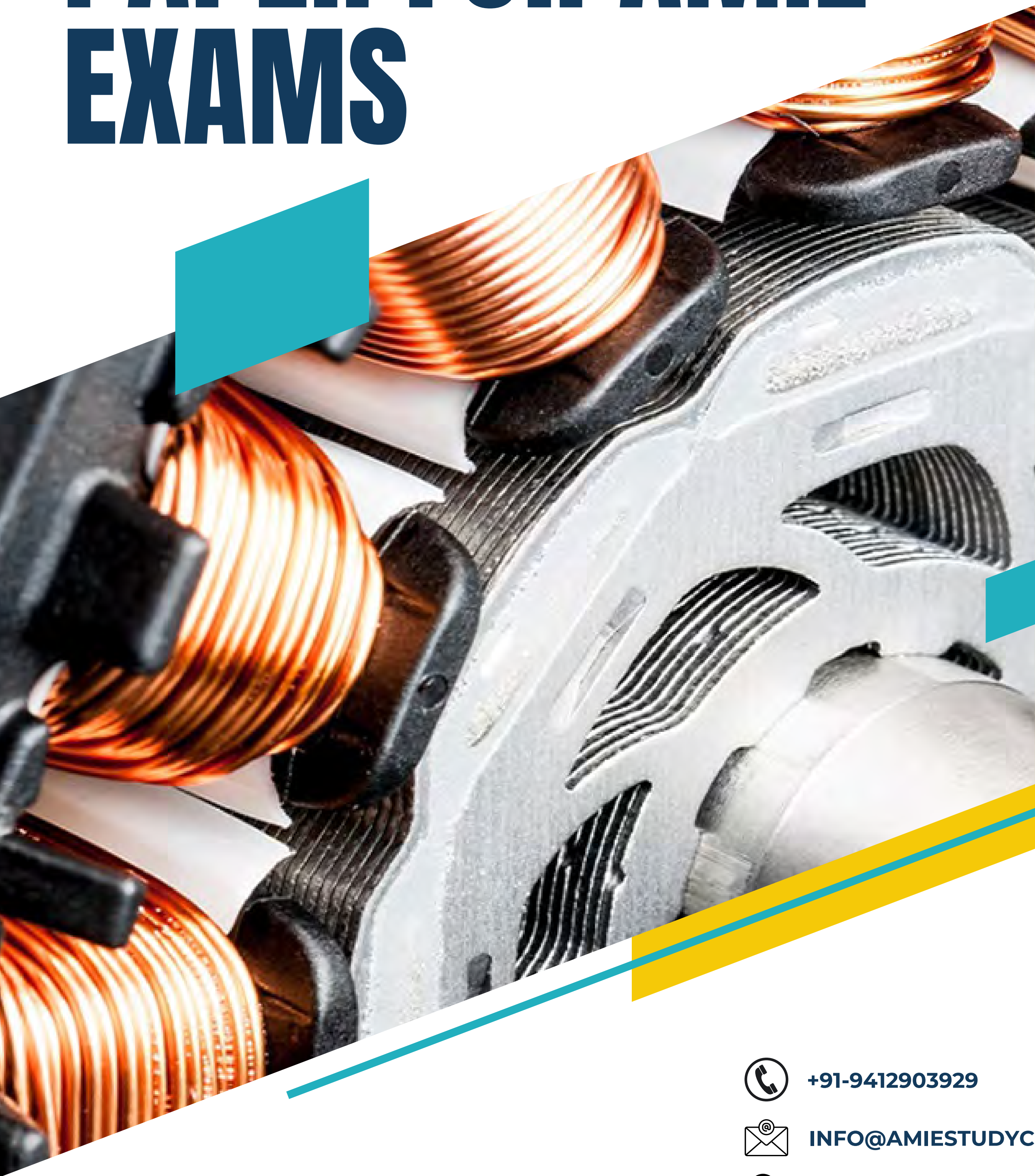
AMIE STUDY CIRCLE, ROORKEE

MODEL TEST PAPER FOR AMIE EXAMS



ELECTRICAL MACHINES

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TEST PAPER 1

ELECTRICAL MACHINES

***Time**: Three Hours*

***Maximum Marks**: 100*

Answer five questions, taking ANY TWO from Group A, any two from Group B and all from Group C.

All parts of a question (a, b, etc.) should be answered at one place.

Answer should be brief and to-the-point and be supplemented with neat sketches. Unnecessary long answer may result in loss of marks.

Any missing or wrong data may be assumed suitably giving proper justification.

Figures on the right-hand side margin indicate full marks.

