

Total No. of Questions :10]

SEAT No. :

P3567

[5560]-511

[Total No. of Pages :3

T. E. (Mechanical)

DESIGN OF MACHINE ELEMENTS-I

(2015 Pattern) (Semester - I) (302041)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) *Answer five questions from the following.*
- 2) *Draw neat labeled diagrams wherever necessary.*
- 3) *figures to the right side indicate full marks.*
- 4) *Use of non programmable electronic calculator is permitted.*
- 5) *Assume suitable/standard data if necessary.*

Q1) a) Write in brief use of standards in design on machine element. What are three basic types of standards used in a design office? **[4]**

b) The Standard cross section for a flat key, which is fitted on a 50mm diameter shaft, is 16×10mm. The key is transmitting 475Nm torque from the shaft to the hub. The key is made of commercial steel ($S_{yt}=S_{yc}=230$ N/mm²). Determine the length of the key, if the factor of safety is 3. **[6]**

OR

Q2) a) Classify the keys and explain it with neat diagram. **[4]**

b) Write design steps of cotter joint and state their applications. **[6]**

Q3) a) Explain different methods of reduction of stress concentration. **[4]**

b) A propeller shaft is required to transmit 45 kW power at 500 rpm. It is a hollow shaft, having an inside diameter 0.6 times of outside diameter. It is made of plain carbon steel and the permissible shear stress is 84 N/mm². Calculate the inside and outside diameters of the shaft. **[6]**

OR

Q4) a) Explain the design procedure for rigid flange coupling. **[6]**

b) Explain the Soderberg and Goodman line diagram with neat sketch. **[4]**

P.T.O.

- Q5)** a) Explain different forms of threads with neat sketch. [4]
 b) A double threaded power screw, with ISO metric trapezoidal threads is used to raise a load of 300kN. The nominal diameter is 100 mm and the pitch is 12mm. The coefficient of friction at the screw threads is 0.15. Neglecting collar friction.
 Calculate
 i) Torque required to raise the load;
 ii) Torque required to lower the load;
 iii) Efficiency of the screw. [12]

OR

- Q6)** a) Explain Re-circulating ball screw with neat sketch and its applications. [4]
 b) The lead screw of a lathe has single start ISO metric trapezoidal threads of 52 mm nominal diameter and 8mm pitch. The screw is required to exert an axial force of 2kN in order to drive the tool carriage during turning operation. The thrust is carried on a collar of 100 mm outer diameter and 60mm inner diameter. The values of coefficient of friction at the screw threads and the collar are 0.15 and 0.12 respectively. The lead screw rotates at 30 rpm.
 Calculate
 i) The power required to drive the lead screw;
 ii) The efficiency of the screw. [12]

- Q7)** a) What are the advantages of welded joints and threaded joints? [8]
 b) Explain eccentrically loaded bolted joints in shear. [10]

OR

- Q8)** a) A steel plate 100 mm wide and 10mm thick is welded to another steel plate by means of double parallel fillet welds. The plates are subjected to a static tensile force of 50kN. Determine the required length of welds if the permissible shear stress in the weld is 94 N/mm². [12]
 b) Explain and draw the neat sketch of cap screws. [6]

- Q9)** a) Explain and draw the neat sketch of the styles of ends of helical compression spring. [6]
 b) Design a helical compression spring subjected to a maximum force of 1250 N. The deflection of the spring corresponding to the maximum force should be approximately 30mm. The spring index can be taken as 6. The spring is made of patented and cold drawn steel wire. The ultimate tensile strength and modulus of rigidity of the spring material are 1090 and 81370 N/mm² respectively. The permissible shear stress for the spring

wire should be taken as 50% of the ultimate tensile strength. Design the spring and calculate,

- i) Wire diameter;
- ii) Mean coil diameter;
- iii) Number of active coils;
- iv) Total number of coils;
- v) Free length of the spring;
- vi) Pitch of the coil.

[10]

OR

Q10)a) What is meant by spring surge and explain its effect. [4]

- b) A railway wagon moving at a velocity of 1.5 m/s is brought to rest by a bumper consisting of two helical springs arranged in parallel. The mass of the wagon is 1500kg. The springs are compressed by 150 mm in bringing the wagon to rest. The spring index can be taken as 6. The springs are made of oil hardened and tempered steel wire with ultimate tensile strength of 1250N/mm² and modulus of rigidity of 81370 N/mm². The permissible shear stress for the spring wire can be taken as 50% of the ultimate tensile strength. Calculate:

- i) Wire diameter;
- ii) Mean coil diameter;
- iii) Number of active coils;
- iv) Total number of coils;
- v) Solid length of the spring;
- vi) Free length of the spring;
- vii) Pitch of the coil;
- viii) Required spring rate;
- ix) Actual spring rate.

[12]



Total No. of Questions :10]

SEAT No. :

[Total No. of Pages : 4

P3568

[5560]-512

T.E. (Mech.)

HEAT TRANSFER

(2015 Course) (Semester-I) (302042)

Time : 2½ Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) *Answers to one questions either or option.*
- 2) *Neat diagrams must be drawn wherever necessary.*
- 3) *Figures to the right side indicate full marks.*
- 4) *Use of scientific non programmable calcultor is allowed.*
- 5) *Assume suitable data, if necessary.*

- Q1) a)** Explain its variation of thermal conductivity with increase in temperature for metals and non-metals. **[4]**
- b) An exterior wall of a house consists of a 10.16 cm layer of common brick having thermal conductivity 0.7 W/m.k. It is followed by a 3.8 cm layer of gypsum plaster with thermal conductivity of 0.48 W/m.k. What thickness of loosely packed rock-wool insulation ($k = 0.065$ W/m.k.) Should be added to reduce the heat loss through the wall by 80%? **[6]**

OR

- Q2) a)** If temperature distribution for a thin and long fin, insulated at its tip is given by $\frac{T(x) - T_{\infty}}{T_0 - T_{\infty}} = \frac{\cosh m(L - x)}{\cosh mL}$ Then show that the heat transfer from the fin is given by $Q_{\text{fin}} = \sqrt{hp k A_c (T_0 - T_{\infty})} \tanh mL$. **[6]**
- b) Define with their physical significance **[4]**
- i) Biot Number
 - ii) Fourier Number
- Q3) a)** Explain the concept of critical thickness of insulation on cylinder with the help of material and surface resistances. **[6]**

P.T.O.

- b) An aluminium sphere having radius 0.0809 m and initially at temperature of 350°C is suddenly immersed in a fluid at 30°C with convection coefficient of 60 W/m².K. Estimate the time required to cool the sphere to 100°C. Take thermo-physical properties as $C = 900 \text{ J/kg.K}$, $\rho = 2700 \text{ kg/m}^3$, $k = 205 \text{ W/m.K}$. [4]

OR

- Q4) a)** Deduce an expression for centerline temperature distribution in a plane wall under steady state heat conduction with uniform heat generation. The wall is insulated on left surface and maintained at temperature T_s on right surface. You may use differential heat conduction equation in

$$x\text{- direction as } \frac{d}{dx} \left(\frac{dT}{dx} \right) + \frac{q_0}{k} = 0 \quad [8]$$

- b) A spherical electronic device (1.4 W/m.k) of 10 mm diameter generates 4W. It is exposed to air at 20° C with a convection coefficient of 20 W/m².K. Find the surface temperature. [2]

- Q5) a)** Prepare formulation for Rayleigh number, Stanton number and Peclet number and interpret them. [6]

- b) A pipe carrying steam runs in a large room and is exposed to air at a temperature of 30°C. The pipe surface temperature is 200°C. The pipe diameter is 20 cm. If total heat loss rate from the pipe per metre length is 1.9193 kW/m, determine the pipe surface emissivity. Use correlation.

$$\text{Nu} = 0.53 (\text{Gr Pr})^{1/4} \text{ and properties of air at } 115^\circ\text{C } k_f = 0.03306 \text{ W/m.K, } \\ \nu = 24.93 \times 10^{-6} \text{ m}^2/\text{s } \text{Pr} = 0.687. \quad [10]$$

OR

- Q6) a)** What do you understand by dimensional analysis? Develop the dimensional analysis for one dimensionless term of forced convection. [8]

- b) A metallic bar of 25 mm diameter is cooled by air at 30°C and with velocity of 2.5 m/s. If the surface temperature of the bar is not to exceed 85°C. The resistivity of the metal is $0.015 \times 10^{-6} \text{ Ohm per metre}$. Calculate

