Course Title: Switch Gear and Protection
Course Code: EPEG 415
Credit Hours: 3

Course Description:
The course presents information on the techniques and hardware used for power system protection.

Course Contents:

Unit 1: Introduction
Principles of power system protection and switchgear; Zone protection, back up schemes

Unit 2: Fuses, Isolator and Reactors
Use, performance, Characteristics, Selection of fuse material, fuse law, types of fuses, selection and co-ordination of fuses, main features of HRC fuses, Types of isolators, Earthing switch, Purpose and construction of various types of reactors, Location of reactors, selection of reactors

Unit 3: Power Circuit Breakers
Requirements of circuit breakers, transient recovery voltage, rate of rise of re-striking voltage, Circuit breaker ratings, Arc formation and arc extinction methods, construction, operation and application of different types of circuit breakers: miniature circuit breaker, moulded case circuit breaker, air circuit breakers, oil circuit breakers, vacuum circuit breakers, SF6 circuit breakers, Auto reclosure

Unit 4: Protective Relays
Essential qualities of relay, Terminologies of relay, Types of relays – electromagnetic attraction, induction, over current relays, relay based on time, non- directional and directional relay, differential and percentage differential relay, distance protection concept- carrier and pilot wire systems, impedance, admittance, reactance relays, Static relays and types, Microprocessor based relays

Unit 5: Apparatus Protection
Induction Motor protection, Transformer protection, Generator protection, bus bar protection, transmission lines protection systems, Application of static relay for protection of transformer, motor, generator and transmission line, microprocessor based protective scheme for transformer, generator and transmission line

Unit 6: Power System Earthing and Lightning Protection
Electric Shock and safety, safe value of electric current, step and touch potentials, system earthing and body earthing, soil resistivity, measurement of soil resistivity, earth resistance, measurement of earth resistance, Earth Leakage Circuit Breaker, methods of earthing, earthing grid and its design, Neutral earthing, Lightning phenomena, wave shape of lightning stroke, classification of direct lightning discharges, over voltage due to lightning stroke, protection form lightning: ground wires, optical ground wire, earth screen, lightning arrestors, surge waves and surge protection devices

Unit 7: Substation

Selection and Location of substation, Classification of substations, Components of substation, Bus-bar arrangements, earthing of substation, case study of a substation in Nepal

References:

1. S. S. Rao, *Switchgear and Protection*, Khanna Publishers
2. B. A. Oza, N. K. C. Nair, R. P. Mehta, V. H. Makwana, *Power System Protection and Switchgear*, Tata McGraw Hill Education Private Limited
3. Y.G. Paithankar and S.R. Bhinde, *Fundamentals of Power system Protection*, PHI
4. B. Ram and D. N. Vishwakarma, *Power system Protection and Switchgear*, TMH,

Evaluation:

In-Semester Evaluation: 50%
End-Semester Evaluation: 50%