SEMESTER S4

DC MACHINES & TRANSFORMERS LAB

Course Code	PCEEL407	CIE Marks	50
Teaching Hours/Week (L: T:P: R)	0:0:3:0	ESE Marks	50
Credits	2	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	PCEET303	Course Type	Lab

Course Objectives:

1. Provide practical experience in operation and testing of DC machines and transformers

Expt. No.	Experiments
	PART A – DC MACHINES
1	**Open circuit characteristics of DC shunt generator (CO1)** Objectives: a. Predetermine the OCC at different speeds b. Determine the critical field resistance c. Determine the maximum voltage built up with given shunt field resistance d. Determine the critical speed for a given shunt field resistance
2	**Load test on DC shunt generator (CO1)** Objectives: Determine the external and internal characteristics
3	**Brake test on DC shunt motor (CO2)** Objectives: Plot the following characteristics a. Performance characteristics b. Electrical characteristics c. Mechanical characteristics

4	**Brake test on DC series motor (CO2)** Objectives: Plot the following characteristics a. Performance characteristics b. Electrical characteristics c. Mechanical characteristics
5	**Load test on DC compound generator (CO1)** Objectives: a. Plot the load characteristics when cumulatively compounded b. Plot the load characteristics when differentially compounded
6	**Swinburne's test on a DC shunt machine (CO3)** Objectives: a. Predetermine the efficiency while DC machine is acting as generator and motor b. Plot the efficiency curves while DC machine is acting as generator and motor
7	**Hopkinson's test on a pair of DC machines (CO3)** Objectives: Determine the efficiency the DC machine while working as a motor and generator under various load conditions
8	**Retardation test on a DC machine (CO3)** Objectives: a. Separate the hysteresis, eddy current, friction and windage losses b. Find the moment of inertia of the rotating system
9	**Separation of losses in a DC shunt motor (CO3)** Objectives: Separate the hysteresis, eddy current, friction and windage losses by conducting no-load tests at different excitations.
	PART B - TRANSFORMERS
10	**OC and SC tests on single-phase transformer (CO4)** Objectives: 1. Predetermine the voltage regulation and efficiency at different loads and power factors. 2. Determine the equivalent circuit referred to LV side and HV side 3. Plot the voltage regulation vs power factor curves at full-load and half full-load. 4. Plot the efficiency curve at unity p.f. and 0.5 p.f. 5. Determine the power factor at which the voltage regulation is zero 6. Determine the load at which maximum efficiency occurs and the maximum

	efficiency.
11	**Load test on single-phase transformer (CO4)** Objectives: Determine the voltage regulation and efficiency at different loads and at unity power factor.
12	**Separation of losses in a single-phase transformer (CO4)** Objectives: a. Separate the hysteresis and eddy current losses using voltage and frequency control. b. Plot losses Vs frequency curves at normal voltage and different frequencies c. Plot losses Vs frequency curves at different frequencies keeping V/f constant
13	**Sumpner's test (CO4)** Objectives: a. Predetermine the voltage regulation and efficiency at different loads (full-load and half full-load) and power factors (unity, 0.8 lag and lead) b. Determine the equivalent circuit referred to LV side and HV side
14	**Parallel operation of two dissimilar single-phase transformers (CO4)** Objectives: a. Determine the load sharing while two dissimilar transformers are operating in parallel b. Verify the load sharing by using the impedances of the two transformers
15	**OC and SC tests on 3-phase transformer (CO5)** Objectives: a. Predetermine the voltage regulation and efficiency at different loads (full-load and half full-load) and power factors (unity, 0.8 lag and lead) b. Determine the per phase equivalent circuit
16	**Scott Connections (CO4)** Objectives: Convert 3-phase AC supply into 2-phase AC by means of Scott connection and to conduct the load test for finding the performance
NOTE: A minimum of TWELVE experiments are mandatory out of the sixteen listed	