- i) The heat transfer coefficient from the surface to air, and
- ii) The permissible current intensity for the bus bar.

$$\text{The properties of air } \nu = 18.65 \times 10^{-6} \text{ m}^2/\text{s, } k_f = 0.0288 \text{ W/m. K and } \\ \text{Pr}_1 = 0.696 \text{ Use correlation } \text{Nu} = 0.683 \text{ Re}^{0.466} \text{ pr}^{1/3}. \quad [8]$$

- Q7)** a) Define blackbody? What are its properties? Why does a cavity with a small hole behave as blackbody? [6]
- b) Two parallel infinite gray surfaces are maintained at temperature of 127° C and 227°C respectively. If the temperature of the hot surface is increased to 327°C. By what factor is the net radiation exchange per unit area increased? Assume the emissivity of colder and hotter surfaces to be 0.9 and 0.7, respectively. [10]

OR

- Q8)** a) Write a short note on gray body approximation. [6]
- b) A hot water radiator of overall dimensions $2 \times 1 \times 0.2$ m is used to heat the room at 18°C. The surface temperature of radiator is 60°C and its surface is black. The actual surface of the radiator is 2.5 times the area of its envelope for convection for which the convection coefficient is given by $h_c = 1.3 (\Delta T)^{1/3}$ W/m².K. Calculate the rate of heat loss from the radiator. [6]
- c) Define irradiation and radiosity establish the relationship between them. [4]
- Q9)** a) Why drop-wise condensation is better than film-wise condensation. What are practical difficulties to obtain drop-wise condensation? [4]
- b) A condenser is employed in a steam power plant to handle 35,000 kg/h of dry and saturated steam at 50°C. The cooling water enters the condenser at 15°C and leaves at 25°C. the tubes are 22.5 mm inside diameter and 25 mm outside diameter. The water flows through the tubes at an average velocity of 2m/s. The heat transfer coefficients are 7020 W/m².K on water side is and 5000 W/m².K on steam side. Ignore thermal resistance of wall material
- Calculate:
- The mass flow rate of water.
 - Heat transfer surface area.
 - Number of tubes required for water flow.

- iv) Number of tube passes in condenser if the length of each tube per pass should not be more than 2.5 m.

Assume that the condensate coming out the condenser is saturated water i.e., steam loose only its latent heat of 2374kJ/kg.

Use properties of water as: $\rho = 998.8 \text{ kg/m}^3$, $C_p = 4180 \text{ J/kg. k}$, [14]

OR

Q10) a) Classify heat exchangers in brief. [2]

b) Define effectiveness of heat exchanger. How maximum heat transfer rate is obtained? [6]

c) Consider the following parallel flow heat exchanger specification [10]

cold flow enters at 40°C : $C_c = 20,000 \text{ W/K}$

hot flow enters at 150°C : $C_h = 10,000 \text{ W/K}$

$A = 30 \text{ m}^2$, $U = 500 \text{ W/m}^2. \text{ K}$.

Determine the heat transfer rate and the exit temperatures.



Total No. of Questions : 10]

SEAT No. :

P3569

[5560]-513

[Total No. of Pages : 4

T.E. (Mechanical/Automobile)

THEORY OF MACHINES - II

(2015 Pattern) (Semester - I) (302043)

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, Q.9 or Q.10.*
- 2) *Neat diagrams must be drawn whenever necessary.*
- 3) *Figures to the right indicate full marks.*
- 4) *Use of logarithmic calculator is allowed.*
- 5) *Assume suitable data whenever necessary.*

Q1) a) Determine the number of teeth and pitch for two toothed wheels to transmit a velocity ratio of 4:1 between two shafts, centre of which are at 676mm. The drive must satisfy the following conditions: **[6]**

- i) The standard module must be chosen from 24, 22, 18, 16, 15, 14, 13, 12 and 11.
- ii) The actual distance between shaft centre must not vary by more than 1% from the given data.
- iii) The number of teeth must be as small as possible.

b) Define : **[4]**

- i) Helix angle
- ii) Lead angle
- iii) Pitch cone angle
- iv) Normal pressure angle.

OR

Q2) a) The following data relate to two spiral gears in mesh: Shaft angle = 90° , centre distance = 160mm (approximately), normal circular pitch = 8mm, gear ratio = 3, friction angle = 5° . For maximum efficiency of the drive, determine: **[6]**

- i) The spiral angles of the teeth
- ii) The number of teeth
- iii) The exact centre distance
- iv) The pitch diameters.

P.T.O.

- b) Two standard full depth gears of pressure angle 14.5° have a module of 5mm. The pinion has 15 teeth while the gear has 60 teeth. If the addendum of the gear is equal to the module: [4]

- i) Show that the gear will interfere with the pinion.
- ii) To what value should the pressure angle be increased in order to eliminate the interference?

- Q3)** a) An epicyclic gear train of a sun and planet type has the fixed outer annular wheel A, sun wheel S rotating at a speed of 720rpm in clockwise direction and the arm E carrying three planet wheel P needed to be driven. If diametral pitch is same for all mating gears and sun wheel S and planet wheel P have 15 and 45 teeth respectively. [8]

Determine :

- i) Number of teeth on annular A.
 - ii) Speed and direction of rotation of planets.
- b) Write any four types of special bevel gears. [2]

OR

- Q4)** Figure.1 shows an epicyclic gear train in which driving gear A has 20 teeth, the fixed annular gear C has 150 teeth and the ratio of teeth in gears D and E is 21:50. If 2 kW of power at a speed of 800 rpm is supplied to the gear A, determine the speed and the direction of rotation of gear E. Also, find the fixing torque required at the gear C. [10]

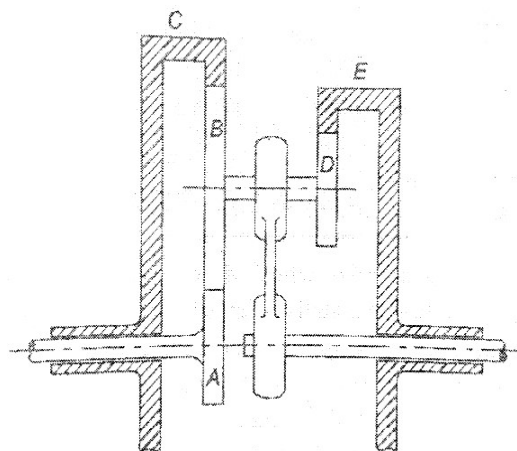


Figure.1

- Q5) a)** Derive an expression for displacement, velocity, acceleration and jerk for 2-3 polynomial advanced cam and also sketch the curves. [10]
- b)** Following data relates to cam and follower mechanism, find out speed of cam in rpm and maximum usable speed of cam without jump if a cam is an eccentric cam with eccentricity 3cm driving a follower of mass 1.5kg. The spring holding the cam has stiffness of 20N/mm and initial compression 3.15cm. The jump is observed at 120° of cam rotation from the lowest position of cam. {6]

OR

- Q6)** A roller follower cam with a roller diameter of 10mm is rotating clockwise. The lift of the cam is 30mm and the axis of the follower is offset to the right by a distance of 5mm. The follower completes the lift with SHM during 120° of cam rotation. The dwell at lift is 60° of cam rotation. First half of the fall takes place with constant velocity and second half with constant acceleration and retardation during 120° of cam rotation. The rest is the dwell at fall. Draw the cam profile giving details of construction and dimensions. Also, determine maximum velocity and acceleration during outward stroke. Assume base circle radius is 25mm. [16]

- Q7) a)** Determine the chebyshev spacing for function $y = x^{1.4}$ for the range $1 \leq x \leq 4$ where three precision points are required. For these precision points, determine $\theta_1, \theta_2, \theta_3$ & ϕ_1, ϕ_2, ϕ_3 if $\Delta\theta = 40^\circ$ & $\Delta\phi = 90^\circ$. [10]
- b)** Find the three precision points in the interval of 30° to 110° by using graphical method of chebyshev spacing. [6]

OR

- Q8) a)** Design a four bar mechanism with input link a, coupler link b & output link c. Angles θ & ϕ for 3 successive positions are given below.

