

GOVT COED POLYTECHNIC, RAIPUR

1. **Name of the department** Electrical Engineering
2. **Name of the Teacher**
3. **Title of the course** **Power System Operation& Protection**
4. **Course Code** **2024572(024)**
5. **Credits** **5**

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| Course Outcomes (Cos) | CO-1 Represent the power system components in p.u. system. |
| | CO-2 Implement methods to regulate the power system stability. |
| | CO-3 Apply various strategies for active and reactive power control. |
| | CO-4 Identify elements of protection and circuit interrupting devices. |
| | CO-5 select suitable protective relays ,circuits breakers for protection of alternators,transformers and motors. |

Session: **Semester: 5th** **Class room instruction start Date**

| Session Outcomes | Class room instruction topics | No. of periods planned | Actual number of periods taken | Remarks |
|---|--|-------------------------------|---------------------------------------|----------------|
| UNIT 1: Representation of Power system. SO 1.1 Represent an interconnected synchronous generator with sending end and receiving end transformers and end loads using single line diagram | Single line Representation of a simple power system with standard symbols. | 1 | | |
| | Single Phase representation of balanced three phase networks | 1 | | |
| | Per unit (PU system) : Introduction, representation, change of base and simple numerical | 1 | | |
| | Tutorial No 1 | 1 | | |
| SO 1.2 Represent a given three phase balanced system by single phase equivalent network | Complex power flow, Concept of torque or Load angle (δ) and Power factor angle (θ) | 1 | | |
| | Tutorial No 2 | 1 | | |
| SO 1.3 Calculate the p.u. values of a power system parameter | Simplified representation of Synchronous Machines | 1 | | |
| | Power angle curve of a synchronous generator | 1 | | |
| | Tutorial No 3 | 1 | | |
| UNIT 2: Power System faults and Stability | Symmetrical Faults: Definition of transients in a transmission | 1 | | |

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| SO 2.1 Differentiate symmetrical and unsymmetrical faults in Transmission lines | lines, Sub- transient, transient and steady state period; reactance offered, LLL and LLLG faults | | | |
| | Short Circuit Capacity (SCC) of a bus, Simple Numerical | 1 | | |
| | Tutorial No 4 | 1 | | |
| SO 2.2 Analyze the unsymmetrical faults (LG, LL & LLG) | Unsymmetrical faults : LG, LL, LLG faults and their effects | 1 | | |
| | Stability: Introduction, Steady state and transients stability, Stability limit | 1 | | |
| UNIT 3: SO 3.1 concept of real and reactive power transfer in transmission lines | Introduction to active and reactive power in power system and their sources | 1 | | |
| | Requirement of reactive power in power system. | 1 | | |
| | Tutorial No 5 | 1 | | |
| SO 3.2 Explain the need to control transmission line voltages | Effect of DC excitation on lagging and leading of a synchronous machine. | 1 | | |
| | V curve of a synchronous machine. | 1 | | |
| SO 3.3 Distinguish the application of Series, shunt, series- shunt FACT controllers with its strengths and limitations | Voltage control in power system: shunt reactor, synchronous phase modifier | 1 | | |
| | shunt capacitors, series capacitors, static VAR system | 1 | | |
| | Tutorial No 6 | 1 | | |
| UNIT 4: Elements of Protection and Circuit Interrupting Devices SO 4.1. Describe the functions of basic elements of a protective system | Basic elements of a protective system | 1 | | |
| | Types, causes and effects of various Faults | 1 | | |
| | Protection zones : Backup protection zones | 1 | | |
| SO 4.2 Explain the use of CT and PT in protection system | CT and PT: Specifications and Connection diagram (single phase and 3 phase | 1 | | |
| | Current limiting reactors. | 1 | | |
| | Neutral Earthing | 1 | | |
| SO 4.3 Describe protective system showing different circuit interrupting devices using | Interrupting devices: Sequence of operation and interlocking | 1 | | |
| | Isolators and Fuses: types, features, testing and | 2 | | |

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| a line diagram. | applications | | | |
| | | 1 | | |
| SO 4.4 Explain arc formation and zero current interruption | Construction, working and testing of circuit breakers: Air break, Air Blast | 1 | | |
| | Construction, working and testing of circuit breakers : Hexa Fluoride (SF6), vacuum | 1 | | |
| | Construction, working and testing of circuit breakers: | 1 | | |
| | Auto-reclosure, Arc phenomena and extinction | 1 | | |
| SO 4.5 Compare arc quenching in A.C. and D.C. circuit breaker. | HVDC: Working principle of arc quenching in HVDC circuit breaker | 1 | | |
| | | 1 | | |
| SO 4.6: Explain the resistance switching for the given situation. | Resistance switching | 1 | | |
| | Tutorial No 7 | 1 | | |
| UNIT 5 Protective Relays and Circuit Breaker SO 5.1 Explain the terms related to relays | Protective relay: Principle of working, construction and operation of electromagnetic induction (shaded pole, watt-hour meter and induction cup), Settings | 2 | | |
| SO 5.2 Describe need for different types of relays | Relay Types: Thermal relay, Directional relay, Distance relay (impedance, reactance and mho) Negative phase sequence relay, Static relay, Microprocessor based relay: Principle and working of. | 2 | | |
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| SO 5.3 Carryout testing of given relays SO 5.4 Explain the various faults and abnormalities in alternator. And in motor and their protection schemes. | Maintenance and testing of relays | 1 | | |
| | Various faults and abnormal operating conditions in Alternator and its protection schemes | 1 | | |
| | Various faults and abnormal occurring in the Motor and its protection schemes | 1 | | |
| SO 5.5 Explain various protection schemes for | Differential Protection of Bus Bars Over current, Percentage | 2 | | |

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| transformer | differential and restricted earth fault protection of Transformers | | | |
| | Inrush phenomenon and over fluxing phenomenon in Transformer | 1 | | |
| | Buchholz Relay, analysis of trapped gases | 1 | | |
| SO 5.6 Describe the protection scheme for transmission line. | Protection scheme -Overload protection, Over- current and earth fault protection, Time graded and current graded protection, Current balance differential protection | 1 | | |
| | Carrier aided protection, Carrier inter-tripping, acceleration and blocking scheme | 1 | | |
| | Distance /Impedance protection, Auto reclosing | 1 | | |
| SO 5.7 Explain protection of given feeders and ring mains and Bus bar | Protection of parallel feeders and Ring Mains | 1 | | |

Number of Total periods planned :

Number of Total periods actually taken:

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(Department of Electrical Engineering)