

Total No. of Questions : 8]

SEAT No. :

[Total No. of Pages : 4

P3876

[5561]-531

B.E. (Mechanical)

HYDRAULICS AND PNEUMATICS

(2015 Pattern) (Semester - I)

Time : 2½ Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) Answer Q.1 OR Q.2, Q.3 OR Q.4, Q.5 OR Q.6, Q.7 OR Q.8
- 2) Neat diagrams must be drawn wherever necessary.
- 3) Figures to the right indicate full marks.
- 4) Assume suitable data, if necessary.

Q1) a) Draw ISO symbols for the following components: **[6]**

- i) 3x2 pneumatically double pilot operated DCV
 - ii) Double acting hydraulic Intensifier
 - iii) Counterbalance valve with bypass & check valve
 - iv) Twin Pressure valve
 - v) Quick Exhaust valve
 - vi) Bi-directional variable displacement hydraulic motor
- b) A hydraulic pump delivers 12 L of fluid per minute against a pressure of 200 bar. **[8]**
- i) Calculate the hydraulic power.
 - ii) If the overall pump efficiency is 60%, what size of electric motor would be needed to drive the pump?

OR

Q2) a) What are the functions of reservoirs? Draw a neat sketch of standard reservoir showing its Internal and External features. **[6]**

- b) What is cushioning of a cylinder? Explain the cushioning mechanism using integral bypass circuit. **[8]**

P.T.O.

- Q3)** a) Explain with neat sketch working of sequence valve. Draw an ISO symbol of it. [6]
- b) Explain features of different centre positions of DCV with ISO symbols [8]
- c) Explain pressure compensated flow control valve with neat sketch. [6]

OR

- Q4)** a) Draw a hydraulic circuit for cylinder synchronization with two cylinders connected in series. State, if it will give perfect synchronization. [8]
- b) What is filter rating? Explain Beta rating and efficiency of the filters. [6]
- c) What is contamination? Explain the sources of contamination. [6]

- Q5)** a) Differentiate between Pneumatic and hydraulic power transmission. [4]
- b) Draw and explain pneumatic circuit for quick exhaust. [6]
- c) Give the classification of air compressors. Why multistage compression is needed? [8]

OR

- Q6)** a) Explain the working of air lubricator with suitable diagram. [4]
- b) Draw a typical circuit showing the application of Shuttle Valve. [6]
- c) Draw pneumatic circuit to explain two hand operation of Single acting cylinder using twin pressure valve. [8]

- Q7)** a) A machine tool cross slide is powered by means of a hydraulic system. The motion of the cylinder is as follows: [12]
- i) Initially it moves through a distance of 200mm against an effective load of 20000N in about 5 seconds.
 - ii) It is followed by a working stroke of another 200mm against an effective load of 30000N. The feed rate during this part of the stroke is required to 1.2 m/min.
 - iii) The load during the return stroke is 20000N.

A meter in type circuit is used. Draw and design hydraulic circuit which will fulfill the requirements.

- b) Analyze the following circuit by naming the components used. [6]

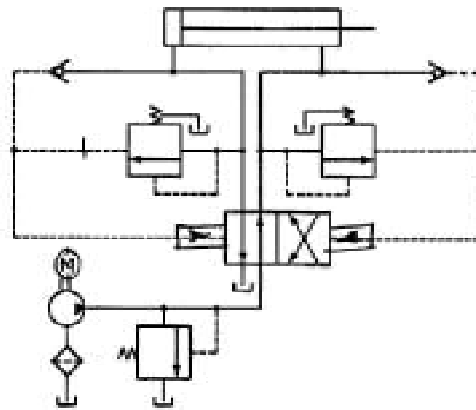


Fig. 7 (b)

OR

- Q8) a)** A plastic component is to be embossed by using a die which is powered by a double acting cylinder. The return of the die is to be effected when the cylinder rod has fully extended to the embossing position and the preset pressure is reached. A roller lever valve is to be used to confirm full extension. The signal for retracting must only be generated when the piston rod has reached the embossing position. The pressure in the piston chamber is indicated by a pressure gauge. Develop pneumatic circuit using sequence valve, 3/2 roller valve, 3/2 push button valve and 5/3 DCV. [10]

- b) Analyze the following circuit and label the components. [8]

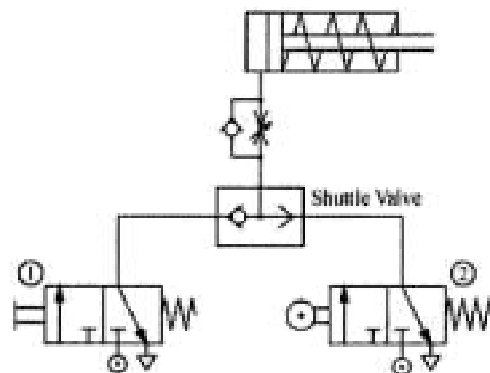


Fig. 8 (b)

DATA

1. Suction Strainer :

Model	Flow Capacity (lpm)
S ₁	38
S ₂	76
S ₃	152

2. Pressure Gauge :

Model	Range (bar)
PG ₁	0 - 25
PG ₂	0 - 40
PG ₃	0 - 100
PG ₄	0 - 160

3. Vane Pump :

Model	Delivery in / pm		
	at 0 bar	at 35 bar	at 70 bar
P ₁	8.5	7.1	5.3
P ₂	12.9	11.4	9.5
P ₃	17.6	16.1	14.3
P ₄	25.1	23.8	22.4
P ₅	39.0	37.5	35.6

4. Relief Valve :

Model	Flow capacity (lpm)	Max Working Pressure & bar
R ₁	11.4	70
R ₂	19	210
R ₃	30.4	70
R ₄	57	105

5. Flow control Valve :

Model	Working Pressure (bar)	Flow Range (lpm)
F ₁	70	0-4.1
F ₂	105	0-4.9
F ₃	105	0-16.3
F ₄	70	0-24.6

6. Directional Control Valve :

Model	Max working Pressure (bar)	Flow Capacity (lpm)
D ₁	350	19
D ₂	210	38
D ₃	210	76

7. Check Valve :

Model	Max working Pressure (bar)	Flow Capacity (lpm)
C ₁	210	15.2
C ₂	210	30.4
C ₃	210	76

8. Pilot Operated Check Valve :

Model	Max working Pressure (bar)	Flow Capacity (lpm)
PQ ₁	210	19
PQ ₂	210	38
PQ ₃	210	76

9. Cylinder (Max Working Pressure-210 bar)

Model	Bore dia. (mm)	Rod dia. (mm)
A ₁	25	12.5
A ₂	40	16
A ₃	50	35
A ₄	75	45
A ₅	100	50

10. Oil Reservoirs :

Model	Capacity (litres)
T ₁	40
T ₂	100
T ₃	250
T ₄	400
T ₅	600

X X X

Total No. of Questions : 10]

SEAT No. :

P3877

[5561]-532

[Total No. of Pages : 3

B.E. (Mechanical)

REFRIGERATION AND AIR-CONDITIONING

(2015 Course) (Semester-I) (302049)

Time : 2½ Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) *Answer three questions out of 6.*
- 2) *Solve Q1 or 2, Q3 or 4, Q5 or 6.*
- 3) *All the three questions should be solved in one answer book and attach extra supplements if required.*
- 4) *Draw Diagrams wherever necessary.*
- 5) *Use of steam table and scientific calculator is allowed.*
- 6) *Assume suitable data wherever necessary.*

Q1) a) State desirable properties of refrigerants. **[5]**

b) Write a short note on “Concept of Cold chain”. **[5]**

OR

Q2) An ammonia refrigeration machine operated between the temperature limits - 15°C and 30°C. The machine circulates 4.5 kg/min. There is no undercooling. The temperature after is entropic compression is 75°C. Determine **[10]**

- i) COP
- ii) ice produced in kg/hr from water at 20°C and ice at -5°C
- iii) Quality of refrigerant entering the compressor.

Assume $C_{pv} = 2.85$ kJ/kg/K for ammonia. C_p of ice = 2.1 kJ/kgK. Also find displacement volume required for compressor in m³/min.

Ts(°C)	h_f (kJ/kg)	h_g (kJ/kg)	S_f (kJ/kgK)	S_g (kJ/kgK)	v_f (m ³ /kg)	v_g (m ³ /kg)
-15	112.3	1426	457	5.549	0.00152	0.509
30	323.1	1469	1.204	4.984	0.00158	0.111

P.T.O.

