

GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

COURSE CURRICULUM

Course Title: D C MACHINES AND TRANSFORMER
(Code: 3330902)

Diploma Programme in which this course is offered	Semester in which offered
Electrical Engineering	Third Semester

1. RATIONALE:

This course will enable the students to develop skills to operate DC Machines and transformers in power, commercial and industrial sector. They will be able to perform different tests and troubleshoot the various types of DC machines and 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 DC machines.**
- ii. **Maintain various types of transformers.**

3. 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	
04	00	04	08	70	30	40	60	200

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P - Practical; C - Credit; ESE - End Semester Examination; PA - Progressive Assessment

Note: It is the responsibility of the institute heads that marks for **PA of theory & ESE and PA of practical** for each student are entered online into the GTU Portal at the end of each semester within the dates specified by GTU.

4. COURSE DETAILS

Unit	Major Learning Outcomes	Topics and Sub-topics
Unit – I Energy Conversion Principles	1a.Explain law of conservation of energy and role of electrical energy 1b. Explain energy conversion principles	1.1 Law of conservation of energy 1.2 Role of electrical energy and uses 1.3 Electro-mechanical energy conversion principle. 1.4 Conditions for production of EMF 1.5 Singly excited and doubly excited machines.
Unit – II DC Generators	2a. Explain working principle. 2b. Describe different parts of DC generator with sketches. 2c. Different types of DC generator winding. 2d. Derive emf equation 2e. classify different types of dc generator with sketches 2f. Explain armature reaction and commutation 2g. Describe performance characteristic different types of Generator 2h. Calculate losses and efficiency.	2.1 Working principle of dc generator 2.2 Construction and functions of various parts of dc generator. 2.3 Materials used for different parts. 2.4 Simplex lap and wave winding. 2.5 EMF equation of dc generator 2.6. Classification of dc generator 2.7. Magnetizing characteristics of DC generator. 2.8 Armature reaction & commutation 2.9 External and internal load characteristics of various generators. 2.10 Different types of losses and its computation for DC generator. 2.11 Power stages and efficiency of DC Generator. 2.12 Derivation of condition for maximum efficiency in DC generator. 2.13 Applications of DC generators in industry.

Unit	Major Learning Outcomes	Topics and Sub-topics
Unit – III DC Motors	3a. Explain working principle of dc motor 3b. Classify different types of dc motors 3c. Derive torque equation of Dc motor 3d. Compare performance characteristics of different types of DC motors 3e. Describe speed control of DC motor 3f. Explain working of various starters for DC motor. 3g. Calculate losses and efficiency 3h. Explain various tests to determine losses and efficiency 3i. list the application of various dc motors	3.1 Working principle of dc motor and concept of back emf 3.2 Construction and types of dc motors: Series, Shunt, and Compound 3.3 Derivation of Torque equation for DC motor. 3.4 Performance characteristics of DC Series, Shunt and Compound motor. 3.5 Speed control of D.C. motor 3.6 Necessity of starter, 3.7 Construction and working of 3 point and 4 point DC motor starters. 3.8 Different types of losses and its computation for DC motors. 3.9 Power stages and efficiency of DC motors. 3.10 Tests to find losses and efficiency of DC machines: brake test, Swinburne's test, field test. 3.11 Applications of DC Series, Shunt and compound motor.
Unit – IV Single Phase Transformers	4a. Explain working principle, classification and construction of single phase transformer 4b. Derive e.m.f. equation of transformer and understand transformation ratio 4c. Explain with sketches vector diagrams of No load and On load conditions 4d. Explain equivalent circuit 4e. Explain various losses in transformer. 4f. Explain condition for maximum efficiency of single phase transformer	4.1 Working principle and construction of single phase transformer 4.2 Classification of single phase transformer based on construction and application. 4.3 Materials for different parts of transformer. 4.4 Computation of EMF equation and transformation ratio. 4.5 Plotting of No load and on load vector diagrams for single phase transformer. 4.6 Derivation of Exact and approximate Equivalent circuit of single phase transformer. 4.7 Different types of Losses in transformer 4.8 Derive condition for maximum efficiency of single phase transformer 4.9 Solve numerical for emf equation, equivalent circuit.

Unit	Major Learning Outcomes	Topics and Sub-topics
Unit – V Testing and parallel operation of Single Phase Transformers	5a. Describe different types of tests for transformer 5b. Describe the need and conditions of parallel operation of transformers 5c. Describe Autotransformer and welding transformer	5.1 Analysis of direct loading test, OC and SC test and sumpner test along with connection diagrams. 5.2 Derivation of equivalent circuit parameters, Losses, efficiency and regulation of transformer 5.3 Need of parallel operation, essential and desirable conditions for parallel operation. 5.4 Parallel operation and load sharing of single phase transformer 5.5 Construction and working of Auto transformer and welding transformer 5.6 Solve numerical for efficiency, voltage regulation and parallel operation.