Position	1	2	3
θ	20°	35°	50°
ϕ	35°	45°	60°

Using Frudenstein's equation, find out other links lengths b, c and d. Assume link length a = 1. [10]

- b)** Derive an equation to evaluate kinematic coefficients for synthesizing the four bar mechanism by using algebraic method. [6]

Q9) a) A ship is propelled by a turbine having a mass of 6500 kg and a speed of 2600 rpm. The direction of rotation of rotor is anticlockwise when viewed from the bow end. The radius of gyration of rotor is 460 mm. Determine gyroscopic effect when: **[14]**

- i) Ship is steering to the left in a curve of 60m radius at a speed of 18 knots (Take 1 knot = 1856m/hr).
- ii) Ship is pitching in SHM with bow descending with maximum velocity. The time period of pitching is 20 seconds and the ship pitches 7.5° above and 7.5° below the normal position.
- iii) Ship is rolling and at the instant, its angular velocity is 0.035 rad/sec counterclockwise when view from stern end.
- iv) Also find the maximum angular acceleration during pitching.

b) Write any four advantages of stepless drive. **[4]**

OR

Q10)a) A four wheeler motor car of mass 2 tonnes has height of CG 60cm above ground level. The engine parts and transmissions are equivalent to a flywheel of 80kg with radius of gyration of 15cm and there axis coincides with the axis of wheel. The car negotiate a curve of 60m radius (take towards right turn) at 72 km/hr with overall gear ratio 4: 1. The radius of road wheel is 30cm and its MI is 3kg-m^2 . Assume wheel track as 1.5m, weight distribution as 50:50, determine reaction at each wheel. **[12]**

b) Draw and explain in detail working principle of any one type of CVT. **[6]**



Total No. of Questions :9]

SEAT No. :

P3570

[5560]-514

[Total No. of Pages :2

T.E. (Mechanical/ Automobile)
METROLOGY AND QUALITY CONTROL
(2015 Pattern) (Semester - I) (302045)

Time : 2½Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) *Neat diagrams must be drawn wherever necessary.*
- 2) *Solve Q.No.1 or 2, Q.No 3 or 4, Q.No.5 or 6, Q.No.7 or 8 & Q.No.9*
- 3) *Assume suitable data if necessary.*
- 4) *Use of non-programmable calculator is allowed*
- 5) *Figures to the right indicate full marks.*

- Q1)** a) Explain the terms: Calibration & Traceability. [4]
b) Write a note on 'LVDT Comparator'. [6]

OR

- Q2)** a) Explain - Adverse effects of Poor Surface Finish. [4]
b) Find the shaft & hole dimensions with tolerance for a 85H8e9 pair given the following data with standard notations -85 mm lies in diameter step of 80 to 100 mm. Upper deviation for e shaft= $-11D^{0.41}$, Tolerance unit, $i=0.45(D)^{0.33} + 0.001D$. IT8=25i & IT9=40i. Show it with a diagrammatic representation. What type of fit it is ? [6]

- Q3)** a) Calculate the effective diameter of metric threads using two wire method: Micrometer reading over standard Cylinder with two wires=15.64mm, Micrometer reading over the gauge with two wires = 15.26 mm, Wire diameter = 2 mm, Thread pitch =2.5mm, Standard cylinder diameter=18mm. [5]
b) Explain various errors in Spur gears. [5]

OR

- Q4)** a) Explain any 4 symbols of Geometrical Dimensioning & Tolerancing (GD & T) [4]
b) Write a note on NPL Flatness Interferometer. [6]

P.T.O.

- Q5)** a) Enlist Basic & New Seven Quality Tools & explain any 2 of them. [8]
 b) Comparison between Deming's & Juran's Quality Concepts. [8]

OR

- Q6)** a) Write a note on Quality of Design, Quality of Conformance & Quality of Performance with their co-relationship. [8]
 b) Explain importance of quality deployment at design & manufacturing & elaborate importance of initial planning for quality. [8]

- Q7)** a) Enlist different types of control charts & their applications/ uses. Elaborate on 'Control Chart Patterns' [10]
 b) The number of defects found in each sample of paper of 1 square meter area are shown below. Draw appropriate control chart & state whether the process is under control or not. If sample falling outside control limits is taken out, what are the new control limits. [6]

Sample	1	2	3	4	5	6	7	8	9	10	11	12
No. of defects found	5	6	2	5	2	6	6	13	6	5	6	4

OR

- Q8)** a) Explain the concept of Process Capability & the indices Cp, Cpk & Ppk. [8]
 b) The lot size N is 2000 in a certain AOQL inspection procedure. The desired AOQL of 2 % can be obtained with any one of the three sampling plans. These are: (i) n=65 c=2, (ii) n=41, c=1 & (iii) n=18, c=0. If a large no. of lots 0.3% defective are submitted for acceptance, what will be the average no. of units inspected per lot under each of these sampling plans? Take $P_a = 0.999, 0.993 \& 0.947$ for plan-i), ii) & iii) respectively [8]

- Q9)** Write note on (Any 3) [18]
 a) 'House of Quality' matrix
 b) FMECA
 c) TPM
 d) Poka-Yoka
 e) Six Sigma
 f) 5S



Total No. of Questions :10]

SEAT No. :

P3571

[5560]-515

[Total No. of Pages : 6

T.E. (Mechanical)

REFRIGERATION AND AIR CONDITIONING

(2015 Pattern) (Semester-II)

Time : 2½ Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) Neat diagrams must be drawn wherever necessary.*
- 2) Figures to the right indicate full marks.*
- 3) Use of logarithmic tables slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.*
- 4) Assume suitable data, if necessary.*

- Q1)** a) Draw the neat schematic of ice plant and explain its working. Discuss the secondary refrigerants used in ice plant. [5]
- b) Explain ozone depletion reaction. Describe alternatives for unitary air conditioning systems. [5]

OR

- Q2)** a) 300kJ/min refrigeration system operates on a vapor-compression refrigeration cycle with refrigerant R-134a as the working fluid and an isentropic efficiency of 85 percent for the compressor. The refrigerant enters the compressor as a saturated vapor at 1.40 Bar and is compressed to 8.00 Bar. Determine (a) the quality of the refrigerant at the end of the throttling process, (b) the coefficient of performance and (C) the power input to the compressor. [6]
- b) Explain the design features of an air conditioning system for multiplex. [4]

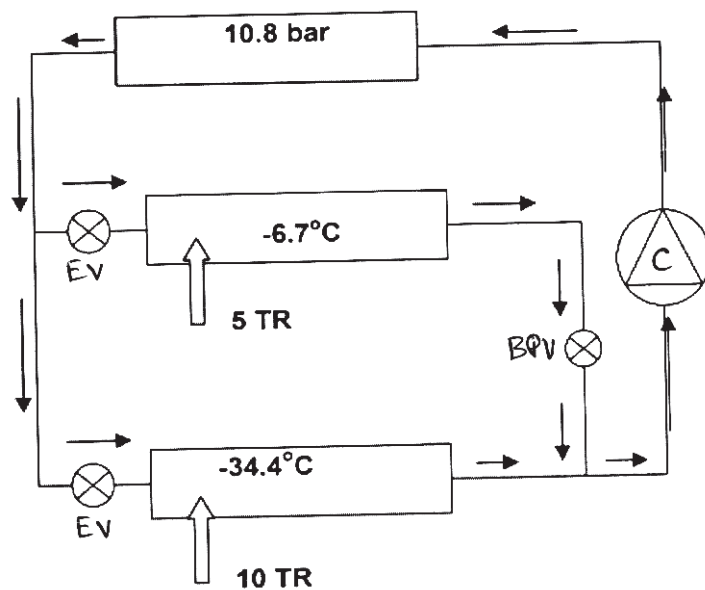
- Q3)** a) Explain Linde-Hampson cycle with neat diagram. Give its applications. [5]
- b) Discuss the methodology for calculating LCCP of various refrigerants. [5]

OR

P.T.O.

Q4) A system working with ammonia as refrigerant is shown in fig.

[10]



Assuming saturated conditions at the exit of evaporators and condenser, ammonia vapour to behave as an ideal gas with a gas constant of 0.4882 kJ/kg. K and isentropic index (C_p/C_v) of 1.29, and isentropic compression :

- Find the required power input to compressor in kW
- Find the required power input if instead of using a single compressor, individual compressors are used for low and high temperature evaporators.

Use properties from table.

T°, C	P_{sat} (kPa)	h_f (kJ/kg) (sat.liquid)	h_g (kJ/kg) sat.vapour
-34.4	95.98	44.0	1417
-6.7	331.8	169.1	1455
27.7	1080.0	330.4	1485

Q5) a) A retail shop located in a city has the following cooling loads:

[12]

Room sensible heat = 58.15 kW

Room latent heat = 14.54 kW

Indoor and outdoor design conditions are:

Outside : 40°C DBT, 27°C WBT

Inside : 25°C DBT, 50% RH

70 cmm of ventilation air is used. Determine the followings:

Ventilation load, GTH, ESHF, ADP dehumidified air quantity, condition of air entering and leaving apparatus.