- Q3) a)** Explain the working of simple vapour absorption system. [5]
- b) Explain the need of multipressure systems. [5]

OR

Q4) Explain single compressor with multiple evaporator and multiple expansion valves system with $p-h$ and $T-s$ diagram. [10]

- Q5) a)** Describe the process of adiabatic mixing of two streams of air. [6]
- b) Explain the term [10]
- i) relative humidity
 - ii) specific humidity,
 - iii) absolute humidity
 - iv) degree of saturation
 - v) dew-point temperature

OR

- Q6) a)** In a laboratory test a psychrometer recorded 36°C DBT and 30°C WBT calculate [12]
- i) vapor pressure
 - ii) relative humidity
 - iii) specific humidity
 - iv) degree of saturation
 - v) dew point temperature
 - vi) enthalpy of the mixture.
- b) Explain “Thermodynamics of human body” [4]

- Q7)** a) Explain all water air-conditioning system with neat sketch. [8]
b) Explain the construction working of DX-type evaporator. [8]

OR

- Q8)** a) Discuss classification of air-conditioning. [4]
b) Explain construction working of electronic expansion valve. [6]
c) Explain construction working of scroll compressors. [6]

Q9) a) A circular duct of 250 mm is selected to carry air in an air conditioned space at a velocity of 240m/min to keep the noise at desired level. If this duct is to be replaced by rectangular duct of aspect ratio of 1.4, find the size of the duct for equal friction method when [12]

- i) Velocity of air in two ducts is same and
ii) Discharge of air in two ducts is same if $f = 0.015$, find pressure loss per 100m length of duct. Take air density as 1.15 kg/m^3 .
b) What are the desirable properties of ideal duct materials? [6]

OR

- Q10)** a) Write a note on classification of duct and explain air flow through simple duct system. [10]
b) Explain Equal Friction Method of Duct Design. List its advantages and disadvantages. [8]

x x x

P5545**[5561]-533****B.E. (Mechanical)****CAD CAM AND AUTOMATION****(2015 Pattern)****Time : 2½ Hours]****[Max. Marks : 70****Instructions to the candidates:**

- 1) *Neat diagrams must be drawn wherever necessary.*
- 2) *Figures to the right side indicate full marks.*
- 3) *Assume suitable data, if necessary.*
- 4) *Use of calculators is allowed.*

Q1) a) Discuss the necessity of mapping geometric models. [5]

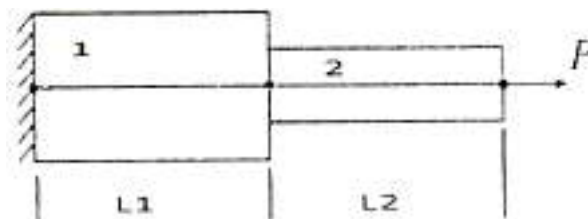
b) Discuss Perspective projection of 3D model on 2D plane. [5]

OR**Q2) a) A line PQ with vertices P (2,5), Q (6, 7) is rotated by 40° in counter clockwise direction about a point P (2, 2) determine the new coordinates. [5]**

b) Discuss Boundary Representation for solid modeling. [5]

Q3) a) Discuss types of synthetic surface modeling techniques. [5]

b) A line is represented by the endpoints P (4, 6) and Q (-3, 12). If the value of Parameter u at P and Q is 0 and 1 respectively, determine the equation of the line. Also determine the coordinate of point on the line at u = 0.2, 0.4 and 0.6. [5]

OR**Q4) A step bar as shown in fig. 1, The loading is initially done at 20°C. The temperature then rises to 60°C. Determine the nodal displacements and the elemental stresses developed using 1D elements. [10]** $E_1 = 72 \text{ GPa}, E_2 = 210 \text{ GPa}, \alpha_1 = 23 \times 10^{-6} \text{ per } ^\circ\text{C}, \alpha_2 = 12 \times 10^{-6} \text{ per } ^\circ\text{C}.$ $A_1 = 300 \text{ mm}^2, A_2 = 200 \text{ mm}^2, L_1 = L_2 = 150 \text{ mm}, P = 10 \text{ kN}.$ **Fig. 1****P.T.O.**

- Q5) a)** Discuss use of subroutine and looping in CNC programing. [8]
- b)** Write CNC program using G and M codes to turn the component shown in fig. 2 having Stock size is $\varnothing 40\text{mm}$. Use canned cycles wherever applicable. Assume suitable data for speed and feed. [10]

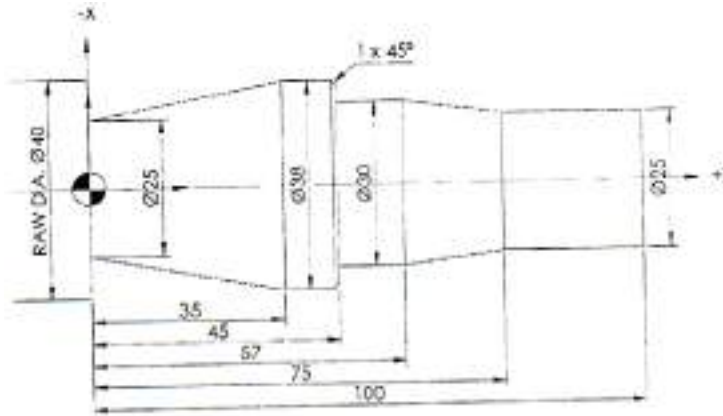


Fig. 2

OR

- Q6) a)** Write CNC program using G and M codes to contour, face and drill the component shown in fig. 3. Use canned cycles wherever applicable. Thickness of blank is 7mm. Assume suitable data for speed and feed. [10]

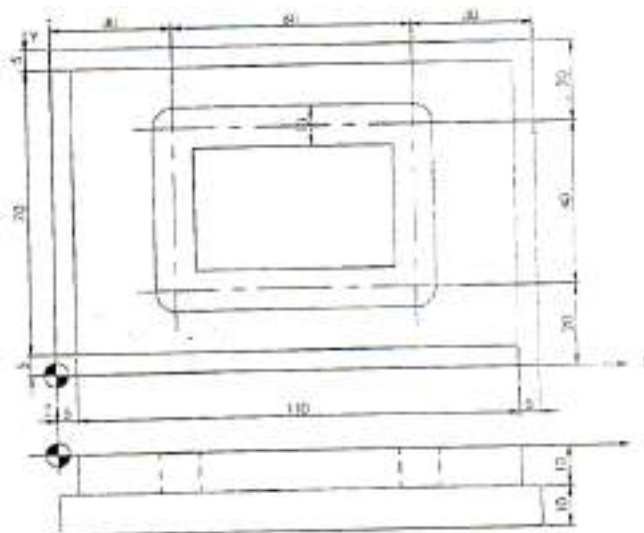


Fig. 3

- b)** Discuss coordinate system of Vertical Mechining Center and Horizontal Machining Center. [8]

- Q7)** a) Discuss the elements of Product Life Cycle. [8]
b) Discuss the application, advantages and disadvantages of Stereo Lithography. [8]

OR

- Q8)** a) Explain working principle of Fused Deposition method for rapid prototyping. [8]
b) Discuss Collaborative Engineering with suitable example. [8]

- Q9)** a) Discuss hard and soft automation. [8]
b) Discuss robot anatomy with neat sketch. [8]

OR

- Q10)** a) Discuss Concepts of Computer Integrated Manufacturing in brief. [8]
b) Discuss need and application of Automated guided vehicle. [8]



Total No. of Questions : 10]

SEAT No. :

P3879

[5561]-535

[Total No. of Pages : 4

B.E.(Mechanical)

FINITE ELEMENT ANALYSIS

(2015Pattern) (Semester - I) (End Sem.) (Elective - I) (402044A)

Time : 2½ Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) Answer Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8, Q9 or Q10.
- 2) Neat diagrams must be drawn wherever necessary.
- 3) Figures to the right side indicate full marks.
- 4) Assume suitable data if necessary.

Q1) a) Explain the concept of FEM briefly and outline the procedure. [6]

b) Explain the properties of stiffness matrix. [4]

OR

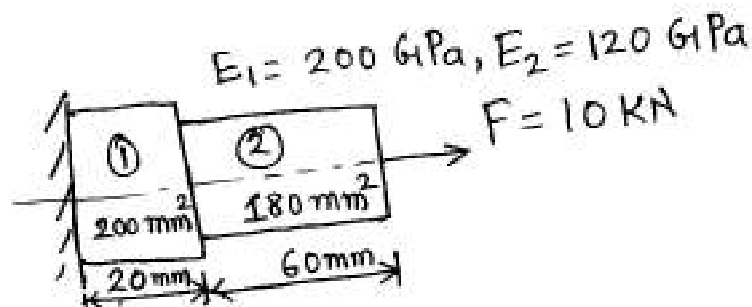
Q2) a) Write short note on [4]

i) Essential Boundary Conditions

ii) Natural Boundary Conditions

b) Derive element stiffness matrix for two noded (linear) bar element using Principle of Minimum Potential Energy Method. [6]

Q3) a) A stepped bar is made of two materials joined together as shown in fig. The bar is subjected to an axial pull of 10kN. Determine the displacements of each of the section using 1D spar element. [6]



b) Explain the term geometric isotropy. Why polynomial shape functions should satisfy these requirements? [4]

OR

P.T.O.

