

GUJARAT TECHNOLOGICAL UNIVERSITY

ELECTRONICS (10) / ELECTRONICS & COMMUNICATION (11) /INSTRUMENTATION & CONTROL (17)

ELECTRICAL MACHINES

SUBJECT CODE: 2131005

B.E. 3RD SEMESTER

Type of course: Engineering Science (ELECTRICAL)/(INTERDISCIPLINARY)

Prerequisite: Fundamentals of Electrical Engineering

Rationale: NA

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks						Total Marks
L	T	P		Theory Marks			Practical Marks			
			ESE (E)	PA (M)		PA (V)		PA (I)		
				PA	ALA	ESE	OEP			
3	0	2	5	70	20	10	20	10	20	150

Contents:

Sr. No.	Subject Content	Hours	Module Weightage
1.	<p>Transformers:</p> <p>Single Phase Transformer: Working principle, Construction, types, EMF equation, Transformer on no load and on load, vector diagram, exact and approximate equivalent circuit, O.C & S.C.test on transformer, regulation of transformer, losses & efficiency, condition for maximum efficiency, All day efficiency, Efficiency curve, Sumpner's test, Auto transformer, Saving of conductor material, Parallel operation, Conditions, Parallel with equal and unequal voltage ratio.</p> <p>3 Phase transformers: Construction, connections, Scott connection, V-V Connection, Instrument transformers, Current transformers and potential transformers.</p>	8	18
2.	<p>Induction Machines:</p> <p>3 Phase induction motor: Construction, types, rotating magnetic field, principle of operation, slip, frequency of rotor current, rotor emf, rotor current, expression for torque, conditions for maximum torque, torque slip characteristics, starting torque in squirrel cage and slip ring motors, effect of change in supply voltage on torque, slip and speed, relation between full load torque and maximum torque, Power stages in induction motor, vector diagram and equivalent circuit, circle diagram, construction and calculation, speed control of 3 phase motor, starting methods for 3 phase induction motor.</p> <p>Single phase motor:</p>	10	22

	Double revolving field theory, starting methods, no load and block rotor test, equivalent circuit, types of single phase motor		
3.	Synchronous Machine: Alternator, Basic principle, construction, pitch factor, distribution factor, emf equation, alternator on load, voltage regulation, synchronous impedance method, mmf method, ZPF method, parallel operation, synchronization of alternator. Synchronous motor: Basic principle, methods of starting, application.	10	20
4.	DC Machines: DC Generator: Construction features, emf equation of dc generator, methods of excitation, losses condition for maximum efficiency, armature reaction, interpoles and compensating winding, commutation, methods of improving commutation, characteristics of separately excited and self excited dc generator. DC Motor: Working principle, voltage equation, condition for maximum power, characteristics, operating characteristics of dc motor, torque developed, starting, 3 point and 4 point starter, speed control methods, Swinburn's and break test of dc shunt motor.	10	20
5	Basic of Power transmission and distribution Operation of different power plants using block diagram-different terminologies like load factor, diversity factor, plant utilization factors etc. Classification of transmission lines, transmission line parameters, ABCD constants, Voltage regulation, Ferranti effect, efficiency of transmission line. 3-phase 3-wire and 3-phase 4-wire distribution system, feeders, distributors, main lines, comparison of various distribution systems, load power factor improvement techniques.	10	20
	Total	48Hrs	100

Reference Books:

1. Text of Electrical Technology; Vol -2; B. L. Theraja, and A. K. Theraja; S. Chand Publication
2. Electrical machines BY Ashfaq Hussain; Dhanpatrai and Co.
3. Principles of Electrical power systems by J. B. Gupta
4. Generalised theory of rotating machines By P S Bhimra

Course Outcome:

After learning the course the students should be able to :

- Understand working principle, performance, control and applications of AC, DC Machines and Transformer.
- Carry out basic experiments on AC, DC machine and Transformer.
- Identify, formulate and solve AC, DC machine and Transformer related problems.
- Understand the working and performance analysis of Transmission and Distribution of power.

List of Experiments:

1. To operate two single phase transformers of different KVA ratings in parallel and plot the variation of currents shared by each transformer versus load current.
2. To perform Open Circuit and Short circuit Test on a transformer and find its efficient and regulation.
3. Speed control of DC Shunt Motor using a) Armature control and b) field control methods

4. To obtain Magnetizing Characteristics, Internal & External Characteristic of Self Excited DC Shunt Generator. Also obtain the critical field resistance of the machine from magnetizing Characteristics.
5. To conduct direct load test on a D.C. compound generator with a) Shunt field alone b) Cumulative and differential compounding for short and long shunt connections.
6. To obtain Speed-Torque characteristics of DC Series Motor
7. To obtain Speed-Torque characteristics of DC Shunt Motor.
8. To study different starters of D. C. motor.
9. To study different starters of three phase induction motor
10. To perform No load and Block rotor test on induction motor and plot equivalent circuit
11. To Study the effect of Inserting resistance on rotor of Slip ring induction motor.
12. To draw the V curves for synchronous machine
13. To find the voltage regulation of synchronous machine
14. To study capacitor start and capacitor run induction motor
15. Find Voltage regulation and efficiency of Medium transmission line
16. Find Voltage regulation and efficiency of Long transmission line
17. To study various power factor improvement methods
18. To study the block diagram of various power plants

Design based Problems (DP)/Open Ended Problem:

1. To find the applications of various single phase/ three AC and DC motors
2. Design capacitor bank to improve the load power factor
3. Design electrical power distribution system to achieve prescribed voltage regulation

Major Equipments:

Transformer, Single phase and three phase induction motor, synchronous machine,

List of Open Source Software/learning website:

Web-based tools for design:

- <http://www.fairchildsemi.com/support/design-tools/power-supply-webdesigner/>
- <http://www.ti.com/lstds/ti/analog/webench/overview.page>

Circuit Lab:

- <https://www.circuitlab.com/editor/>

Open source Math Tools:

- <http://maxima.sourceforge.net/>
- <http://www.sagemath.org/>
- <http://www.scilab.org/>
- <http://www.gnu.org/software/octave/>

Learning website

- <http://www.electrical-engineering-portal.com/>
- <http://nptel.iitm.ac.in/courses.php>

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.

