criteria of Good Research; Meaning of research problem; Sources of research problem; Errors in selecting a research problem; Scope and objectives of research problem; Effective literature studies approaches; Plagiarism; Research Ethics; Problems Encountered by Researchers in India.	**14**
II	**Concept and Importance in Research:** Features of a good research design, Exploratory Research Design: concept types and uses, Descriptive Research Designs: concept, types and uses. Experimental Design: Concept of Independent & Dependent variables. Interpretation : Meaning & Technique; Precaution in Interpretation ; Significance of Report Writing; Layout of the Research Report ; Types of Reports; Precautions for Writing Research Reports ; Effective technical writing; Role of Computer software in report writing.	**14**
III	**Data Collection:** Collection of Primary Data ; Observation Method ; Interview Method ; Collection of Data through Questionnaires; Collection of Data through Schedules; Difference between Questionnaires and Schedules; Collection of Secondary Data.	**14**
IV	**Hypothesis**: Null Hypothesis & Alternative Hypothesis. Basic Concepts Concerning Testing of Hypotheses; Chi-Square Test, Procedure for Hypothesis Testing; Flow Diagram for Hypothesis Testing. Qualities of a good Hypothesis.	**14**
V	**Nature of Intellectual Property:** Patents; Designs; Trade and Copyright. Process of Patenting and Development; technological research; innovation; patenting; development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents; Patenting under PCT. **Patent Rights:** Scope. Licensing and transfer of technology. Patent Information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System. IPR of Biological Systems.	**14**

Text Book/References Books/ Websites

1. C. R. Kothari; Research Methodology; New Age Publication.
2. Wayne Goddard and Stuart Melville; Research Methodology: An Introduction.
3. Ranjit Kumar; 2 nd Edition; Research Methodology: A Step by Step Guide for beginners.
4. Robert P. Merges; Peter S. Menell; Mark A. Lemley; Intellectual Property in New Technological Age.
5. T. Ramappa; Intellectual Property Rights under WTO; S. Chand.

Suggested List of Laboratory Experiments :- (Expandable): Nil

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Subject Code	Subject Title	Credit			Theory			Practical		
		L	T	P	External (70)	Internal (30)	Total (100)	External	Internal	Total
MTPS1102	Advanced Power System Analysis	3	1	-			Min: 40 (D Grade)	Nil	Nil	Nil

Duration of Theory (Externals): 3 Hours

Theory Internal- Max Marks: 30	Best of Two Mid Semester Test – Max Marks:-15	Assignment/Quiz/Attendance- Max. Marks:-15
Practical Internal Max Marks: Nil	Lab work & Sessional – Max Marks:-Nil.	Assignment / Quiz/Attendance - Max. Marks:-Nil.

Pre-Requisite	Knowledge of Basic loads in Power System.
Course Outcome	1. Acquire knowledge to understand the problem of power systems by matrix.
	2. Transmission line, Load flow, per unit system, Generation of electricity by different power plants.
	3. Knowledge of electrical power plant operation and control with respect to its economic aspect.

Unit	Contents (Theory)	Marks Weightage
I	**Load Flow** - Network modeling – Conditioning of Y Matrix – Load flow-Newton Raphson method- Decoupled – Fast decoupled Load flow -three-phase load flow.	**14**
II	**DC Power Flow** –Single phase and three phase -AC-DC load flow - DC system model – Sequential Solution Techniques – Extension to Multiple and Multi-terminal DC systems – DC convergence tolerance – Test System and results.	**14**
III	**Fault Studies** -Analysis of balanced and unbalanced three phase faults – fault calculations - Short circuit faults – open circuit faults.	**14**
IV	**System Optimization** - strategy for two generator systems – generalized strategies-effects of transmission losses - Sensitivity of the objective function- Formulation of optimal power flow-solution by Gradient method-Newton's method.	**14**
V	**State Estimation** – method of least squares – statistics – errors – estimates – test for bad data – structure and formation of Hessian matrix – power system state estimation.	**14**

Text Book/References Books/ Websites

1. J.J Grainger and Stevenson; "Power System Analysis"; Tata McGraw hill, New Delhi.
2. M.A Pai ; "Computer Techniques in Power System Analysis"; Tata McGraw hill, New Delhi.
3. F. S. Hudson and Evans Ltd. Estover; "Geography of Settlements", Plymouth PL 6 7 PZ UK.