Take Bypass factor of apparatus as 0.15

- b) Write a note on : IAQ Requirements. [6]

OR

- Q6)** a) Explain: Specific humidity, Relative humidity, and WBT. [6]

- b) A laboratory has the following cooling loads: [12]

Room sensible heat = 50 kW

Room latent heat = 12 kW

Indoor and outdoor design conditions are :

Outside : 40°C DBT, 27°C WBT

Inside : 25°C DBT, 50% RH

50 cmm of ventilation air is used. Determine the followings, if coil ADP is 10°C:

Ventilation load, GTH, ESHF, BF, dehumidified air quantity, condition of air entering and leaving apparatus.

- Q7)** a) With neat schematic explain all air system. What are the advantages and disadvantages over all water system? [8]

- b) Classify refrigerant compressor. Explain working of any two in details.[8]

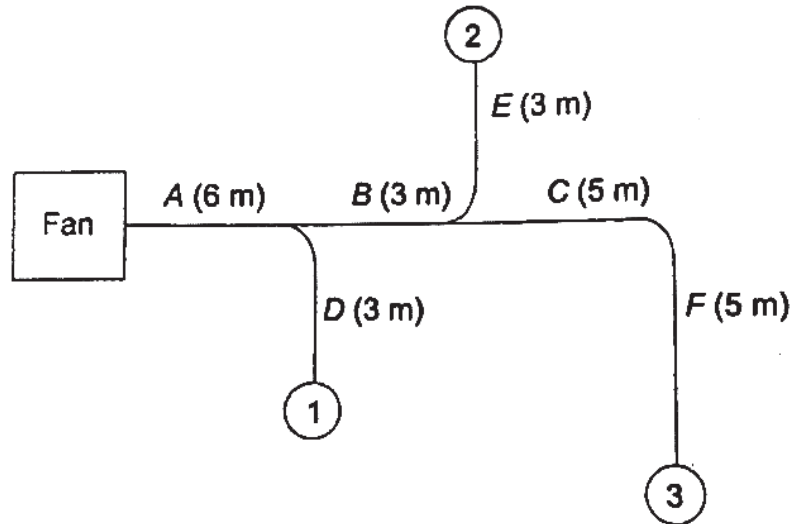
OR

- Q8)** a) Draw neat diagram of EXV and explain its working. What is the selection criteria for expansion device? [8]

- b) Describe all year round air conditioning system. [8]

Q9) a) Classify duct system. Explain commonly used duct materials. [6]

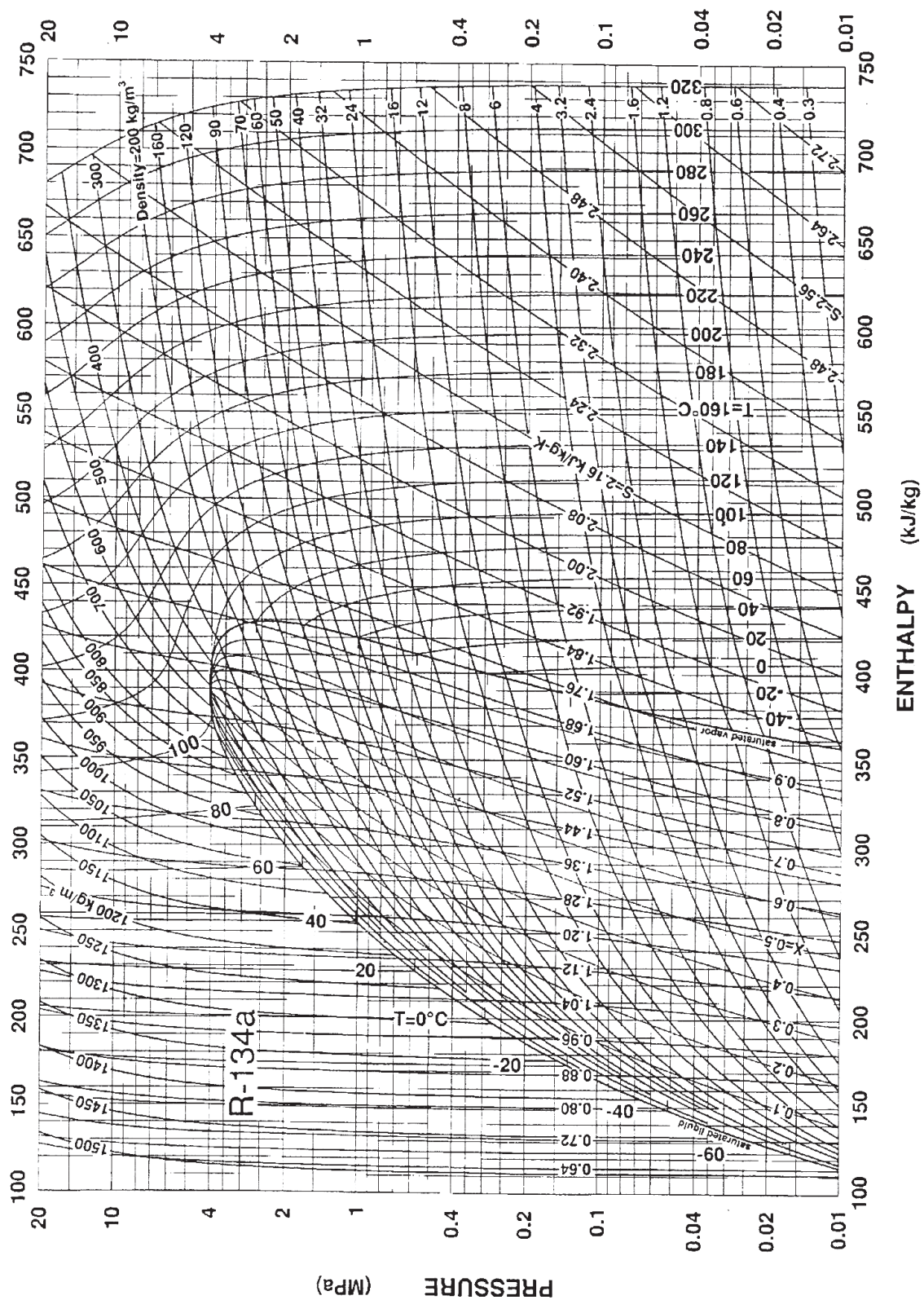
b) In the duct layout shown in Fig. Below, outlet 1 and 2 deliver 20 cmm each and outlet 3 delivers 28 cmm. Select the velocity of 8 m/s in section-A. Size the duct system using the equal friction method and determine its static pressure requirement. [10]

