

GANPAT UNIVERSITY

FACULTY OF DIPLOMA ENGINEERING

Programme	Diploma in Electrical Engineering				
Semester	IV		Version	1.0.0.0	
Effective from Academic Year	2026--27		Effective for the batch Admitted in	JULY 2025	
Course code	1EE4101	Course Name	AC Machine		

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	1EE4101	AC Machine	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

This syllabus is designed to provide diploma students with a comprehensive understanding of core electrical machines widely used in industry, power systems and commercial applications. It builds foundational knowledge in the construction, working principles, performance characteristics and control methods of single-phase and three-phase induction motors and synchronous machines. Emphasis on energy-efficient designs and modern control techniques prepares students to meet current industrial standards and sustainability goals. Practical exposure through tests, maintenance, and troubleshooting equips them with skills to ensure reliable operation and enhance machine performance. This prepares students for technical roles requiring maintenance, repair, and optimization of electrical machines within evolving energy and industrial landscapes.

IV. COURSE LEARNING OUTCOMES

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

- CO1.** Know various transformer accessories.
- CO2.** Know 3 phase induction motor principle and related theories.
- CO3.** Know alternator and related theories.
- CO4.** Know synchronous motor and related theories.
- CO5.** Know 1 phase induction motor and related theories.

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 Poly Phase Transformer	<p>TLO 1.1 Advantage of 3-phase transformer over a bank of 3 single phase transformers.</p> <p>TLO 1.2 Major parts of the 3-phase transformer.</p> <p>TLO 1.3 Different types of connections of 3-phase transformer including vector groups.</p> <p>TLO 1.4 Various cooling methods.</p> <p>TLO 1.5 Need of parallel</p>	<p>1.1 Comparison of three phase transformer with bank of three single phase transformers.</p> <p>1.2 Construction of three phase transformer (Core and winding arrangement, Types of winding), Use of tap changer and losses.</p> <p>1.3 As per IS: 10028 (Part I)-1985 - Selection criteria of distribution transformer and power transformer.</p> <p>1.4 Winding connection and vector group, Accessories of three phase</p>	10	10

	operation of 3-phase Transformer.	transformer. 1.5 Cooling of transformer: Natural cooling, Forced cooling. 1.6 Parallel operation –essential and desirable conditions.		
Unit-2 Poly Phase Induction Motors	TLO 2.1 Rotating field produced by 3 phase induction motor. TLO 2.2 Squirrel cage and wound rotor induction motor with their salient features. TLO 2.3 Torque slip characteristics of 3-phase I.M. TLO 2.4 Testing of 3 phase induction motor. TLO 2.5 Various methods of speed control of 3 phase induction motor. TLO 2.6 Applications of three phase induction motors.	2.1 Construction and types, Applications. 2.2 Production of rotating magnetic field, Synchronous speed and Slip. 2.3 Torque equation, starting, running and condition for the maximum torque. 2.4 Torque-Slip Characteristics 2.5 Necessary and types of starters-DOL, star delta, autotransformer type and rotor resistance starter. 2.6 Losses and Power Stages in Induction Motor. 2.7 Equivalent circuit, No load test and Blocked rotor test. 2.8 Speed control of squirrel cage and slip-ring induction motor. 2.9 Different standards and specifications.	16	16
Unit-3 Alternator	TLO 3.1 Working principle of an alternator. TLO 3.2 Armature winding and its terminology. TLO 3.3 EMF equation. TLO 3.4 Determination of Voltage regulation of an alternator. TLO 3.5 Synchronize an alternator with infinite bus bar.	3.1 Working and construction-salient and cylindrical rotor. 3.2 Armature reaction and its effects on main flux. 3.3 Equivalent circuit and phasor diagram. 3.4 Voltage regulation by direct loading, synchronous impedance method, ampere turn method. 3.5 Need of parallel operation of alternator. 3.6 Synchronization of alternator with bus bar/alternator. 3.7 Cooling system of alternator.	12	12
Unit-4 Synchronous Motor	TLO 4.1 Connect and operate synchronous motor using proper starting method. TLO 4.2 Improve the power factor of the system using synchronous condenser. TLO 4.3 Features between the synchronous and induction motor.	4.1 Construction, working and it's starting methods. 4.2 Effect of change in excitation, V-curve and Inverted V-curve. 4.3 Synchronous condenser and power factor improvement. 4.4 Hunting and its prevention. 4.5 Different torque of a synchronous motor. 4.6 Applications of synchronous motor.	12	12
Unit-5 Single Phase Induction Motors	TLO 5.1 Working principle of different types of single phase motors. TLO 5.2 Working principle of different types of	5.1 Working of different types of single phase induction motors. 5.2 Fractional horse power motors. 5.3 Speed torque characteristic.	10	10

	fractional horse power motors. TLO 5.3 Applications of single-phase induction motors.	5.4 Equivalent circuit of single phase induction motor.		
--	---	--	--	--

