UNIVERSITY OF PUNE

[4363]-111

T. E. (Mechanical Engineering)

Examination - 2013

Machine Design- I

(2008 Pattern)

Total No. of Questions : 12 **[Total No. of Printed Pages :6]**

[Time : 3 Hours] **[Max. Marks : 100]**

Instructions :

*(1) Answers three questions from **Sections I** and three questions from **Section II**.*

*(2) Answers to the **two sections** should be written in **separate answer-books**.*

(3) Black figures to the right indicate full marks.

(4) Neat diagrams must be drawn wherever necessary.

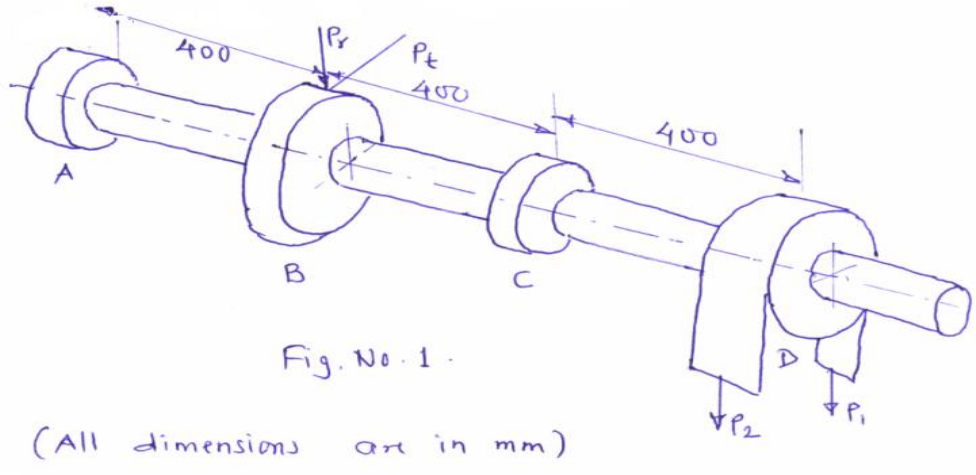
(5) Use of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.

(6) Assume suitable data, if necessary.

SECTION I

Q.1) A transmission shaft supporting a spur gear B and pulley D as shown in fig.1. The shaft is mounted on two bearings A and C. The diameter of pulley and gear are 500 and 350 mm respectively 20 KW power at 500 rpm is transmitted from the pulley to the gear: P_1 and P_2 are the belt tensions in the tight and loose sides. While P_t and P_r are tangential and radial components of the gear tooth force. Assume $P_1 = 3\ P_2$ and $P_r = P_t \tan(20°)$. The gear and pulley are keyed to the shaft. The material for the shaft is 50 C4 (Sut = 700N/mm^2 and Syt = 460N/mm^2)

Determine the shaft diameter using ASME code if $K_b=K_t=1.5$ [16]



OR

Q.2 (a) Explain the steps for design of muff or sleeve coupling. [6]

b) Design a flange coupling for steel shaft transmitting 20 KW power at 250rpm Maximum torque is 30% greater than full load torque. Material properties are as follow:

1) Allowable shear stress for shaft & key = 40 MPa
2) Allowable shear stress for bolts = 30 MPa
3) Allowable crushing stress for shaft & key = 80 MPa
4) Allowable shear stress for flange = 14 MPa
5) Allowable compressive stress for bolts = 60 MPa

Take 4 bolts on P.C.D. -3d [10]

Q.3 (a) Explain different types of threads used for power screws. Give advantages and limitations of each type. [8]

b) A two start trapezoidal is used in a screw jack to raise a load of 300kN. The screw has nominal diameter as 90mm, pitch as 12mm and helix angle (half thread angle) of 15°. Coefficient of friction is screw thread is 0.15. Neglecting collar friction calculate:-

1) Torque required to raise the load
2) Torque required to lower the load
3) Screw efficiency [8]

Q.4 (a) Derive the expression for maximum efficiency of square thread. [8]

b) In a steam engine cylinder, the cylinder head is subjected to steam pressure of 0.8 N/mm^2.The cylinder head is held in position by means of 12 bolts and soft gasket is used to make joint leak proof. The effective diameter of cylinder is 400 mm. find the size of bolts so that the stresses in the bolts is not to exceed 100 MPa. Assume:-
Initial tension due to tightening = 2840d
K=0.5 for soft gasket, and take d_c=0.84d [8]

Q.5 (a) Write a short note on 'Bolt of uniform strength'. [4]

b) A steel plate subjected to 10kN of load and fixed to a vertical channel by means of four identical bolts as shown in fig.2. The bolts are made of plain carbon steel 40c8 (Syt=380 N/mm^2) and factor of safety is 2. Determine the nominal diameter of the bolt. [4]

