

GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

Course Curriculum

Dc Machines & Transformer (Code: 3332401)

Diploma Programme in which this course is offered	Semester in which offered
Power electronics	Third

1. RATIONALE

The aim of introducing this course is to impart knowledge of basic energy conversion in transformer and DC machines. Through the study of this course the diploma engineering students will get adequate knowledge of construction, working, classification and performance of various types of electrical machines for working in any type of industries.

2. COMPETENCY

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

- Operate different types of transformers and DC machines.

3. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	PA	ESE	PA	150
4	0	2	6	70	30	20	30	

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

4. COURSE DETAILS

Unit	Major Learning Outcomes ('Course Outcomes' in Cognitive Domain according to NBA terminology)	Topics and Sub-topics
Unit – I DC Generator	1a. Describe the construction of DC Machines with neat sketches.	1.1. Various parts of DC machine like yoke, winding, commutators, brushes, lap and wave winding, etc.
	1b. Explain working principle of DC generator.	1.2. Basic principle of DC Generator, Flemings right hand rule.
	1c. Classify DC generators with neat diagrams.	1.3. Separately excited, self excited-particularly shunt, series and compound wound type generator.
	1d. Explain the concept of voltage build up and losses.	1.4. E.M.F. equation of generator and various losses in generator.
	1e. Describe various characteristics of DC generator.	1.5. No-load, internal and external characteristics
	1f. Describe armature reaction and commutation.	1.6. Armature reaction and its effects. 1.7. Commutation
	1g. Explain requirement for Parallel operation of DC generator.	1.8. Parallel operation of DC generator.
	1h. List the applications of DC Generator.	1.9. Applications of DC generator.
Unit – II DC Motor	2a. Explain the working of DC motor.	2.1. Basic principle of DC motor, Flemings left hand rule.
	2b. Describe the concept of back emf, voltage equation, torque, speed, losses and efficiency.	2.2. Back emf and voltage equation, condition for maximum power, torque relation, shaft torque, relation between torque and speed of motor, losses and efficiency.
	2c. Describe the behaviour of DC series, shunt and compound motor.	2.3. Different characteristics of DC series, shunt and compound motor.
	2d. List the applications of D.C. Motors.	2.4. General applications of shunt, series, and compound motor.
Unit – III Starting, braking and speed control of DC motor.	3a. Describe starters used in DC Motor.	3.1. Need of starter in DC motor, three-point, four point starter, supporting conventional resistance and static power electronics converter control.
	3b. Explain different types of braking in DC motors.	3.2. Braking: dynamic, plugging, regenerative; shunt, series and compound motor.
	3c. Explain speed control methods of DC Motors.	3.3. Speed control method: armature, field 3.4. Speed control using power electronics static converter along with DC motor supporting static power electronics converter.
Unit – IV Single phase Transformer	4a. Classify the transformers based on different criteria.	4.1. Construction: core type and shell type transformer 4.2. Classification: according to frequency groups,

Unit	Major Learning Outcomes ('Course Outcomes' in Cognitive Domain according to NBA terminology)	Topics and Sub-topics
		<p>mode of operations, purpose of usage and according to cooling systems.</p> <p>4b. Explain the concept of Ideal & practical transformer.</p> <p>4c. Differentiate exact and equivalent circuit</p> <p>4d. Derive performance parameters using OC and SC test.</p> <p>4e. Explain the phasor/ vector diagram with sketches.</p> <p>4f. Determine the various losses, performance indices viz., efficiency/all day-efficiency and voltage regulation etc.</p> <p>4g. Describe parallel operation of single phase transformer.</p>
Unit – V Three phase transformer	<p>5a. Explain the three phase transformer connections with sketches.</p> <p>5b. Explain the working of Instrument transformers.</p> <p>5c. Explain the working of Pulse transformer.</p> <p>5d. Explain the working of Tap changing transformer.</p> <p>5e. Explain the working of variable frequency transformer.</p> <p>5f. Explain the working of audio-frequency transformer.</p> <p>5g. List the applications of the above transformers in the field of power electronics.</p>	<p>4.3. Difference between ideal and practical transformer.</p> <p>4.4. Diagram of exact and approximate equivalent circuit of single phase transformer.</p> <p>4.5. Open-circuit and short circuit test for determining equivalent circuit parameters of single phase transformer.</p> <p>4.6. Phasor diagram of transformer on no load, resistive, lagging pf and leading pf.</p> <p>4.7. Iron and copper loss transformer, calculation of losses, voltage regulation of transformer, condition for zero and maximum regulation, efficiency and condition for maximum efficiency, all-day-efficiency(distribution transformer).</p> <p>4.8. Essential and desirable conditions, polarity test and parallel operation on single phase transformers.</p> <p>5.1. Star-star, star-delta, delta-star, delta-delta connection, Scott connection, input-output voltage and current relations for these connections.</p> <p>5.2. Potential and current transformers.</p> <p>5.3. Pulse transformer, and its input-output waveform.</p> <p>5.4. Off-load and on load tap changing</p> <p>5.5. Variable frequency transformer including mid-band, high and low frequency region.</p> <p>5.6. Audio frequency transformer at different frequency response.</p> <p>5.7. Applications of various transformer in the field of power electronics.</p>

