7|6|24

B.Tech.   End Sem Examination June 2024

Duration: 3 Hrs

Program: Mechanical Engineering

Course Code: PE BTM 733

Maximum Points: 100

Semester: VIII

Course Name: Industrial Robotics

Notes:

1. Solve any **FIVE** questions
2. Assume suitable data whenever necessary

| Q.No.	Questions	Points	CO	BL	Module No.
1 a	Explain the term Automation with suitable examples. Discuss the types of Automation.	10	I	3	I
1b	Explain the relative cost effectiveness of Automation and three laws of Robotics.	10	I	4	III
2a	Discuss the AI in Robotics with goal of AI in Robotics. Explain the Robotic manipulators.	10	IV	5	II
2 b	Enlist the different types of Grippers with the diagrams and discuss the anatomy of Robotics.	10	III	3	II
3 a	Classify the Robots according to the drive technology and workspace envelop.	10	IV	4	III
3 b	Explain the translation and rotation of second frame relative to the first frame, frame {B} is rotated relative to frame {A} about X-axis by 45^0, then translated -12 units in X_A, 3 units in Y_A and 10 units in Z_A. Define the frame {B} relative to frame {A} (find ^A_BT), then find ^AP if $B_p = [-2 \ 6 \ -5]^T$.	10	IV	5	III
4a	Assign frames {0} to {4} for the shown planar 3R (RRR) robotic manipulator, then find the DH parameter table. *Refer figure 4a (Page 2)*	10	IV	3	IV
4b	For the shown RPR robotics manipulator. Calculate the transformation matrices $^0_1T, ^1_2T, ^2_3T, ^3_4T$ and the find ^0_4T. *Refer figure 4b (Page 2)*	10	IV	4	IV
5a	For the 2R robot calculate the forces and moments acting on each joint, then calculate the joint torques and find the Jacobian matrix relative to frame {0} and frame {3} if $^3F = [f_x \ f_y \ f_z]$ $^3N = [0 \ 0 \ n_z]$. *Refer figure 5a (Page 2)*	10	IV	3	VII

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|					
5b	For the 3R non-planer robot, find the Jacobian matrix of the end effector frame {4} relate to frame {0} using direct different method. *Refer figure 5b (Page 2)*	10	IV	4	VII
6a	What is Jacobian. Develop the procedure to obtain Jacobian using velocity propagation method.	10	IV	5	IV
6b	Discuss the social issues and economic issues of Robotics. Explain the link parameters and joint parameters with suitable example.	10	III	5	IV
7a	Discuss the Robotic application in manufacturing such as material transfer, machine loading and unloading, assembly and inspection.	10	II	5	VI
7b	Discuss the problem solving, robot learning and robot task planning.	10	III	5	VI
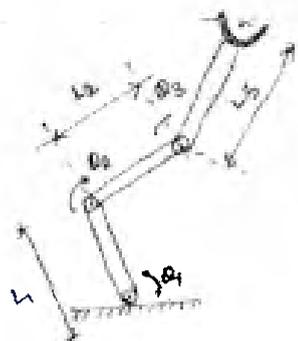
Q.4 figure 4a
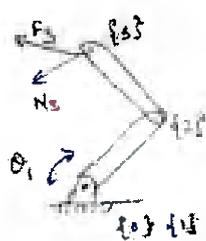
Q4 figure 4b

Q.5 2R Robot figure 5a
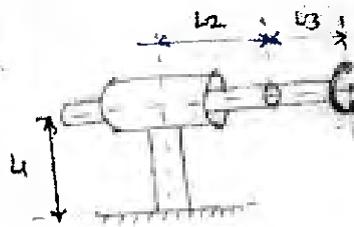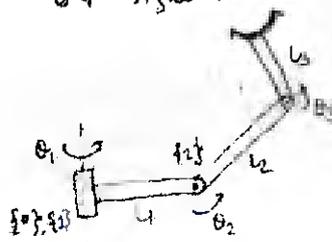
3R non planer

Q.5 figure 5b

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END SEMSTER EXAMINATION JUNE-2024

7/6/24

Program: B.Tech. Mechanical	Duration: 3 Hour
Course Code: PEC-BTM 754	Maximum Points: 100
Course Name: Power Plant Engineering	Semester: VIII

Notes:

1) **Solve: Any FIVE Questions.**

2) Answers must be **SPECIFIC** and in **legible** handwriting.

3) **Draw neat, labelled system and process diagrams** wherever asked or necessary.

4) **Illustrate your answers with suitable examples** wherever asked or necessary.

5) **Use separate Graph papers** for drawing a) **load curve** and **load duration curve in Q.1** and b) **Hydrograph** and **Flow duration curve in Q.2.**

6) **Assume suitable data wherever necessary and state the same.**

Q. No.	Question	Points	CO	BL	Module
1.	a) **Explain:** with significance i) Load factor ii) Capacity factor iii) Reserve factor iv) Use factor for a power plant.	8	1	II	1
	b) The load on a power station for 24 hours is as shown in the table below. 	Time (Hr)	0-6	6-8	8-12	12-14	14-18	18-22	22-24
---	---	---	---	---	---	---	---
Load (MW)	40	50	60	50	70	80	40 | **Construct:** i) Load curve and ii) load duration curve for the above data. If all the load above 60 MW are taken by a standby unit of 20 MW capacity, For the standby unit, **Evaluate:** i) Load factor and ii) Use factor.	12	1, 4	V	1
2.	b) **Discuss:** Factors to be considered for selection of site for hydroelectric power plants.	8	2	II	2
	b) The data for average monthly flow for a hydel plant at a site for 12 months is given table. The water head available is 90 m, turbine efficiency = 90 % and generator efficiency = 96 %. **Construct:** i) Hydrograph and ii) Flow duration curve for the data given in table.	12	2, 4	V	2

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END SEMSTER EXAMINATION JUNE-2024

Month	Discharge Q (m³/s)	Month	Discharge Q (m³/s)
January	100	July	1100
February	325	August	1300
March	400	September	1000
April	700	October	800
May	850	November	600
June	900	December	300

Evaluate: i) Average monthly discharge, ii) capacity of the reservoir required, iii) brake power available at the turbine shaft, iv) power available for distribution to customer