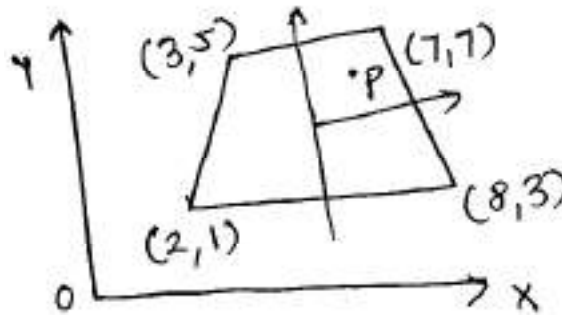
Q4) a) The triangular element has nodal co-ordinates (13,1), (25,6) and (13,3) for nodes 1,2 and 3 respectively. The x-co-ordinate of interior point P is 20 and y - co-ordinate is 6. Determine the shape functions at nodes 1,2 and 3. [6]

b) Write a note on plane stress formulations. [4]

Q5) a) Explain the terms isoparametric, subparametric and superparametric elements. [6]

b) State and explain the three basic laws on which isoparametric concept is developed. [6]

c) Determine the cartesian co-ordinate of the point P ($\zeta = 0.5$, $\eta = 0.6$) show in fig. [6]



OR

Q6) a) Write short note on [8]

i) Substructuring

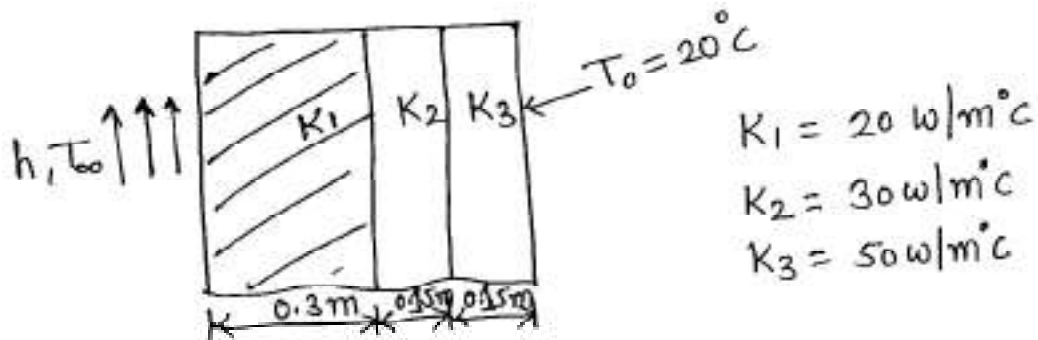
ii) Sub-modeling

b) Evaluate the following integrals. Use three point Gaussian quadrature method [10]

i)
$$\int_{-1}^1 [3^x - 4x] dx$$

ii)
$$\int_{-1}^1 [2 + x + x^2] dx$$

- Q7) a)** A composite wall consists of three materials as shown in fig. the outer temperature is $T_0 = 20^\circ\text{C}$. Convection heat transfer takes place on the inner surface of the wall with $T_\infty = 800^\circ\text{C}$ and $h = 25\text{ W/m}^2\text{ }^\circ\text{C}$. Determine the temperature distribution in the wall. [10]



- b) Derive elements stiffness matrix formulation for one dimensional steady state Heat Conduction problems. [6]

OR

- Q8) a)** A metallic fin. with thermal conductivity $360\text{ W/m}^\circ\text{C}$, 0.1 cm thick and 10 cm long extends from a plane wall whose temperature is 235°C . Determine the temperature distribution and amount of heat transferred from the fin to the air at 20°C with heat transfer coefficient of $9\text{ W/m}^2\text{ }^\circ\text{C}$. Take the width of the fin to be 1 m . [10]

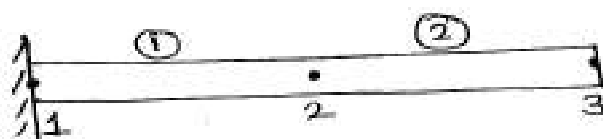
- b) Derive FEA stiffness matrix for pin fin heat transfer problem. [6]

- Q9) a)** Write down consistent and lumped mass matrices for following elements [6]

i) Bar Element

ii) Beam Element

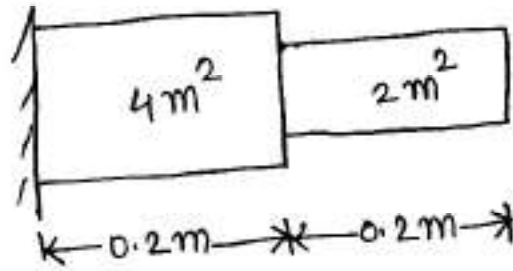
- b) Consider a uniform cross-sectional bar of length L made up of a material whose Young's modulus and density are given by E and ρ . Estimate the natural frequencies of axial vibration of the bar using lumped mass matrix. Use two element mesh. [10]



OR

Q10)a) What is meant by Eigen Values and Eigen Vector? How it is related to Modal analysis of structures? [6]

b) Find the natural frequencies of longitudinal vibrations of the stepped shaft of areas 2 m^2 and 4 m^2 and of equal lengths 0.2 m , when it is constrained at one end as shown in fig. $E = 2.1 \times 10^{11} \text{ N/m}^2$ and density $= 7.8 \times 10^3 \text{ kg/m}^3$. [10]



Total No. of Questions : 10]

SEAT No. :

[Total No. of Pages : 2

P3880

[5561]-536

B.E.(Mechanical)

COMPUTATIONAL FLUID DYNAMICS

(2015 Course) (Semester - I) (Elective - I) (402044B)

Time : 2½ Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) Answer Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8, Q9 or Q10.
- 2) Neat diagrams must be drawn wherever necessary.
- 3) Figures to the right side indicate full marks.
- 4) Use of electronic pocket calculator is allowed.
- 5) Assume suitable data if necessary.

Q1) a) Explain the mathematical nature of hyperbolic equation and their physical boundary conditions. [4]

b) Find the divergence of $\phi = V(u,v,w) = (3x, 2xy, 4z)$. [6]

OR

Q2) a) Difference between Substantial and Local Derivative. [5]

b) Explain the significance of the mass conservation equation in fluid mechanics and derive an expression for the same. [5]

Q3) a) Explain the difference between explicit and implicit methods with its significance. [4]

b) Solve a 2D unsteady state heat conduction problem by explicit method. [6]

OR

Q4) a) Short note on central difference scheme. [4]

b) Write a solution methodology to solve two dimensional steady heat advection equation using Neumann boundary condition. [6]

Q5) a) Write two dimensional heat convection-diffusion equation and discretize it with finite volume method. [10]

b) Define Peclet number and state its importance? [4]

c) Write the demerits of FEM over FVM. [4]

OR

P.T.O.

- Q6)** a) Consider steady 1 -D convection diffusion equation of a property ϕ ,

$$\frac{d(\rho u \phi)}{dx} = \frac{d}{dx} \left\{ \Gamma \left(\frac{d\phi}{dx} \right) \right\}$$

Using control volume approach discretizes the above equation and obtain the neighboring coefficients by using Central difference scheme. [10]

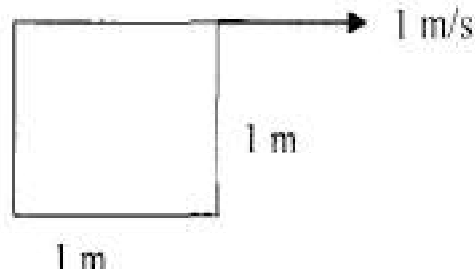
- b) Explain the significance of 1-D transient convection-diffusion system. [8]

- Q7)** a) Explain use of SIMPLE algorithm for solution of 2-D Navier Stokes equations. [10]

- b) Importance of Pressure correction method in SIMPLE algorithm. [6]

OR

- Q8)** a) Using SIMPLE algorithm to solve a two dimensional Lid driven cavity flow. [10]



- b) Explain and significance of the external flow simulation. [6]

- Q9)** a) What is turbulence modeling? Classify turbulence modeling and its advantages and disadvantages. [10]

- b) Write a note on $k-\epsilon$ turbulence modeling. [6]

OR

- Q10)** a) Explain Reynolds average Navier Stokes (RANS) in details. [10]

- b) Write in details necessity of the turbulence modeling. [6]



Total No. of Questions : 10]

SEAT No. :

[Total No. of Pages : 3

P3881

[5561]-537

B.E.(Mechanical)

**HEATING, VENTILATION, AIR-CONDITIONING AND
REFRIGERATION**

(2015 Course) (Semester - I) (Elective - I) (402044C)

Time : 2½ Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) *Solve Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8, Q9 or Q10.*
- 2) *Assume suitable data wherever necessary.*
- 3) *Use of non-programmable pocket calculator is allowed.*
- 4) *Draw neat diagrams wherever necessary.*
- 5) *Figures to the right indicate full marks.*

Q1) a) Explain ejector expansion trans-critical refrigeration cycle. **[3]**

b) A Freon 12 vapor compression system at a condenser temperature of 40°C an evaporative temperature of 0°C develops 15 tons of refrigeration. Determine - **[7]**

- i) The discharge temperature and mass flow rate of the refrigerant circulated
- ii) The theoretical piston displacement of the compressor and displacement per ton of refrigeration.
- iii) The theoretical horse power of the compressor and horse power per ton of refrigeration.
- iv) The heat rejected in the condenser
- v) The Carnot COP and actual COP of the cycle

Use the following values with standard notations

$$h_1 = 187.5 \text{ kJ/kg}, h_2 = 213.96 \text{ kJ/kg}, h_3 = 74.6 \text{ kJ/kg} = h_4$$

$$v_1 = 0.055 \text{ m}^3/\text{kg}, s_1 = s_2 = 0.6966 \text{ kJ/kg.K}$$

OR

Q2) a) Explain the performance characteristic curves of centrifugal compressor. **[4]**

b) Discuss the classification of cooling tower. **[6]**

P.T.O.

