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06EE72

# Seventh Semester B.E. Degree Examination, December 2010

## 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. Draw the equivalent circuit of an arc furnace and thereby obtain the condition for maximum output. **(07 Marks)**

b. A 15 KW, 220 volts single phase resistance oven employs 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 diameter and length of the wire. Assume radiating efficiency to be 0.6 and emissivity as 0.9. For Nickel-Chrome, resistivity = $1.016 \times 10^{-6}$ Ωm. **(08 Marks)**

c. A piece of insulating material is to be heated by dielectric heating. The size of the piece is 12 cm × 12 cm × 3 cm. A frequency of 20 MHz is used and the power absorbed is 450 W. If the material has a relative permittivity of 5 and a power factor of 0.05, calculate the voltage necessary for heating and current that flows in the material. Assume $\epsilon_0 = 8.854 \times 10^{-12}$ F/m. **(05 Marks)**

2 a. Bring out any five differences between resistance and arc welding. **(05 Marks)**

b. Define resistance welding. Explain any two resistance welding processes. **(10 Marks)**

c. Mention any five advantages of eddy current heating. **(05 Marks)**

3 a. Explain the terms current efficiency, voltage and energy efficiency associated with electrolytic processes. **(06 Marks)**

b. Find the thickness of copper deposited on a plate of area 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 = $32.95 \times 10^{-8}$ kg/coulomb. **(06 Marks)**

c. Describe the construction and working of an incandescent lamp. **(08 Marks)**

4 a. Define the following terms :
i) Solid angle ii) Illumination iii) MHCP iv) MSCP **(08 Marks)**

b. Mention the factors to be considered while designing the lightening scheme and thereby explain any two factors briefly. **(10 Marks)**

c. A 250 volt lamp has a total flux of 3000 lumens for a current of 0.8 A. Find MSCP per watt. **(02 Marks)**

### PART – B

5 a. Mention the advantages and limitations of electric drives. **(08 Marks)**

b. With usual notations show that $\frac{1}{2}\left[\frac{1}{\alpha}+\frac{1}{\beta}\right]=\frac{3600\,D}{V_m^2}\left[\frac{V_m}{V_a}-1\right]$. **(07 Marks)**

c. The distance between two stations is 1 km. The schedule speed is 30 kmph and station stopping time is 20 seconds. Assuming braking retardation as 3 kmphpsec and maximum speed is 1.25 times the average speed, determine the acceleration required to run the service, if the speed time curve is approximated by a trapezoidal curve. **(05 Marks)**

6 a. A 200 tonne motor coach has 4 motors, each developing 600 Nm torque, during acceleration, starts from rest. If the gradient is 30 in 1000, gear ratio 4, gear transmission efficiency 90%, wheel radius 45 cm, train resistance 50 N/tonne and additional rotational inertia 10%, calculate the time taken to attain a speed of 50 kmph. If the line voltage is 3000 volts dc and efficiency of motors 85%, find the current during the notching period. **(10 Marks)**

b. Discuss the requirements of electric motors for traction work. **(10 Marks)**

7 a. Explain with the aid of diagrams, series parallel control of motors. **(10 Marks)**

b. A train weighing 400 tonnes, has its speed reduced by regenerative braking, from 40 to 20 kmph over a distance of 2 km on a down gradient of 2%. Calculate the electrical energy and average power returned to the line. Tractive resistance is 40 Newtons/tonne. Allow rotational inertia of 10% and efficiency of conversion 75%. **(10 Marks)**

8 a. Discuss the characteristics of a dc series motor, in view of the requirements for the traction service. **(10 Marks)**

b. An electric train, weighing 100 tonnes, 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/hour. The acceleration and retardation during braking are respectively 1 km/hour/second and 2 km/hour/second. The percentage gradient between these two stations is 1% and the train is to move up the incline. The track resistance is 40 N/tonne. If the combined efficiency of the electric train is 60%, determine :

i) Max power at the driving axle

ii) Total energy consumption.

Assume that journey is being made on simplified trapezoidal speed time curve. **(10 Marks)**

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