

Code No: K0221

R07

Set No.1

IV B.Tech. II Semester Regular/Supplementary Examinations, April, 2012

UTILISATION OF ELECTRICAL ENERGY

(Electrical and Electronics Engineering)

Time: 3 Hours

Max Marks: 80

**Answer any FIVE Questions
All Questions carry equal marks**

1. a) Discuss the terms 'continuous', 'intermittent' and 'variable' loads with examples.
b) What are the reasons for using load equalization in electrical drives? Explain with example a drive requiring load equalization. [8+8]
2. a) Discuss the various modes of heat dissipation.
b) A resistance oven employing nichrome wire is to be operated from 220 V single-phase supply and is to be rated at 10 kW. If the temperature of the element is to be limited to $1,170^{\circ}\text{C}$ and average temperature of the charge is 500°C , find the diameter and length of the element wire. Radiating efficiency=0.57, Emissivity=0.9, Specific resistance of nichrome= 109×10^{-8} ohm-m. [8+8]
3. a) Draw a neat sketch of a spot welding machine and describe its construction and working in detail.
b) Compare AC welding processes with DC welding processes. [8+8]
4. a) What is an integrating sphere? Explain its use in illumination engineering.
b) A lamp of 200 candela is placed 1 m below a plane mirror which reflects 85 percent of light falling on it. The lamp is hung 5 m above the ground. Find the illumination at a point on the ground 4 m away from the point vertically below the lamp. [8+8]
5. a) Explain the construction and working of a pressure mercury lamp.
b) Prove that in a filament lamp the diameter of the filament is directly proportional to $I^{2/3}$, where I is the current flowing in the filament. [8+8]

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6. State the condition under which regenerative braking with DC series motor is possible and explain with the help of circuit diagram. Also, explain the various methods of providing regeneration. [16]
7. a) Draw the speed-time curve of a main line service and explain how it works.
b) A train is required to run between two stations 2 km apart at a scheduled speed of 36 kmph, the duration of the stops being 20 seconds. The braking retardation is 2.7 kmphs. Assuming a trapezoidal speed-time curve, calculate the acceleration if the ratio of maximum speed to average speed is 1.2. [8+8]
8. a) Describe the procedure for calculating the specific energy consumption of an electric train.
b) A 400 tonne goods train is to be hauled by a locomotive up a gradient of 2% with acceleration of 1 km/hr/sec, coefficient of adhesion 20%, track resistance 40 newtons/tonne and effective rotating masses 10% of the dead weight. Find the weight of the locomotive and the number of axles if the axle load is not to increase beyond 22 tonnes. [8+8]

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1. a) Compare group drive and individual drive in industrial environment.
b) Derive an expression for the temperature rise of an electrical machine. State the assumptions made. [8+8]
2. a) With a neat sketch explain the working principle of coreless type induction furnace.
b) Explain the principle of Induction heating. What are the applications of induction heating? [8+8]
3. Describe with neat sketches various methods of electric resistance welding. Give its merits and demerits with respect to arc welding. [16]
4. a) Discuss inverse square law & cosine law of Illumination.
b) A small area of 5 m in diameter is to be illuminated by a lamp suspended at a height of 4.5 m over the center of the area. A lamp having an efficiency of 24 lumens per watt is fitted with a reflector that directs the light output only over the surface to be illuminated. If utilization coefficient is 0.65 and illumination is 800 lux, determine the wattage of the lamp. [8+8]
5. a) Compare a tungsten filament lamp with fluorescent lamp stating their merits and demerits.
b) What are the various types of lighting schemes? Explain with relevant diagrams. [8+8]
6. Describe how plugging, rheostatic braking, and regenerative braking are employed with DC series motor. [16]

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7. a) For a quadrilateral speed-time curve of an electric train, derive expression for the distance between stops and speed at the end of the coasting period.
- b) An electric train weighing 200 tonnes has 8 motors geared to driving wheels; each wheel is of 80 cm diameter. Determine the torque developed by each motor to accelerate the train to a speed of 48 km/hr in 30 seconds up a gradient of 1 in 200. The tractive resistance of 50 Newtons/tonne, the effect of rotational inertia is 10% of the train weight, the gear ratio is 4 in 1 and gearing efficiency is 80%. [8+8]
8. a) An electric train has an average speed of 42 kmph on a level track between stops 1.4 km apart. It is accelerated at 1.7 kmphs and is braked at 3.3 kmphs. Assuming tractive resistance as N per ton, allowing 10 percent for rotational inertia, and efficiency of motors 85 percent: (i) Estimate the specific energy consumption (ii) Draw the speed time curve.
- b) Define specific energy output and specific energy consumption. [10+6]

