

NAME OF THE EXAMINATION: B.E. POWER ENGINEERING FOURTH YEAR FIRST SEMESTER - 2025

SUBJECT: ELECTRIC POWER AUTOMATION AND UTILIZATION (HONS.)

TIME: 3 HOURS

FULL MARKS: 100

USE SEPARATE ANSWER SCRIPTS FOR PART I AND PART II

- CO1:** Describe the concepts of distribution automation system, and its control, management system and communication protocols
CO2: Analyze and classify various types of electrical heating and electrical welding
CO3: Discuss electrolytic process and various aspects of Illumination
CO4: Explain the principles and characteristic of Electric Traction, Electric Vehicle and Hybrid Vehicles
CO5: Solve various problems on Electric Power Automation and Utilization

PART I

Attempt *ALL* questions

Q1. Choose the correct option for any ten (10) questions:

(10@1 = 10)

- (i) In the case of immersion type water heater, the heat is transferred by: [CO2]
 a) radiation
 b) conduction
 c) convection
 d) all of the above methods
- (ii) Inflammable articles like plastic and wooden products etc. can be safely heated by using [CO2]
 _____ heating.
 a) eddy-current
 b) induction
 c) dielectric
 d) resistance
- (iii) The electric arc during welding has: [CO2]
 a) Linear resistance characteristic
 b) Negative resistance characteristic
 c) Positive resistance characteristic
 d) Highly inductive characteristic
- (iv) In direct arc furnace, which of the following has high value? [CO2]
 a) current
 b) voltage
 c) power factor
 d) all of the above
- (v) In Electroplating process, the object undergoing surface plating works as _____ [CO3]
 a) Anode
 b) Cathode
 c) Depends upon the metal to be coated
 d) Depends upon the nature of supply source
- (vi) The spongy coating of electroplating speaks of [CO3]
 a) Higher current density
 b) Poorer electrolyte density
 c) Excessive electrolyte density
 d) Lower current density
- (vii) Candela is the unit of [CO3]
 a) light
 b) luminance
 c) illumination
 d) luminous intensity

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- (viii) The rate of evaporation of tungsten filament in a lamp depends upon [CO3]
 a) Glass shell diameter
 b) Vapor pressure inside the bulb
 c) Exhaust tube diameter
 d) All of the above
- (ix) The most vital factor against electric traction is: [CO4]
 a) The necessity of providing negative booster
 b) High initial cost in laying out overhead electric supply system
 c) Its high maintenance cost
 d) The possibility of power failure
- (x) The free-running speed of a train does NOT depend on the [CO4]
 a) duration of stops
 b) distance between stops
 c) acceleration
 d) running time
- (xi) Which of the following braking systems of the locomotives is costly? [CO4]
 a) Vacuum braking on steam locomotives
 b) Vacuum braking on diesel locomotives
 c) Regenerative braking on electric locomotives
 d) All braking systems are equally costly
- (xii) The current collector which can be used at different speeds under all wind conditions and stiffness of OHE is called _____ collector [CO4]
 a) bow
 b) messenger
 c) pantograph
 d) trolley

Q2 Answer any TWO (2) questions [5×2=10] [CO2]

- (a) Identify the type of furnace shown in figure 1 and label the different parts as marked.
- (b) Show that for dielectric heating of an insulating material, the power loss inside the body to be heated is given by: $P = V^2 2\pi f c \delta$, where symbols have their usual meanings. Draw the relevant phasor diagram. From the above relation, comment on the type of voltage and frequency usually applied for achieving good heating of a dielectric material.
- (c) Complete the chart in figure 2 related electric welding. What is "Arc Blow" in metal arc welding process? What are the effects of arc blow on weld quality? How can arc blow be avoided?

Q3 Answer any TWO (2) questions [5×2=10] [CO3]

- (a) What is electro-deposition? What are its application areas? What are the different types of electro-deposition processes? Identify which of the following factors affect the quality and appearance of the deposited surface:
 Nature of electrolyte, Electrode construction, Current density, Applied voltage, Temperature, Humidity, Conductivity, Density, Electrolytic concentration, Electrolyte colour, Addition of agents, Moisture content, Throwing power, Absorption power, Polarization, Permeability
- (b) Consider a point P on the plane surface AB where illumination due to a light source S of candle power CP at height h from the surface AB as shown in figure 3. Show that illumination at the point P is $\cos^3\theta$ times the illumination at a point just vertically below the light source.
- (c) Identify the type of electric lamp shown in the figure 4 and label the different parts as marked:
 What are the advantages and limitations of fluorescent lamps?

