B.E/B.TECH DEGREE EXAMINATIONS: NOV/DEC 2024

(Regulation 2018)

Third Semester

ELECTRICAL AND ELECTRONICS ENGINEERING

U18EEI3201: Dc Machines and Transformers

COURSE OUTCOMES

CO1: Apply laws of magnetic circuits to understand the performance characteristics of DC machines and its applications.

CO2: Conduct and analyze various testing procedures of DC generators and motors.

CO3: Analyze performance characteristics of transformers and its applications.

CO4: Conduct and analyze various testing procedures of transformers

CO5: Select DC machines and transformers for various applications.

**Time: Three Hours**   **Maximum Marks: 100**

Answer all the Questions:-
PART A (10 x 2 = 20 Marks)
(Answer not more than 40 words)

1.	What is the role of magnetic circuits in the operation of DC machines?	CO1	[K_1]
2.	List the significance of critical field resistance in a shunt generator.	CO1	[K_2]
3.	A DC shunt generator has a field resistance of 200 Ω and an armature resistance of 0.3 Ω. If the supply voltage is 230 V, calculate the field current.	CO2	[K_4]
4.	A transformer operates at 90% efficiency when supplying a load of 500 W. Calculate the total power input to the transformer.	CO3	[K_4]

5. The back EMF in a DC motor is 220 V and the armature current is 10 A with an armature resistance of 0.5 Ω, calculate the applied voltage.   CO1   [K₄]
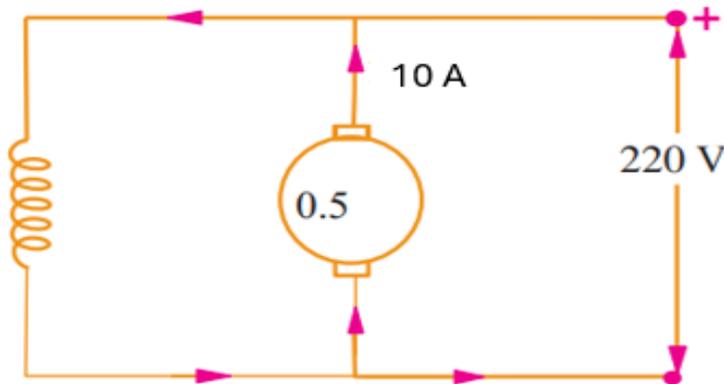
6. Outline the basic steps to be followed in performing Swinburne's test on a DC machine.   CO2   [K₃]

7. Mention the concept of all-day efficiency in transformers and analyze its importance for distribution transformers.   CO3   [K₄]

8. Two transformers operating in parallel share a total load of 100 kW in the ratio of 3:2. Calculate the load carried by each transformer.   CO3   [K₄]

9. Identify the role of each primary component in the equivalent circuit of a transformer.   CO3   [K₂]

10. How is Sumpner's test used for transformer testing and mention its advantages over other testing methods?   CO4   [K₄]

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Answer any FIVE Questions:-
PART B (5 x 16 = 80 Marks)
**(Answer not more than 400 words)**

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11.   **Scenario:**

An industrial manufacturing plant requires a reliable DC power supply for various heavy-duty machines. The plant has different types of loads that require DC motors with variable speeds for conveyor systems, heavy lifting equipment, and automated processes.

a)   A DC shunt generator with a rated output of 250V needs to supply a 15 A load. Given that the armature resistance is 0.2 Ω, calculate the terminal voltage if the armature current increases to 20 A due to an additional load. *(Include a labeled circuit diagram of a DC shunt generator)*   7   CO1   [K₃]

b)   Discuss the necessity of starters for DC motors in the industrial setup and describe a suitable starter for a DC shunt motor used in the conveyor system.   7   CO1   [K₄]

(Illustrate with a diagram of a three-point starter circuit)

c) Explain one advantage of using a series DC motor for lifting applications in such environments.   2   CO5   [K$_6$]

12.   **Scenario:** A renewable energy setup includes wind turbines that require transformers to step up generated voltage for efficient transmission to the grid. The transformers operate under varying load conditions due to fluctuations in wind speed.

a) A single-phase transformer with a primary voltage of 440 V and a secondary voltage of 11 kV is used. If the transformer operates at full load with an efficiency of 95%, calculate the input power and the output power assuming a load current of 50 A on the secondary side.   7   CO3   [K$_4$]
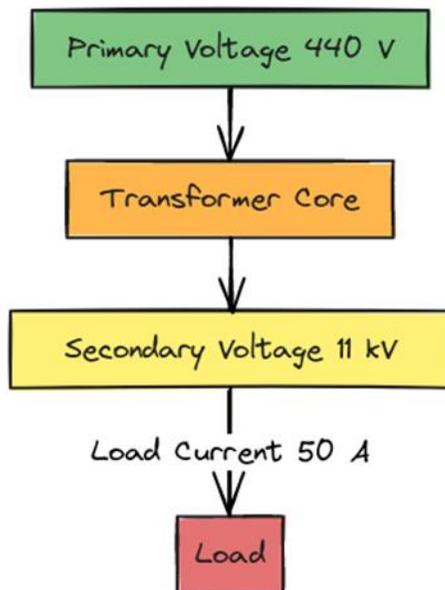
b) Discuss the impact of load variations on transformer performance and how this can affect the power supply from renewable energy sources to the grid.   7   CO3   [K$_2$]

c) Why are auto-transformers preferred in renewable energy applications for voltage adjustment in certain cases?   2   CO5   [K$_2$]

13. a) Describe the process of voltage build-up in a shunt generator. Include the conditions necessary for voltage build-up to occur. *(Include a diagram showing the voltage build-up process)*   7   CO1   [K$_2$]

b) Explain the principle and steps involved in Hopkinson's test. Why is it preferred for efficiency testing of DC machines? *(Provide a setup diagram for*   7   CO2   [K$_3$]

Hopkinson's test)

	c)	State one practical limitation of Hopkinson's test in industrial applications.	2	CO5	[K₁]

14.	a)	Derive the EMF equation of a transformer and explain each term in the equation.	7	CO3	[K₃]
	b)	Discuss the importance of polarity tests in transformers and describe the method for conducting a polarity test on a single-phase transformer.	7	CO4	[K₂]
	c)	Mention one real-world application where polarity testing of transformers is critical.	2	CO5	[K₂]

15.	a)	Explain the torque-speed characteristics of a DC series motor and its suitability for applications like electric traction.	7	CO1	[K₄]
	b)	Discuss the methods for speed control of DC shunt motors and compare their effectiveness in terms of control range and application.	7	CO2	[K₂]
	c)	Identify one advantage of using a separately excited DC motor over a shunt motor.	2	CO5	[K₂]

16.	a)	A single-phase transformer has a primary voltage of 400 V, secondary voltage of 200 V, and operates with a load of 20 A on the secondary side. Calculate the primary current, assuming ideal transformer conditions.	7	CO3	[K₃]
	b)	Explain the equivalent circuit of a transformer and its importance in analyzing transformer performance.	7	CO4	[K₂]
	c)	Describe one limitation of the equivalent circuit model in representing real transformer behavior.	2	CO5	[K₂]

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