Group A

1. (a) Explain, with a neat diagram, how the efficiency of a d.c. machine, can be estimated by Hopkinson's test (regenerative or back-to-back). What are the approximations and assumptions made? Mention them with justifications. Obtain the expression for the efficiency. 6

   (b) The Hopkinson test on two shunt machines gave the following results for full load: 8

   Line voltage = 250 V;

   Line current = excluding field currents, 50A;

   Motor armature current = 380 A;

   Field currents = 5 A and 4.2 A.

   Draw the circuit diagram and mark the values. Assuming resistance of each machine as 0.02 Ω, determine the efficiency of each machine.

   (c) A 200 V, 2000 rpm, 10 A, separately excited d.c. motor has an armature resistance is of 2 Ω. Rated d.c. voltage is applied to both the armature and field winding of the motor. If the armature draws 5 A from the source, find the torque developed by the motor. 6

2. (a) Explain the procedure of bringing a d.c. shunt generator in parallel with a loaded d.c. generator and transferring part load to it. 10

(b) A 250 kW and 750 kW, 550Vgenerators operate in parallel, delivering a total load of 1500 A. The voltage regulation of the smaller machine is 0.058 in per unit and for larger one is 0.035 in per unit. Assume that the external characteristics are straight lines. Effect of armature reaction is negligible. Determine the (i) current delivered by each machine, and (ii) terminal voltage. 10

3. (a) What are the requirements for a satisfactory parallel operation of two 3-phase transformers? 5

(b) What is meant by three-phase transformer vector groups? What is the significance of the groups ? 5

(c) A 100 kVA transformer, having 1% resistance and 4% leakage reactance, is operated in parallel with a 200 kVA transformer having 1% resistance and 6% leakage reactance. If the total load delivered is 300 kVA at unity p.f., calculate the kVA load on each transformer as well as the operating p.f. of each transformer. Also, determine the largest value of load that can be delivered by the parallel combination of two transformers without overloading any of them. Derive the formula used. 10

4. (a) Derive an expression for the power developed by a salient pole synchronous machine. 6

(b) When do you get two different reactances X_d and X_q in a synchronous machine? How do you determine these reactances experimentally? Show the connection and write the steps to be followed. 6

(c) Explain with the help of phasor diagram(s), the V curves of a synchronous motor. 8

Group B

5. (a) Name different methods of controlling the speed of an induction motor. Describe any one of the methods with the diagram of the control element. 10

(b) Starting from the equation for the rotor current, show how you can get the equivalent circuit of a three-phase induction motor. How is the mechanical power developed and calculated from the equivalent circuit? 10

6. (a) A balanced 3-phase induction motor has an efficiency of 85% when its output is 45 kW. At this load both the star copper loss and rotor copper loss are equal to the core loss. The mechanical losses are one-fourth of the no-load losses. Calculate the slip. 10

   (b) A 3-phase, 50 Hz, 400 V wound rotor induction motor runs at 960 rpm at full load. The rotor resistance and stand-still reactance per phase are 0.2 Ω and 1.0 Ω, respectively. If a resistance of 1.8 Ω is added to each phase of the rotor at standstill, what would be the ratio of starting torque with full voltage and the added resistance to the full load torque under normal running conditions? State assumptions made in your calculations. Can the same starting torque be obtained with another value of additional resistance? Explain. If the answer is yes, find its value. 10

7. (a) Why does a single-phase induction motor not-possess any starting torque? 6

   (b) Explain in detail about the working principle and operation of split phase induction motor. 6

   (c) A 4-pole, 230V, 50Hz, single phase induction motor runs at 1425 rpm. The power absorbed by the forward and backward fields are 245 W and 35 W, respectively. The no load rotational losses is 45 W. Determine the developed torque and shall torque. 8

8. (a) What is a servo motor? Why and where is a drag cup rotor servo motor used? 10

   (b) Describe the operation of a variable reluctance type stepper motor. What do you mean by micro stepping? 10

Group C

9. Answer the following in brief: 20

   (i) Why is in a normal synchronous machine X_q smaller than X_d?

   (ii) What is meant by an infinite bus?

   (iii) What are the functions of transformer oil?

   (iv) Explain why in an induction motor a high value of rotor resistance is preferred at starting?

(v) Why is star-delta starter not suitable for high voltage induction motor?

(vi) Do slot harmonics affect the torque-speed curve of a three-phase induction motor?

(vii) Why are interpoles used in a d.c. machines?

(viii) Why are core-type transformer used in high-voltage circuits?

(ix) How are iron losses in a transformer made very small?

(x) Why are the pole shoes of d.c. machines laminated?

(Refer our course material for answers)