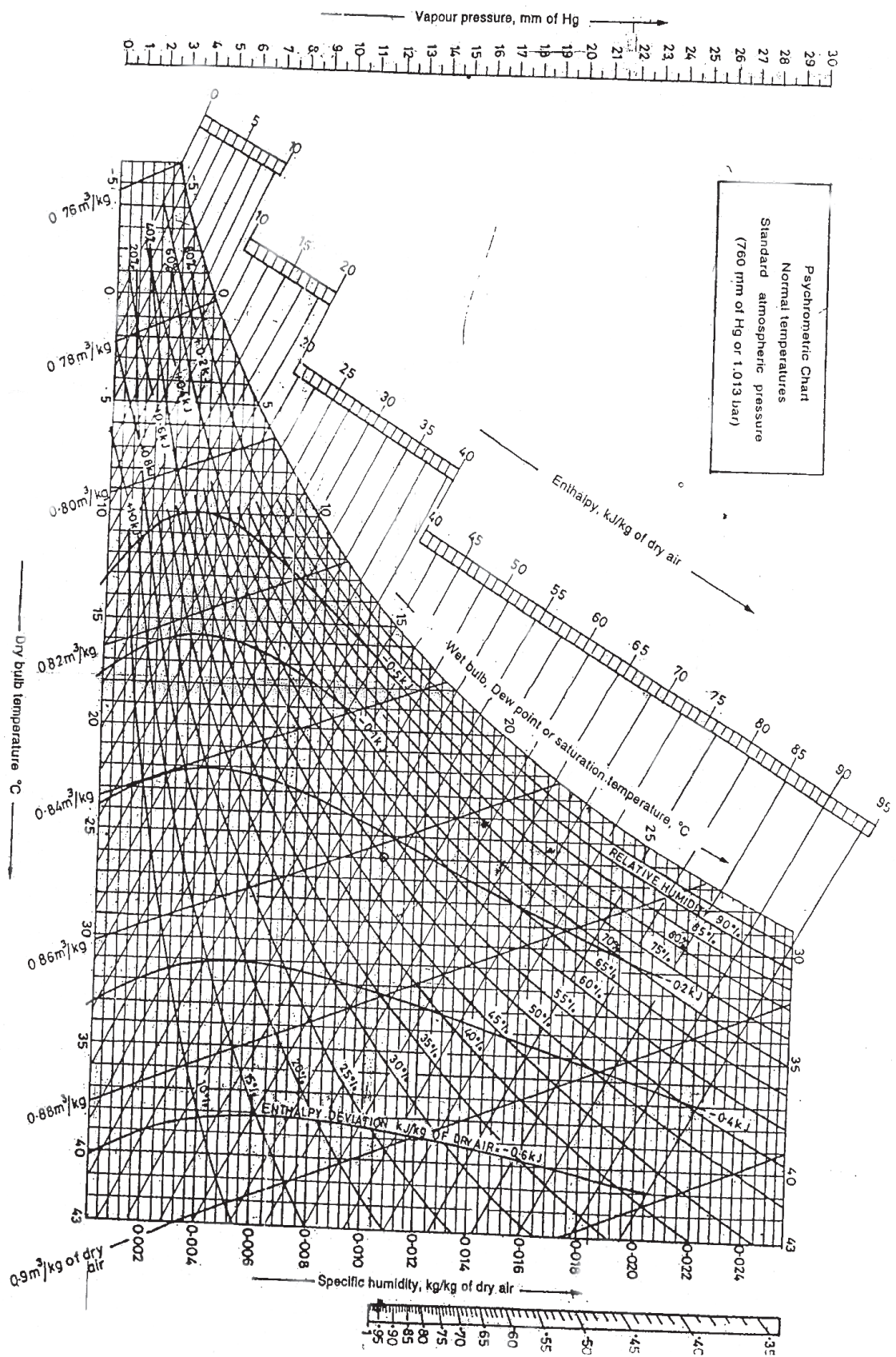


Q10) a) Explain types of fans used in ducting system. Give their selection criteria. [6]

b) Explain, how pressure loss is calculated in the followings: [10]

- i) Elbow
- ii) Bends
- iii) Tees
- iv) Enlargement and contraction
- v) Divided flow fittings.





Total No. of Questions : 12]

SEAT No. :

P3572

[5560]-516

[Total No. of Pages : 3

T.E.(Automobile & Mechanical)

NUMERICAL METHODS AND OPTIMIZATION

(2015 Course) (Semester - II) (302047)

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, Q11 or Q12.
- 2) Neat diagrams must be drawn wherever necessary.
- 3) Figures to the right indicate full marks.
- 4) Use of calculator is allowed.
- 5) Assume suitable data if necessary.

Q1) Explain the convergence and divergence of Successive Iterative method with graphical representation. **[6]**

OR

Q2) Solve by Bisection method $x^3 - 4x + 1 = 0$ correct up to two decimal places. **[6]**

Q3) Solve the following equation by Gauss Elimination method, **[6]**

$$2x + 3y - z = 5, 4x + 4y - 3z = 3, 2x - 3y + 2z = 2$$

OR

Q4) Solve the following simultaneous equations using Tridiagonal Matrix Algorithm (TDMA), **[6]**

$$5x_1 - x_2 = 5.5$$

$$-x_1 + 5x_2 - x_3 = 5$$

$$-x_2 + 5x_3 - x_4 = 11.5$$

$$-x_3 + 5x_4 = 16.5$$

Q5) Solve the following problem of LPP graphically, **[8]**

$$\text{Maximize } Z = 2x_1 + 5x_2$$

$$\text{Subject to, } x_1 + 4x_2 \leq 24$$

$$3x_1 + x_2 \leq 21$$

$$x_1 + x_2 \leq 9$$

$$x_1, x_2 \geq 0$$

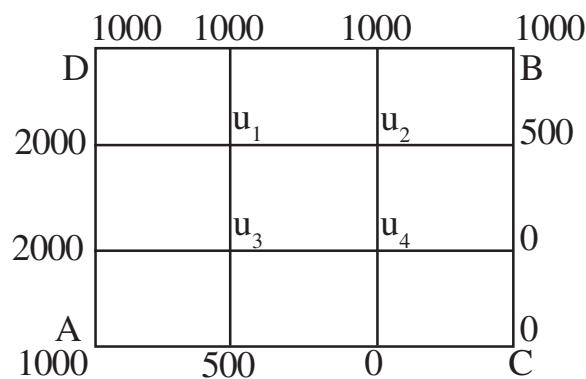
OR

P.T.O.

Q6) Write a short note on Simulated Annealing with flowchart and applications in detail. [8]

Q7) a) Solve the second order differential equation $y'' = xy'^2 - y^2$ for $x = 0.2$ correct to 4 decimal places. Initial conditions are $x = 0, y = 1, y' = 0$, by Runge Kutta 2nd order. Increment in $x = 0.1$. [10]

b) Solve the equation $u_{xx} + u_{yy} = 0$ for the square mesh with the boundary values as shown below : [8]



OR

Q8) a) Solve the boundary value problem $u_t = u_{xx}$ subjected $u(0,t) = u(1,t) = 0$ $u(x,0) = \sin \pi x, 0 \leq x \leq 1$, using Bender Schmidt method taking $h = 0.2$ and $k = 0.02$. [10]

b) Draw flow chart for Solution of Ordinary Differential Equation by Runge Kutta 4th order. [8]

Q9) a) It is known that the curve $y = ax^b$ fits the data given below. Find the best values of a and b . [8]

x	1	2	3	4	5	6
y	1200	900	600	200	110	50

b) From the following data, find y at $x = 43$. [8]

x	40	50	60	70	80	90
y	184	204	226	250	276	304

OR

Q10)a) Draw the flowchart for fitting second degree curve using Least Square Technique. [8]

b) Following data gives values of y corresponding to the values of x. Find value of x when y = 3.5 by applying Langrange's interpolation. [8]

X	1	2	5	7
Y	1	12	117	317

Q11)a) Find double integration of $f(x,y) = 1/(x + y)$ for x = 2 to 3.2 and y = 1 to 2.8 taking no of steps in both x and y as $n_x = n_y = 3$. Use Trapezoidal rule. [8]

b) The table below gives the velocity v of a moving particle at time t seconds. [8]

T	0	2	4	6	8	10	12
V	4	6	16	34	60	94	136

Find the distance covered by the particle in 12 seconds using Simpson's 1/3rd rule.

OR

Q12)a) Draw flow chart for Simpson's 3/8th rule. [8]

b) Evaluate $I = \int_0^{0.8} [\log_e(x+1) + \sin 2x] dx$ by using Gauss quadrate two point formula. [8]



Total No. of Questions : 10]

SEAT No. :

P3573

[Total No. of Pages : 4

[5560] - 517

T. E. (Mechanical)

DESIGN OF MACHINE ELEMENTS - II

(2015 Pattern) (Semester - II)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) *Answer Q No.1 or Q No.2, Q No.3 or Q No.4, Q No.5 or Q No.6, Q No.7 or Q No.8, Q No.9 or Q No.10.*
- 2) *Neat diagrams must be drawn wherever necessary.*
- 3) *Assume suitable data, if necessary.*
- 4) *Figures to the right indicate full marks.*

Q1) a) What are the considerations while selecting the facewidth for a gear tooth? **[3]**

- b) A pair of involute spur gears consisting a 20 teeth pinion meshing with 40 teeth gear Both the gears are made of steel with ultimate tensile strength 480 MPa. The static load on pinion is 1234 N while the dynamic load on the gears is 936 N. The service factor may be taken as 1.5. Both the gears are hardened to 400 BHN. Taking lewis form factor of 0.32 for pinion, module 3 mm and face width twelve times the module determine the factor of safety in bending and pitting. **[7]**

OR

Q2) a) What is bevel factor? Explain the significance of the same. **[4]**

- b) A pair of parallel helical gears made of plain carbon steel consists of a 20 teeth pinion and 60 teeth gear. The material for pinion and gear have ultimate tensile strength 720 N/mm². The normal module of the gear is 3 and face width 32 mm. Find the static load and power transmitted by this pair based on lewis equation, consider service factor 1.5 and factor of safety 2, barth factor 0.623 & lewis form factor 0.32. **[6]**

P.T.O.

