

GANPAT UNIVERSITY

FACULTY OF DIPLOMA ENGINEERING

Programme	Diploma in Electrical Engineering				
Semester	III		Version	1.0.0.0	
Effective from Academic Year	2026-27		Effective for the batch Admitted in	JULY 2025	
Course code	1EE3101	Course Name	DC Machine and Transformer		

I. TEACHING-LEARNING AND ASSESSMENT SCHEME

Course Type	Course code	Course Title	Teaching & Learning Scheme								Examination Scheme								
			Credit				Actual Contact Hrs/week			SLH	Total Learning Hrs/Week	TH			PR			SLA	Total
			CL	TL	LL	Total	CL	TL	LL			CE	SEE	Total	CE	SEE	Total		
DSC	1EE3101	DC Machine and Transformer	4	0	2	5	4	0	4	2	10	40	60	100	60	40	100	20	220

Abbreviation:	CL- Classroom Learning	TL - Tutorial Learning	LL - Laboratory Learning
	SLH - Self Learning Hours	SLA - Self Learning Assessment	SA - Summative Assessment
	CE – Continuous Evaluation	SEE – Semester End Examination	

II. PRE-REQUISITES

Electrical Engineering Fundamentals, Electric & Magnetic Circuits and Electromagnetism

III. INDUSTRY / EMPLOYER EXPECTED OUTCOMES

Despite technological advancements in electrical technology, DC machines continue to play a significant role in many industrial and commercial applications. Transformers play a critical role in modern power systems, ensuring efficient energy transmission and distribution. This course provides students with core principles and hands-on skills in electrical machines. It builds a strong theoretical and practical foundation for careers in electrical engineering and related fields. By the end of the course, Learners will gain expertise in key components like DC machines and Transformers, preparing them for industry demands.

IV. COURSE LEARNING OUTCOMES

At the end of the course, students will be able to achieve the following course learning outcomes:

- CO1.** Understand the principles and methods of energy conversion.
- CO2.** Analyze the construction, working, and performance of DC generators.
- CO3.** Evaluate the operation, characteristics, and applications of DC motors.
- CO4.** Interpret the construction, working, and efficiency of single-phase transformers.
- CO5.** Apply testing methods to assess performance and efficiency of single-phase transformers.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT:

Name of Unit	Theory Learning outcomes (TLO's) aligned to CO's	Learning Content mapped with Theory Learning outcomes (TLO's) & CO's	Marks	Hours
Unit-1 Energy Conversion Principles	TLO 1.1 Law of conservation of energy TLO 1.2 Role of electrical energy TLO 1.3 Conditions for EMF production TLO 1.4 Singly and doubly excited field system	1.1 Energy conservation law 1.2 Electrical energy and its uses. 1.3 Electro-mechanical energy Conversion principle and EMF 1.4 Singly excited and doubly excited electrical machines.	04	04
Unit-2 DC Generators	TLO 2.1 Different parts of DC machine. TLO 2.2 EMF equation of DC generator. TLO 2.3 Working DC Generator. TLO 2.4 Different types of	2.1 Construction and materials used for various parts of DC generator. 2.2 EMF equation of DC Generator. 2.3 Working principle of DC generator	15	15