Q3) A two-cylinder single acting reciprocating compressor with 5% clearance is used in a R22 refrigeration cycle to take refrigeration capacity of 7.2 TR at 5°C (3.6 bar) refrigeration temperature and 40°C (9.6 bar) condensing temperature. The compressor index is 1.15. The speed of piston is limited to 3 m/s. Take L/D 0.8. specific volume as 0.0525 m³/kg. Determine - [10]

- Power
- Volumetric efficiency
- Bore and stroke
- RPM

Temp. (°C)	Pressure (Bar)	h_f (kJ/kg)	h_g (kJ/kg)
5	3.6	40.69	189.65
40	9.6	74.59	203.2

OR

- Q4)** a) Discuss the advantages and disadvantages of centrifugal compressor over reciprocating compressor. [6]
- b) Discuss the Capacity and safety controls and their types of reciprocating refrigeration system. [4]

- Q5)** a) Which are the factors affecting thermal comfort of human being? Explain in detail. [8]
- b) What is CLTD method? How it connects with Time lag and Decrement factor? [8]

OR

- Q6)** a) Discuss types of air distribution devices. [4]
- b) What is Wind effect and Stack effect? Explain in detail. [12]

- Q7)** a) Explain in detail: [8]
- Air Spaces and
 - Solar Air temperature
- b) A building has U-value of 0.5 W/m²K and total exposed surface area of 384 m². The building is subjected to an external load (only sensible) of 2 kW and an internal load of 1.2 kW (sensible). If the required internal temperature is 25°C, state whether a cooling system is required or heating system is required when the external temperature is 3°C. How the result will change, if the U-value of the building is reduced to 0.36 W/m K? [10]

OR

- Q8)** a) Explain the energy conservation building code. [10]
b) How do one achieve energy conservation in the air conditioning in the building? Explain in detail. [8]

- Q9)** a) Explain the Rotary Desiccant Dehumidifier with diagram. [8]
b) Write a note on Liquid Spray Tower. [8]

OR

- Q10)** a) Explain the use of “Heat Pump” for heating and cooling cycle. [8]
b) Explain thermal storage air conditioning system. [8]



Total No. of Questions : 10]

SEAT No. :

P3882

[5561]-538

[Total No. of Pages : 3

B.E. (Mechanical)

AUTOMOBILE ENGINEERING

(2015 Course) (Semester-I) (Elective-II) (402045 A)

Time : 2½ Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) *All questions are compulsory.*
- 2) *Neat diagrams must be drawn wherever necessary.*
- 3) *Figures to the right side indicate full marks.*
- 4) *Use of electronic pocket Calculator is allowed.*
- 5) *Assume suitable data, if necessary.*

Q1) a) Describe the classification of Automobile. **[5]**

b) What are the functions of frame? List three types of chassis construction. **[5]**

OR

Q2) a) What is an over drive? Explain the working of it. **[5]**

b) What is the function of clutch? Discuss various factors affecting the torque transmission in a clutch. **[5]**

Q3) a) Sketch the construction of front axle of automobile. Describe with neat sketch front wheel-stub axle assembly. **[5]**

b) State the requirements of an automobile wheel. Explain with neat sketch construction of Disc type wheel. **[5]**

OR

Q4) a) Describe with neat sketch concept of toe in and toe out. What is purpose of it? **[5]**

b) Explain various considerations for the design of tyre treads. **[5]**

P.T.O.

Q5) a) What is purpose of independent suspension? Explain with neat sketch McPherson strut front independent suspension system. [8]

b) Describe construction and working of disc brakes and compare with conventional drum brake system. [8]

OR

Q6) Write short note on the following: (Any two) [16]

a) Mechanical Brake.

b) Leaf Spring construction and Types.

c) Hydro gas Suspension.

d) Power assisted brakes.

Q7) a) For a Car, the road resistance is given by 23 N per 1000 N, the air resistance is $0.0827 V^2$, transmission efficiency is 88 percent in top speed, Car weight 19934 N when fully loaded. Calculate: [8]

i) The engine power required for a top speed of 144 km/hr.

ii) The acceleration in m/s^2 at 48 Km/h, assuming the torque at 48 km/hr in the top gear 25% more than at 144 km/h.

iii) The power required to drive the car up to a gradient of 1 in 5 at 48 km/h, transmission efficiency 80% in bottom gear.

Consider $g = 9.81 m/s^2$

b) List and discuss ergonomic consideration in design of interior of automobile. [8]

OR

Q8) a) What is purpose of servicing of vehicle? What are advantages of it? Discuss servicing schedule of a light motor vehicle. [8]

b) What are the type of drive motor used in Electric vehicle? Which is the best one? Why? Explain. [8]

Q9) a) Describe various tests carried out to check battery condition. [9]

b) What sensors are used on engine of automobiles? Describe the purpose of each. [9]

OR

Q10) Write short note on the following (any three): [18]

a) Battery for electric vehicles.

b) Oil and Temperature gauges.

c) Maintenance of Clutch.

d) Layout of HEV.



Total No. of Questions : 10]

SEAT No. :

P3883

[5561]-539

[Total No. of Pages : 7

B.E. (Mechanical)

OPERATION RESEARCH

(2015 Pattern) (Semester-I) (Elective-II) (402045C)

Time : 2½ Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) *Answer Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8 Q9 or Q10.*
- 2) *Answers in One answer Books.*
- 3) *Figures to the right indicates full marks.*
- 4) *Assume suitable data, if necessary.*

Q1) a) Discuss the scientific method in operation research. [4]

- b) A department of a company has five employees with five jobs to be performed. The time (in hrs.) that each man takes to perform each job is given in the effectiveness matrix.

		Employees				
		I	II	III	IV	V
Jobs	A	10	5	13	15	16
	B	3	9	18	13	6
	C	10	7	2	2	2
	D	7	11	9	7	12
	E	7	9	10	4	12

How should the jobs be allocated, one per employee, so as to minimize the total man hours? [6]

OR

P.T.O.

Q2) a) Solve the game whose payoff matrix is given below: **[6]**

		Player B			
		B1	B2	B3	B4
Player A	A1	3	2	4	0
	A2	3	4	2	4
	A3	4	2	4	0
	A4	0	4	0	8

b) Discuss different types of Decision making environments. **[4]**

Q3) a) Find the initial basic feasible solution using Vogel's approximation method. **[6]**

	W ₁	W ₂	W ₃	W ₄	Availability
F1	19	30	50	10	7
F2	70	30	40	60	9
F3	40	8	70	20	18
Requirement	5	8	7	14	

b) What do you mean by the term Pure strategies and mixed strategies in the game theory. **[4]**

OR

- Q4)** A pharmaceutical company is producing a single product and it selling it through five agencies situated in different cities. All of a sudden, there is a demand for the product in another five cities not having any agency of the company. The company placed with a problem of deciding on how to assign the exisisting agencies to dispatch the product to needy cities in such a way that the travelling distance in minimized. The distance between the surplus and deficit cities in km is given below. **[10]**

	Deficit Cities				
	P	Q	R	S	T
A	11	17	8	16	20
B	9	7	12	6	15
C	13	16	15	12	16
D	21	24	17	28	26
E	14	10	12	11	13

- Q5) a)** A small project involved 7 activities and their times estimates are listed in the following table. Activities are identified by their beginning (i) and ending (j) node numbers. **[12]**

Activities (i-j)	Estimated Duration (Weeks)		
	Optimistic	Most likely	Pessimistic
1-2	1	1	7
1-3	1	4	7
1-4	2	2	8
2-5	1	1	1
3-5	2	5	14
4-6	2	5	8
5-6	3	6	15

- i) Draw the network diagram of the activities in the projects.
- ii) Find expected duration and variance for each activity. What is the expected project length.
- iii) Calculate the variance and standard deviation of the project length. What is the probability that the project will be completed:
 - 1) At least 4 weeks earlier than expected time.
 - 2) No more than 4 weeks later than expected time.

Given:

Z (0-Z)	1.33
Probability	0.4082

- b) What is looping and Dangling errors in the network. [4]

OR

- Q6)** a) A dentist scheduled all his patients for 30 minute appointments. Some of the patients take more or less than 30 minutes depending on the type of dental work to be done. The following summary shows the various categories of work, their probability and time actually needed to complete the work: [12]

Category of service	Time required in Minute	Probability
Filling	45	0.40
Crown	60	0.15
Cleaning	15	0.15
Extraction	45	0.10
Check up	15	0.20

Simulate the dentist's clinic for four hours and determine the average waiting time for the patients as well as the idleness of the doctor. Assume that all the patients show up at the clinic at exactly their scheduled arrival time starting at 8:00 a.m. Use the following sequence of random numbers to simulate the above problem.

Random Numbers: 40, 82, 11, 34, 25, 66, 17, 79.

- b) Explain the significance of CPM and PERT. [4]

- Q7) a)** A book binder has one printing press, one binding machine and manuscripts of 7 different books. The times required for performing printing and binding operations for different books are shown below: **[10]**

Book	1	2	3	4	5	6	7
Printing Press (Hours)	20	90	80	20	120	15	65
Binding time (Hours)	25	60	75	30	90	35	50

Decide the optimum sequence of processing book in order to minimize the total time required to bring out all the books.

