EE-702

UTILIZATION OF ELECTRIC POWER

Time Allotted: 3 Hours   Full Marks: 70

The questions are of equal value.
The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.

GROUP A
(Multiple Choice Type Questions)

1.   Answer any *ten* questions. $10 \times 1 = 10$

(i) The solid angle subtended at the centre of a spherical surface is
   (A) 360°   (B) 4π
   (C) 2π (D) none of these

(ii) For welding aluminium alloys, the method used is
   (A) tungsten arc welding   (B) acetylene oxygen gas welding
   (C) d.c. arc welding   (D) a.c. arc welding

(iii) Induction heating is used for
   (A) insulating material   (B) magnetic material
   (C) conducting non-magnetic material   (D) magnetic and conducting material

(iv) Quadrilateral speed-time curve is a better approximation to the actual conditions for
   (A) suburban services
   (B) urban services
   (C) main line services
   (D) urban and suburban services

(v) At low frequency of the order of ½ Hz to 10 Hz the induction motors develop
   (A) high starting torque with excessive starting current
   (B) high starting torque without excessive starting current
   (C) low starting torque with excessive starting current
   (D) low starting torque without excessive starting current

(vi) When the speed of the train is estimated taking into account the time of stop at a station in addition to the actual running time between stops, is known as
   (A) average speed   (B) scheduled speed
   (C) notching speed   (D) free running speed

(vii) A train has a scheduled speed of 36 km per hour on a level track. If the distance between the stations is 2 km and the stoppage is 30 seconds, the actual time of run will be
   (A) 260 seconds   (B) 230 seconds
   (C) 200 seconds   (D) 170 seconds

(viii) The depth of penetration at 1000 Hz for a particular change is 2 cm. at 250 Hz, the depth will be
   (A) 0.5 cm   (B) 4 cm
   (C) 1 cm   (D) 8 cm

(ix) Colour of light depends upon
   (A) velocity of light   (B) frequency
   (C) wavelength   (D) both (B) and (C)

(x) Candle power is
   (A) the luminous flux emitted by the source per unit solid angle
   (B) the light radiating capacity of a source in a given direction
   (C) the unit of illumination
   (D) none of these

(xi) The material used as heating element for a furnace should have
   (A) high resistivity   (B) high melting point
   (C) low temperature co-efficient (D) all of these

(xii) Radiant heating is used for

(A) melting of ferrous   (B) annealing of metals

(C) drying of paints and metals   (D) any of the above

(xiii) In direct arc furnace which of the following is of very high value?

(A) current   (B) voltage

(C) power factor   (D) all of these

GROUP B
(Short Answer Type Questions)

Answer any *three* questions. $3 \times 5 = 15$

2. Describe in brief the application of linear induction motor in traction.   5

3. What are polar curves? Mention the uses of polar curves.   2+3

4. Describe a coreless induction furnace.   5

5. Explain why a d.c. series motor is ideally suited for traction purpose.   5

6. (a) What is anodizing?   3
   (b) What is meant by 'Throwing power' of an electrolyte? Explain in brief.   2

GROUP C
(Long Answer Type Questions)

Answer any *three* questions. $3 \times 15 = 45$

7. (a) State and explain the laws of illumination.   3
   (b) Explain the operations of the Halogen Lamp.   5
   (c) Determine the maximum and minimum illumination on the surface of a square table measuring 2 metres each side when a lamp with 410 candela power, in all directions. The lamp is suspended from a ring at a height of 3 metres, which is horizontally 0.5 metre away from the centre of the table.   7

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8. (a) Discuss various methods of controlling the temperature in resistance ovens.
   (b) A three phase electric arc furnace has the following data :
   Current drawn : 5000 A, Arc voltage : 50 V
   Resistance of the transformer (ref. to secondary) : 0.002 Ω
   Reactance of the transformer (ref. to secondary) : 0.004 Ω
   (i) Calculate the p.f. and the kW drawn from the supply.
   (ii) If the overall efficiency of the furnace is 65%, find the time to melt 2 tonnes of steel. Given the latent heat of steel = 8.89 kcal/kg, specific heat of steel = 0.12, melting point of steel = 1370 °C and the initial temperature of steel is 20 °C.

9. (a) Describe – Kando System.
   (b) Two motors rated at 1500 V have armature resistance of 0.15 Ω and take current of 500 A each during starting. The effective weight of the train 140 tonnes, dead weight 120 tonnes, specific resistance of 50 newtons/tonne, tractive effort/motor 38000 newtons, speed at the end of starting period 50 kmph, determine (i) duration of starting period (ii) speed of train at transition (iii) rheostatic loss.

10. (a) Discuss various arrangements of current collection used in electric traction.
    (b) Discuss the advantages of series-parallel control starting as compared to the rheostatic starting for a pair of d.c. traction motors.
    (c) Define the term 'coefficient of adhesion' and explain the factors on which it depends.

11. State the advantages of electric heating. Explain the principle of induction heating. 3+3+2+ What are the applications of induction heating? What are dielectric heating and dielectric loss? A low frequency induction furnace operating at 10 volts in the secondary circuit takes 500 kW at 0.5 p.f. when the hearth is full. If the secondary voltage be maintained at 10 volts, estimate the power absorbed and the power factor when the hearth is half-full. Assume the resistance of the secondary circuit to be thereby doubled and the reactance to remain same.

12. Write short notes on any *three* of the following:
    (a) Kando system of electrification
    (b) High frequency heating
    (c) Fluorescent lamp
    (d) Anodizing and its application
    (e) Buck Boost method of speed control in traction system.

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