3.	a) **Explain**: Principle of Fluidized Bed Combustion (FBC) system. **Draw:** Neat sketch.	8	2	I, II	3
	b) **The** following data refers to an air standard gas turbine power plant using intercooling, regeneration and reheating arrangement. Pressure ratio = 4. The compressor inlet pressure and temperature are1 bar and 26° C. Turbine inlet temperature = 600° C. Compressor and turbine efficiency = 0.8 each, Regenerator effectiveness = 0.8. **Evaluate:** Thermal efficiency of cycle. **Draw:** System diagram and T-s diagram.	12	2, 4	I, V	5
4.	a) **Describe:** Essential elements of a nuclear reactor with their functions and features. **Draw:** Neat sketch of the system.	10	2	I, II	4
	b) **Explain:** Working of BWR and PWR. **Compare:** advantages and disadvantages and **Draw:** Neat system diagram of each.	10	2	I, II, IV	4
5.	a) **Explain:** Working of simple Closed Cycle Gas Turbine Plant (CCGT). **Draw:** A neat system diagram. **Compare:** Advantages and disadvantages of OCGT and CCGT plants.	8	2	I, II, IV	5
	b) **Explain:** I) Work ratio and ii) Air rate for a gas turbine plant. An air standard simple open cycle gas turbine (OCGT) plant operates with air at inlet to compressor at 30 °C and 1 bar pressure. The pressure ratio of the compressor is 6. Temperature of working fluid at inlet to gas turbine is 900	12	2, 4	I, II, V	5

	°C. **Evaluate:** Thermal efficiency of plant for i) Ideal cycle of operation ii) For cycle of operation with Isentropic efficiency of turbine ($\eta_{T,I}$) and compressor ($\eta_{C,I}$), each = 85%. **Draw:** T-s diagram for indicating each of the two cases. **State:** Conclusion from the results of calculations.				
6.	**a) Describe:** Simple Gas Turbine cycle combined with Single Pressure Steam Turbine cycle (SGT1ST). **Draw:** Neat system diagram and T-s Diagram.	8	2	I, II	6
	b) Compare: Favorable as well as adverse features of hydroelectric plant and steam power plant for use of each plant as a base load and peak load plant. It is proposed to supply a maximum demand of 500 MW with load factor of 70%. Choice is to be made between a hydroelectric and steam power plant. **Evaluate:** The overall cost per kWh of energy generated for each plant from scheme of cost elements shown in the table. Assume the maximum demand equal to the plant capacity. **State:** Choice of power plant and **Justify:** your recommendation.	12	1, 2, 4	IV, V	1,6
7.	**a) Discuss:** Environmental impact of nuclear power plants in terms of hazards due to operational nuclear plant and nuclear wastes from the plant. **Explain:** Methods of disposal of various nuclear wastes. **Draw:** Neat sketches of systems involved.	10	3	I, II	4,7
	b) State: Various methods of controlling SO_2 emission from thermal power plants. **Explain:** Working of a wet scrubber for the same. **Draw:** Neat schematic diagram of the system.	10	3	I, II	7

Table within question 6b:

Element of cost	Steam power plant	Hydroelectric power plant
Capital cost per MW installed	Rs. 3 Crore	Rs. 4 Crore
Interest on capital	6 %	5 %
Depreciation	6 %	4 %
Operating cost per kWh(including fuel)	Rs. 0.30	Rs. 0.05
Transmission and distribution cost per kWh	Rs. 0.02	Rs. 0.03

END SEMESTER EXAMINATION JUNE 2024

11/6/24

Program: Mechanical Engineering Sem VIII

Duration: 3 Hours

Course Code: PE BTM755

Maximum Points: 100

Course Name: **Automobile Engineering**

Semester: 8

Note:

1) Question number 1 is compulsory

2) Solve any 4 main questions out of remain six main questions

3) Write solution point wise and draw necessary sketch whenever required

No.	Questions	Points	CO	BL	Module No.
Q1A	Write a short note on starting system used in an automobile? [5] Explain real prime movers torque, speed and power characteristic using sketch? [5]	10	2	1,2	3,6
Q1B	Explain how the valve timing diagram of a 4-stroke engine influences its performance. Describe the phases of intake, compression, power, and exhaust strokes. [5] Q2) Compare and contrast spark ignition (SI) engines and compression ignition (CI) engines. Discuss differences in their working principles, fuel types, efficiency, and applications.	10	1	4	1
Q2A	Draw neat sketch of hydraulic brake system used in light passenger vehicle? Give function of each elements using 3 points?	10	3	2	5
Q2B	For an engine working on the ideal Dual cycle, the compression ratio is 10 and the maximum pressure is limited to 70 bar. If the heat supplied is 1680 kJ/kg, find the pressures and temperatures at the various salient points of the cycle and the cycle efficiency. The pressure and temperature of air at the commencement of compression are 1 bar and 100 °C respectively. Assume Cp = 1.004 kJ/kg K and Cv = 0.717 kJ/kg K for air.	10	2	3	1
Q3A	Draw neat sketch of clutch function as representation of 'speed Vs time'? Draw neat sketch of clutch in engaged and disengaged position? a) Draw neat sketch of multi-rail selector fork and explain how the gear interlock mechanism makes gear shift reliable?	10	4	1	3

END SEMESTER EXAMINATION JUNE 2024

Q3B	Give the working principle of Coil Ignition System with the help of a neat sketch?	10	4	2	6
Q4A	With the help of neat sketch write short note on "Double wishbone suspension" system? [5] Draw neat sketch of twin tube shock absorber and explain its working? [5]	10	2	1	3
Q4B	When an automobile is steered using steering mechanism, then obtain expression for side slip angle (β) and radius of turn (R) using "kinetics of Bicycle model"?	10	3	3	2
Q5A	Analyze the various parameters that need to be considered during the body design of an automobile. Discuss how these parameters impact the overall vehicle performance, safety, and aesthetics.	10	1	4	4
Q5B	List down desirable performance parameters to be taken care by brake system? Explain any one using sketch in details? [5] Obtain general expression for maximum brake force can be applied for rear wheel and front wheel (give all terminology and necessary sketch)? [5]	10	3	3	5
Q6A	Explain the multi-point fuel injection (MPFI) system. Describe the two basic arrangements: i. Port Injection ii. Throttle Body Injection. Include a schematic diagram for each arrangement in your explanation.	10	4	2	7
Q6B	Give significance any one parameters of wheel alignment required to be maintained, along with their sketch? [5] List down elements of steering column and give their functions? [5]	10	1	1,3	2
Q7A	Explain the Common Rail Direct Injection (CRDI) system. Provide a detailed description of its working principle and components, and include a schematic diagram to illustrate the system	10	2	2	7
Q7B	Describe the main functions of an automobile chassis. Additionally, classify the different types of chassis used in vehicles and explain the advantages and disadvantages of any two types.	10	3	3	4

