

GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

**COURSE CURRICULUM
COURSE TITLE: ADVANCE ELECTRICAL MACHINES
(COURSE CODE: 3350906)**

Diploma Programmes in which this course is offered	Semester in which offered
Electrical Engineering	5 th Semester

1. RATIONALE

Electrical machines play a vital role and are the basic needs of industries for various applications like, production, processing, fabrications, Assembling etc. Due to research and development electrical machines are modernized. Advance electrical machines will be useful to create awareness with modern technology. Advance electrical machines have higher efficiency, small size and useful for specific applications. The most significant development in recent years in the allied area of motor control also plays an important role. Essential efforts are made in this course to make familiarize the students with advance technology in machines which is a necessity for successful technician.

2. COMPETENCY

The course content should be taught and implemented with the aim to achieve different types of skills leading to achieve the following competencies.

- **Maintain different advance electrical machines.**

3. Course Outcomes:

The students will be able to:

- Maintain different types of three phase transformers.
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4. Teaching and Examination Scheme

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	ESE	PA	ESE	PA	
3	0	2	5	70	30	20	30	

Legends: L-Lecture; T – Tutorial/Teacher Guided Theory Practice; P - Practical; C – Credit ESE - End Semester Examination; PA - Progressive Assessment.

5. COURSE DETAILS

Unit	Major Learning Outcomes	Topics and Sub-topics
Unit – I THREE PHASE TRANSFORMER	1a.Explain the V-V connection and scott connection 1b.Explain the working of Three winding transformer. 1c. Explain the working of Constant Voltage Transformer & Constant Current Transformer	1.1 Open delta or V-V connection 1.2 Scott connection 1.3 Construction, working and application of (a)Three winding transformer (Tertiary winding) (b)Constant current transformer (CCT) (c)constant voltage transformer (CVT)
Unit – II INDUCTION MACHINES	2a.Explain the working principle of induction generator 2b.Explain the working principle of double cage induction motor.	2.1 Working of induction motor as induction generator 2.2 Principle, construction and working of double cage induction motor, slip-torque characteristics 2.3 Phenomenon of crawling and cogging 2.4 Principle, construction and working of induction regulator 2.5 Principle, construction and working of submersible motor.
Unit-III STARTERS	3a.Explain the working of DC motor starters with control circuit diagram. 3b.Grading of DC shunt and DC series motor starters. 3c.Explain principle of soft starters.	3.1 DC machine automatic starter (a)Back emf starter (b)Time delay starter 3.2 Working principle and common settings of soft starter. 3.3 Slip-ring induction motor starter. 3.4 Resistance calculation of DC shunt and series motor starters.
Unit-IV SALIENT POLE SYNCHRONOUS MACHINE	4a.Explain the theory on which salient pole synchronous machine works. 4b.Derive the expression for synchronizing power. 4c. Describe slip test to determine X_d and X_q salient pole synchronous machines 4d. Explain static excitation system with the help of neat sketch.	4.1 Two reaction theory 4.2 Phasor diagram 4.3 Power developed by synchronous generator 4.4 Synchronizing power and torque developed by two alternators in synchronism 4.5 Torque-angle characteristics 4.6 Slip test 4.7 Static Excitation system for synchronous m/c
Unit-V SPECIAL ELECTRICAL MACHINES	5a.Explain the construction, working & application of single phase synchronous motor. 5b.Explain the construction, working & applications of elementary stepper motor & its types. 5d. Explain construction and	Construction, working, and application of 5.1 Single phase synchronous motor – Hysteresis and reluctance. 5.2 Permanent magnet synchronous motor 5.3 Permanent magnet DC motor 5.4 Stepper motor 5.5 Brushless DC motor 5.6 Switched reluctance motor 5.7 Servomotors

Unit	Major Learning Outcomes	Topics and Sub-topics
	working and applications of Brushless DC Motor 5e. Explain the significance of Brushless DC Motor. 5c. Explain construction and working and applications of Switch Reluctance Motor 5c. Explain construction and working of permanent magnet DC motor	5.8 Synchros 5.9 Resolver 5.10 Linear Induction motor 5.11 Comparison between variable reluctance stepper motor and switched reluctance stepper motor 5.12 Comparison between Conventional DC motor and Brushless DC motor

6. SUGGESTED SPECIFICATION TABLE WITH HOURS & MARKS (THEORY)

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Three Phase Transformer	08	00	06	00	10
II	Induction Machines	06	00	08	00	10
III	Starters	06	00	12	08	16
IV	Salient Pole Machine	08	04	10	08	16
V	Special Electrical Machines	14	04	02	08	18
Total		42	08	38	24	70

Legends: R = Remembrance; U = Understanding; A = Application and above levels (Revised Bloom's taxonomy)

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.

7. SUGGESTED LIST OF EXERCISES/PRACTICALS

The practical/exercises should be properly designed and implemented with an attempt to develop different types of cognitive and practical skills (**Outcomes in cognitive, psychomotor and affective domain**) so that students are able to acquire the competencies. Following is the list of practical exercises for guidance.

