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Paper Code : PC-EE 801 Utilization of Electric Power
UPID : 008387

Time Allotted : 3 Hours   *Full Marks :70*

The Figures in the margin indicate full marks.
Candidate are required to give their answers in their own words as far as practicable

Group-A (Very Short Answer Type Question)

1. Answer any ten of the following :   [1 x 10 = 10]
    (I)   Magnetic materials are heated with the help of _____ loss.
    (II) Can A.C. welding machine be used for MIG welding?
    (III) The voltage applied to the electrodes for electroplating is in the range of _____ .
    (IV) In electric traction, if contact voltage exceeds 1500 V, then which kind of electrification system is used?
    (V)   Filament lamps operate normally at a power factor of _____ .
    (VI) Electric ovens using heating elements of .... can produce temperatures up to 3000°C
    (VII) When a body reflects entire radiation incident on it, then it is known as _____ .
    (VIII) In electrode-positive welding _____ of the total heat is produced at the electrode.
    (IX) The energy required for refining of gold in kWh / tone is about
    (X)   When '*Skidding*' of a vehicle always occurs?
    (XI) Which gas can be filled in GLS lamps?
    (XII) In an electric press mica is used as _____ .

Group-B (Short Answer Type Question)

Answer any three of the following :   [5 x 3 = 15]

2. Which scheme is generally used for overhead electrification of long distance railway in India? Why?   [5]

3. Derive the relation between Luminance and Illuminance of a point light source   [5]

4. A suburban train runs with an average speed of 36 km/h between two stations 2 km apart. Values of   [5]
    acceleration and retardation are 1.8 km/h/s and 3.6 km/h/s. Compute the maximum speed of the train
    assuming trapezoidal speed/time curve.

5. Discuss about the Laws of Illumination and establish them with mathematical analysis.   [5]

6. Compare resistance welding and arc welding.   [5]

Group-C (Long Answer Type Question)

Answer any three of the following :   [15 x 3 = 45]

7. (A) A corridor is lighted by 4 lamps spaced 10 m apart and suspended at a height of 5 m above the centre   [5+10]
    line of the floor. If each lamp gives 200 C.P. in all directions below the horizontal, find the illumination at
    the point on the floor mid-way between the second and third lamps.
    (B) Define the following terms:
    (i) Candela
    (ii) Luminous Intensity
    (iii) Coefficient of Reflection
    (iv) Mean spherical candle-power
    (v) Luminous Exitance

8. (A) Discuss about different methods of heat transfer with proper mathematical expression.   [7+8]
    (B) A resistance oven employing nichrome wire is to be operated from 220 V single-phase supply and is to
    be rated at 16 kW. If the temperature of the element is to be limited to 1,170°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.

9. (A) Discuss about the Depreciation Factor (p) of a light source.   [5+10]
    (B) Let us consider that your classroom, 7 m × 10 m × 4 m high is to be illuminated to 135 lm/m2 on the
    working plane. If the coefficient of utilization is 0.45 and the sources give 13 lumens per watt, work out
    the total wattage required, assuming a depreciation factor of 0.8 . Sketch roughly the plan of the room,
    showing suitable positions for fittings, giving reasons for the positions chosen.

10. (A) Give a brief overview on electric arc furnaces. [7+8]

(B) If a 3-phase arc furnace is to melt 10 tonne steel in 2 hours, estimate the average input to the furnace if overall efficiency is 50%. If the current input is 9,000 A with the above kW input and the resistance and reactance of furnace leads (including transformer) are 0.003 Ω and 0.005 Ω respectively, estimate the arc voltage and total kVA taken from the supply

Specific heat of steel = 444 J kg−1°C−1

Latent heat of fusion of steel = 37.25 kJ/kg

Melting point of steel = 1,370 °C

11. (A) Discuss about Regenerative Braking with D.C. Motors traction drive [8+7]

(B) The following figures refer to the speed-current and torque – current characteristics of a 600 V d.c. series traction motor.

Current, amperes :	50	100	150	200	250
Speed, kmph :	73.6	48	41.1	37.3	35.2
Torque, N-m :	150	525	930	1,335	1,750

Determine the braking torque at a speed of 48 kmph when operating as self-excited d.c. generator. Assume resistance of motor and braking rheostat to be 0.6Ω and 3.0 Ω respectively.

*** END OF PAPER ***