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END SEM EXAMINATION JUNE 2024

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Program: BTECH MECH Sem VIII	**Duration: 3 Hour**
Course Code: PE-BTM734	**Maximum Points: 100**
Course Name: Supply Chain Management	**Semester: VIII**

Instructions:

Solve any 5 questions.

Assume suitable data wherever necessary

Q.No.	Questions	Point	CO	BL	Module
Q1A	**Numerical on Facility Locations Decisions in SCM** Following Automobile showrooms are located according to following information showing coordinate location of each show room. What is the best location for a new warehouse / temporary storage facility considering only distances and quantity sold per month?	10	2	5	2

Sr.No.	Showroom location	X Axis	Y Axis	Quantity Sold per month
1	A	150	250	1200
2	B	300	550	1500
3	C	700	900	1700

- Plot the existing facilities on two dimensional plane (graph) and show their coordinates.
- Compute the X coordinate of Warehouse location.
- Compute the Y Coordinate of Ware house location.
- State the method adopted to find the warehouse location.
- Prepare the table to distinguish the facility location sites according to rural, suburban and urban areas.

Q.No.	Questions	Point	CO	BL	Module
Q1B	Draw the reverse supply chain of electronic waste material. Show all flows. Identify the challenges in the same and recommend the industry 4.0 technologies to address the challenges with necessary justification	10	1,3	5	4, 6
Q2A	Numerical on Supplier evaluation in SCM. Refer the following suppliers' data for a typical organization. Find out the best supplier based on the data.	10	2	5	2,3

Supplier Sn Evaluation criteria	S1	S2	S3	S4	S5
Number of Units accepted	93	92	96	94	92
Number of Units supplied	97	99	99	98	97
Delivery promised in days	42	42	42	42	42
Delivery done	45	46	48	45	47
Price per unit	24	25.5	23	23.8	26
Credit in days	35	45	40	35	45
Distance (km)	12	15	15	35	40
Service Facilities %	89	92	87	95	94
Number of Change request done in financial year	7	7	7	7	7

Number of Change request processed in financial year	6	7	7	6	5				
Number of kaizen for cost reduction in financial year	2	3	2	2	3				

If the weightage for above criteria are as follows.

Sr No	Criteria	Weightage
1	Quality	20
2	Delivery Schedule Adherence	15
3	Price	20
4	Credit	15
5	Proximity	10
6	Service Facilities	10
7	Change request processed	05
8	Kaizen	05

Q2B	Prepare the list of Supply Risks in JIT Implementation. Prepare the ishikawa diagram of Supply Risks in JIT implementation. Explain it.	10	1,3	5	1,3
Q3A	Numerical on Forecasting in SCM Refer the following service supply chain of Healthcare having 12 hospitals. Revenues (x, or the independent variable) and profits (y, or the dependent variable) for each hospital are given below. Develop the forecasting model and compute profits for a hospital with \$10 million in revenues. All figures are in millions of dollars. Multi Hospital System Revenues and Profits Data is as follows.	10	1,2	5	2

Hospital	Revenue (x)	Profit (y)
1	7	0.15
2	2	0.10
3	6	0.13
4	4	0.15
5	14	0.25
6	15	0.27
7	16	0.24
8	12	0.20
9	14	0.27
10	20	0.44
11	15	0.34
12	7	0.17

Q3B	Draw the conceptual model of Supply Chain of Electric Vehicle manufacturing Industry. Explain it with reference to following • Players of Supply Chain • Key Requirements of each player • Various flow of Supply Chain • Technologies useful to manage the supply chain processes	10	2,3	5	1,6
Q4A	Numerical on Demand Pattern Analysis A stockist keeps stock of Product X. The record shows the demand as shown in table. Consider the following sequence of random numbers 48, 78, 19, 51, 56, 77, 15, 14, 68, 8	10	2	5	1,2
Q4B	Explore the Critical Success Factors for stakeholder involvement in Green Supply Chain. Draw the Blockchain IOT integrated architecture for above stakeholder involvement. State and explain the features of Blockchain for stakeholder involvement in Supply Chain Management. State and explain the features of IOT for stakeholder involvement in Supply Chain Management. Explain the use of information flow of Blockchain IOT integrated architecture in support of Critical Success Factors.	10	1,3	5	3,6
Q5A	Numerical on Inventory decisions in SCM A company need 50000 units per year which costs Rs10 per unit. Ordering cost is estimated to be 100 per order carrying cost are 15% per annum of average inventory. The supplier is ready to give 2 % discount in price of the original value if the company purchases 10000 units or more but less than 20000 lot size. A further of 1 % in price of original value is available on the order of 20000 or more units. Find the economical lot size and min total cost.	10	2	5	3
Q5B	Draw and explain the diagram showing Transportation Decision Making in an Integrated Supply Chain. Compare various modes of transportation (Road, Rail, Air, Water, Pipeline)on a scale of (Very Low , low, medium, high , very high) Use the following Characteristics for comparison Door to Door Service, Price, speed ,reliability, Packaging needs, Risk of Damage/loss, Flexibility, environmental impact	10	1,3	5	5
Q6A	Numerical on Supply Chain decisions –New Product Development " The top management of a company is considering the problem of marketing a new product.The investment of fixed cost for NPD is Rs 15000. NPD programme has following three uncertain factors Sale price, variable cost, sale volume.	10	2	5	2

Q4A demand table:

