Gyanmanjari Innovative University

Course Syllabus
Gyanmanjari Institute of Technology
Semester-7

Subject: Power System Operation & Control - BETEE17331

Type of course: Professional Core and Professional Elective Courses.

Prerequisites: Basic structure of power system (Generation, Transmission, distribution), per-unit system and power system components

Rationale:

Electrical Machine Design enables students to understand the principles and methods required to design efficient, reliable, and economical electrical machines such as transformers and motors. It develops skills in selecting materials, determining dimensions, and analyzing performance, preparing students for practical industrial applications.

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	
3	0	0	3	60	30	10	00	50	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.	**Introduction** Necessity for voltage and frequency regulation of power systems – P-f and Q-V control loops – recent trends in real-time control of power system – Introduction to load dispatching, load forecasting, unit commitment, load shedding, and islanding.	9	10%

2.	**Frequency Control** Plant and system level control – mathematical model of speed governing system – speed load characteristics – regulation of two generators in parallel – concept of control area – LFC control of a single area system – static and dynamic response of uncontrolled and controlled system - LFC of two area system – static and dynamic response of uncontrolled system – tie line with frequency bias control of two area system.	12	35%
3	**Voltage Control** Type of excitation system – Characteristics of excitation system – block diagram of excitation system - static and dynamic analysis. Methods of voltage control: OLTC, synchronous condenser, SVC, shunt capacitor – Power system level voltage control using tap changing transformer (simple problems)	12	20%
4	**Economic Dispatch and Unit Commitment** Incremental cost curve – co-ordination equation without loss – solution by Lamda iteration method – co-ordination equation with loss – solution of co-ordination equation using Bmn coefficients (no derivation) – base point and participating factors. Unit commitment (UC) problem – constraints in UC – Solution methods – Priority list method (Numerical problems) – Economic dispatch controller added to load frequency control.	12	35%

Continuous Assessment:

Sr. No	Active Learning Activities	Marks
1	**Load Frequency Control of a Single-Area Power System** Students analyze the load frequency control of a single-area power system. Identify the components of the speed governing system, develop the mathematical model, and study the static and dynamic response of uncontrolled and controlled systems. Prepare a report and upload it on the GMIU web portal. (No. of students per group – 02)	20
2	**Analysis of Excitation System and Voltage Control Techniques** Students will explore excitation systems used in power systems and evaluate various voltage control methods.Report must include block diagram representation, system characteristics, and comparative analysis of control techniques such as OLTC, SVC, and synchronous condenser. Upload the final report on the GMIU web portal.(No. of students per group – 02)	10

3	**Optimal Power Generation and Cost Minimization** Students will perform a task of studying the principles of economic dispatch and determine optimal generation scheduling using appropriate methods. The Task should involve understanding incremental cost, coordination equations, and solving a numerical problem using iteration techniques. Submit the report on the GMIU web portal. (No. of students per group – 02)	20
Total		50

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	30 %	30%	10%	15%	15%	-

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	Analyze the speed governing system and evaluate the load frequency control of a single-area power system under steady-state and dynamic conditions.
CO2	Evaluate a two-area interconnected power system focusing on tie-line power flow and frequency bias control.
CO3	Compare and analyze different excitation systems and apply various voltage control methods such as OLTC, SVC, synchronous condenser, and shunt capacitors.
CO4	Formulate and solve the economic dispatch problem using coordination equations and lambda iteration method, considering transmission losses.

Instructional Method:

The course delivery method will depend upon the requirements of the content and the needs of students. The teacher, in addition to conventional teaching methods by blackboard, 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 the 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] C. L. Wadhwa, Electrical Power Systems, New Age International Publishers, Latest Edition.

[2] S. Sivanagaraju and G. Sreenivasan, Power System Operation and Control, Pearson Education, Latest Edition.

[3] N. V. Ramana, Power System Operation and Control, Pearson Education, Latest Edition.

[4] P. Kundur, Power System Stability and Control, McGraw-Hill Education, 1994.

[5] A. J. Wood and B. F. Wollenberg, Power Generation, Operation, and Control, Wiley India, Latest Edition.