Sr. No.	Unit No.	Practical Exercises (Outcomes' in Psychomotor Domain)	Hrs. required
1	I	Perform V-V connection on the three phase transformer and measure load carrying capacity of the V-V connected transformer	2
2	I	Perform two phase to three phase conversion and vice versa using Scott connection. (Transformer A : secondary winding has 50% tapping and Transformer B : both windings have 86.6% tapping)	2
3	1	Conduct test on Constant Voltage Transformer to plot V-I characteristics.	2
4	I	Conduct test on Constant Current Transformer to plot V-I	2

		characteristics.	
5	II	Plot torque-speed characteristics of induction generator and compare with that of induction motor.	2
6	II	Plot torque- slip characteristics of double cage induction motor and compare with that of induction motor.	4
7	II	Measure output voltage of the induction regulator for different position of the rotor.	2
8	III	Understand the working of Back emf starter with a neat control circuit diagram.	2
9	III	Understand the working of Time delay starter with a neat control circuit diagram.	2
10	III	Calculate starter resistance and its grading for DC Shunt motor.	2
11	III	Calculate starter resistance and its grading for DC Series motor.	2
12	IV	Perform Slip test on Salient pole synchronous motor and determine X_d & X_q .	2
13	V	Conduct test on Stepper motor for forward/ reverse & position control.	2
14	V	Perform torque-rotor position characteristics of the three phase Switched Reluctance Motor	2
15	V	Demonstrate each part of Linear induction motor and working of it	2
16	V	To perform torque- rotor position with respect to stator of the BLDC motor.	2
Total			28

8. SUGGESTED LIST OF STUDENT ACTIVITIES

Following is the list of proposed student activities like: course/topic based seminars, internet based assignments, teacher guided self learning activities, course/library/internet/lab based mini-projects---etc.

1. Identify and select various measuring instruments as per required range
2. Prepare journal based on experiments performer in the laboratory
3. Prepare chart displaying the various parts of DC machine
4. Prepare chart displaying the various parts of AC machine

9. SPECIAL INSTRUCTIONAL STRATEGIES (if any)

10. SUGGESTED LEARNING RESOURCES

A) List of Books

Sr. No.	Title of Book	Author	Publication
1.	B.L.Theraja	Fundamentals of Electrical Engg.	S Chand
2.	B.L.Theraja-II	Electrical Machines	S Chand

3.	V.K.Mehta	Fundamentals of Electrical Engg.	S Chand
4.	S.L.Uppal	A text book of Electrical Engg.	Khanna publication
5.	A K SAWHNEY	Electrical measurement and instrumentation	Dhanpat Rai & Sons
6.	J B GUPTA	Electrical Power Utilization and Traction	S.K.Kataria & Sons

B) List of Major Equipment/ Instrument with Broad Specifications

- Stepper motor trainer kit**- forward/ reverse, speed controls to all Actuators control. HALF, FULL and WAVE modes, Unipolar and Bipolar stepper motor. Step rate measurement, motor phase, mode and direction indication
- Brushless DC motor trainer kit**- Variable speed control (PWM) with 4 quadrants, Power supply: 24Vdc, Speed and Current (no load): 4200rpm/0.4A, Speed/torque/current (with load): 3250rpm/0.24Nm/4.8A, LCD display with 4 lines of 18 characters
- Transformers**- coils and mechanical parts, copper excluded, for the construction of the transformers
 single phase, 1000 VA, 220/380 V
 three phase, 1000 VA, 220/380 V
 It must be possible to perform the following exercises:
 Single - phase transformer 1000 VA, 220 - 380 / 180 V
 Three - phase transformer 1000 VA, 220 - 380 DY / 110 Y V

4.Power analyzer

- 3 phase / 1 phase measurement
- True RMS Voltage 600/1200 V
- True RMS Current 80 A
- Power measurement (Active power, reactive power & apparent power)
- Power factor measurement
- Frequency Measurement
- RS-232 serial communication
- LCD display

C) List of Software/Learning Websites

Searching engine could be used to locate textile related sites

- A. www.electricalandelectronics.org
- B. www.allaboutcircuits.com
- C. www.nmbtc.com

11. COURSE CURRICULUM DEVELOPMENT COMMITTEE**Faculty Members from Polytechnics**

- Prof. R D Panchal, Lecturer in Electrical Emgg, R C Technical Institute, Ahmedabad
- Prof. H C Chawda, Lecturer in Electrical Emgg, R C Technical Institute, Ahmedabad
- Dr. A S Pandya, HOD Electrical, G.P. Rajkot
- Prof. N. N. PANDYA, Lecturer in Electrical Engineering, Govt.Poly, Ahmedabad.

Coordinator and Faculty Members from NITTTR Bhopal

- Prof. (Mrs.) Susan S. Mathew
- Dr. Joshua Earnest,