- b) Draw the sketch of queuing system and explain various components of it. **[6]**

OR

- Q8) a)** Arrivals at telephone booth are considered to be Poisson with an average time of 10 minutes between one arrival and the next. The length of phone calls is assumed to be distributed exponentially, with a mean of 3 minutes. **[10]**

- i) What is the probability that a person arriving at the booth will have to wait?
 - ii) The telephone department will install a second booth when convinced that an arrival would expect waiting time at least 3 minutes for phone call. By how much should the flow of arrivals increase in order to justify a second booth?
 - iii) What is the average length of the queue that forms from time to time?
 - iv) What is the probability that it will take a customer more than 10 minutes altogether to wait for the phone and complete his call?
- b) Explain Johnson's procedure for scheduling "n" jobs on two machines M1 and M2. **[6]**

Q9) a) Solve the following integer LP problem using branch and bound method: [12]

$$\text{Minimize } Z = 3X_1 + 2.5X_2$$

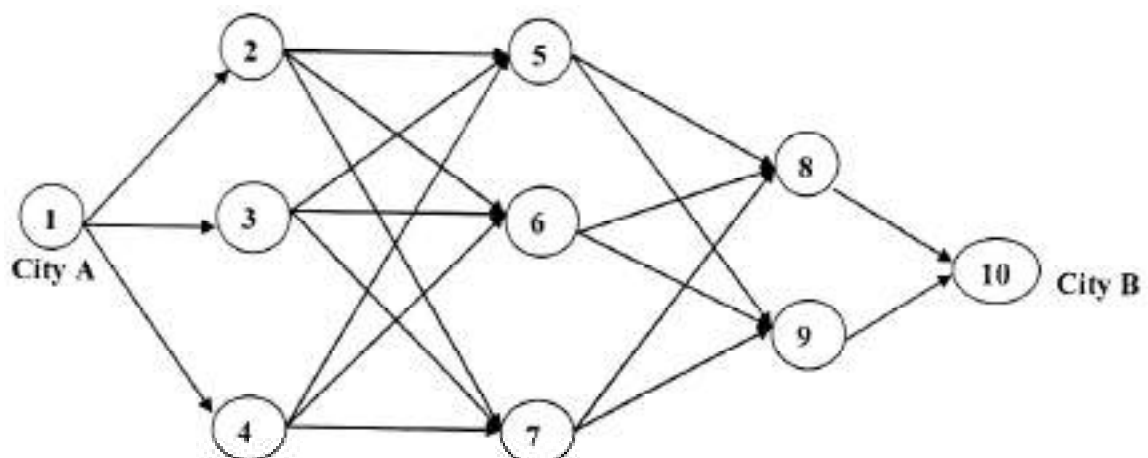
Subject to constrain

- i) $X_1 + 2X_2 \geq 20$
- ii) $3X_1 + 2X_2 \geq 50$
- iii) $X_1, X_2 \geq 0$ and integers

b) Explain in brief Dynamic programming (DP) model. [6]

OR

Q10)a) A salesman located in a city A decided to travel to city B. He knew the distances of alternative routes form city A to city B. He then drew a highway network map as shown in following figure. The city of origin A, is city 1. The destination city B is city 10. Other cities through which the salesman will have to pass through are numbered 2 to 9. The arrow respresentating routes between cities and distance in kilometers are located on each route. The salesman problem is to find the shortest route that covers all the selected cities from A to B. The time for each activity is given in the table. (Solve by using Dynamic programming). [12]



Activity	Duration	Activity	Duration
1-2	4	4-5	6
1-3	6	4-5	10
1-4	3	4-7	5
2-5	7	5-8	4
2-6	10	5-9	8
2-7	5	6-8	3
3-5	3	6-9	7
3-6	8	7-8	8
3-7	4	7-9	4
		8-10	7
		9-10	9

b) Explain methodology used in cutting plane method.

[6]



Total No. of Questions : 10]

SEAT No. :

P3884

[5561]-540

[Total No. of Pages : 3

B.E. (Mechanical)

ENERGY AUDIT AND MANAGEMENT

(2015 Pattern) (Semester-I) (Elective-II) (402045 C)

Time : 2½ Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) *Answer Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8 Q9 or Q10.*
- 2) *Draw a neat diagram wherever necessary.*
- 3) *Figures to the right indicate full marks.*
- 4) *Use of calculator, steam tables is allowed.*
- 5) *Assume suitable data if necessary.*

Q1) a) Define with an example in each: **[4]**

- i) Primary and secondary energy
 - ii) Commercial and non-commercial energy.
- b) What are Energy Efficiency, Energy Conservation and Energy Benchmarking? **[6]**

OR

Q2) a) Explain any four strategies for better energy security of the nation? **[4]**

- b) How do an industry, nation and globe would benefit from energy efficiency programs? **[6]**

Q3) a) What are the key features of Energy Audit Software? **[4]**

- b) Distinguish between 'preliminary energy audit' and 'detailed energy audit'. How does a preliminary energy audit help conduct detailed energy audit? **[6]**

OR

Q4) a) What are the principles of energy management? **[5]**

- b) Briefly explain with examples on what is fuel and energy substitution? **[5]**

P.T.O.

- Q5) a)** What is the Net Present Value of an ENCON project with cash flows given in table below? The discount rate is 10%. Is the ENCON project attractive for implementation? [8]

Initial Investment	Rs. 10,00,000/-
Savings in Year	Cash Flow
1	Rs. 2,00,000/-
2	Rs. 2,00,000/-
3	Rs. 3,00,000/-
4	Rs. 3,00,000/-
5	Rs. 3,50,000/-

- b) What are important guidelines to achieve energy efficiency in steam systems? [8]

OR

- Q6) a)** Use the Net Present value method to evaluate which of ENCON Project-I or Project-II is finalized to be implemented in an organization. Assume the annual discount rate as 8%. [10]

	Project-I	Project-II
Capital Investment	Rs. 80,000/-	Rs. 80,000/-
Year	Savings (Rs.)	Savings (Rs.)
1	12,000/-	13,200/-
2	12,000/-	13,200/-
3	12,000/-	12,600/-
4	12,000/-	12,600/-
5	12,000/-	12,000/-
6	12,000/-	12,000/-
7	12,000/-	11,400/-
8	12,000/-	11,400/-
9	12,000/-	10,800/-
10	12,000/-	10,800/-
11	12,000/-	10,000/-

- b) Explain any six options for financing an energy saving financing program in any organization? [6]

- Q7)** a) What are the parameters to be monitored for evaluating 'direct efficiency' of boilers and what is the empirical relation used? [8]
- b) Explain the factors that affect the performance evaluation of an Electric Heating Furnace? [8]

OR

- Q8)** a) Explain as to how do you assess the performance of centrifugal fan? [8]
- b) Find the furnace efficiency to melt one ton of steel from an ambient temperature of 30 Deg C. Following is the test data obtained: [8]

Specific heat of steel = 0.682 kJ/kg/Deg C

Latent heat of melting of steel = 272 kJ/kg

Melting point of Steel = 1650 Deg C.

The melting furnace consumes 625 kWh to melt one ton of Steel.

- Q9)** a) What are the different effects of acid rain? [6]
- b) Explain briefly Kyoto Treaty and its importance to the world. [6]
- c) Why cogeneration systems play an important role in any industry? [6]

OR

- Q10)** a) Explain global warming and its implications. [6]
- b) Explain three different types of instruments used during an energy audit. [6]
- c) What are the different energy saving opportunities in any residential electrical lighting system? [6]



Total No. of Questions :10]

SEAT No. :

P3885

[5561]-541

[Total No. of Pages :3

B. E. (Mechanical) (Mechanical Sandwich)

ENERGY ENGINEERING

(2015 Pattern) (Semester - II) (402047)

Time : 2½ Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) Attempt Q.1 OR Q.2, Q.3 OR Q.4, Q.5 OR Q.6, Q.7 OR Q.8, Q.9 OR Q.10.*
- 2) Neat diagrams must be drawn wherever necessary.*
- 3) Figures to the right of each question indicate full marks.*
- 4) Assume suitable data wherever necessary and mention the same clearly.*
- 5) Use of steam tables, Mollier chart and calculator is allowed.*

Q1) a) Explain the concept of cascade efficiency. **[5]**

- b) In thermal power plant steam turbine of 11 MW capacity requires 5.1 kg of steam per hour per kW. The quantity of air leakage into the condenser is 1 kg per 1 ton of steam used by the turbine. The vacuum in the condenser is 71 cm of Hg and barometer reading is 760 mm of Hg. The temperature at the suction of air pump is 31 degree Celsius. The surface condenser is fitted with separate condensate extraction and air pump. The rise in the temperature of cooling water of condenser is 8 degree Celsius. The quality of steam entering condenser is 0.89 dry and no under cooling in the condenser. Determine : **[5]**

- i) The capacity of air pump per minute basis
- ii) Quantity of cooling water required in tones per minutes.

OR

Q2) a) What is a purpose of coal beneficiation? Explain flow in this process with suitable diagram. **[5]**

- b) Explain the methods used to control Nox in thermal power plant. **[5]**

Q3) a) Write Note on following. **[5]**

Flow duration curve and its use.

- b) What do you mean by Supercritical Boiler? Explain the advantages of the same. **[5]**

OR

P.T.O.