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1. a) Discuss the advantages and disadvantages of electric drive over other drives.
b) A 440 V shunt motor while running at 1500 rpm takes an armature current of 30 A and delivers an output of 15 HP with the load torque varies as the square of speed. Calculate the value of the resistance to be connected in series with the armature for reducing the motor speed to 1300 rpm. [8+8]
2. a) Describe the Ajax Wyatt (vertical type) type induction furnace and explain its working.
b) What are the factors which decide frequency and voltage of the dielectric heating? Derive the expression for the heat produced in a dielectric material. [8+8]
3. a) Explain the principle of electric spot welding and seam welding. What are the differences between these two welding processes?
b) What are the important components of DC and AC welding sets and explain their functions. [8+8]
4. a) What are polar curves? How it is useful to an illumination engineer.
b) A light is placed 4.5 m above the ground and its candle power is $200 \cos \theta$ in any downward direction making an angle θ with the vertical. If A and B are two points on the ground, A being vertically under the light and the distance between A and B being 4.5 m, calculate (i) the illumination of the ground at A and also at B (ii) the total radiation sent down by the lamp. [6+10]

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5. a) Describe with a circuit diagram the working of a florescent lamp. Enumerate its advantages and disadvantages. Explain how its disadvantages can be overcome?
b) A hall 30 m long and 15 m wide with a ceiling height of 5 m is to be provided with a general illumination of 120 lumens per m². Taking a coefficient of utilization of 0.5 and depreciation factor of 1.42, determine the number of fluorescent tubes required, their spacing, mounting height and total wattage. The luminous efficiency of fluorescent tube as 40 lumen per watt for 80 W tube. [8+8]
6. a) What are different systems of track electrification. Discuss merits and demerits of track electrification.
b) Discuss the special features of traction motor. [8+8]
7. Explain the speed time curve for a main line service and derive the following expression
$$\frac{1}{2} \left[\frac{1}{\alpha} + \frac{1}{\beta} \right] = \frac{3600D}{V_m^2} \left[\frac{V_m}{V_a} - 1 \right], \text{ where the symbols have their usual meaning} \quad [16]$$
8. a) Derive expression for the specific energy output for a trapezoidal speed-time run of an electric train. Also write the factors affecting specific energy consumption.
b) Derive an expression for the tractive effort developed by a train unit. [8+8]

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1. a) Discuss the various factors that govern the choice of a motor for a given service.
b) A 500 V shunt motor drives a load with its torque varies as the square of the speed. When running at certain speed, it takes a current of 30 A. If a resistance of 10 ohms is included in series with the armature, determine the new speed as a percentage of the original speed. Assume the shunt field resistance of the motor is 250 ohms and neglect the armature resistance. [8+8]
2. a) Explain the design procedure of the heating element when the power and voltage of the oven is known..
b) What are the advantages of electric heating? Give classification of various electric heating methods along with brief account of their working principles. [8+8]
3. a) Explain with a neat sketch how the spot welding is carried out by spot welding machine.
b) Describe briefly the various types of arc welding processes used in industry. [8+8]
4. Define and explain the following terms:

(a) Mean spherical Candlepower	(b) Mean horizontal Candlepower
(c) Mean hemispherical Candlepower	(d) Luminous flux
(e) Luminous intensity	(f) Solid angle
(g) Illumination	(h) Luminance

[8×2=16]

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5. a) Explain with a neat diagram the principle of operation of a sodium vapour lamp. Mention its uses.
b) A building frontage 50 m X 15 m is to be illuminated by flood lighting projectors situated 25 m away. If the illumination is 100 lux, coefficient of utilization is 0.5, depreciation factor is 1.5, Waste light factor is 1.2, estimate the number and size of projectors. Sketch the projectors recommended indicating the usual adjustments provided. [8+8]
6. a) Compare AC and DC supply system for Track electrification on following points:
i) Type of electrical drives used ii) Weight of traction motor
iii) Cost of track electrification iv) Distance between two traction substations
b) Which system you consider to be the best for the suburban railways in the vicinity of large cities? Give reasons for your answer. [8+8]
7. a) Discuss the main features of various train services. What type of train services corresponds to trapezoidal and quadrilateral speed time curves.
b) For a trapezoidal speed time curve of an electric train, derive expression for maximum speed and distance between stops. [8+8]
8. a) What is specific energy consumption of a train? Discuss various factors affecting it.
b) What is coefficient of adhesion? How does it affect slipping of the driving wheel of a traction unit? [8+8]