6TH SEM

TEACHING SCHEME

Subject code	Subject	Teaching Scheme				Examination Scheme				
						THEORY MARKS		PRACTICAL MARKs		Total
		T	Tut	Pra	C	(ESA)	(PA)	(ESA)	(PA)	
3360901	Switchgear & Protection	4	0	2	6	70	30	20	30	150
3360902	Installation, Commissioning & Maintenance	4	2	2	8	70	30	20	30	150
3360907	Maintenance of Transformer & Circuit breaker	3	0	2	5	70	30	20	30	150
3360908	Electrification of Building & Complex	3	0	2	5	70	30	20	30	150
3360909	Project II (Idp/Udp)	0	0	6	6	00	00	60	90	150
	TOTAL	**14**	**2**	**14**	**30**	**280**	**120**	**140**	**210**	**750**

DE EE SEM-6 Detail Syllabus

(3360901) SWITCHGEAR AND PROTECTION

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Mark		Practical		Total
L	T	P	C	ESE	PA	ESE	PA	150
4	0	2	6	70	30	20	30	

1. **Elements of protection:** Need of protective system, Functions of basic elements of a protective system, Basic functional characteristics of protection system, Types, causes and effects of various Faults, Protection zones, Backup protection & its types, Necessity of Protective Transformers, Specifications and Connection diagram of Current Transformer and Potential Transformer both single and 3 phase, Use of current limiting reactors and their arrangements, Importance and methods of neutral Earthing.
2. **Circuit Interrupting Devices:** Necessity and types of interrupting devices, Sequence of operation and interlocking, Fuse, types, terms related to fuse, characteristics, testing and applications, Requirement and types of isolators, Arc phenomena and arc extinction in circuit breaker, Important terms associated with circuit Breaker, Resistance switching, Construction, working principle of Air break, Air Blast, Sulphur Hexa Fluoride (SF6) and

vacuum circuit breakers, Circuit breaker ratings, Auto-reclosure, Testing of circuit breaker, Working principle of arc quenching in HVDC circuit breaker.

3. **Protective Relays:** Protective relay, classification and selection, Basic terms related to relay - Pick up value, reset value and operating current etc., Principle of working ,construction and operation of electromagnetic induction(shaded pole, watt-hour meter and induction cup),Thermal relay, Settings of various types of relays, Directional relay, Distance relay(impedance, reactance and mho), Negative phase sequence relay, Need of static relay, Construction and types, Principle and working of Microprocessor based relay, Maintenance and testing of relays.

4. **Protection of transmission line and feeder: N**eed of transmission line protection scheme, Selection of protection scheme -Overload protection, Over-current and earth fault protection, Time graded and current graded protection, Current balance differential protection, Need of Carrier aided protection, Carrier inter-tripping, acceleration and blocking scheme, Distance /Impedance protection, Necessity and types of Auto reclosing, Protection of parallel feeders and Ring Mains.

5. **Protection of transformer, alternator, motor and bus bar: O**ver current, Percentage differential and Restricted earth fault protection of Transformers, Inrush phenomenon and over fluxing phenomenon in Transformer, Buchholz Relay, analysis of trapped gases, Various faults and abnormal operating conditions in Alternator and its protection schemes, Various faults and abnormal occurring in the Motor and its protection schemes, Differential Protection of Bus bars.

6. **Over voltage protection:** Causes of over voltages, Methods of reducing over voltages, Operating principles, construction and Applications of lightning arrester, Insulation co-ordination, volt- time characteristic and basic impulse insulation level.

Text Books: Switchgear and Protection-Rao S. S. -Khanna Publications, New Delhi (Latest Edition)

Syllabus of (3360902) INSTALLATION, COMMISSIONING AND MAINTENANCE

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	ESE	PA	ESE	PA	150
4	2	2	8	70	30	20	30	

1. **INSTALLATION OF ELECTRICAL EQUIPMENTS -** Introduction, Unloading of electrical equipment at site, Inspection, Storage, Foundation, Alignment of electrical machines, Tools/Instruments necessary for installation, Inspection, storage and handling of transformer, switchgear and induction motor, Preparation of technical report

2. **COMMISSIONING AND TESTING –** Tests before commissioning of electrical equipment :Electrical and Mechanical test, Specific test son -transformer, induction motor, alternator, synchronous power and electrical power installation, Need of gradually loading of electrical equipment, Preparations before commissioning of power transformer, Commissioning-power transformer, three phase induction motor, Transformer insulation oil: Properties as per IS, sampling, testing and filtering/purifying, standard tests as per IS, Measurement of insulation resistance of different equipments/machines, Methods of Drying the winding of electrical equipments and its record, Classification and measurement of insulation resistance, Polarization Index, Appropriate insulation test for specific purpose, Factor affecting the insulation , Various Tests to be performed after commissioning and before starting the machine , Various instruments required for testing, Commissioning of switchgear, Test report on commissioning and test certificate.