- Q4) a)** What are different methods for disposal of Nuclear waste? [5]
- b) Explain typical closed type condensing plant with simple diagram? [5]

Q5) a) The air enters the compressor of a gas-turbine power plant at 1 bar, 30 degree Celsius and 162 tons per hour. The maximum cycle temperature, pressure are 650 degree Celsius, 5 bar respectively. The two stage expansion with reheating pressure of 2.24 bar is used in the plant. In the reheater gas is heated up to maximum cycle temperature. The isentropic efficiency of compressor, first turbine, and second turbine is 80%, 85%, 90% respectively. Take adiabatic index for air gas as 1.4, 1.33 respectively. Take specific heat for air, gas as 1KJ/kg-K, 1.15 KJ/kg-K respectively. Neglect mass flow rate of fuel. Draw cycle arrangement and T-s diagram and determine. [10]

- i) The thermal efficiency of cycle.
- ii) Power out put of plant in MW.
- b) Explain General Layout of Diesel Power Plant indicating different systems. [8]

OR

Q6) a) Air enters the compressor of a gas-turbine power plant having capacity 12 MW at 1 bar and 27 degree Celsius. The maximum cycle temperature, pressure are 577 degree Celsius, 6.5 bar respectively. The two stage compression with perfect inter cooling arrangement is incorporated in the plant. The compression in both stages and expansion in turbine are isentropic. Take adiabatic index, specific heat for both air and gas as 1.4, 1 KJ/kg-K respectively. Assume calorific value of fuel as 45.5 MJ/Kg. Draw Cycle arrangement and T-s diagram and determine. [10]

- i) Maximum work saved per kg of air compressed due to use of inter cooling.
- ii) Fuel consumption in Tph (with inter cooling arrangement)
- iii) The thermal efficiency of cycle with considering effect mass flow rate of fuel on air.
- b) Explain the advantages, disadvantages and applications of diesel power plant. [8]

- Q7)** a) Explain the superheated steam geothermal power plant with simple diagram. [6]
 b) Explain the Claude cycle for OTEC with component arrangement diagram. [6]
 c) What are applications of solar photovoltaic power systems? [4]

OR

- Q8)** a) Explain the working of open cycle MHD generator with simple figure. [6]
 b) Write Note on : Solar Chimney. [6]
 c) How wind turbines are classified? [4]

- Q9)** a) What is function of circuit breaker in supply system? Explain working of air circuit breaker with simple sketch and list out its limitations. [8]
 b) Input output curve of 25 MW capacity generating power plant is given by $I = 5 \times 10^6 (7 + 0.2L + 0.1L^2)$ [I in kJ/hr and L in MW] then [8]
 Determine:
 i) Average rate of heat supplied (heat supplied MW-hr) when plant operating at 25 MW load for 10 hours in a day and kept at zero load for 14 hours
 ii) Saving in heat rate if same energy is produced for whole day at constant load.

OR

- Q10)** a) Write note on following : [8]
 i) Generator cooling ii) Effects of short circuits
 b) Explain following terms with its significance. [4]
 i) Plant capacity factor ii) Plant use factor
 c) A steam power station has an installed capacity of 120 MW and average load of 50 MW. The coal consumption is 0.4 kg per kWh and cost of coal is Rs. 80 per ton. The annual expenses on salary bill of staff and other overhead charges excluding cost of coal are Rs. 50×10^5 . The power station works at a load factor of 0.5 and the capital cost of the power station is Rs. 4×10^5 . If the rate of interest and depreciation is 10%. Determine the cost of generating per kWh. [4]



Total No. of Questions : 10]

SEAT No. :

P3886

[5561]-542

[Total No. of Pages : 4

**B.E. (Mechanical/Machanical Sandwich)
MECHANICAL SYSTEM DESIGN
(2015 Pattern) (Semester - II) (402048)**

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) *Answer Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8, Q9 or Q10.*
- 2) *Neat diagrams must be drawn wherever necessary.*
- 3) *Figures to the right side indicate full marks.*
- 4) *Assume Suitable data if necessary.*

- Q1)** a) State and explain the parameters used in kinematic design of gearbox. [6]
b) Explain design and natural tolerances. [4]

OR

- Q2)** a) Draw the structure and gear box diagrams for the following equations of twelve speed gear box and determine the maximum transmission range for each equation for R 5 Series. $\phi = \sqrt[3]{10}$. [6]
i) $Z = 2(6) 2(1) 3(2)$
ii) $Z = 2(3) 2(6) 3(1)$
iii) $Z = 2(6) 2(3) 3(1)$
b) Define the following terms: [4]
i) Population
ii) Sample
iii) Random variables

Also explain the concept of reliability based design

- Q3)** a) Explain the steps involved in belt conveyor analysis? [4]
b) A three idler through belt, horizontal conveyor is to be used used for transporting 500 ton/hr of coal having weight density 8000 N/m³. The surcharge factor 'c' for three idler through belt is 0.1. If the belt speed is 100 m/min. Select the standard belt width for conveyor belt. Available standard belt width is : 400, 450, 500, 650, 750, 800, 900, 1000, 1200, 1400, 1600, 1800, 2000 mm. [6]

OR

P.T.O.

- Q4)** a) Explain the concept of containerization. [4]
b) A three idler, troughed belt, horizontal conveyor is to be used for transporting 500 ton of iron per hour having mass density of iron ore is 1700 kg/m^3 . If the belt speed is 2 m/sec , determine the required belt width. Take surcharge factor = 0.1. [6]

- Q5)** a) Explain, with the help of neat sketches, the different types of formed heads used as end closures in cylindrical pressure vessels. [8]
b) A high pressure compound cylinder consists of a inner and outer diameters of 300 mm and 400 mm OD respectively. It is jacketed by an outer cylinder of 500 mm outside diameter. The tubes are assembled by a shrinking process in such a way that the maximum principal stress induced in any tube is limited to 100 N/mm^2 . Calculate the shrinkage pressure and original dimensions of the tube assuming $E = 210 \text{ GPa}$. [10]

OR

- Q6)** A pressure vessel consists of a cylindrical shell with an inner diameter of 1500 mm and thickness of 20mm. It is provided with a nozzle of inner diameter 250 mm and thickness 15 mm. The yield strength of the material for the shell and the nozzle is 200 N/mm^2 and the design pressure is 2.5 Mpa. The extension of the nozzle inside the vessel is 15 mm. The corrosion allowance is 2mm, while the weld joint efficiency is 0.85. Neglecting the area of welds, determine whether or not a reinforcing pad is required for the opening. If so, determine, the dimensions of the pad made from a plate of 15 mm thickness. [18]

- Q7)** a) Explain the buckling of connecting rod? Why I section preferred for connecting rod? [6]
b) The following data is given for the piston of four stroke diesel engine. Cylinder bore = 100mm, Material of piston rings = grey cast iron, Allowable tensile stress = 90 N/mm^2 [10]

Allowable radial pressure on cylinder wall = 0.035 MPa

Thickness of piston head = 16mm

Number of piston rings = 4

Calculate:

- i) Radial width of piston rings;
- ii) Axial thickness of piston rings;
- iii) Gap between the free ends of piston ring before assembly and after assembly;
- iv) Wwidth of top land;
- v) Width of ring grooves;
- vi) Thickness of piston barrel; and
- vii) Thickness of barrel at open end.

OR

Q8) The following data is given for the connecting rod of a diesel engine. [16]

Cylinder bore = 85 mm

Length of connecting rod = 350mm

Maximum gas pressure = 3 MPa

Factor of safety against buckling failure = 5

(l/d) ratio for piston pin bearing = (1.5)

(l/d) ratio for crank pin bearing = (1.25)

Allowable bearing pressure for piston pin bearing = 13MPa

Allowable bearing pressure for crank pin bearing = 11MPa.

length of stroke = 140 mm

Mass of reciprocating parts = 1.5 kg

Engine speed = 2000 rpm

Thickness of bearing bush = 3 mm

Material of cap = 40 C8 ($S_{yt} = 380 \text{ N/mm}^2$)

Material of bolts=Alloy steel ($S_{yt} = 450\text{N/mm}^2$)

Factor of safety for cap and bolts = 4 and 5 respectively.

Density of connecting rod = 7800 kg/m^3

Determine:

- a) Dimensions of the cross-section of connection rod.
- b) Dimensions of small and big end of bearings.
- c) Nominal diameters of bolts for the cap.
- d) Thickness of cap; and
- e) Magnitude of whipping stress.

Q9) a) Differentiate between optimum designs problems with normal specifications and redundant specifications. [6]

b) A cantilever beam is to function as a spring subjected to varying load of $\pm 120\text{N}$. Following materials are available. [10]

Material	Density Kg/m ³	Cost Rs./Newton	Fatigue Strength, MPa
M1	8450	120	24
M 2	8020	120	42
M 3	7830	80	38

The length of the cantilever is 350 mm and width to height ratio is 6:1, factor of safety is 2. Design the cantilever for optimum cost. Specify the material, cross section dimensions and the cost for selected design.

OR

Q10) The optimum material and dimensions for a machine shaft subjected to twisting moment of 3 KNm and desiring a torsional stiffness of 100Nm/degree, so as to have a minimum weight of the shaft. Following materials are available. Factor of safety = 2. [16]

Material	Mass density Kg/m	Yield strength MPa	Modulus of rigidity GPa	Material factor $\rho G / S_{yt}^2$
Mg. Alloy	1760	225	16	5.53×10^{-4}
Plastic	1200	55	2	8.533×10^{-4}
Ti-Alloy	3600	910	42	1.825×10^{-4}
Steel	7650	1380	84	3.374×10^{-4}



Total No. of Questions : 10]

SEAT No. :

P4764

[Total No. of Pages : 4

[5561]-543

B.E. (Mechanical) (Semester - II)

TRIBOLOGY

(2015 Pattern) (Elective - III)

Time : 2½ Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) *Write Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8, Q9 or Q10.*
- 2) *Neat diagrams must be drawn whenever necessary.*
- 3) *Figures to the right indicate full marks.*
- 4) *Use of electronic pocket calculator is allowed.*
- 5) *Assume suitable data, if necessary.*

Q1) a) List the various physical and chemical properties of lubricant and explain any five of them. **[6]**

b) List the different theories of wear and explain Archard's wear theory in brief. **[4]**

OR

Q2) a) What is the difference between gasket and oil seal? Explain non-metallic gasket. **[4]**

b) List the different methods to measure friction and explain pin-on-disc rig. **[6]**

Q3) a) What are the factors affecting wear? **[2]**

b) What do you understand by infinitely long journal bearing and infinitely short journal bearing? Comment on pressure gradient and load carrying capacity in both cases. **[8]**

OR

Q4) a) Differentiate between real and apparent area of contact. **[2]**

b) A 360° hydrodynamic journal bearing has 50 mm diameter and 50 mm length. The journal is carrying a load of 15 kN and rotating at a speed of 1450 rpm. The eccentricity ratio is 0.75. if the radial clearance is 20 microns, **[8]**

P.T.O.

