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10EE72

Seventh Semester B.E. Degree Examination, Dec.2016/Jan.2017
Electrical Power Utilization

Time: 3 hrs. Max. Marks:100

Note: 1. *Answer FIVE full questions, selecting at least TWO questions from each part.*
2. *Any missing data may be suitably assumed.*

PART – A

1 a. Discuss the main advantages of electric heating over other systems of heating (namely, coal, oil or gas heating). **(04 Marks)**

b. Discuss the advantages and disadvantages of resistance electric welding. **(04 Marks)**

c. A 15 kW, 220 V, single phase resistance oven employ nickel-chrome wire for its heating elements. If the wire temperature is not to exceed 1000°C and the temperature of the charge is to be 600°C. Calculate the length and diameter of the wire. Assume radiating efficiency to be 0.6 and emissivity as 0.9. Resistivity for nickel-chrome wire is 1.016×10^{-6} ohm-meter. **(12 Marks)**

2 a. Discuss the major drawback of a direct core type induction furnace. **(04 Marks)**

b. Discuss the advantages of high frequency eddy current heating. **(04 Marks)**

c. Estimate the efficiency of a high frequency induction furnace which takes 10 minutes to melt 1.8 kg of aluminium. The input to the furnace being 5 KW and initial temperature 15°C.
Given : Specific heat of aluminium = 880 J/kg/°C ;
Melting point of aluminium = 660°C.
Latent heat of fusion of aluminium = 32 KJ/kg
$1J = 2.78\times10^{-7}$ KWh **(12 Marks)**

3 a. Discuss the principle of dielectric heating. **(04 Marks)**

b. A slab of insulting material 130 cm^2 in area and 1 cm thick is to be heated by dielectric heating. The power required is 380 W of 30 MHz. Material has a relative permittivity of 5 and power factor of 0.05. Absolute permittivity = 8.854×10^{-12} F/m. Determine the necessary voltage. **(06 Marks)**

c. The power required for dielectric heating of a slab resin 150 cm^2 in area and 2 cm thick is 200 watts, frequency 30 MHz. The material has a relative permittivity of 5 and power factor of 0.05. Determine the voltage necessary and current flowing through the material. If the voltage is limited to 600 V, what will be the value of the frequency to obtain the same heating? Assume absolute permittivity = 8.854×10^{-12} F/m. **(10 Marks)**

4 a. Explain the basic principle of electrolysis. **(02 Marks)**

b. Calculate the thickness of copper deposited on a plate area of 2.2 cm^2 during electrolysis if a current of 1A is passed for 90 minutes.
Electro chemical equivalent of copper = 32.95×10^{-8} kg/columb and
Density of copper = 8900 kg/m^3. **(06 Marks)**

c. A copper refining plant using 500 electrolytic cells carries a current of 6000 A; Voltage per cell being 0.25 volt. If the plant were to work 40 hours/week, calculate the energy consumption per tonne assuming electro chemical equivalent of copper as 0.3281 mg/columb of electricity. **(12 Marks)**

PART – B

5 a. Define the following terms and their units:
(i) Luminous flux (ii) Luminous intensity (iii) Illumination
(iv) Mean horizontal candle power (v) Mean spherical candle power **(05 Marks)**

b. Discuss the laws of illumination. **(05 Marks)**

c. A filament lamp of 500 watts is suspended of a height of 5 meters above working plane and gives uniform illumination over an area of 8 meter diameter. Assume efficiency of reflector as 60%, determine the illumination on the working plane. Efficiency of lamp is 0.9 watt per candle power. **(10 Marks)**

6 a. Explain the following terms related to train movement:
(i) Crest speed (ii) Average speed (iii) Schedule speed. **(03 Marks)**

b. Discuss the factors that affect the schedule speed of a train. **(05 Marks)**

c. The speed time curve of a train consists of,
(i) Uniform acceleration of 6 km per hour per second for 25 seconds.
(ii) Free running for 10 minutes.
(iii) Uniform deceleration of 6 km per hour per second to stop the train.
(iv) A stop of 5 minutes.
Find the distance between the stations, the average and schedule speed. **(12 Marks)**

7 a. Derive the tractive efforts required for propulsion of a train considering gradient and resistance to train movement. **(08 Marks)**

b. An electric train weighing 200 tonnes has eight motors geared to driving wheels, each wheel is 90 cm diameter. Determine the torque developed by each motor, to accelerate the train to a speed of 48 km per hour. The tractive resistance is of 50 newtons per tonne, the effect of rotational inertia is 10% of the train weight, the gear ratio is 4 to 1 and gearing efficiency is 80 percent. **(12 Marks)**

8 a. Define energy consumption and specific energy consumption related to electric fraction. **(04 Marks)**

b. Discuss the factors that influence the specific energy consumption of a train operating on a given schedule speed. **(04 Marks)**

c. An electric train has an average speed of 42 km/hour on a level track between stops 1.4 km apart. It is accelerated at 1.7 km per hour per second and is braked at 3.3 km/hour/second. Assuming Fractive resistance as 50 newtons/tonne, allowing 10 percent rotational inertia and efficiency of motors 85 percent. Estimate the specific energy consumption. Assume maximum speed, V_m = 52 kmph, Duration of braking = 15.8 seconds (t_3). **(12 Marks)**

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