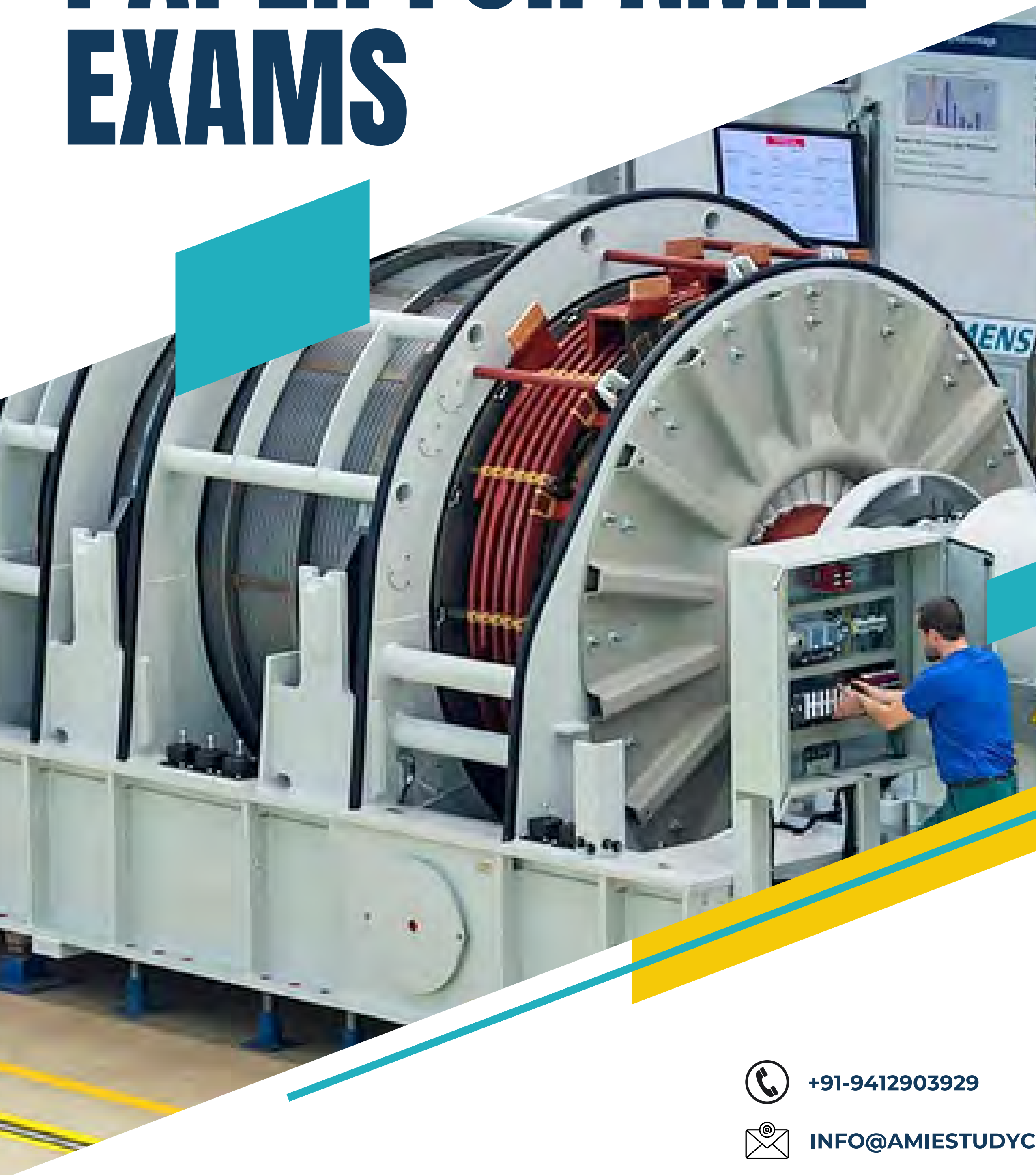
AMIE STUDY CIRCLE, ROORKEE

# MODEL TEST PAPER FOR AMIE EXAMS



+91-9412903929

INFO@AMIESTUDYCIRCLE.COM

CITY PRIDE COMPLEX, NR IIT CAMPUS, ROORKEE

AMIESTUDYCIRCLE.COM

## DESIGN OF ELECTRICAL SYSTEMS

### TEST PAPER 1

# DESIGN OF ELECTRICAL SYSTEMS

***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) Define specific magnetic loadings ($B_{av}$) and specific electric loadings (a. c), and obtain an expression for the 'output coefficient' for a d.c. machine. 10

   (b) Explain the guiding factors for selection of armature slots of a d.c. machine. 10