Suggested List of Laboratory Experiments :- (Expandable): Nil

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Programme: **Master of Technology** **Specialization: Power Systems** **Semester –I**

Subject Code	Subject Title	Credit			Theory			Practical		
		L	T	P	External (70)	Internal (30)	Total (100)	External	Internal	Total
MTPS1103	Advanced Power System Protection	3	1	-			Min: 40 (D Grade)	Nil	Nil	Nil

Duration of Theory (Externals): 3 Hours

Theory Internal- Max Marks: 30	Best of Two Mid Semester Test – Max Marks:-15	Assignment/Quiz/Attendance- Max. Marks:-15
Practical Internal Max Marks: Nil	Lab work & Sessional – Max Marks:-Nil.	Assignment / Quiz/Attendance - Max. Marks:-Nil.

Pre-Requisite	Knowledge of power system protection and switchgear.
Course Outcome	1. Identify Rotor, Stator Faults, inter turn faults and their protection.
	2. Express Oil circuit Breaker, Air Blast circuit Breakers, SF6 Circuit Breaker.
	3. Identify DMT,IDMT type relays.

Unit	Contents (Theory)	Marks Weightage
I	**Static Relays:** Advantages of static relays-Basic construction of static relays-Level detectors-Replica impedance –Mixing circuits-General equation for two input phase and amplitude comparators-Duality between amplitude and phase comparators.**Amplitude Comparators:** Circulating current type and opposed voltage type- rectifier bridge comparators, Direct and Instantaneous comparators.	**14**
II	**Phase Comparators**: Coincidence circuit type- block spike phase comparator, techniques to measure the period of coincidence-Integrating type-Rectifier and Vector product type- Phase comparators.**Static Over Current Relays:** Instantaneous over-current relay-Time over-current relays-basic principles –definite time and Inverse definite time over-current relays.	**14**
III	**Static Differential Relays:** Analysis of Static Differential Relays –Static Relay schemes –Duo bias transformer differential protection –Harmonic restraint relay. **Static Distance Relays**: Static impedance-reactance-MHO and angle impedance relay-sampling comparator – realization of reactance and MHO relay using sampling comparator.	**14**
IV	**Multi-Input Comparators:** Conic section characteristics-Three input amplitude comparator – Hybrid comparator-switched distance schemes –Poly phase distance schemes- phase fault scheme –three phase scheme – combined and ground fault scheme. **Power Swings:** Effect of power swings on the performance of distance relays –Power swing analysis-Principle of out of step tripping and blocking relays-effect of line and length and source impedance on distance relays.	**14**
V	**Microprocessor Based Protective Relays:** (Block diagram and flowchart approach only)-Over current relays–impedance relays-directional relay-reactance relay. Generalized Mathematical expressions for distance relays-measurement of resistance and reactance – MHO and offset MHO relays-Realization of MHO characteristics-Realization of offset MHO characteristics -Basic principle of Digital computer relaying.	**14**

Text Book/References Books/ Websites

1. Badri Ram and D.N.Vishwakarma; "Power system protection and Switch gear "; TMH publication
2. Bhavesh Bhalja, R. P. Maheshwari, Nilesh G. Chothani; "Protection and Switchgear"; Oxford.
3. C. Christopoulos and A. Wright ; Electrical Power System Protection; Springer International.
4. T.S.Madhava Rao , "Static relays", TMH publication, second edition.

Suggested List of Laboratory Experiments :- (Expandable): Nil.