Calculate :

- i) The minimum oil-film thickness;
- ii) The viscosity of oil;
- iii) The quantity of oil in circulation;

Q5) a) Derive an equation for load carrying capacity for given instantaneous velocity of approach and film thickness in case of circular plate approaching a plane. **[10]**

b) Explain squeeze film lubrication. State and explain any six practical examples of squeeze film. **[8]**

OR

Q6) a) Derive equation for friction and pumping power losses in hydrostatic bearings. **[8]**

b) Following data is given for a hydrostatic thrust bearing : **[5]**

Supply pressure = 5 N/mm²

Shaft diameter = 400 mm

Specific gravity of oil = 0.86

Specific heat of oil = 1.76 kJ/kg °C

Oil viscosity = 30 cP

Film thickness = 0.15 mm

Find :

- i) The load carrying capacity of bearing;
- ii) The flow requirement in l/min;
- iii) The frictional power loss;
- iv) The pumping power loss, and
- v) The temperature rise

Assume that the total power loss in the bearing is converted into frictional heat.

- c) The two parallel plates of 30 mm length and infinite width are separated from the plane by an oil- film of 25 μm thickness and having viscosity of 0.65 N-s/ m^2 . If the normal load per unit width of 15 kN/m is applied on the plate, determine : [5]

- i) The time required to reduce the film thickness to 2.5 μm
- ii) The maximum pressure

Q7) a) Write short notes on [8]

- i) Gas lubricated bearings
 - ii) Features of gas lubricated bearings
- b) What do you understand by gas lubricated bearings? Compare gas lubricated bearings with oil lubricated bearings based on following parameters [8]
- i) Viscosity of lubricant
 - ii) Viscous resistance
 - iii) Frictional power loss

OR

Q8) a) Write Ertel-Grubin equation with all specific terms and also write the limitations of this equation. [8]

- b) Explain in brief, working principle of hydrostatic gas lubricated bearings. [8]

Q9) a) Write short note on: selection of coatings. [8]

- b) State and discuss the lubricant and lubricating method for gears. [8]

OR

Q10) Write short notes on :

[16]

- Lubricant and lubricating method for rope and chain
- Lubrication system in I.C. engine

$\frac{l}{d}$	$\frac{h_0}{c}$	ϵ	S	$\left(\frac{r}{c}\right)f$	$\frac{Q}{rcn_s l}$	$\frac{Q_s}{Q}$	$\frac{P_{max}}{P}$
1	0.00	1.00	0.0000	0.000	0.000	1.0000	0.0000
	0.03	0.97	0.00474	0.514	4.820	0.973	6.579
	0.10	0.90	0.0188	1.050	4.740	0.919	4.048
	0.20	0.80	0.0466	1.700	4.620	0.842	3.195
	0.40	0.60	0.1210	3.220	4.330	0.680	2.409
	0.60	0.40	0.2640	5.790	3.990	0.497	2.066
	0.80	0.20	0.6310	12.800	3.590	0.280	1.890
	0.90	0.10	1.3300	26.400	3.370	0.150	1.852
	1.00	0.00	∞	∞	3.142	0.0000	0.0000



Total No. of Questions : 12]

SEAT No. :

P5140

[Total No. of Pages : 3

[5561]-544

B.E. (Mechanical Engineering)
INDUSTRIAL ENGINEERING (Elective - III)
(2015 Pattern) (Semester - II)

Time : 2 Hours 30 Minutes]

[Max. Marks : 70

Instructions to the candidates:

- 1) *Answers should be written in one answer book.*
- 2) *Answer Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8, Q.9 or Q.10, Q.11 or Q.12.*
- 3) *Neat diagrams must be drawn wherever necessary.*
- 4) *Figures to the right side indicate full marks.*
- 5) *Assume Suitable data jf necessary.*

- Q1)** a) Define productivity? Explain various factors which affect productivity?[4]
b) Explain any two productivity models used in Industrial Engineering? [4]

OR

- Q2)** a) Enlist elements of an organization? Explain the term departmentalization in details? [4]
b) Enlist any 4 objectives of an industrial engineering? [4]

- Q3)** What are therblings? Give any 5 therblings with symbols? [6]

OR

- Q4)** Describe Travel chart following with suitable example. [6]

- Q5)** a) Define the term:- work sampling. [2]
b) In a work sampling study carried out in heat treatment shop, following data was collected [4]

- i) Total time spent by the operator = 450 minutes
- ii) Number of components produced = 150 No's
- iii) Working time of the operator = 70%
- iv) Idle time for operator = 30%
- v) Avg. rating for operator = 90%

Calculate the standard time for the component if total relaxation allowance is 30% of the basic time?

P.T.O.

OR

- Q6)** a) Define the term with suitable example:- MOST. [2]
b) Compare : Work sampling and PMTS? [4]

- Q7)** a) Explain SCM with flow diagram? Discuss its importance in industry?[8]
b) Write a short note on [8]
i) Aggregate planning
ii) Push and Pull System

OR

- Q8)** a) Discuss the importance of sales forecasting. Explain any one method of sales forecasting? [8]
b) Discuss MRP-I and MRP-II with suitable example. [8]

- Q9)** a) Enlist & Explain different computer aided layout design techniques? [8]
b) Classify & Explain different types of material handling equipments? [8]

OR

- Q10)**a) Define Inventory and its importance. Enlist different types of Inventories? Also explain various costs involved with Inventory? [8]
b) A manufacturing company requires 9000 units per year. Ordering cost is Rs. 125/- per order and carrying cost is 20%. Purchase price per unit is Rs. 42 Determine [6]
i) EOQ
ii) Optimum number of orders
iii) Total cost including acquisition of material
c) Explain the term:- ABC analysis. [2]

- Q11)**a) Write a short note on : [10]
i) KRA
ii) Break even analysis
b) What is cost accounting? What are objectives of cost accounting? Explain elements of cost. [8]

OR

Q12)a) What is industrial safety? What are the objectives of industrial safety?
Explain general safety rules. **[8]**

b) Calculate B.E.P.(In Unit and In Rupee) from the following information.**[5]**

Fixed cost = Rs 1200/-

Variable cost = Rs 4000/-

Sales in rupee = Rs 7000

Sales in unit = Rs 1000/-

c) Explain the term:- Payback method. **[5]**

▽▽▽▽

Total No. of Questions : 10]

SEAT No. :

P5548

[Total No. of Pages : 2

[5561]-545
B.E. (Mechanical) (Semester - II)
ROBOTICS
(2015 Pattern) (Elective - III)

Time : 2½ Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) *Answer Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8 and Q.9 or Q.10.*
- 2) *Neat diagram must be drawn wherever necessary.*
- 3) *Figures to the right side indicate full marks.*
- 4) *Assume suitable data if necessary.*

- Q1)** a) Explain Technical Specification (performance characteristics) of Robots. [6]
b) Explain static force analysis of Robot Manipulator. [4]

OR

- Q2)** a) Discuss the classification of Grippers. Explain with neat sketch Vacuum gripper. [5]
b) Explain the construction & working of Vision sensor used in robotic. [5]

- Q3)** a) Classify Robot actuator. Discuss construction & working of Stepper Motor. [6]
b) Differentiate between Forward & Inverse Kinematic. [4]

OR

- Q4)** a) List out application of Robots. Explain any one in details with neat sketch. [5]
b) Write a short note on Position sensor in robotics. [5]

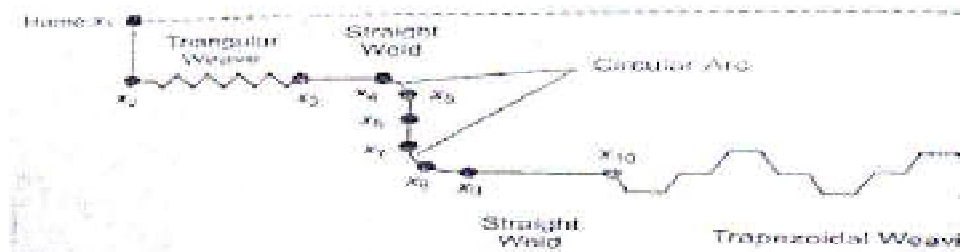
- Q5)** a) Explain types of potential field method for motion planning of manipulator. [8]
b) An actuated joint of six axis robot is to be rotated from 20° to 80° in 6 seconds. [8]
Determine coefficients of cubic polynomial to interpolate a smooth trajectory.
Plot linear, quadratic and cubic trajectories for the joint.

OR

P.T.O.