- Q3) a)** Derive an expression for virtual number of teeth on a helical gear. [4]
- b)** A pair of straight teeth bevel has a 20 teeth pinion meshing with a 36 teeth gear and transmitting power at right angles. Pinion receives power 3 KW at 1500 rpm. Gears are made of steel with ultimate tensile strength 400 MPa. Determine the factor of safety based on Lewis equation taking Barth factor 0.33712, service factor 1.5 and bevel factor 0.72265, Lewis form factor 0.342. Gears have a module 4 mm and face width 32 mm. [6]

OR

- Q4) a)** Describe following terms (Any two): [4]
- i) Static load carrying capacity
 - ii) Dynamic load carrying capacity
 - iii) Rated life of bearing
- b)** A single row - deep groove ball bearing is subjected to a radial load of 5 kN and thrust load of 2 kN. The radial and thrust factors may be taken as 0.56 and 1.5 respectively. The shaft rotates at 1500 rpm. The diameter of the shaft 75 mm and bearing 6315 with $C = 112000$ N is selected for this application. Estimate. [6]
- i) Life of bearing with 90% reliability
 - ii) Reliability for 20000 hours life.

- Q5) a)** Explain single and double enveloping worm with neat sketch. [6]
- b)** A worm gear box with an effective surface area of 1.5 m^2 is operating in still air with a heat transfer coefficient of $15 \text{ W/m}^2 \text{ }^\circ\text{C}$. The temperature rise of the lubricating oil above the atmospheric temperature is limited to $50 \text{ }^\circ\text{C}$. The worm gears are designated as 1/40/10/4. The worm shaft is rotating at 1440 rpm and normal pressure angle is 20° . Calculate the Power transmitting capacity based on the thermal considerations and the forces acting on worm and worm gear teeth. [10]

OR

- Q6) a)** What is irreversibility of worm gear drives? How it is achieved? [4]
- b)** A pair of worm and worm wheel is designated as 2/52/10/4. Worm receives 5 KW Power at 720 rpm. The coefficient of friction may be taken as 0.03 and the pressure angle is 20° . Calculate the tangential, axial and radial components of the resultant gear tooth force acting on the worm wheel. If worm rotates in counter clockwise direction seen from left worm is situated below worm gear. Represent the directions of the tooth forces on a neat sketch. [12]

- Q7)** a) Explain the selection of flat belt from manufacturer's catalogue. [8]
b) The following data is given for an open type v belt drive.
Diameter of driving pulley 50 mm
Diameter of driven pulley 300 mm
Centre distance 1m
groove angle 40° , mass of belt 0.25 kg/m.
Maximum permissible tension 750N.
Coefficient of friction 0.18
Calculate the maximum power transmitted by the belt and corresponding belt velocity Neglect power losses. [10]

OR

- Q8)** a) Describe various types of chains along with the neat sketch, applications. [6]
b) Explain following. [12]
i) Belt tensioning methods
ii) Wire rope construction
iii) Ribbed v belts
- Q9)** a) Describe various desirable properties of bearing materials. [4]
b) The following data is given for a 360° hydrodynamic bearing. [12]
Radial load 3.2 kN
Journal speed 1500 rpm
Diameter of journal 50 mm
Length of bearing 50 mm
Radial clearance 0.05 mm
Viscosity of lubricant 30 cp.
Assuming that the total heat generated is carried away by the lubricant calculate
i) Coefficient of friction
ii) Power lost in friction
iii) Minimum oil film thickness
iv) Flow requirement in litres / min
v) Temperature rise
Use Table 1 data

OR

- Q10) a)** Following data is given for 360° hydrodynamic bearing [12]
 Radial load 8 kN
 Journal speed 1200rpm
 Journal diameter and 60 mm
 length of bearing
 Minimum oil film thickness 0.009 mm
 The class of fit is $H > e > (fine)$ running fit specify the viscosity of the lubricant for this application. Use the data from Table 1

TABLE 1

$\frac{1}{d}$	ε	$\frac{ho}{c}$	s	$\left(\frac{r}{c}\right)f$	$\frac{Q}{rcn_s l}$	$\frac{Q_s}{Q}$
	0.4	0.6	0.264	5.79	3.99	0.497
	0.6	0.4	0.121	3.22	4.33	0.680
	0.8	0.2	0.0446	1.70	4.62	0.842

- b) Explain various bearing design parameters. [4]



Total No. of Questions :10]

SEAT No. :

P3574

[5560]-518

[Total No. of Pages : 4

T.E. (Mechanical)

TURBO MACHINES

(2015 Pattern) (Semester-I) (302044)

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) Figures to the right side indicate full marks.
- 3) Use of Scientific Calculator and steam table is allowed.
- 4) Assume data wherever necessary and mention it.
- 5) Draw neat and suitable figures wherever necessary.

- Q1)** a) Derive the expression for the force exerted by a jet of water on a hinged plate in the direction of jet. [4]
- b) A double jet Pelton Wheel has a specific speed of 14 and is required to deliver 1000 kW. The turbine is supplied through pipeline from a reservoir whose level is 400 m above the nozzles. Allowing 5% for frictional loss in the pipe, calculate:
- i) Speed in RPM
 - ii) Diameter of jets
 - iii) Mean Diameter of Bucket circle
- Take $C_v = 0.98$, speed ratio = 0.46 and overall efficiency = 85%, the specific speed is based on power output per jet. [6]

OR

- Q2)** a) For the Francis turbine following data is available shaft power = 130 kW
Net Head = 9m, Speed = 120 RPM, Overall Efficiency = 75%,
Hydraulic efficiency = 90% Velocity of flow at inlet = $1.15\sqrt{H}$,
Maximum absolute velocity at inlet = $3.45\sqrt{H}$. Assume radial discharge at exit, Find
- i) Guide blade angle and moving vane angle at inlet
 - ii) Diameter of runner at inlet. [6]
- b) Define unit quantities for the turbines. [4]

P.T.O.

- Q3)** a) Explain the necessity of draft tube in reaction turbines. [4]
- b) A Kaplan turbine operates at a discharge of $77 \text{ m}^3/\text{s}$. The runner diameter and hub diameter are 4.2m and 1.5m respectively. Taking the speed ratio of 2.1, determine
- The net head,
 - The power developed and
 - The specific speed. Assume the mechanical and hydraulic efficiency of 88% and 92% respectively and no whirl at outlet. [6]

OR

- Q4)** a) Define
- Mechanical efficiency
 - Run away speed. [4]
- b) A jet of water 5cm diameter moving with a velocity of 25m/sec. Strikes horizontally a single moving vane, moving in the direction of jet with velocity of 16m/sec. The vane deflects the jet through 130° . Find the axial force exerted by the jet on the vane. Also find the velocity and direction of water at outlet. Neglect friction. [6]
- Q5)** a) Compare impulse turbine & reaction steam turbine. [4]
- b) Explain the need of compounding in steam turbines. Discuss any one method. [4]
- c) Steam issues from the nozzles at angle of 20° at a velocity of 440m/s. The friction factor is 0.9. For a single stage turbine designed for maximum efficiency, determine
- the blade velocity
 - moving blade angles for equi-angular blades
 - the blade efficiency
 - the stage efficiency if the nozzle efficiency is 93%
 - power developed for a mass flow rate of steam of 3kg/s. [8]

OR

- Q6)** a) For a certain stage of 50% reaction turbine mean root diameter is 1.35m and speed ratio is 0.69. The rotor speed is 3000 rpm and outlet blade angle is 55° . Find:
- Inlet blade angle
 - Blade efficiency and maximum blade efficiency [8]
- b) Define the following terms
- Diagram efficiency
 - Nozzle efficiency [4]
- c) Explain with neat sketch throttle governing of steam turbine. [4]
- Q7)** a) Explain the effect of blade angle (outlet) on discharge in centrifugal pump. [4]
- b) Explain NPSH and cavitation with respect to centrifugal pump. [4]
- c) A three stage centrifugal pump has impeller diameter at outlet 400 mm and 20 mm wide. The vane angle at outlet is 45° and the area occupied by the thickness of vane is 8% of total area. Inner diameter of impeller is half of outer diameter and inlet width is twice as that of outlet. The pump discharges 3.6 m^3 per minute and runs at 920 rpm. Flow velocity is constant from inlet to outlet. Find
- Power output of pump in kW.
 - Total manometric head
 - Specific speed
 - Shaft Power
 - Vane angle at inlet
- Take mechanical efficiency = 88%
Manometric efficiency = 77%. [10]