Daily Demand	0	10	20	30	40	50
Probability	0.01	0.20	0.15	0.50	0.12	0.02

Product has a life of only one year	Probability	Unit Variable cost Rs.	Probability	Sales Volume	Probability				
14	0.35	2	0.3	3000	0.25				
15	0.50	3	0.5	4000	0.40				
16	0.15	4	0.20	5000	0.35				

Find the average profit and percentage rate of return from the above investment on the basis of 10 trials of Monte Carlo Simulation. Use following random numbers.
A. 39,59,26,18,78,06,90,61,20,47
B. 91,75,43,89,46,83,06,77,20,61
C. 85,46,95,58,21,35,49,12,71,05

Q6B	Draw the Green Supplier Development Process Model based on Toll Gate approach. Explain it in detail.	10	1,3	5	3
Q7A	Numerical on Facility Location Decisions in SCM An operations manager has narrowed the search for a new facility location to four communities. The annual fixed costs (land, property taxes, insurance, equipment, and buildings) and the variable costs (labor, materials, transportation, and variable overhead) are shown below. Total costs are for 20,000 units.	10	3	5	2

Community	Fixed Cost /year	Variable Cost / unit
A	$150000	62
B	$300000	38
C	$500000	24
D	$600000	30

	Plot the total cost curves for all the communities on a single graph. Identify on the graph the approximate range over which each community provides the lowest cost. Calculate the break-even quantities over the relevant ranges. If the expected demand is 15,000 units per year, what is the best location?				
Q7B	State the characteristics of a Good Measure. Explore the Distribution Center Metrics for automotive industry.	10	1,2	4	7

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11/6/24

Program: B. Tech Mechanical Sem VIII   **Duration: 3 Hour**

Course Code: PE BTM756   **Maximum Points: 100**

Course Name: Renewable Energy Sources and Utilization   **Semester: VIII**

Notes:

1) Question number ONE is compulsory and solve any FOUR out of remaining SIX questions.
2) Use of steam table, refrigeration properties table and Gamma function table is permitted.
3) Draw neat sketches wherever required.
4) Assume suitable data and justify the same.

Q.No.	Questions	Points	CO	BL	Module Number
1	(a) Discuss India's production and reserves of commercial energy sources via (i) Fossil Fuels (ii) Hydro power. (b) Explain the principle of working of the solar cell. (c) What is Ocean Thermal Energy Conversion? Also explain open cycle OTEK system with neat sketch. (d) What is geothermal energy explain it in short.	20	1,2,4	1,2	1,3,5,6
2(a)	Calculate the overall loss coefficient for a flat-plate collector with two glass covers by calculation. (Without using empirical formula) Given the following data: Size of the absorber plate ($L_1 \times L_2$) :1.90 m × 0.9m Spacing between plate and the first glass cover (L) : 4 cm Spacing between first and the second glass cover (L) : 4 cm Plate emissivity (ε_p) : 0.92 Glass cover emissivity (ε_c) : 0.88 Collector tilt (β) : 20° Mean Plate temperature (T_{pm}) : 70°C Ambient air temperature (T_a) : 24°C Wind speed (V_∞) : 2.5 m/s Back insulation thickness (δ_b) : 8 cm Side insulation thickness (δ_s) : 4 cm Thermal conductivity of insulation (k_i) : 0.05 W/m-K	12	2	2,3	2
2(b)	Define maximum conversion efficiency for Solar PV cell. Draw typical current-voltage characteristics of a solar cell showing the effects of illumination levels. Also draw diagram	08	2	1,2	3

	for variation of theoretical cell efficiency with band gap energy for various materials used for manufacture of solar cells for incident global radiation AM0 and AM1.5 respectively with clear sky and illumination 1000 W/m². (Materials: Si, GaAs, CIGS, CdTe, a-Si:H)				
3(a)	Explain the mechanism of producing electricity by using geothermal energy. Also explain dry steam power plant using geothermal energy with neat sketch.	10	4	1,2	6
3(b)	It is proposed to set-up a wind form at a promising location in Konkan region for which long-term data on wind speed is not available. In order to assess the wind potential and select suitable wind machines, a large number of discrete measurements of hourly wind speed are made over some representative days for a couple of years. The measurements yield the following values of the average wind speed and standard deviation: $\bar{V}$ = 5.8 m/s σ = 3.5 m/s Plot the annual wind speed-frequency distribution under the assumption that it is a Weibull distribution.	10	2	2,3	4
4(a)	Classify the water turbines. Explain in detail Kaplan propeller turbine with neat sketch.	10	3	1,2	5
4(b)	Calculate the energy content in the wind for data given below. Also calculate the actual energy available for wind machine for which the cut in speed is 14 kmph, the design speed is 36 kmph and the cut-out speed is 90 kmph for following location. Location : Indore Month : May Take ρ for air = 1.20 kg/m³.	10	2	2,3	4

Interval	May	Interval	May	Interval	May	Interval	May
00	3.2	10-12	3.9	22-24	7.4	34-36	5.7
00-02	1.6	12-14	4.0	24-26	8.0	36-38	4.1
02-04	0.9	14-16	6.3	26-28	4.3	38-40	1.7
04-06	1.3	16-18	6.2	28-30	5.1	40-42	2.2
06-08	2.0	18-20	6.5	30-32	7.5	42-44	0.8
08-10	1.3	20-22	10.3	32-34	4.5	44-46	0.7