Course Assessment Method

(CIE: 50 marks, ESE: 50 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Preparation/Pre-Lab Work experiments, Viva and Timely completion of Lab Reports / Record (Continuous Assessment)	Internal Examination	Total
5	25	20	50

End Semester Examination Marks (ESE):

Procedure/ Preparatory work/Design/ Algorithm	Conduct of experiment/ Execution of work/ troubleshooting/ Programming	Result with valid inference/ Quality of Output	Viva voce	Record	Total
10	15	10	10	5	50

- *Submission of Record: Students shall be allowed for the end semester examination only upon submitting the duly certified record.*

- *Endorsement by External Examiner: The external examiner shall endorse the record*

Course Outcomes (COs)

At the end of the course students should be able to:

	Course Outcome	Bloom's Knowledge Level (KL)
CO1	Analyze the performance of DC generators by conducting load/no-load tests	**K3**
CO2	Sketch the performance characteristics of DC shunt and series motors	**K3**
CO3	Investigate the losses and efficiency in DC machines by conducting no-load tests	**K3**
CO4	Examine the performance of individual and parallel connected single-phase transformers by conducting load/no-load tests	**K3**
CO5	Determine the voltage regulation and efficiency of 3-phase transformer by conducting no-load tests.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO- PO Mapping (Mapping of Course Outcomes with Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2		2					3	2		3
CO2	3	2		2					3	2		3
CO3	3	2		2					3	2		3
CO4	3	2		2					3	2		3
CO5	3	2		2					3	2		3

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Reference Books			
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Electrical Machinery	P.S. Bimbhra	Khanna Publishers	7th edition 2021
2	Electric Machines	D P Kothari & I J Nagrath	Tata McGraw Hill	5th edition 2017

Continuous Assessment (25 Marks)

1. **Preparation and Pre-Lab Work (7 Marks)**
   - Pre-Lab Assignments: Assessment of pre-lab assignments or quizzes that test understanding of the upcoming experiment.
   - Understanding of Theory: Evaluation based on students' preparation and understanding of the theoretical background related to the experiments.

2. **Conduct of Experiments (7 Marks)**
   - Procedure and Execution: Adherence to correct procedures, accurate execution of experiments, and following safety protocols.
   - Skill Proficiency: Proficiency in handling equipment, accuracy in observations, and troubleshooting skills during the experiments.
   - Teamwork: Collaboration and participation in group experiments.

3. **Lab Reports and Record Keeping (6 Marks)**
   - Quality of Reports: Clarity, completeness and accuracy of lab reports. Proper documentation of experiments, data analysis and conclusions.
   - Timely Submission: Adhering to deadlines for submitting lab reports/rough record and maintaining a well-organized fair record.

4. **Viva Voce (5 Marks)**
   - Oral Examination: Ability to explain the experiment, results and underlying principles during a viva voce session.

Final Marks Averaging: The final marks for preparation, conduct of experiments, viva, and record are the average of all the specified experiments in the syllabus.

Evaluation Pattern for End Semester Examination (50 Marks)

1. **Procedure/Preliminary Work/Design/Algorithm (10 Marks)**

   - Procedure Understanding and Description: Clarity in explaining the procedure and understanding each step involved.
   - Preliminary Work and Planning: Thoroughness in planning and organizing materials/equipment.
   - Algorithm Development: Correctness and efficiency of the algorithm related to the experiment.
   - Creativity and logic in algorithm or experimental design.

2. **Conduct of Experiment/Execution of Work/Programming (15 Marks)**

   - Setup and Execution: Proper setup and accurate execution of the experiment or programming task.

3. **Result with Valid Inference/Quality of Output (10 Marks)**

   - Accuracy of Results: Precision and correctness of the obtained results.
   - Analysis and Interpretation: Validity of inferences drawn from the experiment or quality of program output.

4. **Viva Voce (10 Marks)**

   - Ability to explain the experiment, procedure results and answer related questions
   - Proficiency in answering questions related to theoretical and practical aspects of the subject.

5. **Record (5 Marks)**

   - Completeness, clarity, and accuracy of the lab record submitted