	<p>armature winding. TLO 2.5 Classify different types of DC generator with sketches TLO 2.6 Performance characteristic of different types of DC Generators TLO 2.7 Losses and efficiency. TLO 2.8 Armature reaction and commutation</p>	<p>2.4 Simplex lap and wave winding. 2.5 Different types of DC Generators. 2.6 Characteristics of various types DC generators. 2.7 Efficiency and losses of DC generator. 2.8 Armature reaction and its effects and commutation</p>		
<p>Unit-3 DC Motors</p>	<p>TLO 3.1 Working of DC motor. TLO 3.2 Torque equation of DC motor. TLO 3.3 Need of DC motor starter. TLO 3.4 Working of DC motor starter. TLO 3.5 Different types of DC motors. TLO 3.6 Performance of different types of DC motors. TLO 3.7 Speed control of DC motor. TLO 3.8 Losses and efficiency TLO 3.9 Brake test, Swinburne's test and field test. TLO 3.10 BLDC motor TLO 3.11 Applications of various types of DC motors</p>	<p>3.1 Working principle of DC motor, back emf. 3.2 Torque equation for DC motor. 3.3 Need DC motor starters. 3.4 Construction and working of DC motor starters. 3.5 Series, Shunt and Compound DC motors. 3.6 Performance characteristics of DC Series, Shunt and Compound motor. 3.7 Speed control of D.C. Motor. 3.8 Losses in DC motors and its computation. 3.9 Brake test, Swinburne's test, field test. 3.10 Construction and working of BLDC motor. 3.11 Applications of DC Series, Shunt and compound motor.</p>	15	15
<p>Unit-4 Single Phase Transformer</p>	<p>TLO 4.1 Working of a single-phase transformer with sketches TLO 4.2 Derive EMF equation of transformer and transformation ratio TLO 4.3 Differentiate between core and shell type transformer with sketches. TLO 4.4 Performance of the transformer on no load, resistive, inductive, and capacitive loads with phasor diagrams TLO 4.5 Various losses in transformer TLO 4.6 Derive expression for efficiency</p>	<p>4.1 Single phase transformer: Working principle, construction, materials used for different parts. 4.2 EMF equation and transformation ratio. 4.3 Core and shell type of transformers. 4.4 No load and On load phasor diagram. 4.5 Losses of transformer, separation of core loss. 4.6 Efficiency Condition for maximum efficiency of single phase transformer. 4.7 Voltage regulation, application of transformer.</p>	18	18

	and the condition for maximum efficiency of a single-phase transformer TLO 4.7 Significance of voltage regulation TLO 4.8 Describe working of an autotransformer with sketches. TLO 4.9 Various parameters for the transformer equivalent circuit	4.8 Auto transformer: construction and working. 4.9 Equivalent circuit of single phase transformer.		
Unit-5 Testing of single-phase transformer	TLO 5.1 State the need for conducting different types of tests on single phase transformers. TLO 5.2 Describe the steps for conducting various test of single phase transformer. TLO 5.3 Describe the need and conditions for parallel operation of transformers	5.1 Direct load test, OC and SC test and Back to Back Test along with connection diagrams, efficiency and regulation of transformer. 5.2 Need of parallel operation. 5.3 Conditions of parallel operation in single phase transformer. 5.4 Parallel operation and load sharing of single-phase transformer.	08	08

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL

Sr. No.	Practical/Laboratory Learning Outcome (LLO)	Practical Titles	Relevant COs
1	LLO 1.1 Examined construction, magnetic circuit, and commutation system of DC machine.	Demonstration of Cut-section of D.C. Machine.	CO2
2	LLO 2.1 Evaluated load characteristics, efficiency, and voltage regulation.	Test the Performance of a separately excited dc shunt generator.	CO2
3	LLO 3.1 Obtained external and internal characteristics considering armature reaction and voltage drop.	Test the DC shunt generator for external and Internal load characteristic	CO2
4	LLO 4.1 Analyzed voltage–current and load characteristics of series excitation.	Test Performance characteristic of DC series generator.	CO2
5	LLO 5.1 Studied cumulative compounding effect and voltage regulation under load.	Test the DC compound generator for external and Internal load characteristic	CO2
6	LLO 6.1 Analyzed starting current limitation and protective features (NVC and OLR).	Demonstration of operating mechanism of three-point starter of D.C. shunt machine.	CO3
7	LLO 7.1 Verified speed control by armature voltage and field flux variation.	Perform speed control of dc shunt motor by armature and field control.	CO3
8	LLO 8.1 Studied stator–rotor structure, electronic commutation, and Hall sensors.	Study construction of BLDC motor and it's parts.	CO3
9	LLO 9.1 Verified turns ratio and voltage ratio relationship.	Transformation ratio of single-phase transformer.	CO4

