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10EE72

Seventh Semester B.E. Degree Examination, June/July 2016
Electrical Power Utilization

Time: 3 hrs. Max. Marks:100

Note: *Answer any FIVE full questions, selecting atleast TWO questions from each part.*

PART – A

1 a. Derive and explain the design procedure for a circular heating element. **(06 Marks)**

b. Discuss briefly various types of resistance welding techniques. **(10 Marks)**

c. A piece of an insulating material is to be heated by dielectric heating. The size of piece is 10 × 10 × 3cm. A frequency of 20MHz is used and the power absorbed is 400 watts. Calculate the voltage necessary for heating and the current that flows in the material. The material has a relative permittivity of 5 and a power factor of 0.05. **(04 Marks)**

2 a. Define the following terms referred to electrolytic processes :
i) Faraday's laws of electrolysis ii) Electro – chemical equivalent iii) Current efficiency iv) Energy efficiency. **(08 Marks)**

b. What is Electro deposition? What are the applications of electrolysis? Briefly explain the factors affecting electro deposition process. **(08 Marks)**

c. Find the thickness of copper deposited on a plate area of $0.00025 m^2$ during electrolysis if a current of one ampere is passed for 100 minutes. Density of copper is $8900 kg/m^3$ and ECE of copper = 32.95×10^{-8} kg/coulomb. **(04 Marks)**

3 a. Define the following terms : i) MHCP ii) Solid angle iii) Illumination. **(06 Marks)**

b. State and prove i) Inverse square law ii) Lambert's cosine rule, with respect to the illumination. **(08 Marks)**

c. Two lamp posts are 16m apart and are fitted with a 100 CP lamp each at a height of 6m above ground. Calculate the illumination on the ground i) under each lamp ii) midway between the lamps. **(06 Marks)**

4 a. Explain the following : i) Flood lighting ii) Street lighting. **(06 Marks)**

b. What are the factors, which have to be taken into consideration for design of the lighting scheme? **(08 Marks)**

c. A class room size 30m × 30m is to be illuminated with 75 lux. The lamps are required to be hung 5m above the work bench. Assume a space height ratio around unity, a utilization factor of 0.5, lamp efficiency of 15 lumens/watt, candle power depreciation of 20%. Estimate number, rating and disposition of lamps. **(06 Marks)**

PART – B

5 a. With usual notations, show that

$$V_m = \frac{T}{K} = \sqrt{\left(\frac{T}{K}\right)^2 - \frac{7200D}{K}}, \text{ where } K = \left[\frac{1}{\alpha} + \frac{1}{\beta}\right].$$ **(08 Marks)**

b. What are the various systems of traction? Compare the system of traction with respect to their merits and demerits. **(08 Marks)**

c. A train is required to run between two stations 2km apart at an average speed of 40kmph. The run is to be made according to a simplified quadrilateral speed time curve. If the maximum speed is to be limited to 60kmph, acceleration of 2kmphps, costing retardation to 0.15 kmphps and braking retardation 3kmphps, determine the duration of accelerating, costing and braking periods. **(04 Marks)**

6 a. Define Specific Energy Consumption of an train. Derive an expression for the same. What are the factors that affect the specific energy consumption? **(12 Marks)**

b. A 250 tonnes motor coach having 4 motors each developing 5000 N-m torque during acceleration starts from rest. If up-gradient is 25 in 1000, gear ratio 5, gear transmission efficiency 88%, wheel radius 44cm , train resistance 50N/tone, rotational inertia weight is 10%, calculate the time taken to reach a speed of 45kmph. **(08 Marks)**

7 a. Explain the working principle and construction of a linear induction motor. **(06 Marks)**

b. Write short note on train lighting system. **(06 Marks)**

c. An electric train weighing 132 tonnes is equipped with four 600V motors arranged in two pairs for series parallel control. If during series – parallel starting the current per motor is maintained at 400A, estimate i) the duration of the starting period ii) the speed of the train at transition iii) the rheostatic losses during series and parallel steps of starting.
At 400A and 600V, the tractive effort per motor is 19270Nw and the train speed is 39kmph. Assume that the train is started up a gradient of 1 in 100 and the resistance to traction is 44.5 Nw per tonne. Allow 10% for the effect of rotational inertia. Each motor has a resistance of 0.1 ohm. **(08 Marks)**

8 a. What is Hybrid vehicle? Explain configuration and performance of hybrid vehicle. **(06 Marks)**

b. Write a note on tramways and trolley buses. **(06 Marks)**

c. A 400 tonne train travels down a gradient 1 in 70 for 120secs during which period its speed is reduced from 80 kmph to 50 kmph by regenerative braking. Find the energy returned to lines if the tractive resistance is 5kg/tone and allowance for rotational inertia is 7.5%. Overall efficiency of motors is 75%. **(08 Marks)**

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