Seventh Semester B.E. Degree Examination, June/July 2019

Electrical Power Utilization

Time: 3 hrs.   Max. Marks:100

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

PART – A

1. a. State and explain Stefan's law of radiation. **(04 Marks)**

   b. Six resistance each of 80 Ωs are used in resistance heating furnace, how much power is drawn when they are connected to 1ϕ, 400 V in the following combination:
   i) Three groups in parallel, each of 2-resistance
   ii) Two groups in parallel, each of 3-resistance **(04 Marks)**

   c. In a 3ϕ, arc furnace to melt 10 tons of steel in 2 hrs, estimate the average input to the furnace, if overall efficiency is 50%. If the input current is 9000 A, with the above KW input and resistance and reactance of furnace leads are 0.03 Ω and 0.05 Ωs respectively. Estimate the arc voltage and total KVA taken from supply. Given:
   i) Sp. heat of steel = 444 Kkg^{-1}C$^{\circ -1}$
   ii) Latent heat of fusion = 37.25 kJ/kg
   iii) Melting point of steel = 1370°C
   iv) Initial temperature = 20°C **(12 Marks)**

2. a. Show that in case of Di-electric heating, power required is given by
   $$P = 2\pi f \frac{\in_0 \in_r A}{t} . V^2 . R / Z .$$ **(06 Marks)**

   b. What is depth of penetration in case of induction heating? Find the depth of penetration in case of hardening of a steel pulley, if the relative permeability is unity and specific resistance is 5×10^{-7} Ω-m and frequency is 56.3 kHz. **(06 Marks)**

   c. What are requirements of Good weld? Compare resistance welding versus arc welding. **(08 Marks)**

3. a. Discuss various factors governing better electro deposition. **(10 Marks)**

   b. A rectangular plate 20 cm × 10 cm is to be coated with Nickel with a layer of 0.2 mm thick. Determine the quantity of electricity in Amp-hr and time taken for the process, given:
   Current density = 190 Amp/m^2
   Current efficiency = 90%
   Density of Ni = 8900 kg/m^3
   ECE of Ni = 0.0003043 **(10 Marks)**

4. a. State and explain the laws of Illumination. **(06 Marks)**

   b. A 250 V, lamp has a total flux of 3000 lumens and takes a current of 0.8A. Calculate
   (i) Lumens/watt   (ii) MSCP/watt **(06 Marks)**

   c. A small light source with intensity uniform in all directions is mounted at a height of 10 mtrs above a horizontal surface. Two points A and B both lie on the surface with point 'A' directly beneath the source. How far is point 'B' from 'A', if the illumination at point 'B' is only $\frac{1}{10}$th as great as at point A? **(08 Marks)**

PART – B

5 a. What are basic requirements of an ideal traction systems? **(06 Marks)**

b. What are simplified speed time curves? For a simplified trapezoidal speed time curve, develop an expression for crest-speed. **(06 Marks)**

c. The speed-time curve of a train consists of
- Uniform acceleration of 6 kmphps for 25 secs
- Uniform retardation of 6 kmphps to stop the train
- Free running for 10 mins
- A stop of 5 mins

Find: i) Distance between the station
ii) Average speed
iii) Schedule speed **(08 Marks)**

6 a. Derive an expression for Tractive effort required by train for propulsion along a gradient. **(08 Marks)**

b. A train weighing 120 tons is to be driven up an incline of 2% at a speed of 36 kmph. If the train resistance at this speed is 2 kg/ton, find the current required at 1500 V d.c., if the efficiency of motors and gears is 88%. If the current were cut off, how long would the train take to come to rest? **(12 Marks)**

7 a. Develop an expression for specific energy output of a locomotive, using a simplified speed time curve. State the factors affecting the same. **(08 Marks)**

b. An electric train weighing 100 tons has a rotational inertia of 10%. This train while running between two stations, which are 2.5 km apart has an average speed of 50 km/hr. The acceleration of retardation during braking are 1 kmphps and 2 kmphps respectively. The percentage gradient between these stations is 1% and the train is to move up the incline. The track resistance is 40 N/ton. If the combined efficiency of electric train is 60%, determine:
i) Maximum power at driving Axle
ii) Total energy consumption
iii) Specific energy consumption

Assume that journey estimation is being made on simplified trapezoidal speed time curve. **(12 Marks)**

8 Write short notes on (any FOUR):
a. A.C. series motor
b. Performance of electrical vehicles
c. Traction motor characteristics
d. Train lighting system
e. Linear induction motor **(20 Marks)**

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