Q4 Answer any TWO (2) questions [5×2=10] [CO4]

- (a) Among the following, identify which are advantages of (1) Steam engine (2) Diesel engine and (3) Electric engine for use in locomotives and fill in the following table (add rows if necessary):
 Affordable in low density traffic areas,

Due to low height, its center of gravity is comparatively low, that enables the locomotive to negotiate curves at higher speeds quite safely
 Easy speed control
 Fast starting time
 High starting torque
 In addition to the mechanical braking, electrical braking can also be used that reduces the wear on the brake shoes, wheels, etc.
 It can withstand temporary overloads
 It has no smoke – so it is the only option for underground metro railways
 It is a self-contained unit, and therefore it is not tied to any route
 It is cleaner and easier to handle
 Low capital cost as track electrification is not required
 Low initial investment
 No interference with communication line
 No need of storage of coal and water that in turn reduces the maintenance cost as well as the saving of high-grade coal
 Regenerative braking is possible
 Simple braking system
 Simplicity in design and construction
 Simplified maintenance
 The maintenance and running costs are comparatively low
 The vibrations produced are much lower owing to smoother torque profile
 There is no need of providing additional generators for train hotel load

Advantages		
Steam Engine Drive	Diesel Engine drive	Electric Drive

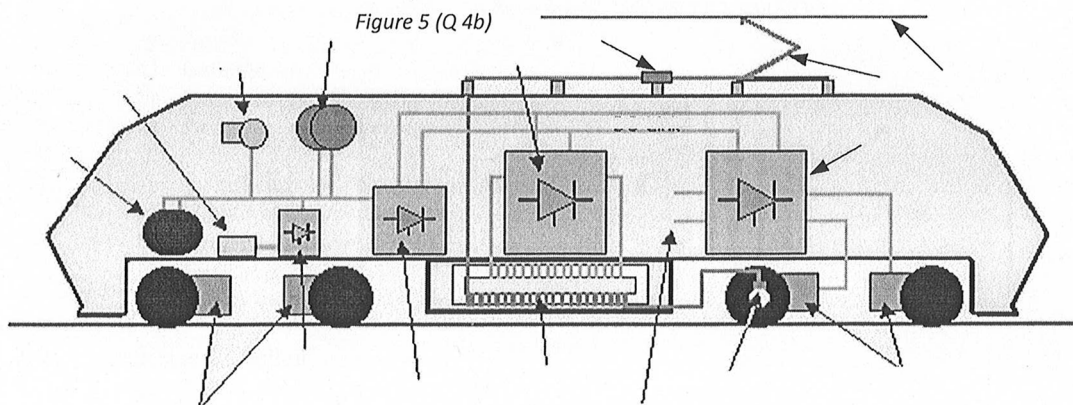
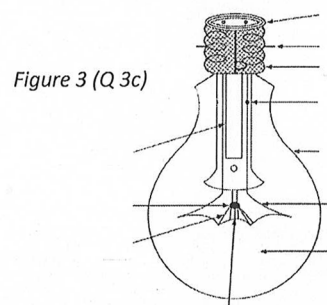
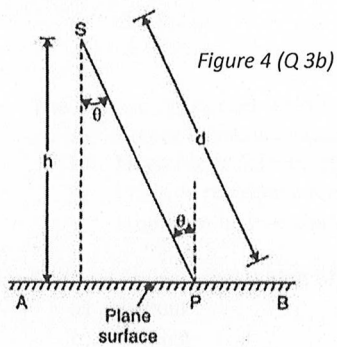
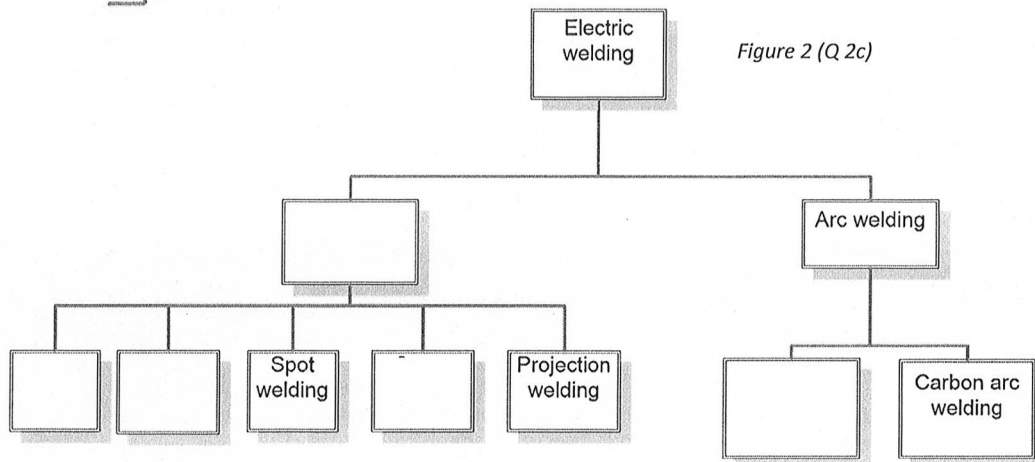
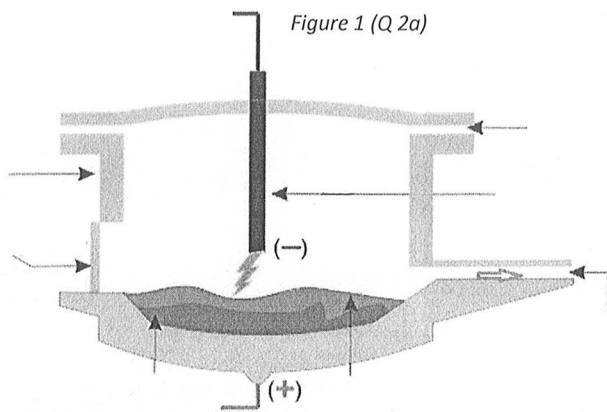
- (b) In the block diagram of a modern AC electric locomotive engine shown in figure 5, label at least 10 different traction equipment present.
- (c) Discuss in brief, the general architectures of Hybrid Electric Vehicles