OR

- Q8)** a) A centrifugal pump at 900 rpm has an impeller diameter of 500mm and eye diameter of 300 mm. The blade angle at outlet is 35° with tangent. Determine assuming zero whirl at inlet, the inlet blade angle, absolute velocity at outlet and its direction and the manometric head. The velocity of flow is constant throughout and is 3 m/sec. [10]
- b) What is the significance of specific speed? Derive the relation for the same for centrifugal pump. [4]
- c) Explain different types of casing used in centrifugal pumps. [4]

- Q9)** a) Explain the construction and working of an axial flow compressor. [6]
b) A centrifugal compressor develops a pressure ratio of 5 and an air consumption of 30 kg/s. The inlet temperature and pressure are 15°C and 1 bar respectively. If isentropic efficiency is 0.85, Calculate
i) The work done
ii) Exit total temperature
iii) the power required. [6]
c) Describe the classification of compressors. [4]

OR

- Q10)** a) Following data is given for a centrifugal compressor.
i) RPM = 15000
ii) Air flow rate = 30 kg/sec.
iii) Air enters the compressor axially
iv) Conditions at exit : Radius = 0.3 m and relative velocity of air at the tip = 100 m/s at an angle of 80°. Find the torque and power required to drive the compressor. [8]
b) Explain surging and choking of centrifugal compressor. [8]



Total No. of Questions : 10]

SEAT No. :

P3575

[5560]-519

[Total No. of Pages : 4

TE (Mechanical) (Mechanical S/W)
MECHATRONICS
(2015 Course) (Semester - II) (302050)

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) Draw a suitable diagram and explain the working of the 2 bit R-2R type Digital to Analog converter. [6]
- b) Discuss, in detail, any four criterion for accessing the measurement performance of a rotary Potentiometer. [4]

OR

- Q2)** a) A 4-bit DAC has a V_{ref} of 0-10 V. For a binary input of 1010, find the equivalent analog output voltage given by the DAC. [6]
- b) Using a suitable diagram, explain the working of an optical type proximity sensor. [4]

- Q3)** a) Using a suitable diagram explain the application of Mechatronics in an automotive system. [8]
- b) Discuss, in brief, the operating principle of the LVDT type position sensor. [2]

OR

- Q4)** a) Reduce the block diagram in Figure 1 and determine the transfer function: X/Y . [8]

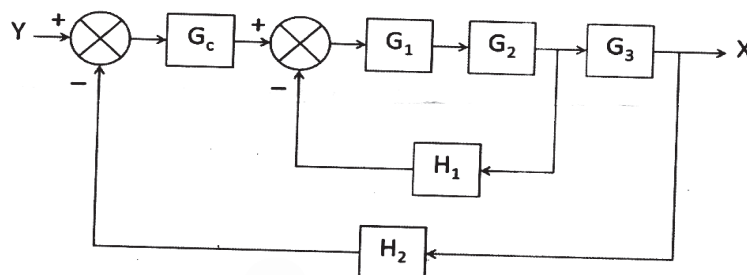


Figure 1

- b) Discuss, in brief, the operating principle of the Thermocouple. [2]

P.T.O.

- Q5) a)** Given three push to on switches (P1, P2, and S), with two lamps (L1 and L2), write a PLC program to satisfy following objectives. [10]
- When P1 (start switch) is pushed, L1 shall go On and cycle shall start. the cycle shall continue to remain On until P2 (stop switch) is pushed.
 - When L1 is On then L2 is Off and vice a versa.
 - When S switch is pushed for four times the program shall stop.
 - When P2 (stop switch) is pushed, the program shall stop.
 - When program stops, L2 shall be On.
- b)** Draw a suitable diagram and discuss, in detail, the working of a PLC. [6]

OR

- Q6) a)** Consider a tank with inflow valve V1 and outflow valve V2 connected to the tank at top and bottom respectively. The level high (LH) and level low (LL) float switches are mounted at top and bottom to indicate the level. Develop a PLC ladder program to achieve the following objectives:[10]
- When LL is OFF and LH is OFF, the V1 should be ON
 - V1 shall continue to be ON till LH is ON
 - When LL and LH is ON, V1 should be OFF and V2 should be ON
 - V2 should continue to be ON till LL is OFF
- b)** Using suitable example, explain the working of the following in a PLC. [6]
- Timer
 - Counter

- Q7) a)** A mass spring damper system is mounted on an massless cart as shown in Figure 2. Derive the transfer function between output y and input u . [10]

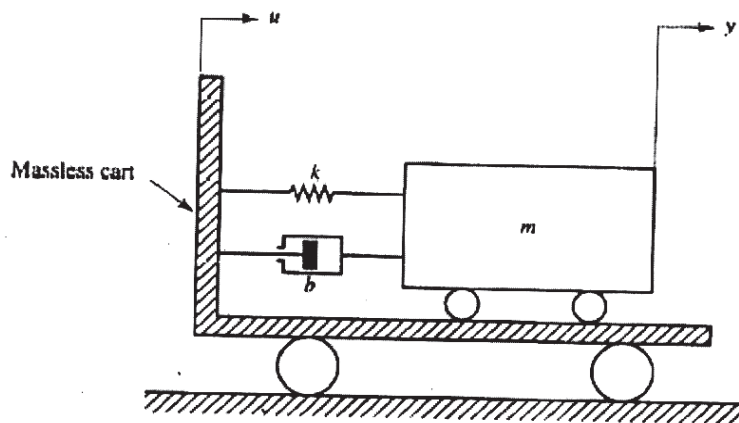


Figure 2

- b)** Using Routh Hurwitz criterion, determine the range of K that would confirm closed loop stability of system given by Eq. (2). [6]

$$s^3 + 101.71s^2 + 171s + 6.63K = 0$$

OR

- Q8) a)** For the system in Figure 3, assume m =mass=2 kg, k =stiffness=4 N/m and b =damping = 0.3 Ns/m. Also, F =Force input in N and x = displacement output in m. **[10]**

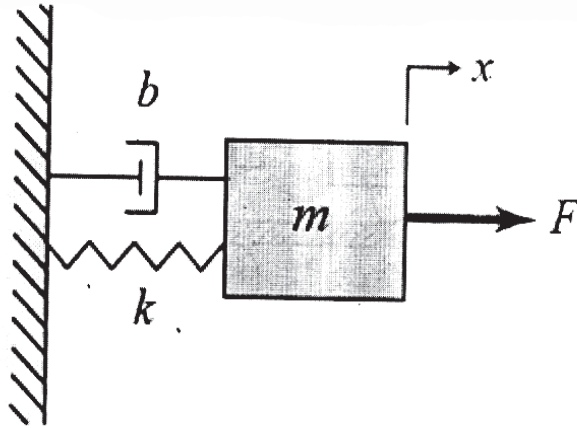


Figure 3

For this system:

- i) Derive the transfer function: $x(s)/F(s)$,
 - ii) Identify the location of the Poles and Zeros and
 - iii) Comment on the absolute stability of the system.
- b) Draw suitable sketch to depict the unit step response of a generic second order system when its: **[6]**
- i) poles are negative, real and collocated
 - ii) poles are complex conjugate pair with negative real part
 - iii) poles are a imaginary pair with no real part

- Q9) a)** Figure 4 shows an error versus time graph. Sketch the PD controller (parallel form) output with respect to time. Assume $K_p = 10\%/s$, $K_D = 0.5\% / s$ and $P_0 = 20\%$. [10]

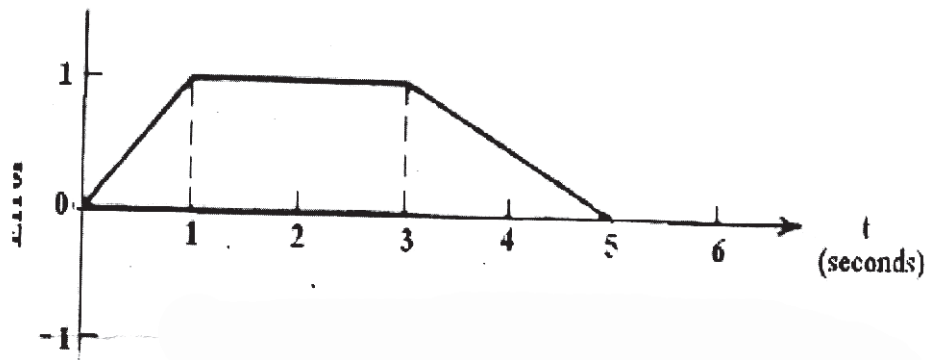


Figure 4

- b) Discuss the significance of transient specifications with respect to assessment of performance of the PID controller. [8]