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Programme: **Master of Technology** **Specialization: Power Systems** **Semester –I**

Subject Code	Subject Title	Credit			Theory			Practical		
		L	T	P	External (70)	Internal (30)	Total (100)	External	Internal	Total
MTPS1104	High Voltage Engineering	3	1	-			Min: 40 (D Grade)	Nil	Nil	Nil

Duration of Theory (Externals): 3 Hours

Theory Internal- Max Marks: 30	Best of Two Mid Semester Test – Max Marks:-15	Assignment/Quiz/Attendance- Max. Marks:-15
Practical Internal Max Marks: Nil	Lab work & Sessional – Max Marks:-Nil	Assignment / Quiz/Attendance - Max. Marks:-Nil

Pre-Requisite	Knowledge of the high voltage applications and general knowledge about high voltage engineering.
Course Outcome	1. Understand breakdown phenomena in gases and to elucidate the concepts used for the generation of high voltages and currents.
	2. Measurement of high voltages and currents and design corresponding circuits.
	3. Understand high voltage testing techniques of Power apparatus and causes of over voltage in Power systems.

Unit	Contents (Theory)	Marks Weightage
I	**Introduction to High Voltage Engineering**: Electric Field Stresses, Gas / Vacuum as Insulator, Liquid Dielectrics, Solids and Composites, Estimation and Control of Electric Stress, Numerical methods for electric field computation, Surge voltages, their distribution and control, Applications of insulating materials in transformers, rotating machines, circuit breakers, cable power capacitors and bushings.	**14**
II	**Break Down in Dielectric Materials**: Gases as insulating media, collision process, Ionization process, Townsend's criteria of breakdown in gases, Paschen's law. Liquid as Insulator, pure and commercial liquids, breakdown in pure and commercial liquids. Intrinsic breakdown, electromechanical breakdown, thermal breakdown, breakdown of solid dielectrics in practice, Breakdown in composite dielectrics, solid dielectrics used in practice.	**14**
III	**Generation & Measurement of High Voltages & 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. Measurement of High Direct Current voltages, Measurement of High Voltages alternating and impulse, Measurement of High Currents-direct, alternating and Impulse, Oscilloscope for impulse voltage and current measurements.	**14**
IV	**Over Voltages & Insulation Co-ordination**: Natural causes for over voltages – Lightning phenomenon, Overvoltage due to switching surges, system faults and other abnormal conditions, Principles of Insulation Coordination on High voltage and Extra High Voltage power systems.	**14**
V	**Testing of Materials & Electrical Apparatus:** Measurement of D.C Resistivity, Measurement of Dielectric Constant and loss factor, Partial discharge measurements. Testing of Insulators and bushings, Testing of Isolators and circuit breakers, testing of cables, Testing of Transformers, Testing of Surge Arresters, and Radio Interference measurements.	**14**

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Programme: **Master of Technology** **Specialization: Power Systems** **Semester –I**

Text Book/References Books/ Websites:-

1. M.S Naidu. and V Kamaraju; "High Voltage Engineering" TMH Publications, 3rd Edition.
2. A.P Malvino. and B.P Leach.; "Digital Principles and Applications"; 4th Edn. McGraw Hill.
3. T.C. Bratee; "Digital computer Fundamentals"; 6th Edn. McGraw Hill.

Suggested List of Laboratory Experiments :- (Expandable): Nil.

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Programme: **Master of Technology** **Specialization: Power Systems** **Semester –I**

Subject Code	Subject Title	Credit			Theory			Practical		
		L	T	P			Total (100)	External	Internal	Total
MTPS1105	EHV AC Transmission System	3	1	-	External (70)	Internal (30)	Min: 40 (D Grade)	Nil	Nil	Nil

Duration of Theory (Externals): 3 Hours

Theory Internal- Max Marks: 30	Best of Two Mid Semester Test – Max Marks: - 15	Assignment/Quiz/Attendance- Max. Marks: - 15
Practical Internal Max Marks: Nil	Lab work & Sessional – Max Marks:-Nil	Assignment / Quiz/Attendance - Max. Marks:-Nil

Pre-Requisite	Know the necessity, merits and demerits of EHVAC transmission and mechanical aspects.
Course Outcome	1. Analyze the effect of corona, electrostatic field of EHVAC lines.
	2. Design SVC schemes and voltage controlling devices.
	3. Analyze the surface gradient on two conductor and bundle with more than 3 sub conductors.