10	LLO 10.1 Determined efficiency and voltage regulation under load.	Perform direct load test of single-phase transformer.	CO4
11	LLO 11.1 Determined equivalent circuit parameters, losses, efficiency, and regulation.	Perform Open circuit and short circuit test on single phase transformer to determine equivalent circuit parameters, voltage regulation and efficiency.	CO5
12	LLO 12.1 Verified load sharing and conditions for parallel operation.	Perform parallel operation on two single phase transformers.	CO5
13	LLO 13.1 Determined winding polarity for safe parallel operation.	Perform polarity test on single phase transformer.	CO5

VII. SUGGESTED MICRO PROJECT / ASSIGNMENTS / ACTIVITIES FOR SELF LEARNING / SKILL DEVELOPMENT (SELF LEARNING)

- Prepare chart showing different material used for various parts of D.C. machines.
- Collect specification from different manufacturers of D.C. machines and prepare market survey report.
- Collect specification from different manufacturers of single-phase transformer and prepare market survey report.
- Prepare simple model of single-phase transformer.
- Prepare chart of industrial applications of various types of D.C. motor and generator.
- Prepare chart of application single-phase transformer and auto transformer.
- Prepare report on power saving in BLD.C. motor.
- Prepare model of Lap and Wave winding of D.C. Machines.

VIII. LIST OF INSTRUMENTS / EQUIPMENT / TRAINER BOARD

1	Cut section of dc machine.
2	DC Shunt Generator – 3 KW, 230 V, 13.5 A, 1500 RPM
3	DC Series Generator – 3 KW, 230 V, 13.5 A, 1500 RPM
4	DC Compound Generator – 3 KW, 230 V, 18 A, 1500 RPM
5	DC Shunt Motor - 3 KW, 230 V, 11.8 A, 1500 RPM
6	1-phase transformer – 1 KVA, 230 V / 115 V

IX. LIST OF REFERENCE BOOKS

Sr. No.	Title	Author	Publication
1	A text book of Electrical Technology vol. II	B. L. Theraja & A.K. Theraja	S. Chand and Co., New Delhi,
2	Electrical Machines-II	J.B. Gupta	S. K. Kataria & Sons, New Delhi
3	Electrical Machines	Kothari D. P. and Nagrath I. J.	McGraw Hill Education. New Delhi, ISBN: 9780070699670.
4	Principles of Electrical Machines	Mehta V. K. and Mehta, Rohit	S. Chand and Co. Ltd., New Delhi, ISBN: 9788121930888.
5	DC Machines and Transformers	Murugesh Kumar K	S. Chand and Co. Ltd., New Delhi, I, ISBN: 9788125916055

X. LINK OF LEARNING WEB RESOURCE

1	https://youtu.be/D4RFFnzRdkk?si=d5iNR_WSZbl01NvT3
2	https://youtu.be/1OfLgpFq6Rc?si=bwN9d7_ESIV2Utz6
3	https://archive.nptel.ac.in/courses/108/105/108105155/
4	www.electricaltechnology.org
5	www.electrical4u.com

6	https://www.tutorialspoint.com/electrical_machines/index.htm
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XI. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE							
Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	Energy Conversion Principles	CO1	04	2	1	1	04
2	DC Generators	CO2	15	6	6	3	15
3	DC Motors	CO3	15	5	6	4	15
4	Single Phase Transformers	CO4	18	8	6	4	18
5	Testing of Single-Phase Transformers	CO5	08	4	2	2	08
Grand Total			60	25	21	14	60

XII. COs AND POs AND PSOs MAPPING										
Course outcome (Cos)	Programme Outcomes (POs)							Programme Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	1	1	1	1	1	0	0	2	1	0
CO2	3	3	2	3	2	0	1	3	3	0
CO3	3	3	2	3	2	0	1	3	3	0
CO4	3	2	2	2	1	0	1	2	2	0
CO5	3	2	2	3	1	0	1	3	2	0
Legends: - 3- High 2-Moderate/Medium 1-Slight/Low 0-None										