



10EE72

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 Ω s are used in resistance heating furnace, how much power is drawn when they are connected to 1 ϕ , 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 3 ϕ , 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 Ω s respectively. Estimate the arc voltage and total KVA taken from supply. Given:
i) Sp. heat of steel = 444 Kkg⁻¹C⁻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
$$P = 2\pi f \frac{\epsilon_0 \epsilon_r A}{t} \cdot V^2 \cdot R / Z.$$
 (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 $5 \times 10^{-7} \Omega\text{-m}$ 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 \times 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/m²
Current efficiency = 90%
Density of Ni = 8900 kg/m³
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 kmphs for 25 secs
 - Uniform retardation of 6 kmphs 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 kmphs and 2 kmphs 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)