5(a)	Explain the manufacturing process of Copper Indium Gallium Diselenide (CIGS) thin film multicrystalline solar cell with neat sketch.	10	2	1,2	3
5(b)	A propeller wind machine has a rotor diameter of 60 m. It is operating at a location having a wind speed of 35 kmph and rotating at 20 rmp. Calculate theoretically, the power which the machine can extract from the wind if (a) only wake rotation is considered (b) both wake rotation and the effect of drag are considered. For part (b) assume that value of $\varepsilon=0.012$.	10	2	2,3	4
6(a)	Draw neat schematic diagram of downdraft gasifier and explain the biomass gasification process in detail.	10	4	1,2	7
6(b)	A residential house has a power requirement of 500 W for 5 hours every night. It is proposed to meet the requirement by using a PV array, a battery storage system and an inverter. The whole system is over designed so that it can meet one extra night's requirement even if there has been no sunshine during the day. Calculate the number of PV modules and batteries required. Take conversion efficiency =12.5% and Module size: 119.1 cm × 53.3 cm. Take the following: (i) Solar radiation is available for an average of six hours daily and average hourly global radiation flux incident on the array is 550 W/m^2. (ii) Battery rating = 12 V; 120 Ah. Depth of discharge = 0.7 Charging and discharging efficiency = 0.9 (iii) Inverter efficiency at full load = 0.85	10	4	1,2	3
7(a)	Calculate the efficiency of closed cycle OTEC system using ammonia as the working fluid and installed at a location where the warm and cold sea water streams are at temperature of 29°C and 8°C respectively. Make an allowance of about 5°C for the temperature difference required in the evaporator and condenser for transferring heat, and assume that the ammonia is evaporating at 24°C and condensing at 13°C. Take the isentropic efficiencies of the turbine and pump to be 90 and 80 per cent respectively.	10	3	3	6
7(b)	Explain the method of Bio-ethanol and Bio-diesel production in detail.	10	2	1,2	7

Data Sheet and Properties of Air

I. Relationship between Nusselt and Rayleigh numbers.

$$Nu_L = 1 \; ; \; Ra_L \cos \beta < 1708$$

$$Nu_L = 1 + 1.446 \left(1 - \frac{1708}{Ra_L \cos \beta} \right), \; 1708 < Ra_L \cos \beta < 5900$$

$$Nu_L = 0.229 \, (Ra_L \cos \beta)^{0.252}, \; 5900 < Ra_L \cos \beta < 9.23 \times 10^4$$

$$Nu_L = 0.157 \, (Ra_L \cos \beta)^{0.285}, \; 9.23 \times 10^4 < Ra_L \cos \beta < 10^6$$

$$h_w = 8.55 + 2.56 \, V_\infty$$

Table A.4.2 *Properties of dry air at atmospheric pressure*

T $^\circ C$	ρ kg/m^3	C_p kJ/kg-K	$\mu \times 10^6$ N-s/m^2	k W/m-K	Pr	$\nu \times 10^6$ m^2/s
0	1.293	1.005	17.2	0.0244	0.707	13.28
10	1.247	1.005	17.7	0.0251	0.705	14.16
20	1.205	1.005	18.1	0.0259	0.703	15.06
30	1.165	1.005	18.6	0.0267	0.701	16.00
40	1.128	1.005	19.1	0.0276	0.699	16.96
50	1.093	1.005	19.6	0.0283	0.698	17.95
60	1.060	1.005	20.1	0.0290	0.696	18.97
70	1.029	1.009	20.6	0.0297	0.694	20.02
80	1.000	1.009	21.1	0.0305	0.692	21.09
90	0.972	1.009	21.5	0.0313	0.690	22.10
100	0.946	1.009	21.9	0.0321	0.688	23.13
120	0.898	1.009	22.9	0.0334	0.686	25.45
140	0.854	1.013	23.7	0.0349	0.684	27.80
160	0.815	1.017	24.5	0.0364	0.682	30.09
180	0.779	1.022	25.3	0.0378	0.681	32.49
200	0.746	1.026	26.0	0.0393	0.680	34.85
250	0.674	1.038	27.4	0.0427	0.677	40.61
300	0.615	1.047	29.7	0.0461	0.674	48.33
350	0.566	1.059	31.4	0.0491	0.676	55.46
400	0.524	1.068	33.0	0.0521	0.678	63.09
500	0.456	1.093	36.2	0.0575	0.687	79.38
600	0.404	1.114	39.1	0.0622	0.699	96.89
700	0.362	1.135	41.8	0.0671	0.706	115.4
800	0.329	1.156	44.3	0.0718	0.713	134.8
900	0.301	1.172	46.7	0.0763	0.717	155.1
1000	0.277	1.185	49.0	0.0807	0.719	177.1

Gamma Function for Γ(x)

x	1	2	3	4	5	6	7	8	9	10
0	1	1	2	6	24	120	720	5040	40320	362880
0.05	0.97	1.02	2.1	6.39	25.88	130.72	790.83	5575.35	44881.53	406177.83
0.1	0.95	1.05	2.2	6.81	27.93	142.45	868.96	6169.59	49973.71	454760.75
0.15	0.93	1.07	2.31	7.27	30.16	155.31	955.16	6829.42	55659.8	509287.17
0.2	0.92	1.1	2.42	7.76	32.58	169.41	1050.32	7562.29	62010.76	570499.03
0.25	0.91	1.13	2.55	8.29	35.21	184.86	1155.38	8376.51	69106.23	639232.6
0.3	0.9	1.17	2.68	8.86	38.08	201.81	1271.42	9281.39	77035.56	716630.69
0.35	0.89	1.2	2.83	9.47	41.2	220.41	1399.63	10367.92	85899.08	803156.43
0.4	0.89	1.24	2.98	10.14	44.6	240.88	1541.34	11485.89	95869.46	900608.9
0.45	0.89	1.28	3.15	10.85	48.3	263.26	1698	12650.08	106893.21	1010140.79
0.5	0.89	1.33	3.32	11.63	52.34	287.89	1871.25	14034.41	119292.46	1133278.39
0.55	0.89	1.38	3.51	12.47	56.75	314.95	2062.92	15575.08	133166.94	1271744.28
0.6	0.89	1.43	3.72	13.38	61.55	344.7	2275.03	17290.25	148696.14	1427482.93
0.65	0.9	1.49	3.94	14.37	66.8	377.42	2509.83	19200.21	166081.84	1602689.78
0.7	0.91	1.54	4.17	15.43	72.53	413.41	2769.83	21327.69	185550.94	1799844.13
0.75	0.92	1.61	4.42	16.59	78.78	453.01	3057.82	23698.13	207358.61	2021746.44
0.8	0.93	1.68	4.69	17.84	85.62	496.61	3376.92	26339.99	231791.89	2271560.56
0.85	0.95	1.75	4.99	19.2	93.1	544.61	3730.6	29285.17	259173.77	2552861.66
0.9	0.96	1.83	5.3	20.67	101.27	597.49	4122.71	32569.41	289867.73	2869690.49
0.95	0.98	1.91	5.64	22.27	110.21	655.77	4557.58	36232.73	324282.91	3226614.98

Bharatiya Vidya Bhavan's

SARDAR PATEL COLLEGE OF ENGINEERING

(Government Aided Autonomous Institute)

Munshi Nagar, Andheri (W) Mumbai – 400058

END SEMESTER EXAMINATION JUNE 2024   13|6|24

Program: Final Year B. Tech. (C/M/E) Sem VIII

Course Code: OE–BTM712

Course Name: Introduction to Research Methodology

Duration: 03 Hrs.