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL

Sr. No.	Practical/Laboratory Learning Outcome (LLO)	Practical Titles	Relevant COs
1	LLO 1.1 Identified constructional parts and their functions.	Identify various parts of the three-phase transformer.	CO1
2	LLO 2.1 Learned practical determination of slip from rotor speeds.	To measure the value of slip of 3-phase induction motor by Tachometer method.	CO2
3	LLO 3.1 Analyzed starting current and torque control methods.	Make connection and study different types of starters used in 3-Phase induction motor.	CO2
4	LLO 4.1 Evaluated efficiency and performance under load.	Load test on 3-phase induction motor.	CO2
5	LLO 5.1 Determined equivalent circuit parameters and losses of an induction motor.	No load and block rotor test on induction motor.	CO2
6	LLO 6.1 Measured voltage regulation under actual load.	Measurement of voltage regulation of alternator using direct loading method.	CO3
7	LLO 7.1 Estimated regulation considering armature reaction.	Measurement of voltage regulation of alternator using ampere turns method.	CO3
8	LLO 8.1 Predicted regulation using OCC and SCC tests.	Measurement of voltage regulation of alternator using synchronous impedance loading method.	CO3
9	LLO 8.1 Understood synchronization and load sharing.	Parallel Operation of two Alternators.	CO3
10	LLO 10.1 Analyzed effect of field excitation on armature current and power factor.	Perform V-curve of synchronous motor.	CO4
11	LLO 11.1 Learned phase sequence control for changing motor rotation direction.	Reverse direction of single and three phase induction motor.	CO5
12	LLO 12.1 Observed power factor improvement and reduction in power consumption using capacitors.	Measurement of power with and without capacitor in single phase induction motor.	CO5

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

- Vector Group Testing – Verify Dyn11, Ynd1, etc. using a phase sequence indicator.
- Star-Delta Starter for 3-Phase Motors – Using a 3-phase transformer.
- Different types of starters and speed control methods of 3-phase I.M.
- Standards and specifications of 3-phase I.M. (IS, IEC, NEMA, efficiency classes)
- Starting methods: DOL, star-delta, auto-transformer.
- Slip measurement of 3-phase I.M. (tachometer, galvanometer, stroboscope)
- Standards and specifications of synchronous machines. (IS, IEC, NEMA)
- Power factor improvement demonstration of synchronous machines.
- Construct capacitor start/run motor model.

VIII. LIST OF INSTRUMENTS / EQUIPMENT / TRAINER BOARD	
1	Tachometers: Contact and non-contact types: 100 to 10000 RPM.
2	Cut section of 3-phase I.M.
3	3-Phase I.M. 5 HP, 7.5 A, 1440 RPM, 415 V
4	3-phase I.M. 3 HP, 4.5 A, 1440 RPM, 415 V
5	3-phase Alternator 3.5 KVA, 220 V, 8.1 A, 1500 RPM
6	3-Phase Load & 3-Phase Variac
7	Three Phase Synchronous Motor: 3HP, 415 V, 1500 RPM, 4-pole, 50 Hz

IX. LIST OF REFERENCE BOOKS			
Sr. No.	Title	Author	Publication
1	Theory & Performance of Electrical Machine”	J.B. Gupta	S. K. Kataria & Sons, New Delhi ISBN-13: 978-9350142776
2	Electrical Machines-II	J.B. Gupta	S. Chand and Co. Ltd., New Delhi, ISBN: 9788121924375.
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	Basic Electrical Engineering	Mittle V. N. and Mittle, Arvind.	McGraw Hill Education, New Delhi, ISBN: 9780070593572.
6	Electrical Machines	Bhattacharya S. K.	McGraw Hill Education, New Delhi, ISBN: 9789332902855.

X. LINK OF LEARNING WEB RESOURCE	
1	https://www.youtube.com/watch?v=exfUnnxnGEw&list=PLbRMhDVUMngeDrGXlt-hX-ekpldUIC2b6 -NPTEL Course on Electrical Machines - II NOC Jan 2019: Electrical Machines - II NPTEL IIT Kharagpur
2	https://www.youtube.com/playlist?list=PLqQE5uI_2_7k0601t2dt_3IHKqTjZpd4p- Single Phase Induction Motors
3	https://www.youtube.com/playlist?list=PLqQE5uI_2_7nMuEfgkX358-sJI3jpJG2 -Three Phase Induction Motors
4	https://www.youtube.com/playlist?list=PLqQE5uI_2_7k2QDlpPuxKQb5CxJLtNdGT -Three Phase Synchronous Motors
5	https://www.youtube.com/playlist?list=PLqQE5uI_2_7mzaJgqV25wNghzlbAljAct -Alternators
6	https://electrical-engineering-portal.com/category/electrical-machines - Electrical-Engineering Portal (EEP) - Technical articles on electrical machines - Good for deeper articles, case studies, maintenance practices

XI. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE

Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	Poly Phase Transformer	CO1	10	4	4	2	10
2	Poly Phase Induction Motors	CO2	16	8	6	2	16
3	Alternator	CO3	12	4	4	4	12
4	Synchronous Motor	CO4	12	5	4	3	12
5	Single Phase Induction Motors	CO5	10	4	4	2	10
Grand Total			60	25	22	13	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	3	2	1	2	3	2	0	3	2	1
CO2	3	1	3	3	0	3	1	2	3	1
CO3	3	3	1	2	0	1	3	3	2	3
CO4	2	2	3	0	1	3	2	1	3	2
CO5	3	1	2	0	3	2	2	3	1	2
Legends: - 3- High 2-Moderate/Medium 1-Slight/Low 0-None										