Unit	Contents (Theory)	Marks weightage
I	E.H.V.A.C. Transmission line trends and preliminary aspect standard transmission voltages – Estimation at line and ground parameters-Bundle conductor systems-Inductance and Capacitance of E.H.V. lines – positive, negative and zero sequence impedance – Line Parameters for Modes of Propagation.	**14**
II	Electrostatic field and voltage gradients – calculations of electrostatic field of AC lines – effect of high electrostatic field on biological organisms and human beings - surface voltage gradients and maximum gradients of actual transmission lines – voltage gradients on sub conductor.	**14**
III	Electrostatic induction in unenergized lines – measurement of field and voltage gradients for three phase single and double circuit lines – un energized lines. Power Frequency Voltage control and over-voltages in EHV lines: No load voltage – charging currents at power frequency-voltage control – shunt and series compensation – static VAR compensation.	**14**
IV	Corona in E.H.V. lines – Corona loss formulae- attention of traveling waves due to Corona – Audio noise due to Corona, its generation, characteristic and limits. Measurements of audio noise radio interference due to Corona - properties of radio noise – frequency spectrum of RI fields – Measurements of RI and RIV.	**14**
V	Design of EHV lines based on steady state and transient limits - EHV cables and their characteristics	**14**

Text Book/References Books/ Websites

1. R. D. Begamudre; "EHVAC Transmission Engineering"; New Age International (p) Ltd.
2. S.Rao; "HVAC and DC Transmission"; Khanna publishers.
3. Rokosh Das Begamudre;"Extra High Voltage AC Transmission Engineering"; New Age International Publishers.
4. Edison;"EHV Transmission line"- Electric Institution.

Suggested List of Laboratory Experiments :- (Expandable): Nil.

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Programme: **Master of Technology** **Specialization: Power Systems** **Semester –I**

Subject Code	Subject Title	Credit			Theory			Practical		
		L	T	P			Total			Total (100)
MTPS1106	Power System Lab	-	-	2	External (70)	Internal (30)	Nil	External (70)	Internal (30)	Min: 40 (D Grade)

Duration of Theory (Externals): Nil

Theory Internal- Max Marks: Nil	Best of Two Mid Semester Test – Max Marks:-Nil	Assignment/Quiz/Attendance- Max. Marks:-Nil
Practical Internal Max Marks: 30	Lab work & Sessional – Max Marks:-15	Assignment/ Quiz/Attendance - Max. Marks:-15

Pre-Requisite	**Nil.**
Course Outcome	1. Ability to understand the knowledge of Electrical Machines.
	2. Implementation of various relays in power System.
	3. Acquire knowledge of designing of Power System.

Unit	Contents(Theory)	Marks Weightage
I	Synchronization of two synchronous machine in the grid, different types of Relays and its related concepts, phenomenon of Generation in Induction Machine which is running at super synchronous speed as well as the loading characteristics in the power system etc.	**100**

Text Book/References Books/ Websites

1. J.J Grainger and Stevenson; "Power System Analysis"; Tata McGraw hill, New Delhi.
2. M.A Pai; Computer Techniques in Power System Analysis; Tata McGraw hill, New Delhi.
3. F. S. Hudson and Evans Ltd, Estover; "Geography of Settlements"; Plymouth PL 6 7 PZ UK.

Suggested List of Laboratory Experiments :- (Expandable):

1. To study the power angle characteristics of the given synchronous machine by synchronizing it to the grid.
2. Overcurrent Relay and Undervoltage Relay: (a) Study, Observe and determine characteristics of the relay for two plug settings and two time settings for each type of relay. (b) Observe one set of readings for digital overcurrent relay also.
3. Percentage biased Differential Relay protecting a Transformer: Determine the characteristics of percentage-biased relay for at least two bias settings.
4. Directional Relay and Digital distance relay: (a) Study the given directional relay and determine the characteristic of the relay. (b) Study on distance protection scheme with a Digital Relay.
5. To study the phenomenon of Generation employing an Induction Machine run at super synchronous speeds and study the loading characteristics.