2. (a) Prove that power developed by the armature $P_a$ of a d.c. machine is given by

$$P_a = \frac{P(1+2\eta)}{3\eta} \text{ for small motors}$$

$$P_a = \frac{P(1+2\eta)}{3\eta} \text{ for small generators}$$

   under the assumption that friction, windage and iron losses amount to one-third of the total losses. (P and $\eta$ stand for power output and efficiency, respectively.) 10

   (b) Discuss the various factors to be considered for deciding "length of air gap" of dc machine and how is it estimated? 5

   (c) Determine suitable values for the number of poles, the armature diameter and armature length for a 1000 kW, 500 V, 300 rpm, d.c. generator. Assume average air gap density as 10000 gauss and specific magnetic loading as 400 A-cond/cm. 5

3. (a) Determine the maximum rated output that can be obtained from a 375 rpm d.c. generator without exceeding a peripheral speed of 40 m/sec, an average emf of 7 V in each conductor and an electric loading of 45,000 conductor per meter. Derive the formula used. 12

   (b) Differentiate between single layer and double layer windings. Which one is preferred for armature winding and why? 8

4. (a) Write short notes on (i) design of rheostat (ii) causes of harmonics in ac machines (iii) classification of armature windings of ac machines. (iv) Skin effect and eddy current losses in a c. machines 12

   (b) What are the salient functions of a starter used for dc motor starting. Further, describe main steps followed in design of dc series motor starter. 8

## *Group B*

5. (a) Explain magnetic loading and electric loading with respect to a single phase core type transformer. What are the factors influencing the choice of specific magnetic loading and specific electric loading with reference to design of a.c. machine. 8

   (b) Derive an equation for output voltage per turn, $V_t = C\sqrt{kVA}$ and discuss significance of the factor "C" used in the expression of V and also the factor upon which 'C depends. 8

   (c) What are the simplifying assumptions made in the derivation of a formula for leakage reactance calculation in a three-phase core type transformer. 4

6. (a) Determine the main dimensions of the four-stepped core force 250 kVA, 6600/415 V, 50 Hz, three-phase transformer with star-connected winding. Assume the following data : Approximate voltage per turn, $V_t$ = 9, maximum flux density = 1.25 $Wb/m^2$, iron area ($A_t$) = 0.62 $d^2$ (d is the diameter of circumscribing circle), window space factor = 0.27, ratio of height of window-to-width of window = 2, and current density = 250 $A/cm^2$. 10

   (b) Determine the core and yoke dimensions for a 250 kVA, 50 Hz, 1-ϕ, core type transformer. The voltage per turn (V) is 15 V/turn. The window space factor is 0.33, current density is 3 $Amp/mm^2$ and maximum flux density 1.1 $Wb/m^2$. Given the distances between the centres of square section core is 10 twice the width of the core.

7. (a) Describe the method of estimating the magnetising currant of an induction motor. 4

(b) What is meant by specific magnetic and electric loadings of rotating machine? Discuss the factors which affects the choice of specific loadings in an induction motor. 4

(c) Determine the approximate diameter and length of the rotor core, the number of slots and the number of conductors for a 15 h.p. 400 V, 3-phase, 4-pole, 1425 r.p.m. induction motor. Adopt a specific magnetic loading of 0.45 $Wb/m^2$ and a specific electric loading of 230 ac/cm. Assume that a full load efficiency of 85 percent and a full load power factor of 0.88 will be observed. 12

8. (a) Find the current in the bars and end rings of a cage rotor of a 6-pole, 3-phase, induction motor having 72 stator slots with 15 conductors in each slot, if the stator current per phase is 20 A and the rotor slots are 55. Hence, find the suitable size of the cage bars and end rings. 12

(b) Describe in detail Radial main system and ring Distribution system. What are their advantages and drawbacks. 8

## *Group C*

9. Answer the following in brief: 20

(i) Diversity factor.

(ii) Determination of number of cooling tubes for a transformer.

(iii) Advantages of fractional slot winding

(iv) Why is the yoke of generator made of cast iron?

(v) Residual magnetism is the essential prerequisite for starting d.c. series generator. Why?

(vi) If in a transformer the secondary turns are doubled and at the same time the primary voltage is reduced by half, the secondary voltage will not change. Why?

(vii) State the reason why air gaps should be kept to a minimum of length and maximum of cross-section.

(viii) A dummy coil is used in the armature of a d.c. machine. Is the machine lap or wave wound?

(ix) When a d.c. motor produces maximum output power?

(x) Magnetic leakage and leakage coefficient

*(Refer our course material for answers)*