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	DC. Generator	12	06	04	02	15
II	DC. Motor	12	06	04	02	15
III	Starting, braking and speed control of DC motor.	08	02	03	03	10
IV	Single phase transformer	12	06	04	02	15
V	Three phase transformer	12	06	04	02	15
Total		56	26	19	11	70

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

6. SUGGESTED LIST OF EXERCISES/PRACTICAL

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

Note: Here only course 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/Exercise (‘Course Outcomes’ in Psychomotor Domain according to NBA terminology)	Approx Hours Required
1.	I	Perform open circuit test on a separately excited DC shunt generator to plot the magnetisation characteristics	02
2.	I	Obtain External & Internal characteristics of DC Shunt generator.	02
3.	II	Identify various parts of a DC motor and explain the functioning of each part.	01
4.	II	Identify the parts of DC 3 point and 4 point starter and explain the functioning of each part.	01
5.	II	Perform speed control of DC Series motor using (i) Armature Control (ii) Field Control.	04
6.	II	Perform speed control of DC Shunt motor using Field Control.	02
7.	II	Perform speed control of DC Shunt motor using Armature Control.	02
8.	II	Determine losses and efficiency of DC shunt motor by Swin-burne test.	02
9.	III	Conduct experiment to demonstrate braking in DC Motor.	02
10.	IV	Identify various parts of transformer.	01
11.	IV	Perform OC test on single phase transformer.	02

S. No.	Unit No.	Practical/Exercise (‘Course Outcomes’ in Psychomotor Domain according to NBA terminology)	Approx Hours Required
12.	IV	Perform SC test on single phase transformer	02
13.	IV	Perform load test on single phase transformer.	02
14.	IV	Perform voltage ration and polarity test on single phase transformer.	02
15.	IV	Operate two single phase transformer in parallel.	02
16.	V	Perform Scott connection test on 3 phase transformer.	02
17.	V	Perform open delta connection test on 3 phase transformer.	02
Total			33

7. SUGGESTED LIST OF STUDENT ACTIVITIES

- i. Students may prepare charts, models of different types of DC Machines/Transformers.
- ii. Students may survey the market to collect specification and cost of different type of DC Machines/Transformers available in the market.

8. SPECIAL INSTRUCTIONAL STRATEGIES (If Any):

- i. A visit to generating substation of small scale industries to demonstrate working of DC Generator, DC Motor, single phase and three phase transformer may be arranged.
- ii. Video/animation films may be shown on working principles of DC Machines and Transformers.
- iii. The continuous evaluation of theory may include the following activities;
 - Class Test/objective test/surprise test
 - Internet/ Library based Assignments
 - Seminar/Symposium on application of electrical machines
 - Mini Projects

9. SUGGESTED LEARNING RESOURCES

(A) List of Books:

S. No.	Title of Books	Author	Publication
1	Electrical Machines	Nagrath I. J. & Kothari D. P	Tata McGraw-Hill Education (2010)
2	Electrical Technology	Theraja B. L.	S. Chand Publishers (2010)
3	Electrical Technology	Uppal S. L.	Khanna Publishers (1997)
4	Electrical Machines-I	Gupta J.B.	S.K. Kataria & Sons. (2010)
5	Electrical Technology-I	Baxi U. A. & Baxi V. U.	Technical publications, (2009)
6	Electrical Machinery	Dr. Bhimra P. S.	Khanna Publishers (2011)
7	Electrical Machines	Say M. G.	CBS Publishers (2002)

B. List of Major Equipment/Materials

- i. 1-phase transformer and 3-phase transformer of 1KVA to 5 KVA ratings
- ii. DC Motor/DC Generator of 0.75 hp to 1hp and its various parts.
- iii. Clamp on meter/Multi-meter/tachometer/DS

C List of Software/Learning Websites/Journals

1. Electrical India, Monthly magazine, Chary Publications, Mumbai.
2. Power Line, Monthly magazine, India infrastructure publishing Pvt.Ltd, New Delhi, India.
3. EMMA journal, Connect Journals, Ghajiyabad, India.
4. Electronics for you, Monthly magazine, EFY Enterprise, New Delhi, India
5. MATLAB software
6. PSIM software
7. Lab view software
8. <http://www.animations.physics.unsw.edu.au/jw/AC.html>
9. <http://en.wikipedia.org/wiki/Transformer>
10. <http://www.alpharubicon.com/altenergy/understandingAC.htm>
11. www.ieee.org
12. www.oreilly.com/openbook
13. www.honganbooks.com
14. www.faadooengineers.com
15. www.getbookee.org
16. www.emetor.com
17. www.infolytica.com
18. www.motor-design-software.com

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

- **Prof.V.N. Makwana**, LPE, Power Electronics Dept., Dr. S. &S. S. Ghandhy College of Engineering & Technology, Surat.
- **Prof. S.L. Dhoriyani**, LPE, Power Electronics Dept., Dr. S. &S. S. Ghandhy College of Engineering & Technology, Surat.

Coordinator and Faculty Members from NITTTR Bhopal

- **Dr. Joshua Earnest**, Professor, Department of Electrical and Electronics Engineering.
- **Dr. Shashi Kant Gupta**, Professor and Coordinator for State of Gujarat