3. **MAINTENANCE OF ELECTRICAL EQUIPMENTS** - General aspectof maintenance, Classification, Preventive maintenance-concept, classification, advantages,activities, functionsof the Maintenance Department, Breakdown maintenance-concept, advantages, activities, Reasons of failure of electrical equipment due to poor maintenance, Factors for preparing maintenance schedule, Frequency of maintenance, Maintenance schedule of transformer below and above 1000Kva, Maintenance schedule -induction motor, circuit Breaker, overhead line, storage Battery, Probable faults due to poor maintenance in transformer, induction motor, circuit breaker, overhead lines and battery.

4. **TROUBLE SHOOTING** - Causesof fault in electrical equipments-Internal and external, Instrumentsand tools fortrouble shooting, Common troubles in electrical equipment – DC Machines, AC Machines, Transformers, Circuit-breaker, under-ground cable, electrical Installation, Need of trouble shooting chart,advantages, Trouble shooting chart –DC Motor, DC Generator, Transformer, Synchronous Motor, Induction Motor, Circuit-breaker, Trouble shooting chart for Domestic appliances-electrical iron, ceiling fan, Washing machine, Air cooler, Vacuumcleaner, Fluorescent tube light: Construction, working and troubleshooting chart.

5. **EARTHING** - Necessity of earthing , System earthing : advantage of neutral earthing of generator in power station, Equipment earthing: Objective, Types of earth electrodes, Methods of earthing : plate earthing ,pipe earthing and coil earthing, Earthing in extra high voltage and underground cable, Earthing resistance- factor affecting, Determination of maximum permissible resistance of the earthing system , Measurement of earth resistance: voltmeter-ammeter method, earth tester method, ohm meter method and earth loop tester method, Define: earthing , grounding and bonding, Comparison between equipment earthing and system grounding, Earthing procedure - Building installation, Domestic appliances, Industrial premises, Earthing in substation, generating station and overhead line.

6. **ELECTRICAL ACCIDENTSAND SAFETY** - Causes of electrical accident, Factors affecting the severity of electrical shock, Actions to be taken when a person gets attached to live part, Safety regulations and safety measures, Indian electricity supply act1948-1956, Factory act 1948, Procedure of shut down for sub-station and power lines, Permit to work :

certificate of (i)requisition for shut down(ii) Permit to work and (iii)Line clear certificate, Instruction for the safety of persons working on a job with a permit to work , Fire extinguishers- For fixed installation and portable devices

Text Books: Testing Commissioning operation and maintenance of Electrical Equipments by Rao S - Khanna Publication (Latest edition)

Syllabus of (3360907) Maintenance Of Transformer And Circuit Breaker

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme1				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	ESE	PA	ESE	PA	150
3	0	2	5	70	30	20	30	

1. **Preventive Maintenance -** Maintenance and its types -Preventive and Breakdown, Advantages of preventive maintenance, Scope of preventive maintenance, Economics of preventive maintenance.

2. **Maintenance of Transformers** - Significance of transformer maintenance, Parts of transformer- tank. Core, winding, conservator, radiators, bushings, terminals, temperature measurement system, safety valves, tap changers and accessories/ fittings etc., Factors affecting the life of transformer-moisture, water oxygen, solid impurities, varnish, slackness of windings and dust, Inspection-sensory, records and electrical test, General/Typical maintenance schedule of power transformers- up to 1000 kVA and above 1000 Kva, Maintenance of transformer oil- characteristic, interpretation of tests, procedure of testing BDV, filtering plant, Causes of failures of power transformers and preventive actions, Detective devices-Buchholz relay, Pressure relief device, Differential relay, Dial thermometer alarm contact, Overcurrent relay, ground fault relay, voltmeter, ammeter, Human senses, Check list of maintenance of power transformers, Causes and methods to reduce Audible Noise (AN) from transformer, Maintenance of distribution transformer, **i.** Reasons for failure of Distribution Transformers and the remedial measures thereof, **ii.** Inspection & Maintenance Schedule for Distribution Transformers:, **iii.** Inspection & Maintenance of transformer and accessories within the sub-station and its proximity, Procedure of measuring the insulation resistance of transformer windings.

