GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT
COURSE CURRICULUM

Course Title: POLYPHASE TRANSFORMER AND AC ROTATING ELECTRICAL MACHINES
(Code: 3340901)

Diploma Programme in which this course is offered	Semester in which offered
Electrical Engineering	**4th Sem**

1. RATIONALE

This course will enable the students to develop skills to operate AC Machines and poly phase transformers in power, commercial and industrial sector. They will be able to perform different tests and troubleshoot the various types of AC machines and ploy phase transformers. Essential theoretical and practical knowledge will be achieved by this course.

2. COMPETENCY

The course content should be taught and implemented with the aim to develop different types of skills so that students are able to acquire following competency:

i. Maintain various types of AC machines.

ii. Maintain various types of poly phase transformers.

(The course content should be taught and implemented with the aim to develop different types of skills so that students are able to acquire following competency)

3. Course Outcomes:

Student will be able to:

- Know the constructional details & working principal of various types of ac machines & Operate given machine properly.
- Use the knowledge for testing of machine.
- Select motors of proper rating for particular use.

(Relate this knowledge to understand the subject of higher semester)

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**	
4	0	4	8	70	30	40	60	200

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. **POLY PHASE TRANSFORMER**	1.a Execute various test on transformer to find out regulation & efficiency. 1.b Operate transformers in parallel satisfying necessary conditions.	1.1 Construction of three phase core and shell type transformer 1.2 Comparison of a bank of three single phase transformer and single three phase transformer. 1.3 Vector group 1.4 Parallel operation of 3-phase transformer. 1.5 Accessories of transformer: Main tank, bushings, conservator with breather, oil level gauge, radiators, buchholz relay, explosion vent, temperature indicators, junction box 1.6 Cooling of transformer: Natural cooling, Forced cooling 1.7 Name plate
Unit– II **POLY PHASE INDUCTION MOTORS**	2.a Use different methods of starting for three phase Induction motor. 2.b Operate three phase Induction Motor at different load conditions. 2.c Computation of motor performance from circle diagram.	2.1 Principle of working and construction. 2.2 Rotating magnetic field 2.3 Types of three phase induction motor 2.4 Slip 2.5 Effect of slip on the frequency and voltage 2.6 Torque and condition for the maximum torque 2.7 Effect of change in supply voltage on speed and torque. 2.8 Effect of change in frequency on speed and torque 2.9 Torque-slip curve 2.10 Necessary of starter. 2.11 Types of starter, their connection diagrams and working. 2.12 Power stages and maximum power output. 2.13 Vector diagram and

Unit	Major Learning Outcomes	Topics and Sub-topics
		equivalent circuit of poly phase induction motor. 2.14 No load test and Blocked rotor test 2.15 Computation of motor performance using circle diagram. 2.16 Measurement of slip 2.17 Speed control of induction motor of squirrel cage and slip-ring induction motor 2.18 Concept of Induction generator 2.19 Principle of working and construction of submersible motor. 2.20 Linear induction motor.
Unit– III ALTERNATOR	3.a Operate an alternator on different types of load 3.b Methods of voltage regulation of an alternator 3.c Synchronize an alternator with infinite bus bar.	3.1 Principle of working & construction. 3.2 Salient pole and Cylindrical pole type alternator 3.3 Damper winding 3.4 Types of armature winding 3.5 Define: Distribution factor, pitch factor 3.6 Induced emf equation 3.7 Effect of Armature reaction 3.8 Vector diagram of alternator. 3.9 Different Methods of voltage regulation 3.10 Parallel operation of alternators 3.11 Synchronizing of alternators with busbar 3.12 Cooling system of alternator

Unit	Major Learning Outcomes	Topics and Sub-topics
Unit–IV SYNCHRONOUS MOTOR	4.a Connect and operate synchronous motor using proper starting method 4.b Improve the power factor of the system using synchronous motor 4.c Draw Vector diagrams and analyzes 'V'-curves	4.1 Principle of working & construction. 4.2 Methods of starting 4.3 Power developed by synchronous motor 4.4 Effect of change in excitation 4.5 Vector diagrams and 'V'-curve 4.6 Methods of starting 4.7 Hunting and function of damper winding 4.8 Different torque of a synchronous motor 4.9 Comparison between induction motor and synchronous motor 4.10 Applications
Unit-V SINGLE PHASE INDUCTION MOTORS	5.a Identify the types, construction and characteristics of single phase induction motors 5.b Select different types of motors based on applications.	5.1 Classification of single phase induction motor 5.2 Double field revolving theory 5.3 Making single phase induction motor self staring 5.4 Equivalent circuit 5.5 Construction, characteristics and application of various types of single phase induction 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	POLYPHASE TRANSFORMER	10				12
II	POLYPHASE INDCUTION MOTORS	16				18
III	ALTERNATOR	12				16
IV	SYNCHRONOUS MOTOR	10				14
V	SINGLE PHASE INDUCTION MOTORS	8				10
	Total	**56**				**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.