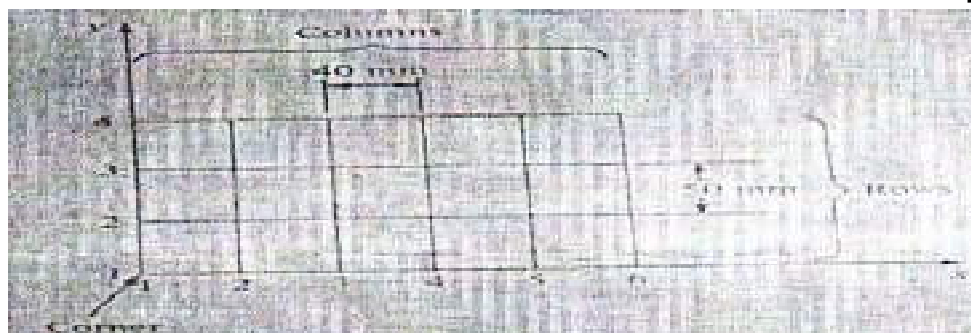
- Q6)** a) Write a short note on [8]
 i) Steps in trajectory planning
 ii) Robot Dynamic
 b) The second joint of the SCARA manipulator is required to move from 30° to 150° in 5 seconds Find the cubic polynomial to generate a smooth trajectory of joint. Find the angle at which maximum velocity occurs for this trajectory. [8]

- Q7)** a) Explain with block diagram Machine vision system for Robots. [8]
 b) Write a Programme using VAL for following weld to be made [10]



OR

- Q8)** a) Explain the different steps involved in Segmentation. [8]
 b) Write a Programme using VAL for palletizing operation as shown in fig. The robot must pick up parts from an incoming conveyor & deposit them on to pallet. The pallet has four rows that are 50 mm apart & six columns that are 40 mm apart. The object to be picked up are about 25 mm tall. [10]



- Q9)** a) Explain the forward & backward search technique in problem solving for AI. [8]
 b) What are different tools used in simulation of robotics. [8]

OR

- Q10)** a) Write a short note on [8]
 i) Internet of things
 ii) Industry 4.0
 b) Explain Need of AI & application of Artificial Intelligence for Robotics System. [8]



Total No. of Questions : 10]

SEAT No. :

P4774

[Total No. of Pages : 2

[5561]-546

B.E. (Mechanical Engineering)

**ADVANCED MANUFACTURING PROCESSES (Elective - IV)
(2015 Pattern) (Semester - II)**

Time : 2½ Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) All questions are compulsory i.e. Solve Q.1 or Q.2, solve Q.3 or Q.4, Solve Q.5 or Q.6, Solve Q.7 or Q.8, Solve Q.9 or Q.10.*
- 2) Neat diagrams must be drawn wherever necessary.*
- 3) Figures to the right indicate full marks.*

Q1) a) Explain with neat sketch forming and list their applications. **[6]**

b) Explain the construction and working of Ultrasonic welding. **[4]**

OR

Q2) a) Explain with neat sketch Magnetic pulse forming and list their applications. **[6]**

b) List applications of adhesive bonding. **[4]**

Q3) a) Explain with sketch working principle of Abrasive Water Jet machining with the process parameter. **[6]**

b) Explain the process of underwater welding. **[4]**

OR

Q4) a) Explain with sketch working principle of wire electric discharge machining with the process parameter. **[6]**

b) Write short note on welding of plastics and composites. **[4]**

Q5) a) Explain how the ultrasonic micro machining carried out. **[6]**

b) Explain the challenges in micro and nano fabrication process. **[6]**

c) Write short note on Lithography. **[4]**

OR

P.T.O.

- Q6)** a) Explain the need of micro machining. [6]
b) Explain the process of focused Ion Beam Machining. [6]
c) Write short note on Diamond micro machining. [4]

- Q7)** a) Explain in detail post processing of parts manufactured by additive manufacturing processes. [6]
b) Explain the generalized additive manufacturing process. [6]
c) Write application of additive manufacturing processes in aerospace industry. [4]

OR

- Q8)** a) What are factors which play important role while designing the object which is manufactured by additive manufacturing? [6]
b) Explain any one Additive Manufacturing process with its principle, process steps and materials. [6]
c) Write application of additive manufacturing processes in medical technology. [4]

- Q9)** a) Explain in detail the importance of material characterization. [6]
b) Explain operating principle of Scanning Electron Microscopes with neat sketch. [6]
c) Describe the applications of microscope. [6]

OR

- Q10)** a) Explain operating principle of Atomic Force Microscopes with neat sketch. [6]
b) Explain with sketch operating principle of X-Ray Diffraction Spectroscopy. [6]
c) Describe the applications of spectroscope. [6]



Total No. of Questions : 10]

SEAT No. :

P5577

[Total No. of Pages : 3

[5561]-547

B.E. (Mechanical) (Semester - II)
SOLAR AND WIND ENERGY
(2015 Pattern) (Elective - IV)

Time : 2½ Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) Draw suitable neat diagrams, wherever necessary.*
- 2) Figures to the right indicate full marks.*
- 3) Use of electronic pocket calculator is allowed.*
- 4) Assume suitable data, if required.*

Q1) a) Explain present energy scenario and role of governing bodies for solar and wind energy. **[6]**

b) Explain Solar tower with figure. **[4]**

OR

Q2) a) Explain any one solar measurement instrument with figure. **[6]**

b) Explain solar distillation with figure. **[4]**

Q3) a) Classify solar thermal collectors and describe flat plate collector with the help of suitable diagram. **[6]**

b) Explain solar PV Cell with figure. **[4]**

OR

Q4) a) Classify solar concentrating collectors and explain point contact concentrator with figure. **[6]**

b) Describe classification of solar cells based on type of active material. **[4]**

P.T.O.

- Q5)** Design a solar PV System wherein load consists of a CFL, TV, Fan, Refrigerator and Computer. The system should allow the use of loads in non sunshine hours. The operating hours and the power rating of these loads are given in following table. **[18]**

Load	Watts	Hr/day	Numbers
CFL	18	6	10
Fan	70	4	8
TV(21")	250	2	2
Refrigerator	150	8	8
Computer	250	1	3

OR

- Q6)** An evacuated tube solar water heating system is designed for daily hot water supply of 300 lit. The daily average solar global radiation is 780 W/m^2 . The inlet and outlet temperature of water is 25°C and 50°C . The effective sunshine hours are 7 hours. Calculate number of evacuated tube required if dimension of one tube is $1800\text{mm} \times \phi 57\text{mm} \times 47\text{mm}$. Calculate efficiency of the system. **[18]**

- Q7)** a) Sketch the diagram of HAWT and explain function of its main components. **[8]**
- b) Describe main considerations in selecting a site for wind generators. **[8]**

OR

- Q8)** a) Explain analysis of aerodynamic forces acting on wind mill blades with figures. **[8]**
- b) Explain various design considerations for horizontal and vertical axis wind turbines. **[8]**

Q9) A propeller type turbine has a following data : **[16]**

Speed of free wind at a height of 10m = 15 m/sec

$\alpha = 0.14$

air density = 1.226 kg/m³

height of tower = 100m

diameter of rotor = 90m

wind velocity at turbine reduces by 25%

generator efficiency = 90%

Find total power available to wind, power extracted by wind turbine, electrical power generated, axial thrust on turbine, maximum axial thrust on turbine.

OR

Q10) a) Explain in detail step by step design process for miniature wind mill. **[8]**

b) Explain status of wind energy potential and installation in India. **[8]**



Total No. of Questions : 10]

P3410

SEAT No. :

[Total No. of Pages : 2

[5561]-548

B.E. (Mechanical Engineering)

PRODUCT DESIGN AND DEVELOPMENT

(2015 Pattern) (Elective - IV) (Semester - II)

Time : 2.½ Hours]

[Max. Marks : 70

Instructions to the candidates :

- 1) Answer Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6 Q.7 or Q.8 Q.9 or 10.
- 2) Neat diagrams must be drawn wherever necessary.
- 3) Assume suitable data if necessary.

- Q1)** a) With suitable example explain Product Verification and Product Validation. [6]
b) For an appropriate product discuss the concept of economic analysis.[4]

OR

- Q2)** a) With suitable examples discuss different types of Customer needs in detail. [6]
b) Explain concept of Concurrent Engineering useful in modern Product development. [4]
- Q3)** a) Explain Function tree of standard coffee making machine using subtract and operate procedure [8]
b) What are design drivers. [2]

OR

- Q4)** a) Construct Pugh's Matrix for Mobile handset by considering four variants and five factors. [8]
b) Explain uses of Product testing. [2]

P.T.O.

- Q5)** a) Discuss in detail the process of Product Tear down with suitable example. [10]
b) Discuss detail procedure of Benchmarking with suitable example. [8]

OR

- Q6)** a) Which are different types of product portfolio architecture and how to choose the type architecture for particular product. [10]
b) How to set product specifications based on the benchmarking. [8]

- Q7)** a) Explain how reliability is ensured during design state. [8]
b) Discuss various guide lines of Design for assembly and explain their significance. [8]

OR

- Q8)** a) With suitable example explain environmental concerns implemented in product design. [8]
b) Explain process of Product Life Cycle assessment with example and what design strategies are used for extending product life cycle. [8]
- Q9)** a) Which are different phases of product life cycle and various technologies applied in PLM. [8]
b) Explain three major subsystems of product life cycle management tool. [8]

OR

- Q10)** a) Explain significance of customer involvement in the process of detail design with suitable example. [8]
b) Discuss the concept of product workflow and explain link between product data and product workflow with example. [8]