Maximum Points: 100

Semester: VIII

Notes:

1. Attempt any **FIVE** questions.
2. Each question carries equal marks.
3. Assume suitable data wherever necessary and justify the same.

No.	Questions	Points	CO	BL	Module No.
Q1)	a) Explain how research methodology can be applied to solve a real-life problem. Provide a specific example to illustrate its importance and effectiveness.	10	1	3,4,5	1
	b) Discuss how ethics in research play a critical role. Provide examples to support your answer.	10			
Q2)	a) What is the need for research design in a study? Explain the key features of a good research design. Provide examples to illustrate your points.	10	1	1,2,3	2
	b) Explain the concept of a research hypothesis. Differentiate between null and alternative hypotheses with examples. Also, explain Type 1 and Type 2 errors in hypothesis testing.	10			
Q3)	a) Explain the significance of ISBN, ISSN, DOI, UDC, and RIS in academic research and publishing.	10	1	1,2,3	3
	b) Define primary data and secondary data in research methodology. Explain the key differences between them and provide examples of each type of data. How might a researcher choose which type of data to use for a study?	10			
Q4)	a) Discuss the criteria for good research. Why are these criteria important?	10	1,3	4,5,6	1,4
	b) Describe the key characteristics of structured and unstructured interviews in research methodology. Compare and contrast the	10			

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END SEMESTER EXAMINATION JUNE 2024

	two interview types, highlighting their advantages and disadvantages. Provide an example scenario where each type of interview would be the most appropriate				
Q5)	a) A company wants to understand the relationship between its advertising expenditure and sales. Here are the data for 5 months:	10	2	3	5

Month	Advertising Expenditure (X)	Sales (Y)
Jan	10	200
Feb	20	300
Mar	15	250
Apr	5	150
May	25	350

Find Correlation coefficient between advertising expenditure and sales using:

1. Spearman Rank Correlation (5 Marks)
2. Karl Pearson Rank Correlation (5 Marks)

b) A researcher is studying the relationship between the number of training hours (X) and the performance score out of 150 (Y) of employees in a company. The performance score predicted (Y) and actual performance score (Y') are tabulated below. Also, Using the data provided, perform a detailed analysis to understand the relationship between the number of training hours and the performance scores. Your analysis should include: Calculating the Pearson correlation coefficient between the training hours and the actual performance scores; formulating the null and alternative hypotheses for testing the significance of the correlation; conducting a hypothesis test at a significance level of 0.05 to evaluate the significance of the correlation; calculating the mean squared error (MSE) between the predicted performance scores and the actual performance scores; and providing a detailed interpretation and conclusion on the relationship between the number of training hours and the performance scores, supported by your calculations.

(10 marks for part b)

Training hours (X)	Predicted performance score (Y)	Actual performance score (Y')
2	50	48
3	55	53
5	65	68
7	75	72
8	80	78
10	90	85
12	100	98
14	110	107
15	115	113
18	130	125

Q6)

a) A subject's (Research Methodology) difficulty level is determined out of 100 in a certain engineering institute. The mean difficulty level of all the subjects is 43. The difficulty level for 'Research Methodology' is 60. ($\sigma=10$)   **10 2 3 6**

Find the following.

1. Percentage of subjects which are more difficult than 'Research Methodology'
2. Percentage of subjects which are less difficult than 'Research Methodology'
3. Percentage at the extremes of 'Research Methodology'

b) A sociologist wants to investigate whether education level is independent of gender. To test this, a random sample of 395 people was surveyed, and each person was asked to report their highest level of education. The results are summarized in the following table: **10**

Class grouping	High School	Bachelors	Masters	PhD	Total
Female	60	54	46	41	201
Male	40	44	53	57	194
Total	100	98	99	98	395

Using the chi-square test of independence, determine if education level is independent of gender at a significance level of 0.05. Formulate the null and alternative hypotheses, calculate the chi-square statistic, and interpret the results.

|						
Q7)	a) Explain different referencing formats used in report writing and give one example of each.	10	4	1,2,4,5	7
	b) Discuss the key components of a research report. How do these components contribute to effectively communicating the research conclusions?	10			

STANDARD NORMAL DISTRIBUTION: Table Values Represent AREA to the LEFT of the Z score.

