5105 – SUBSTATION PRACTICE

Teaching Schedule Per Week			Progressive Assessment		Examination Schedule (Marks)			
Lectures	Practical	Credits			Theory		Practical Ex.	Total
4	2	6	25	25	3 Hrs	100	50/or	200

Pre-requisite	Source
4110	ELL

Semester	Theory	Test	Total	TW	PR	Gr Total
	75	25	100	25	50	175

Rationale: Electrical Substation forms the important link between generation and distribution of Electrical power. The subject intends to impart knowledge on substation as regards to identification of various components, layout, operation, earthing, practice cable fault location. The knowledge gained will help the student in operation and maintenance of substation in an efficient manner.

COURSE CONTENTS

	Hrs	Mks
1. SUB - STATION Types of sub-station, outdoor, indoor, underground, pole mounted, Selection of site, Location of various types of substations.	6	8
2. BUSBARS Types of bus bars, single, double (main & transfer) sectional, bus arrangement & layout.	4	8
3. POTENTIAL TRANSFORMERS & CURRENT TRANSFORMER Study of constructional details of C.T. and P.T. Transformation ratio and phase angle error (no derivation), burden effect of open circuiting the secondary of C.T. Types of C.T.s, Terminal marking of C.T. s and P.T.s as per I.S. and method of connection. General specifications for procurement. Clip on ammeter and its application.	6	8
4. SUB STATION COMPONENT AND LAYOUT Various components, their functions their symbols and general specifications, PLCC components and their functions, Single line diagram of substations (11kV pole mounted substation, 33/11 kV & 220 kV substation)	4	8
5. CONTROL AND RELAY PANELS FOR SUBSTATION Types of panels, control and indicating equipment on a panel, (Audio & visual) – mimic diagrams.	2	4
6. EARTHING AND LIGHTNING PROTECTION Methods of earthing, Earth resistance, value for different substation as per IS 3043, effect of power & voltage rating of system on the values of earth resistance, selection of size of earth continuity conductor, Neutral earthing – comparison between isolated & grounded system) solid earthing , Resistance earthing reactance earthing.	12	16
7. LIGHTING & SWITCHING SURGE Lighting & Switching surge & their effects on substation equipment. Surge protection. Various types of lightning arrests. Surge deviators their constructional features, specification & applications. Protection of buildings and structure against lightning.		
8. TARIFF AND POWER FACTOR IMPROVEMENT Tariff – Definition, factors influencing tariff, types of tariff, Merits and demerits of each. Effect of power factor on system. Methods of improvement of power factor of Industrial load, calculation of KVAR capacity of P.F. improvement devices and use of capacitors and their location.	8	12

9. CABLES	10	16
General construction of Power cables-types of cables and their special features, Standard size & current rating – factors affecting it, S.C. current capacity based on empirical relations, Methods of laying, standard practices cable laying w.r.t depths, bending radius spacing between the cables, cable and wall (both vertical and horizontal configuration), Control cable – types and specification. Voltage drop calculation (using regulation constant) and selection of power cables.		
10. MAINTENANCE OF SUBSTATION ACCESSORIES	8	16
Batteries – charging of batteries, care and maintenance of batteries, Testing of transformer oil, measure to improve the quality. Testing of breather oil seals, silica gel. Re-activation of silica gel, Line clearance and safety precautions in carrying out work in substations, Preventive maintenance schedule for substation.		
11. SPECIAL SUBSTATION	4	4
(a) Traction substation- Location, type, components & function.		
(b) H.V.D.C. substation – Type, component, their function.		
Total	64	100

LIST OF EXPERIMENTS:

1. Visit & sketching of symbols of equipment used in substation 250kV or 110 kV substation.
2. Identifying and sketching of pole mounted substation showing the equipment and connection including earthing.
3. Study of control panel of H.V. substation.
4. Cable fault location by pulse reflection method. Cable fault location by varley's lop method and Murray loap method (2 turns).
5. Transformer oil testing.
6. Relay connection & testing (Differential , IDMT, overcurrent and earthfault relay).
7. Testing of current transformer & potential transformer.
8. Visit to 33 kV substation.
9. Cable testing (acceptance tests).
10. Cable laying.
11. Cable jointing.

REFERENCE BOOKS:

1. Power cables & their aplication, by Siemen.
2. Substation Design & Equipment, by P.V. Gupta and P. S. Satnam.
3. Power station electrician, by S. Leznov A. Taits.
4. Electrical Engineering Hand book, by Siemen
5. Industrial power supply, by A. Fyodorov,
6. Electric Power system, by Ashafag Hussain
7. Electric power system design, by M.V. Deshpande.
8. Preventive Maintenance of Electrical Appliances, by Sharotri.
9. EHV Substation & Equipment, Bhoumic & Bhattachrya.