Note: Here only outcomes in psychomotor domain are listed as practical/exercises. However, if these practical/exercises are completed appropriately, they would also lead to development of **Programme Outcomes/Course Outcomes in affective domain** as given in a common list at the beginning of curriculum document for this programme. Faculty should refer to that common list and should ensure that students also acquire those Programme Outcomes/Course Outcomes related to affective domain

S. No.	Unit No.	Practical Exercises (Outcomes' in Psychomotor Domain)	Hrs. required
1	I	To identify different parts of three phase dismantled transformer.	2
2	I	To perform parallel operation on three phase transformer.	2
3	II	(a) To measure the slip of 3-phase IM by 1) Tachometer. 2) Comparing rotor & stator frequency 3) Stroboscopic method. (b) To reverse the direction of rotation of 3-phase IM.	6
4	II	To perform direct load test on three phase induction motor and find its efficiency at various load condition.	4
5	II	To perform no load test and blocked rotor test on three phase induction motor and construct its circle diagram and find out its various performance parameters.	4
6	II	To make connections of DOL starter / star-delta starter / auto transformer / rotor rheostat starter for appropriate three phase induction motor.	4
7	II	To perform speed control of squirrel cage induction motor by 1. By changing the supply voltage. 2. By changing the applied frequency.	2
8	II	To perform speed control of slip-ring induction motor by 1. Rotor rheostat control. 2. By injecting an emf from rotor side. 3. By operating two motors in cascade connection.	4

9	III	To perform direct loading test on alternator and find out voltage regulation of it.	4
10	III	To find out voltage regulation of alternator by synchronous impedance method for : 1. Unity power factor. 2. Lagging power factor. 3. Leading power factor.	4
11	III	To find out voltage regulation of alternator by ampere turn method for : 1. Unity power factor. 2. Lagging power factor. 3. Leading power factor.	4
12	III	To perform synchronizing of alternator with bus bar.	2
13	III	To list & explain various starting methods of synchronous motor & applying one of them to start the synchronous motor.	2
14	IV	To construct V-curves of synchronous motor at different load conditions.	2
15	V	Testing of circuit of capacitor start capacitor run single phase motor (ceiling fan).	2
Total			**48**

8. SUGGESTED LIST OF STUDENT ACTIVITIES

Following is the list of proposed student activities like:

- Prepare chart for accessories of three phase transformer
- To list the various types of 1-phase Induction motor, collect literature form Dealers/Manufactures from local places and compare on following points
  (a)Method of starting
  (b)Cost
  (c)performance
  (d)Starting torque
- To list & explain various starting methods of synchronous motor & applying one of them to start the synchronous motor. Plot V curve & inverted V curve of the same
- To list different types of starters used for 3-phase IM .Identify it & use the same to
  To start three phase induction motor
- Download catalogue of three phase transformer, three phase induction motor, synchronous motor and alternator and study it

9. SPECIAL INSTRUCTIONAL STRATEGIES (if any)

Visit transformer and induction motor manufacturer/ workshop site

10. SUGGESTED LEARNING RESOURCES

A) List of Books

S. No.	Title of Book	Author	Publication
1.	Electrical Technology Vol. II	B. L. Theraja	S chand & Co.
2.	Electrical Machines	Smarajit Ghosh	Pearson
3.	*Electrical Machinery*	A.E.Fitzgerald Charles Kingsley, Jr. Stephen D. Umans	Mc. Graw Hill
4.	Theory & performance of Electrical Machines	J.B.Gupta	S.K. Kataria & sons
5.	Electrical Machines	Ashfaq Hussain	Dhanpatrai & Company
6.	Electrical Machine 1	J.S.Katre	Tech max publications, Pune

B) List of Major Equipment/ Instrument with Broad Specifications

- Three phase transformer : 2KVA, 415V /415V, 50 Hz, 2.8A
- Three phase induction motor : 5 HP, 440V, 8.0A, 1400 RPM Squirrel cage type with brake drum arrgangement
- Three phase induction motor : 5 HP, 440V, 8.0A, 1400 RPM Slip-ring induction motor
- Synchronous motor : 3 HP, 415V, 3-phase, 50Hz, 1500 RPM
- DC shunt motor- Alternator set :DC shunt motor : 5 HP, 220V, 1500 RPM, 18A, Excitation- 220V DC
- Alternator : 3KVA, 415V, 3-phase, 3.5A, 1500 RPM, Excitation-220V DC Single phase induction motor: 1 HP, 220 V, 50Hz, 1440 RPM Drum brake with spring balances

C) List of Software/Learning Websites

1. www.sskphdmm.com
2. WWW.nptel.iitm.ac.in

11. COURSE CURRICULUM DEVELOPMENT COMMITTEE

Faculty Members from Polytechnics

- Prof. H C CHAWDA, RC TECHNICAL INSTITUTE, AHMEDABAD
- Prof. R D PANCHAL, RC TECHNICAL INSTITUTE, AHMEDABAD

Coordinator and Faculty Members from NITTTR Bhopal

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