Z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
-3.9	.00005	.00005	.00004	.00004	.00004	.00004	.00004	.00004	.00003	.00003
-3.8	.00007	.00007	.00007	.00006	.00006	.00006	.00006	.00005	.00005	.00005
-3.7	.00011	.00010	.00010	.00010	.00009	.00009	.00008	.00008	.00008	.00008
-3.6	.00016	.00015	.00015	.00014	.00014	.00013	.00013	.00012	.00012	.00011
-3.5	.00023	.00022	.00022	.00021	.00020	.00019	.00019	.00018	.00017	.00017
-3.4	.00034	.00032	.00031	.00030	.00029	.00028	.00027	.00026	.00025	.00024
-3.3	.00048	.00047	.00045	.00043	.00042	.00040	.00039	.00038	.00036	.00035
-3.2	.00069	.00066	.00064	.00062	.00060	.00058	.00056	.00054	.00052	.00050
-3.1	.00097	.00094	.00090	.00087	.00084	.00082	.00079	.00076	.00074	.00071
-3.0	.00135	.00131	.00126	.00122	.00118	.00114	.00111	.00107	.00104	.00100
-2.9	.00187	.00181	.00175	.00169	.00164	.00159	.00154	.00149	.00144	.00139
-2.8	.00256	.00248	.00240	.00233	.00226	.00219	.00212	.00205	.00199	.00193
-2.7	.00347	.00336	.00326	.00317	.00307	.00298	.00289	.00280	.00272	.00264
-2.6	.00466	.00453	.00440	.00427	.00415	.00402	.00391	.00379	.00368	.00357
-2.5	.00621	.00604	.00587	.00570	.00554	.00539	.00523	.00508	.00494	.00480
-2.4	.00820	.00798	.00776	.00755	.00734	.00714	.00695	.00676	.00657	.00639
-2.3	.01072	.01044	.01017	.00990	.00964	.00939	.00914	.00889	.00866	.00842
-2.2	.01390	.01355	.01321	.01287	.01255	.01222	.01191	.01160	.01130	.01101
-2.1	.01786	.01743	.01700	.01659	.01618	.01578	.01539	.01500	.01463	.01426
-2.0	.02275	.02222	.02169	.02118	.02068	.02018	.01970	.01923	.01876	.01831
-1.9	.02872	.02807	.02743	.02680	.02619	.02559	.02500	.02442	.02385	.02330
-1.8	.03593	.03515	.03438	.03362	.03288	.03216	.03144	.03074	.03005	.02938
-1.7	.04457	.04363	.04272	.04182	.04093	.04006	.03920	.03836	.03754	.03673
-1.6	.05480	.05370	.05262	.05155	.05050	.04947	.04846	.04746	.04648	.04551
-1.5	.06681	.06552	.06426	.06301	.06178	.06057	.05938	.05821	.05705	.05592
-1.4	.08076	.07927	.07780	.07636	.07493	.07353	.07215	.07078	.06944	.06811
-1.3	.09680	.09510	.09342	.09176	.09012	.08851	.08691	.08534	.08379	.08226
-1.2	.11507	.11314	.11123	.10935	.10749	.10565	.10383	.10204	.10027	.09853
-1.1	.13567	.13350	.13136	.12924	.12714	.12507	.12302	.12100	.11900	.11702
-1.0	.15866	.15625	.15386	.15151	.14917	.14686	.14457	.14231	.14007	.13786
-0.9	.18406	.18141	.17879	.17619	.17361	.17106	.16853	.16602	.16354	.16109
-0.8	.21186	.20897	.20611	.20327	.20045	.19766	.19489	.19215	.18943	.18673
-0.7	.24196	.23885	.23576	.23270	.22965	.22663	.22363	.22065	.21770	.21476
-0.6	.27425	.27093	.26763	.26435	.26109	.25785	.25463	.25143	.24825	.24510
-0.5	.30854	.30503	.30153	.29806	.29460	.29116	.28774	.28434	.28096	.27760
-0.4	.34458	.34090	.33724	.33360	.32997	.32636	.32276	.31918	.31561	.31207
-0.3	.38209	.37828	.37448	.37070	.36693	.36317	.35942	.35569	.35197	.34827
-0.2	.42074	.41683	.41294	.40905	.40517	.40129	.39743	.39358	.38974	.38591
-0.1	.46017	.45620	.45224	.44828	.44433	.44038	.43644	.43251	.42858	.42465
-0.0	.50000	.49601	.49202	.48803	.48405	.48006	.47608	.47210	.46812	.46414

STANDARD NORMAL DISTRIBUTION: Table Values Represent AREA to the LEFT of the Z score.

Z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.50000	.50399	.50798	.51197	.51595	.51994	.52392	.52790	.53188	.5358
0.1	.53983	.54380	.54776	.55172	.55567	.55962	.56356	.56749	.57142	.5753
0.2	.57926	.58317	.58706	.59095	.59483	.59871	.60257	.60642	.61026	.6140
0.3	.61791	.62172	.62552	.62930	.63307	.63683	.64058	.64431	.64803	.6517
0.4	.65542	.65910	.66276	.66640	.67003	.67364	.67724	.68082	.68439	.6879
0.5	.69146	.69497	.69847	.70194	.70540	.70884	.71226	.71566	.71904	.7224
0.6	.72575	.72907	.73237	.73565	.73891	.74215	.74537	.74857	.75175	.7549
0.7	.75804	.76115	.76424	.76730	.77035	.77337	.77637	.77935	.78230	.78524
0.8	.78814	.79103	.79389	.79673	.79955	.80234	.80511	.80785	.81057	81327
0.9	.81594	.81859	.82121	.82381	.82639	.82894	.83147	.83398	.83646	.83891
1.0	.84134	.84375	.84614	.84849	.85083	.85314	.85543	.85769	.85993	.86214
1.1	.86433	.86650	.86864	.87076	.87286	.87493	.87698	.87900	.88100	.88298
1.2	.88493	.88686	.88877	.89065	.89251	.89435	.89617	.89796	.89973	.90147
1.3	.90320	.90490	.90658	.90824	.90988	.91149	.91309	.91466	.91621	.91774
1.4	.91924	.92073	.92220	.92364	.92507	.92647	.92785	.92922	.93056	.93189
1.5	.93319	.93448	.93574	.93699	.93822	.93943	.94062	.94179	.94295	.94408
1.6	.94520	.94630	.94738	.94845	.94950	.95053	.95154	.95254	.95352	.95449
1.7	.95543	.95637	.95728	.95818	.95907	.95994	.96080	.96164	.96246	.96327
1.8	.96407	.96485	.96562	.96638	.96712	.96784	.96856	.96926	.96995	.97062
1.9	.97128	.97193	.97257	.97320	.97381	.97441	.97500	.97558	.97615	.97670
2.0	.97725	.97778	.97831	.97882	.97932	.97982	.98030	.98077	.98124	.98169
2.1	.98214	.98257	.98300	.98341	.98382	.98422	.98461	.98500	.98537	.98574
2.2	.98610	.98645	.98679	.98713	.98745	.98778	.98809	.98840	.98870	.98899
2.3	.98928	.98956	.98983	.99010	.99036	.99061	.99086	.99111	.99134	.99158
2.4	.99180	.99202	.99224	.99245	.99266	.99286	.99305	.99324	.99343	.99361
2.5	.99379	.99396	.99413	.99430	.99446	.99461	.99477	.99492	.99506	9520
2.6	.99534	.99547	.99560	.99573	.99585	.99598	.99609	.99621	.99632	.99643
2.7	.99653	.99664	.99674	.99683	.99693	.99702	.99711	.99720	.99728	.99736
2.8	.99744	.99752	.99760	.99767	.99774	.99781	.99788	.99795	.99801	.99807
2.9	.99813	.99819	.99825	.99831	.99836	.99841	.99846	.99851	.99856	.99861
3.0	.99865	.99869	.99874	.99878	.99882	.99886	.99889	.99893	.99896	.99900
3.1	.99903	.99906	.99910	.99913	.99916	.99918	.99921	.99924	.99926	.99929
3.2	.99931	.99934	.99936	.99938	.99940	.99942	.99944	.99946	.99948	.99950
3.3	.99952	.99953	.99955	.99957	.99958	.99960	.99961	.99962	.99964	.99965
3.4	.99966	.99968	.99969	.99970	.99971	.99972	.99973	.99974	.99975	.99976
3.5	.99977	.99978	.99978	.99979	.99980	.99981	.99981	.99982	.99983	.99983
3.6	.99984	.99985	.99985	.99986	.99986	.99987	.99987	.99988	.99988	.99989
3.7	.99989	.99990	.99990	.99990	.99991	.99991	.99992	.99992	.99992	.99992
3.8	.99993	.99993	.99993	.99994	.99994	.99994	.99994	.99995	.99995	.99995
3.9	.99995	.99995	.99996	.99996	.99996	.99996	.99996	.99996	.99997	.99997