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

Unit	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Energy Conversion Principles	04	02	02	00	04
II	DC Generators	14	06	08	08	18
III	DC Motors	14	06	08	08	18
IV	Single Phase Transformers	16	04	04	04	20
V	Testing and parallel operation of Single Phase Transformers	08	02	04	04	10
Total		56	20	26	24	70

Legends: R = Remember; U = Understand; A = Apply and above levels (Bloom's revised taxonomy)

Note: This specification table shall be treated as only general guideline for students and teachers. The actual distribution of marks in the question paper may vary from above table.

6. SUGGESTED LIST OF EXERCISES/PRACTICAL

The practical/exercises should be properly designed and implemented with an attempt to develop different types of skills so that students are able to acquire the competency.

Following is the list of experiments for guidance.

S. No.	Unit No.	Practical/Exercise	Apprx. Hrs. Required
1	II	Identify various parts of DC machine	01
2	IV	Identify various parts of single phase transformer	01
3	II	Maintain constant voltage of DC generator at different load conditions.	04
4	II	Test DC shunt generator for magnetizing characteristics.	04
5	II	Test DC shunt generator for external and internal load	04

S. No.	Unit No.	Practical/Exercise	Apprx. Hrs. Required
		characteristic.	
6	II	Test DC series generator for external and internal load characteristic.	04
7	II	Test DC compound generator for external and internal load characteristic.	04
8	III	Demonstration of three point and four point starters for DC motor.	02
9	III	Control the speed of DC shunt motor by armature and field control.	04
10	III	Control the speed of DC series motor.	04
11	III	Perform Swinburne's test of DC machine.	04
12	V	Perform Load test on single phase transformer.	04
13	V	Perform OC and SC test of single phase transformer.	04
14	V	Perform polarity test on single phase transformer.	04
15	V	Operate two single phase transformers in parallel having i) Equal impedances ii) Different impedances.	04
16	V	Perform Sumpner's test on single phase transformer.	04
		Total	56

7. SUGGESTED LIST OF STUDENT ACTIVITIES

Following is the list of proposed student activities like:

- i. Prepare journals based on practical performed in laboratory.
- ii. Assignments on solving numerical
- iii. Identify different types of dc machine based on their winding arrangement
- iv. Identify different types of transformer based on application
- v. Prepare chart displaying the various parts of dc machine
- vi. Prepare chart displaying the various parts of transformer
- vii. Prepare chart displaying the various parts of a three and four point dc motor starter

8. SUGGESTED LEARNING RESOURCES

(A) List of Books

S. No.	Title of Books	Author	Publication
1	Electrical Technology Vol-II	Theraja, B.L.	S. Chand, New Delhi, 2011
2	Electrical Technology	Uppal, S.L.	Khanna Publication, New Delhi, 2011
3	Electrical Machine	Nagrath, I.J. and Kothari, D.P.	Tata McGraw Hill, New Delhi, 2011
4	Electrical Machines	Despande, M.V.	Prentice Hall of India, New Delhi, 2011
5	Electrical Machine-I	Gupta, J. B.	S. K. Kataria & Sons, New Delhi, 2011

B. List of Major Equipment/Materials with Broad Specifications

- i. DC shunt ,series and compound motor – 230 V DC , 19 A, 1000 RPM, 5HP

- ii. DC shunt motor-generator set – 230 V DC, 16 A, 1000 RPM, 5 HP
- iii. Single phase transformer – 230 V / 115 V, 1 kVA 1-phase transformer
- iv. Auto transformer : 0 – 230 V, 10 Amp
- v. Welding transformer: 50 V, 50 /100 Amp

C List of Software/Learning Websites

- i. www.nptel.com/iitm/
- ii. www.howstuffworks.com/
- iii. www.vlab.com

9. COURSE CURRICULUM DEVELOPMENT COMMITTEE

Faculty Members from Polytechnics

- Shri. R.L. Patel, Sr. Lecturer, Electrical engineering Department, Govt. Polytechnic, Jamnagar
- Shri M. J. Aghara, Sr. Lecturer, Electrical Engineering Department, Govt. Polytechnic, Rajkot
- Shri A. P. Shah, Lecturer, Electrical Engineering Department, B. & B. Institute of Technology, V.V.Nagar
- Shri V. C. Jagani, Sr. Lecturer, Electrical Engineering Department, Govt. Polytechnic, Junagadh.
- Shri K. V. Dave, Sr. Lecturer, Electrical Engineering Department, Govt. Polytechnic, Rajkot

Coordinator and Faculty Members from NITTTR Bhopal