Course code: ECE 3021 ELECTRICAL MACHINES AND POWER SYSTEMS

Programme: **B.Tech. (ECE/CCE)** Year: **3rd** Semester :**ODD**
Course Type: **Program Elective** Credits :**3** Hours : **42**

Course Context and Overview (100 words):

The primary objective of the course is to provide students with an in-depth understanding of how transformers work, how DC generators and DC motors work, how AC generators and AC motors work, and how power systems work.

Prerequisites Courses: Basic Electronics or equivalent elsewhere

Course outcomes(COs):

On completion of this course, the student:
CO1: Should be able to derive and use analytical equations for determining the performance parameters of single-phase and three-phase power systems.
CO2: Should be able to derive and use analytical equations for determining the performance parameters of transformers.
CO3: Should be able to derive and use analytical equations for determining the performance parameters of D.C. Generators and D.C. Motors.
CO4: Should be able to derive and use analytical equations for determining the performance parameters of A.C. Generators and A.C. Motors (both single-phase and three-phase).
CO5: Should be able to understand the nature of commonly encountered faults in power systems and their rectification methods.

Course Topics:

Topics	**Lecture Hours**	
UNIT - I		
1. **Basics**		
1.1. Introduction, structure of power systems, major components	2	6
1.2. Circuit fundamentals, three-phase circuits, balanced and unbalanced systems, star connection, delta connection, three-wire and four-wire systems, line voltage and phase voltage calculations, line current and phase current calculations, power calculations	4	
2. **Generators, Motors, and Transformers**		14
2.1. D.C. Generators and D.C. Motors		
2.1.1. Principle of operation, construction details, e.m.f. equation, torque equation, lap winding and wave winding, equivalent circuits, armature reaction, back e.m.f., speed control, losses and efficiency, performance characteristics	4	

2.2. A.C. Generators and A.C. Motors		
2.2.1. Synchronous and asynchronous (induction) machines, principles of operation, construction details, losses and efficiency, performance characteristics, stator current heating limit, field current heating limit, ventilation	4	
2.2.2. Nuclear power generators, principle of operation, construction details, advantages and disadvantages	2	
2.3. Transformers		
2.3.1. Principle of operation, construction details, e.m.f., equation, three-phase and single-phase transformers, performance parameters, cooling	4	
UNIT - II		
3. **Transmission Lines**		6
3.1. Telegrapher's equations, primary constants, secondary constants, transmission losses, active and reactive power flows, incident and reflected power flows, load matching, transient behaviour, modeling for steady-state considerations	6	
4. **Network modeling**		
4.1. Nodal formulation of network problems, the use of numerical techniques, the use of MATLAB	4	4
UNIT - III		
5. **Faults and Protection**		
5.1. Symmetrical faults, shorts and opens in single-phase and three-phase systems	2	6
5.2. Unsymmetrical faults, single-phase-to earth, phase-to-phase, and line-to-line faults	2	
5.3. Protection methods, fuses, relays, circuit breakers	2	
5.4.		
UNIT - IV		
6. **Stability and Control**		
6.1. Steady-state stability, transient stability	2	4
6.2. Dynamic stability	1	
6.3. Control	1	
7. **Economic operation of power systems**		2
7.1. Cost optimization, initial costs, maintenance costs, recurring and non-recurring costs	2	

Textbook/ references (IEEE format):
TEXT BOOKS:

1. *Modeling and analysis of electric power systems*, Lecture Notes, G. Andersson, Swiss Federal Institute of Technology, Sept 2008
2. *Power system analysis*, H. Saadat,, Second Edition, Tata McGraw-Hill, 2011.
3. *A text book of electrical technology*, B.L. Theraja, S. Chand publications, New Delhi, 2015

Evaluation Methods:

Item	Weightage
Quiz (at least 2)	20%
Midterm	30%
Final Examination	50%

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