OR

- Q10) a)** Write the equation for their control signal and discuss, in detail, the advantages as well as the dis-advantages of the following terms in the PID control. [10]

- i) Proportional
- ii) Integral
- iii) Derivative

- b) Write the cost function of an LQR control algorithm, define as well as discuss the significance of all the terms mentioned in the cost function. [8]



Total No. of Questions : 10]

SEAT No. :

P3576

[5560]-520

[Total No. of Pages : 2

T.E. (Automobile) (Mechanical Engg.)
MANUFACTURING PROCESSES - II
(2015 Course) (Semester - II) (302051)

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, Q.9 or Q.10.*
- 2) Figures to the right indicate full marks.*
- 3) Use of electronic pocket calculator is allowed.*
- 4) Assume suitable data if necessary.*

- Q1)** a) Discuss the various types of chips produced during metal cutting, along with neat sketches. [6]
- b) A tool life of 80 minute is obtained at a speed of 30 mpm and 8 minute at 60 mpm. Determine the following : [4]
- i) Tool life equation.
 - ii) Cutting speed for 4 minute tool life.

OR

- Q2)** a) Draw a neat labelled sketch of radial drilling machine. [4]
- b) What are the functions of cutting fluid? Discuss various types of cutting fluids. [6]
- Q3)** a) List out the various operations carried out on milling machine. Explain any two with neat sketch. [6]
- b) Explain continuous broaching machines with working sketch. [4]

OR

- Q4)** a) Describe the tool and cutter grinder along with neat sketch. [6]
- b) Explain "buffing" process. Mention the applications of "buffing". [4]

P.T.O.

- Q5) a)** Explain Laser beam machining process along with advantages, limitations and applications. [8]
- b) Explain Abrasive Jet Machining Process along with advantages, limitations and applications. [8]

OR

- Q6) a)** Explain with neat sketches EDM process. State the advantages, limitations and applications. [8]
- b) Explain Ultrasonic Machining (USM) process with its advantages, limitations and applications. [8]

- Q7) a)** Explain CNC machines with neat sketch. State its advantages and limitations. [6]
- b) Write short note on "Automatic Tool Changer" (ATC). [6]
- c) What are G codes & M codes? Explain with suitable examples. [4]

OR

- Q8) a)** Differentiate between "absolute and incremental positioning system" in CNC. [6]
- b) Explain DNC machines with neat sketch. State its advantages & limitations. [6]
- c) Explain subroutine and canned cycle. [4]

- Q9) a)** What is 3-2-1 location principle? Explain with neat sketches. [6]
- b) What are the different types of jigs? Explain with suitable sketches. [6]
- c) Explain with sketch any two "Indexing methods" used in jigs & fixtures. [6]

OR

- Q10)a)** List the various types of locating devices used in jigs & fixtures. Explain any one in detail. [6]
- b) State various types of clamping devices used in jigs & fixtures and explain any one. [6]
- c) Write short notes on Milling fixtures and Pokayoke concept in jigs and fixtures. [6]



Total No. of Questions :12]

SEAT No. :

P3577

[5560]-521

[Total No. of Pages :4

T. E. (Mechanical Sandwich)

NUMERICAL METHODS AND OPTIMIZATION

(2015 Pattern) (Semester - I) (302047)

Time : 2½ Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) *Solve 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.*
- 2) *Neat diagrams must be drawn wherever necessary.*
- 3) *Figures to the right indicate full marks.*
- 4) *Use of programmable calculator is not permitted.*
- 5) *Assume suitable data, if necessary.*

Q1) Find the absolute error and relative error in $\sqrt{6} + \sqrt{7} + \sqrt{8}$ correct to 3 significant digits. **[6]**

OR

Q2) Determine using bi-section method, a root of the equation $x \cdot \log_{10} x - 1.2 = 0$, upto 4th iteration. **[6]**

Q3) Solve the equations by Gauss-Seidel method. **[6]**

$$27x - 6y - z = 85$$

$$x + y + 54z = 110$$

$$6x + 15y + 2z = 72$$

OR

Q4) Use Gauss elimination method with partial pivoting to find V_1, V_2 , and V_3 . **[6]**

$$2V_1 - V_2 + 3V_3 = 5$$

$$-4V_1 - 3V_2 - 2V_3 = 8$$

$$3V_1 + V_2 - V_3 = 4$$

P.T.O.

- Q5) a)** Maximize : $z = 5x + 3y$ [5]
subjected to the conditions:

$$4x + 5y \leq 1000$$

$$5x + 2y \leq 1000$$

$$3x + 8y \leq 1200$$

Also , $x \geq 0, y \geq 0$

Use graphical method.

- b) Using Newton's method find the maximum value for the equation $x^3 - 5x^2 + 3x$. Take initial guess as zero upto accuracy 0.001. [3]

OR

- Q6)** Maximize $Z = 50,000x + 12,000y$ [8]
subjected to

$$75x + 15y \leq 1000$$

$$100x + 30y \leq 1500$$

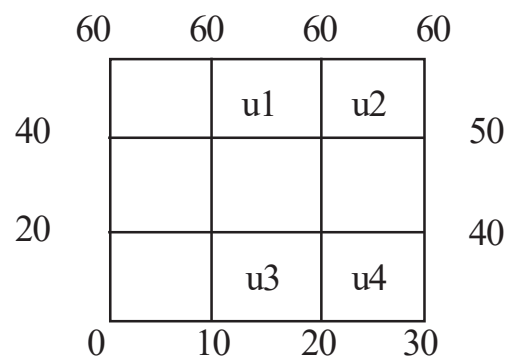
$$45x + 10y \leq 750$$

$$x, y \geq 0$$

Use Simplex method.

- Q7) a)** Find the Taylor's series method, the values of y at $x=0.1$ and $x=0.2$ to five places of decimals from $\frac{dy}{dx} = x^2y - 1, y(0)=1$. [8]

- b) Solve the Laplace's equation $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$ for the square mesh shown below. [10]



OR

Q8) a) Apply Runge-Kutta method to find approximate value of y for x=0.2, in steps of 0.1, if $\frac{dy}{dx} = x + y^2$, given that y=1 where x=0. [6]

b) Solve for $\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2}$ the following explicit finite scheme, given by, [12]

i) $u = \sin(\pi x)$ for t=0 where $0 \leq x \leq 1$

ii) $u=0$ for x=0 and x=1 for t=0 to 0.06, and

iii) Increment in t is k=0.02 and in x is h=0.2

Calculate values of u for t=0 to 0.06 at x=0 to 1.

Q9) a) For tabulate values of x and y given below, fit a linear curve of type $y=mx+c$. [8]

x	1.0	3.0	5.0	7.0	9.0
y	1.5	2.8	4.0	4.7	6.0

b) The population of a town is as follows: [8]

Year (x)	1941	1951	1961	1971	1981	1991
Population in Lakhs (y)	20	24	29	36	46	51

Estimate the population increase during the period 1941 to 1946.

OR

Q10)a) Using least square technique, fit a curve $y = ax^b$ for a set of points given below and find the values of a and b. [8]

x	0.5	1.5	2.0	2.5	3.0
y	0.7425	3.8579	5.9397	8.301	10.912

b) The velocity distribution of a fluid near a flat surface is given below: [8]

x	0.1	0.3	0.6	0.8
V=y	0.72	1.81	2.73	3.47

Where, x is the distance from the surface (mm) and V is the velocity (mm/sec). Use Lagrange's interpolation polynomial to obtain the velocity at x=0.4.

Q11)a) Use Simpson's $1/3^{\text{rd}}$ rule to find $\int_0^{0.6} e^{-x^2} dx$ by taking seven ordinates. **[8]**

b) Find the double integral $f(x, y) = 2x + y + 1$ for $x=0$ to 2 and $y=0$ to 2
Use Simpson's $1/3^{\text{rd}}$ rule. **[8]**

OR

Q12)a) Find $\int_0^6 \frac{1}{1+x^2} dx$, using Trapezoidal method, Take 4 strips. **[8]**

b) Using Gauss-Legendre three point formula find $\int_3^5 x^2 - 5x + 2 dx$ **[8]**