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Subject Code	Subject Title	Credit			Theory			Practical		
		L	T	P			Total			Total (100)
MTPS1107	Fundamental of MATLAB	-	-	2	External (70)	Internal (30)	Nil	External (70)	Internal (30)	Min: 40 (D Grade)

Duration of Theory (Externals): Nil

Theory Internal- Max Marks: Nil	Best of Two Mid Semester Test – Max Marks: Nil	Assignment/Quiz/Attendance Max. Marks: Nil
Practical Internal Max Marks: 30	Lab work & Sessional – Max Marks: 15	Assignment / Quiz Max. Marks: 15

Pre-Requisite	**Nil.**
Course Outcome	1. Working with the MATLAB user interface.
	2. Analyzing vectors and matrices.
	3. Writing programs with logic and flow control.

Unit	Contents (Theory)	Marks Weightage
I	Introduction to MATLAB and it's related concepts, various operation on Matrices, various analysis in MATLAB, Harmonic and Transient analysis, measurement of active power, pole zero plot, simulation in DC circuits, various theorems etc.	**100**

Text Book/References Books/ Websites

1. Agam Kumar Tyagi ;"Matlab and Simulink for Engineers"; Oxford University Press.
2. Ms Holly Moore; "MATLAB for Engineers"; Global Edition.

Suggested List of Laboratory Experiments :- (Expandable):

1. Basic Operations on Matrices.
2. Mesh and Nodal Analysis of Electrical circuits.
3. Application of Network Theorems to Electrical Networks.
4. Generation of various signals and sequences (Periodic and Periodic).
5. Simulation of DC Circuits.
6. Locating the Zeros and Poles and Plotting the Pole Zero maps in S plane and Z-Plane for the given transfer function.
7. Harmonic analysis of non sinusoidal waveforms.
8. Transient Analysis.
9. Measurement of active Power of three phase circuit for balanced and unbalanced load.
10. Simulation of single phase diode bridge rectifiers with filter for R & RL load.

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Programme: **Master of Technology** **Specialization: Power Systems** **Semester –I**

Subject Code	Subject Title	Credit			Theory			Practical		
		L	T	P			Total (50)			
MT1108	**Audit Course - I (Value Education)**	2	-	-	**External (35)**	**Internal (15)**	Min: 20 (D Grade)	**External** Nil	**Internal** Nil	**Total** Nil

Duration of Theory (Externals): 2 Hours

Theory Internal- Max Marks: 15	Best of Two Mid Semester Test – Max Marks: Nil	Assignment/Quiz/Attendance Max. Marks: 15
Practical Internal Max Marks: Nil	Lab work & Sessional – Max Marks: Nil	Assignment/Quiz/ Attendance Max. Marks: Nil

Pre-Requisite	**Nil.**
Course Outcome	1. Knowledge of self-development.
	2. Learn the importance of Human values.
	3. Developing the overall personality.

Unit	Contents (Theory)	Marks Weightage
I	Values and self-development –Social values and individual attitudes; Work ethics, Indian vision of humanism; Moral and non- moral valuation; Standards and principles; Value judgments.	**07**
II	Importance of cultivation of values; Sense of duty. Devotion, Self-reliance. Confidence, Concentration; Truthfulness, Cleanliness; Honesty, Humanity; Power of faith, National Unity; Patriotism. Love for nature, Discipline	**07**
III	Personality and Behavior Development - Soul and Scientific; attitude; Positive Thinking. Integrity and discipline; Punctuality, Love and Kindness; Avoid fault Thinking; Free from anger, Dignity of labour.	**07**
IV	Universal brotherhood and religious tolerance; True friendship; Happiness Vs suffering, love for truth; Aware of self-destructive habits; Association and Cooperation; Doing best for saving nature.	**07**
V	Character and Competence –Holy books vs Blind faith; Self-management and Good health.; Science of reincarnation; Equality, Nonviolence, Humility, Role of Women; All religions and same message; Mind your Mind, Self-control; Honesty, Studying effectively.	**07**

 # Mandatory (Non Credit) subject according to AICTE. Non University Examination, End Sem marks not to be included in total marks and credit. Students must pass in this subject.

Text Book/References Books/ Websites

1. S.K. Chakroborty; Values and Ethics organizations Theory and practice; Oxford University Press, New Delhi.

Suggested List of Laboratory Experiments :- (Expandable): Nil.