GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Engineering

Level: Diploma

Branch: Automation & Robotics

Course / Subject Code : DI03041041

Course / Subject Name : Electrical Machines

w. e. f. Academic Year:	2024-25
Semester:	3rd
Category of the Course:	PCC

Prerequisite:	Basic concepts of Electricity and magnetism
Rationale:	The syllabus provides Diploma Automation and Robotics Engineering students with foundational machine knowledge for modern automation and robotic systems. Electrical machines are crucial for converting energy between electrical and mechanical forms, and they are fundamental to modern life, playing a vital role in everything from domestic appliances to industrial processes and even renewable energy systems. These machines, including generators, motors, and transformers, are essential for powering our homes, transportation, and industries.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
01	Use energy conversion principles in electro-mechanical systems.	R & U
02	Distinguish types of D.C. Generators and D.C. Motors.	R, U & A
03	Interpret constructional and operational features of transformer.	R, U & A
04	Distinguish types of A.C. Motors.	R, U & A
05	Use the special purpose machine for their relevant applications.	R, U & A

**Revised Bloom's Taxonomy (RBT)*

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Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	ESE (E)	PA(M)	PA(I)	ESE (V)	
3	0	0	3	70	30	00	00	100

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	**ENERGY CONVERSION PRINCIPLES** 1.1. Law of conservation of energy 1.2. Role of electrical energy and uses 1.3. electro-mechanical energy conversion principles and devices 1.4. Condition of production of e.m.f. 1.5. singly excited and doubly excited field system	**04**	10
2.	**D.C. GENERATOR AND D.C. MOTOR** 2.1 Working principle of DC generator (Single loop generator, action of commutator) 2.2 Construction of DC generator 2.3 E.M.F. equation of DC generator 2.4 Types of DC generator 2.5 Power stage and Losses in DC generator 2.6 Condition for maximum efficiency 2.7 Applications of DC generator 2.8 Working principle of D.C. motor 2.9 Significance of the Back EMF 2.10 Voltage equation of DC motor 2.11 Types of DC motor 2.12 Torque in DC motor (Armature torque, Shaft torque and BHP) 2.13 Speed of DC motor 2.14 Power stage and Losses in DC motor 2.15 Applications of DC motor	**16**	35

	2.16 Comparison of DC generator and DC motor		
3.	**TRANSFORMER** 3.1 Working principle of transformer, construction and types 3.2 Theory of an ideal transformer 3.3 E.M.F. equation of a transformer 3.4 Transformer with load and no load 3.5 Losses of transformer 3.6 Efficiency of transformer, condition for maximum efficiency 3.7 Voltage regulation and application of transformer	**9**	20
4.	**INDUCTION MOTOR** 4.1 Working principle of induction motor and its construction 4.2 Rotating field due to two phase and three phase supply 4.3 Torques and condition for maximum torque (Starting and running) 4.4 Effect of change in supply voltage on speed and torque 4.5 Power stage in induction motor	**6**	10
5.	**SYNCHRONOUS MOTOR** 5.1 Principle of synchronous motor and construction 5.2 Starting methods. 5.3 Effect of change in excitation 5.4 Applications	**4**	10
6.	**SPECIAL PURPOSE MACHINES** 6.1 Types, construction, working of stepper motor 6.2 Working principle of Permanent magnet DC motor 6.3 Principle of brushless DC motor 6.4 Working principle of Servomotor 6.5 Working principle of synchros 6.6 Applications of Stepper, PMDC, BLDC, Servo motor and synchros.	**6**	15
	Total	**45**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
25	**50**	**25**	**-**	**-**	**-**

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

Sr. No	Title of Book	Author	Publication with place, year and ISBN
1	A Textbook of Electrical Technology Volume – II: AC and DC Machines	B. L. Thereja and A. K. Theraja	S. Chand Publishing, 2025, ISBN : 9789355018250
2	Principle of Electrical Machines	V K Mehta & Rohit Mehta	S. Chand Publishing, 2002 ISBN : 9788121921916
3	Electrical Machines	S. K. Bhattacharya	McGraw Hill Education. New Delhi, 2017, ISBN: 9789332902855
4	Electrical Machine-I	Gupta, J. B.	S. K. Kataria & Sons, New Delhi, 2013, ISBN : 9789350144916
5	Electrical Machine	P.K. Mukherjee And S. Chakravorti	Dhanpat Rai Publications (P) Ltd. 2nd revised edition ISBN: 9788189928667

(b) Open source software and website:

1. https://onlinecourses.swayam2.ac.in/ntr25_ed47/preview (Electrical motors and transformers)
2. https://archive.nptel.ac.in/courses/108/105/108105155/ (Electrical Machine-I)
3. https://archive.nptel.ac.in/courses/108/105/108105131/ (Electrical Machines-II)
4. https://www.youtube.com/watch?v=6NC5CyRNGmk&list=PLoZc0Q6MPz9Me09xv2d5dBZLfYftxl-DX
5. https://www.youtube.com/watch?v=JXmrmfMFdLc&list=PL_mruqjnuVd9gwSDO9GOx2P6rTIyAkwjv
6. https://www.electrical4u.com/electrical-engineering-articles/transformer/
7. www.vlab.co.in

List of Laboratory/Learning Resources Required:

- Computer System, smart phone & LCD Projector

Suggested Activities for Students:

- Take visit to nearby industries/substation where medium or big size DC machines/Transformers are installed.
- Identify major parts/accessories and their features and functions should be understood.
- Present seminar on various topics from course content.
- Undertake a market survey of various machines required for different application.
- Enhance knowledge and skills through additional online learning and certification programs.
- Show animation/ video films related to course content.
- Simulate experiment with circuits and concepts virtually through online platforms or software.
- Analyze real-world applications of electrical machines.
- Foster collaborative learning and deeper understanding of concepts through peer discussion and problem-solving.
- Encourage creativity and teamwork by designing and building circuits to meet specific challenges.

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