Gyanmanjari Innovative University

Course Syllabus
Gyanmanjari Institute of Technology
Semester-6

Subject: Power System Protection - BETEE16324

Type of course: Professional Core

Prerequisite: Electrical Power System

Rationale:

This course provides B.Tech Electrical Engineering students with knowledge of power system equipment, fault analysis, and protection schemes using circuit breakers and relays, focusing on skills for safe and reliable system operation.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks					Total Marks
				Theory Marks		Practical Marks		CA	
CI	T	P	C	ESE	MSE	V	P	ALA	
4	0	2	5	60	30	10	20	30	150

Legends: CI-Classroom Instructions; T – Tutorial; P - Practical; C – Credit; ESE - End Semester Examination; MSE- Mid Semester Examination; V – Viva; CA - Continuous Assessment; ALA- Active Learning Activities.

Course Content:

Unit No.	Course content	Hrs	% Weightage
1.	**Protective Devices and Relaying Systems** Introduction of protection, Nature, causes, and consequences of faults, Zone of protection, Requirements of a protective scheme, Basic terminology and components, Classification and principles of electromagnetic relays, Phase and magnitude comparators Duality of comparators, Electromagnetic, Overcurrent, Directional, Distance(Impedance, Reactance, Mho type), and Differential relays.	15	25%

2.	**Protection of Power System Components** Feeder Protection, Overcurrent and earth fault protection, distance protection, pilot wire and carrier current protection, Generator Protection, Biased differential protection, restricted earth fault protection, field suppression, negative sequence protection, and rotor earth fault detection, Transformer Protection, Biased differential protection, restricted earth fault protection, Buchholz relay, and protection of combined transformer and alternator, Bus Zone Protection, Frame leakage and circulating current schemes, use of Translay relay	15	25%
3.	**Circuit Breakers and Fuses** Formation and characteristics of electric arc, Theories of arc interruption, Recovery and restriking voltage, Interruption of capacitive and inductive currents, Current chopping, AC and DC circuit breaking principles, Requirements and ratings of a good circuit breaker, Types of Circuit Breakers, Air break, Air blast, Plain break, Controlled break, Minimum oil, Vacuum, SF6, and DC circuit breakers,H.R.C. Fuse, Construction and characteristics.	12	20%
4.	**Static Relays and Advanced Protection Systems** Static Relays, Development and classification of static relays, Different types of phase and amplitude capacitors, Basic static relays used in protective scheme, Elementary idea about digital & numerical protection. Testing and maintenance of protective gear, Protection against surge-surge absorber, Surgediverter. Arrangement of Bus bar Circuit breaker and isolator. Current limiting reactors in power systems and their arrangement calculation of fault MVA for symmetrical short circuits. Circuit breaker capacity.	18	30%

Continuous Assessment:

Sr. No	Active Learning Activities	Marks
1	**Identify and Classify Protective Devices**: Students collect images of various protective devices (MCB, RCCB, relays, fuses, etc.), classify their functions based on operation, application, rated current, breaking capacity etc. Upload a document on GMIU web Portal.	10

2	**Network Analysis:** Faculty assign a base power system (a simplified network) to the students. They have to analyze the impact of a specific change. For example:"What if a transmission line is suddenly taken out of service?", "What if a large industrial load is added to the system?", "What if a renewable energy source is integrated at a specific location?" Upload findings on GMIU web portal. (No. of Students Per group - 03).	10
3	**Industry Visit Report** Students visit a power substation or industrial plant and prepare a report on the protection schemes used, including relay coordination, circuit breaker types, and real-world fault-handling techniques. Upload a report on the GMIU web portal. (Group of 5 students)	10
Total		30

Suggested Specification table with Marks (Theory):60

Distribution of Theory Marks (Revised Bloom's Taxonomy)						
Level	Remembrance (R)	Understanding (U)	Application (A)	Analyze (N)	Evaluate (E)	Create (C)
Weightage	20%	30%	15%	10%	20%	05%

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Course Outcome:

After learning the course the students should be able to:	
CO1	Interpret the principles of protection and the different components involved in protections.
CO2	Compare the overcurrent protection, distance protection and carrier-current protection of transmission line.
CO3	Use and maintain the various protective schemes of the transformer.
CO4	Utilize various protective schemes of Alternator and Induction Motor.
CO5	Understand the operation, structure, and uses of circuit breakers.
CO6	Analyze insulation coordination and safeguard the system against overvoltage.

List of Practical:

Sr. No	Descriptions	Unit No	Hrs
1.	To Study about Different Types of Relays.	1	2
2.	To Obtain The Characteristics Of Over Current Relays	1	2
3.	To Perform the Radial Feeder Protection	2	4

4.	To Perform the Parallel Feeder Protection	2	4
5.	To Perform the biased differential protection of 1-Φ transformer	3	2
6.	Study of differential protection and differential relay DTH-31	3	2
7.	To Perform The Protection of Three Phase Induction Motor.	4	2
8.	Study of Motor protections and numerical Motor protection relay-Siemens 7JS61	4	2
9.	To Obtain The Characteristic of Miniature Circuit Breaker (MCB)	5	2
10.	Study the protective scheme of alternator	5	2
11.	Test the various protective scheme of induction motor using numerical relay	5	2
12.	Identify various components of a circuit breaker. SF6 CB, Vacuum CB, Tripping Circuit Supervision Relay and Gas Pressure Healthiness Assessment circuit	5	4
	Total		**30**

Instructional Method:

The course delivery method will depend upon the requirement of content and the needs of students. The teacher, in addition to conventional teaching methods by black board, may also use any tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.

From the content 10% topics are suggested for flipped mode instruction.

Students will use supplementary resources such as online videos, NPTEL/SWAYAM videos, e-courses, Virtual Laboratory

The internal evaluation will be done on the basis of Active Learning Assignment

Practical/Viva examination will be conducted at the end of semester for evaluation of performance of students in the laboratory.

Reference Books:

[1] Bhavesh, et al., Protection and Switchgear, 1st ed., Oxford, 2011.
[2] N. Veerappan, S. R. Krishnamurthy, Power System Switchgear and Protection, 1st ed., S. Chand, 2009.
[3] B. A. Oza, N. C. Nair, R. P. Mehta, and V. H. Makwana, Power System Protection and Switchgear, McGraw-Hill Education Ltd., 2010, ISBN: 978-0070671188
[3] Y. G. Paithankar and S. R. Bhide, Fundamentals of Power System Protection, 1st ed., PHI, 2000.
[4] B. Ram, D. N. Vishvakarma, S. R. Mohanty, and S. K. Kataria, Power System Protection and Switchgear, Reprint ed., New Delhi: S. K. Kataria and Sons, 2013, ISBN: 9789350142790.