3. **Commissioning and Recharging of Transformers** - Concept of commissioning and recharging of transformer, General checks, Insulation resistance test, Measurement of oil characteristics, Off circuit tap switch, Continuity test, Measurement of winding resistance , Voltage ratio tests, Magnetizing current, Charging of the transformer, Do's and Don'ts for transformer, Various commissioning tests on a power transformers, Procedure of loading the transformers, Transformer grounding.

4. **Maintenance of Circuit Breaker** - Steps in maintenance of CB, Maintenance of moulded case circuit breakers -Frequency and routine maintenance tests, Maintenance of low-voltage circuit breakers -Frequency and maintenance procedures, Maintenance of medium-voltage circuit breakers – Air, Oil and Vaccum circuit breakers - Frequency of maintenance, safety practices and maintenance procedures for each of the above, Maintenance of high-voltage circuit breakers - frequency of inspections, External and internal inspection guidelines, typical internal breaker problems, Influence of duty imposed, Types of tests performed, OIL CB, Post fault maintenance, Steps in maintenance of MOCB, Maintenance for AIR CB and Frequency of maintenance, Maintenance of AIR BLAST CB, Maintenance of SF6 gas circuit breakers i. Properties of SF6 (sulphur hexafluoride) gas ii. Handling non faulted SF6 iii. Handling faulted SF6 iv. Procedure of filling SF6 gas in single pressure puffer type SF6 CB v. Gas monitoring system and gas handling system for SF6 filled equipment vi. Types and function of SF6 gas handling units vii. Maintenance of SF6 CB, Maintenance of VACCUM CB, Life of arcing contacts in various CB in case of normal current switching and short circuit operation, Causes of failure of CB, trouble shooting and procedure of failure analysis, Typical Record card for maintenance work of CB, Commissioning tests on HV a.c. CB , Operating mechanism used in HV a.c. CB, Safety precautions to be taken in maintenance of CB

Text Books: Testing Commissioning operation and maintenance of Electrical Equipments - Rao S - Khanna Publication (latest edition)

Syllabus of (3360908) ELECTRIFICATION OF BUILDING AND COMPLEXES

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical		Total Marks
L	T	P	C	ESE	PA	ESE	PA	
3	0	2	5	70	30	20	30	150

1. **Elements of electrification: C**lassification of Electrical Installation, General requirement of Electrical installation, Reading and Interpretation of Electrical Engineering Drawings, diagrams, plans and layout, Testing of wiring Installation for verification of current; earthing, insulation resistance and continuity as per IS, Preparation of testing/supervisory report, Selection of main cable, main switches, circuit breakers, etc., Illumination requirements in high rise, Commercial and public Building, Economical consideration in the illumination design.
2. **Electrification of multistory buildings:** Wiring layout of an electrical installation, Electrification of wiring supply-location from nearby substation, Type of wiring- Concealed, conduit or Surface conduit, Decision on number of sub circuits from the total circuit requirement, Calculation of total load on electrical distribution work, Estimation of material requirements floor wise, Specification of wiring material and accessories, Estimation of total cost of electrification using Schedule Of Rates, Case studies, Requirements of approval from

electrical inspection for high rise building, Load calculation for lifts, escalators, air conditioners and their simplified wiring diagram, Problems, Case studies.

3. **Electrification of complexes and public buildings:** Concept of commercial Installation, Comparison of Residential and commercial Installation, Fundamental considerations for planning of an electrical installation system for commercial building, Special requirements of hotels, theaters, library and cultural halls etc. from electrification points of view, Estimation of material requirement, unit cost and total cost of electrification of complexes, Case studies.

4. **Distribution system for multistoried buildings:** Methods and Estimation of underground service connection, Incoming supply to substation for multistoried high rise buildings (building height more than 15m.), Distribution panels and bus bar system, Meter connection- bifurcation of metering-meters as per consumers demand, use of digital – meters for prevention of theft of power, Cable laying in building, special precautions

5. **Electrical safety and IE rules:** Importance of safety rules, Safety precaution in electrical installation of multistoried buildings, Fire alarm system, Smoke detection system, Safety for lifts and escalators, Earthing system (IE rules regarding safety), Lightening arrestors arrangements, Use of ELEB and MCB in an installation, Electronic safety locks at the entrance, Use of national building code (electrical service) for safety, Use of D.G. set as a standby power supply in case of emergency, IE rules related to Electrical Installation and Testing

Text Books: Electrical Design Estimation & Costing - Raina K.B., Bhattacharya S.K., Willet Estern Ltd., Latest edition