Q5 Answer any TWO (2) questions

[5×2=10] [CO5]

- (a) 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 1170°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 = $(109 \times 10^{-8}) \Omega\text{-m}$.
- (b) An iron plate of surface area 2.35 cm² is to be electroplated with copper. If a current of 1A is passed for 90 minutes, find the thickness of copper deposited on the plate. Density of copper is 8.9 gm/cc and ECE of copper is 0.0003295 gm/coulomb.
- (c) A suburban train runs with an average speed of 40 kmph between two stations 2.0 km apart. Values of acceleration and retardation are 1.4 km/hr/s and 1.6 km/hr/s respectively. Calculate the maximum speed, acceleration period and braking period.

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B.E. Power Engineering, Fourth year 1st Semester Examination, 2024-25

SUBJECT: Electric Power Automation and Utilization (HONS.)

Time: Three hours

Full Marks: 100.

Instructions: **USE SEPARATE ANSWER SCRIPTS FOR PART-A and PART-B**

Figure in the margin indicate marks for each Question.

PART- II**Answer any five questions [5x10 = 50 marks]**

1. Define Distribution Automation (DA). Discuss different categories/ functions of DA and objectives of Distribution Automation.	(10)
2. Define Remote Terminal Unit (RTU) with block diagram. Discuss briefly functions of major elements of RTU.	(10)
3. Define SCADA. Discuss briefly the various functions of SCADA.	(10)
4. Discuss briefly various protocols used in SCADA with advantages and disadvantages of each protocol.	(10)
5. What makes substation automation "New". Discuss benefits of substation automation system (SAS).	(10)
6. Apart from "GOOSE" discuss about other protocols of IEC 61850 Standard with simple block diagram indicating functioning of communication protocol. Write short note on Digital substation.	(10)
7. A two Bus System [Generating Plant #1 is on Bus -1 and Generating Plant #2 in Bus-2] and load is only on Bus-2. If 100 MW is transmitted from Plant-1 to the load , a transmission loss of 10MW is incurred.	
a) Find the required Generation of each plant and power received by load when system $\lambda = \text{Rs.}25/\text{MWH}$. The incremental Fuel cost of the plants are given below: $(dc_1)/(dP_{G1}) = 0.02 P_{G1} + 16$; $(dc_2)/(dP_{G2}) = 0.04 P_{G2} + 20$ in Rs. Per MWH	(4)
b) As per obtained load demand in (a) above find the optimum load distribution between two plants when losses are included but not coordinated..	(3)
c) and also find the savings per hour when losses are also coordinated.	(3)
8. Discuss steps to be taken and Technologies to be used for implementation of Demand side management (DSM)	(10)
9. Discuss briefly with block diagram of the Load forecasting and Distribution System Engineering and Planning.	(10)
10. In connection with Power Plant Main Auxiliary Distribution system, draw the logic circuit for Closing of Incoming Breaker and Auto throw over of TIE Breaker through Automation System.	(10)