Chi-Square Distribution Table
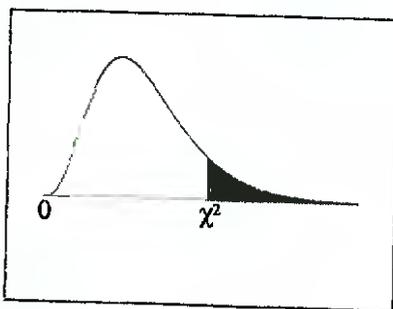
The shaded area is equal to α for $\chi^2 = \chi^2_\alpha$.

df	$\chi^2_{.995}$	$\chi^2_{.990}$	$\chi^2_{.975}$	$\chi^2_{.950}$	$\chi^2_{.900}$	$\chi^2_{.100}$	$\chi^2_{.050}$	$\chi^2_{.025}$	$\chi^2_{.010}$	$\chi^2_{.005}$
1	0.000	0.000	0.001	0.004	0.016	2.706	3.841	5.024	6.635	7.879
2	0.010	0.020	0.051	0.103	0.211	4.605	5.991	7.378	9.210	10.597
3	0.072	0.115	0.216	0.352	0.584	6.251	7.815	9.348	11.345	12.838
4	0.207	0.297	0.484	0.711	1.064	7.779	9.488	11.143	13.277	14.860
5	0.412	0.554	0.831	1.145	1.610	9.236	11.070	12.833	15.086	16.750
6	0.676	0.872	1.237	1.635	2.204	10.645	12.592	14.449	16.812	18.548
7	0.989	1.239	1.690	2.167	2.833	12.017	14.067	16.013	18.475	20.278
8	1.344	1.646	2.180	2.733	3.490	13.362	15.507	17.535	20.090	21.955
9	1.735	2.088	2.700	3.325	4.168	14.684	16.919	19.023	21.666	23.589
10	2.156	2.558	3.247	3.940	4.865	15.987	18.307	20.483	23.209	25.188
11	2.603	3.053	3.816	4.575	5.578	17.275	19.675	21.920	24.725	26.757
12	3.074	3.571	4.404	5.226	6.304	18.549	21.026	23.337	26.217	28.300
13	3.565	4.107	5.009	5.892	7.042	19.812	22.362	24.736	27.688	29.819
14	4.075	4.660	5.629	6.571	7.790	21.064	23.685	26.119	29.141	31.319
15	4.601	5.229	6.262	7.261	8.547	22.307	24.996	27.488	30.578	32.801
16	5.142	5.812	6.908	7.962	9.312	23.542	26.296	28.845	32.000	34.267
17	5.697	6.408	7.564	8.672	10.085	24.769	27.587	30.191	33.409	35.718
18	6.265	7.015	8.231	9.390	10.865	25.989	28.869	31.526	34.805	37.156
19	6.844	7.633	8.907	10.117	11.651	27.204	30.144	32.852	36.191	38.582
20	7.434	8.260	9.591	10.851	12.443	28.412	31.410	34.170	37.566	39.997
21	8.034	8.897	10.283	11.591	13.240	29.615	32.671	35.479	38.932	41.401
22	8.643	9.542	10.982	12.338	14.041	30.813	33.924	36.781	40.289	42.796
23	9.260	10.196	11.689	13.091	14.848	32.007	35.172	38.076	41.638	44.181
24	9.886	10.856	12.401	13.848	15.659	33.196	36.415	39.364	42.980	45.559
25	10.520	11.524	13.120	14.611	16.473	34.382	37.652	40.646	44.314	46.928
26	11.160	12.198	13.844	15.379	17.292	35.563	38.885	41.923	45.642	48.290
27	11.808	12.879	14.573	16.151	18.114	36.741	40.113	43.195	46.963	49.645
28	12.461	13.565	15.308	16.928	18.939	37.916	41.337	44.461	48.278	50.993
29	13.121	14.256	16.047	17.708	19.768	39.087	42.557	45.722	49.588	52.336
30	13.787	14.953	16.791	18.493	20.599	40.256	43.773	46.979	50.892	53.672
40	20.707	22.164	24.433	26.509	29.051	51.805	55.758	59.342	63.691	66.766
50	27.991	29.707	32.357	34.764	37.689	63.167	67.505	71.420	76.154	79.490
60	35.534	37.485	40.482	43.188	46.459	74.397	79.082	83.298	88.379	91.952
70	43.275	45.442	48.758	51.739	55.329	85.527	90.531	95.023	100.425	104.215
80	51.172	53.540	57.153	60.391	64.278	96.578	101.879	106.629	112.329	116.321
90	59.196	61.754	65.647	69.126	73.291	107.565	113.145	118.136	124.116	128.299
100	67.328	70.065	74.222	77.929	82.358	118.498	124.342	129.561	135.807	140.169