



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Engineering

Level: Diploma

Branch: Power Electronics

Course / Subject Code: DI03024021

Course / Subject Name: DC Machines and Transformer

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

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, troubleshooting, maintenance and performance various types of DC machines and transformer for working in any type of industries.
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Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
01	Use different types of DC generators.	R,U,A
02	Operate different types of DC motors.	R,U,A
03	Perform routine test on 1-phase transformer.	R,U,A
04	Connect different types of 3-phase transformer for various industrial applications.	R,U,A
05	Maintain various types of DC motor and Transformers.	R,U,A

**Revised Bloom's Taxonomy (RBT)*

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
L	T	PR		C	Theory		Tutorial / Practical	
			ESE (E)		PA(M)	PA(I)	ESE (V)	
3	0	2	4	70	30	20	30	150



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Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	DC Generator Conservation of Energy, Energy stored in Magnetic Field, Forces and torque in magnetic systems, Singly Excited System. Basic principle of DC Generator, Fleming's right-hand rule. Various parts of DC generator: yoke, pole core and pole shoes, armature winding, commutators, brushes, lap and wave winding. Separately excited, self-excited-particularly shunt, series and compound wound type generator. E.M.F. equation of generator and various losses in generator. No-load, internal and external characteristics, Applications of DC generator.	10	23%
2.	DC Motor Basic principle of DC motor: Fleming's left-hand rule. Back EMF and voltage equation, condition for maximum power, torque relation, shaft torque, relation between torque and speed of motor, losses and efficiency. Different characteristics of DC series shunt and compound motor. Need of starter in DC motor, three-point, four-point starter. Speed control method: armature, field. General applications of shunt, series, and compound motor.	11	24%
3.	1-Phase Transformer Basic principle: Mutual inductance, EMF equation, voltage and turns ratio. Classification and Constructions of transformer. Properties of ideal transformer, Equivalent circuit of ideal transformer. Properties of Practical transformer, transformer with winding resistance and leakage reactance. Equivalent circuit of practical transformer. Transformer test: Open-circuit (No load test), Short circuit test, Polarity test, load (back-to-back) test. Transformer losses: Iron (core) loss (hysteresis and eddy current loss), Copper (I^2R) loss, stray loss and dielectric loss. Variac: working principle, advantages and application. Transformer name plate reading.	11	24%



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4.	<p>3-Phase transformer. Construction, Advantages, Labeling of transformer terminals. 3-Phase transformer connections:</p> <ul style="list-style-type: none"> • Star-Star: 0° and 180° connections, Problems and solutions. • Delta-Delta: 0° and 180° connections, Advantages and disadvantages. • Star-Delta: ±30°connections, application and advantages • Delta-Star: ±30°connections, application and advantages • Choice of connections: star/star, delta/delta, star/delta. <p>Input-output voltage and current relations for these connections. Load test on 3-phase transformer.</p>	6	14%
5.	<p>Maintenance and troubleshooting of DC machine and Transformer. <u>DC Machine:</u> Armature problems: troubles and remedies of commutators and brush gear. Factors affecting the life of commutator brush and slip ring. Locate short circuit, earth fault and open circuit in shunt field coil. Locate open circuit in armature coils. Troubles with DC motor, their cause and remedies.</p> <p><u>Transformer:</u> cause of transformer failures Fault with developed gases: arcing, corona, sparking, overheating. Buchoz relay: features, working principle, Operation, application. Causes of noise in transformer.</p>	7	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
20	60	20			

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



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References/Suggested Learning Resources:

(a) Books:

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	A Textbook Of Electrical Technology: Vol 2 AC And DC Machines	Theraja B.L., Theraja A.K..	S. Chand, New Delhi, 2014, ISBN: 978-8121924375
2	Electrical Machines	Nagrath I. J. & Kothari D. P	McGraw Hill Education,2010 ISBN 978-0070699670
3	Electrical Machinery	Bimbhra P.S.	Khanna Publishers,2021 ISBN: 978-9389139105
4	Electric Machines	Husain Ashfaq, Harroon Ashfaq	Dhanpat Rai & Co. 2016 ISBN: 978-8177001662
5	Testing Commissioning Operation & Maintenance of Electrical Equipments	Rao S.	Khanna Publishers,2021 ISBN: 9788174091857
6	Electric motor Maintenance and Troubleshooting.	Augie Hand	McGraw Hill Education, 2011 ISBN: 978-0071763950
7	Electrical Equipment Handbook	Philip Kiameh	McGraw Hill Education, 2011 ISBN: 9780071396035

(b) Open-source software and website:

1. <https://www.vlab.co.in>
2. <https://nptel.ac.in>
3. <https://ocw.mit.edu/courses/6-685-electric-machines-fall-2013/>
4. <https://swayam.gov.in/>
5. <https://shodhganga.inflibnet.ac.in>

Suggested Course Practical List:

S. No.	Practical list
1.	Identify the parts of D.C. machines, note down the name plate details and interpret it.
2.	Identify the terminals, and test the field and armature windings of a DC machine for open circuit, short circuit and ground faults using test lamp / megger



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S. No.	Practical list
3.	Perform open circuit test on a separately excited DC shunt generator to plot the magnetization characteristics
4.	Obtain External & Internal characteristics of DC Shunt generator.
5.	Obtain External & Internal characteristics of DC compound generator.
6.	Connect, start and run a DC. Motor using a 3 point and or 4-point starter
7.	Control the Speed of DC shunt motor by Field Control Method. Plot the graph.
8.	Control the Speed of DC shunt motor by Armature voltage control. Plot the graph.
9.	Draw the Speed v/s armature current characteristics of a DC shunt motor.
10.	Perform speed control of DC Series motor using (i) Armature Control (ii) Field Control.
11.	Identify various parts of 1-Phase transformer.
12.	Perform OC test on single phase transformer.
13.	Perform polarity test on single phase transformer.
14.	Perform SC test on single phase transformer
15.	Perform load test on single phase transformer.
16.	Perform voltage ration and polarity test on single phase transformer.
17.	Identify various parts of 3-Phase transformer.
18.	Identify various parts of Current and Voltage transformer.
19.	Identify various parts of Pulse transformer.
20.	Perform Scott connection test on 3-phase transformer.
21.	Prepare maintenance schedule and troubleshooting chart for DC machine
22.	Prepare maintenance schedule and troubleshooting chart for transformer.
23.	Conduct dielectric strength test on transformer oil.

List of Laboratory/Learning Resources Required:

S. No.	Equipment Name with Broad Specifications
1.	M-G. Set D.C.-D.C. 1/3kW 110/220V D.C. (shunt) with starter. with panel board indicating motor, Generator, meters brought out connections to connecting terminals.
2.	M-G. Set D.C.-D.C. 1/3kW 110/220V D.C. (Compound) with starter. with panel board indicating motor, Generator, meters brought out connections to connecting terminals
3.	Variac: 3phase (O/P: 0-450V,15A, input: 3ph 400V) and 1-phase (O/P: 0-240V,15Amp, input-230V)
4.	Wire wound rheostats –assorted ranges.



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S. No.	Equipment Name with Broad Specifications		
5.	Tachometers- Analog 0-5000 RPM, portable ammeter and voltmeter, multimeter.		
6.	Cut Section of DC Shunt Motor:		
	Voltage	<100 V	
	Type	Externally Excited	
	Torque	<0.20 mNm	
	Power	<50 W	
	Current	<100 mA	
7.	Commutation		Brush
	Transformer oil testing kit		
	Capacity	60KVA	
	Display	ANALOG	
	Frequency	50HZ	
Input Voltage	220VAC		

Suggested Project List:

1. Make a Presentation a various types of DC motor and Transformer used in relevant industries.
2. Prepare a report of strategies for installing DC motors.
3. Prepare a report of strategies for installing Transformer.

Suggested Activities for Students:

1. Interpret name plate details of various DC machine and transformer.
2. Make a chart of Classification for DC motor and generator with practical applications.
3. Make a chart of Classification for transformers with practical applications.
4. Undertake a market survey for special purpose DC motors.
5. Undertake a market survey for special types of Transformers.