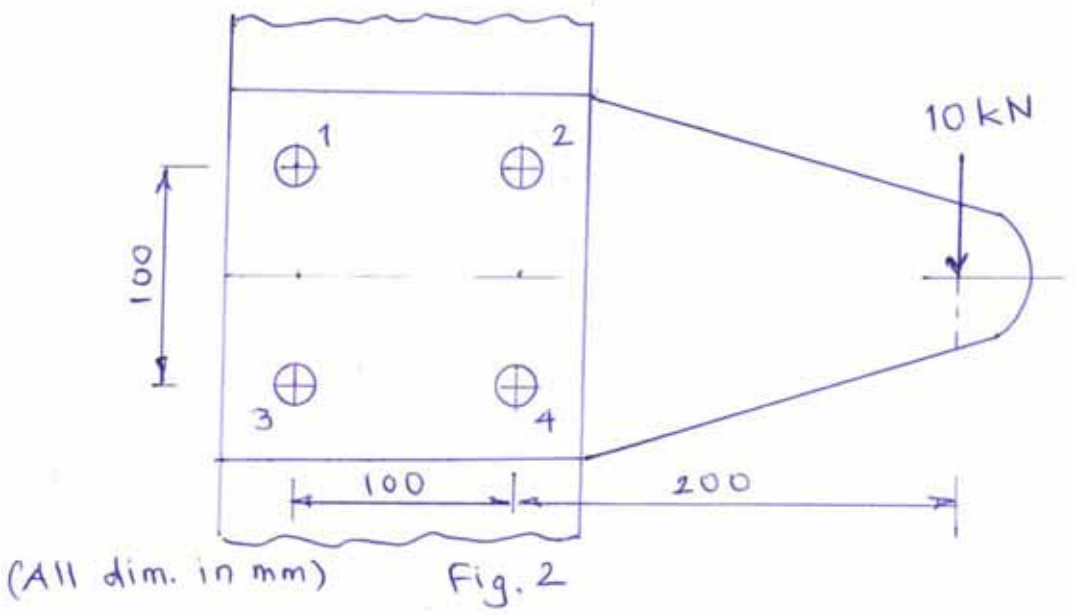


Fig. 2

OR

Q.6) Fig.3 shows an eccentrically loaded bracket is welded to the support. The permissible shear stress for the weld material is 55 N/mm^2 and the load is static. Determine the throat and kg dimensions for the weld. [18]

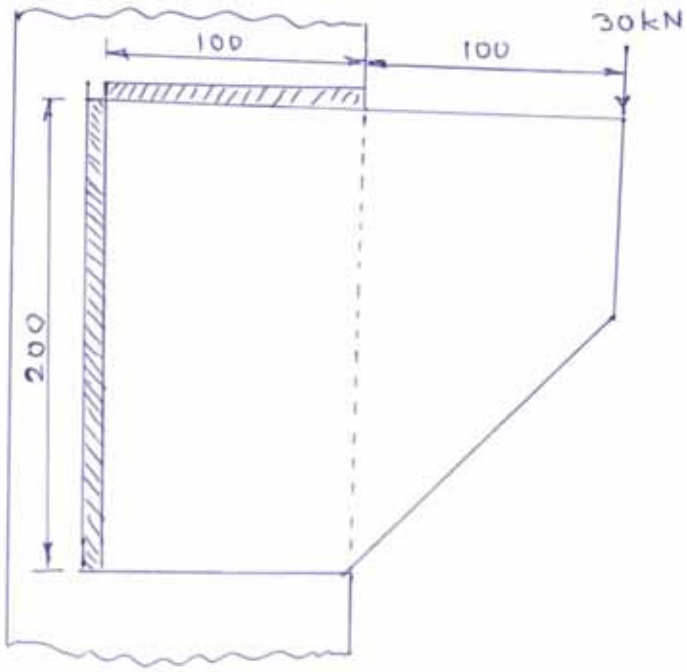


Fig. No. 3
(All dimensions are in mm)

SECTION II

Q.7 (a) What are the advantages of split type flywheel over solid one piece flywheel [4]

b) the following data is given for rimmed flywheel of grey cast iron:

- Mean radius of rim = 1
- Thickness of the rim = 100mm
- Width of the rim = 200mm
- Number of spokes = 4
- cross sectional are of each spoke = 6500 mm^2
- Speed of rotation = 720 rpm
- Mass density of flywheel = 7200 kg/m^3

Calculate:

1) The maximum tensile stress in the rim
2) Axial stress in each spoke [12]

OR

Q.8 (a) What is coefficient of fluctuation of speed? What is coefficient of fluctuation of energy? Explain its significance in design of flywheel [4]

b) A machine with a constant resisting torque is driven by an I.C. engine.
The torque developed by the engine is given by an expression:
T=4000=1500sin θ=+4000sin 2θN-m.
A rimmed flywheel made of grey cast iron FG 150 (p=7000 kg/m^3) is used to maintain speed of the engine between 200 rpm and 210 rpm. The rim contributes 90% of the required mass moment of inertia. A maximum diameter of the flywheel is limited to 2.1 m. if the factor of safety is 7.5, design the flywheel. Neglect the effect of restrain of arm on the flywheel rim. [12]

Q.9 (a) A safety valve of 60 mm diameter is to blow off at a pressure of 1.2 MPa. It is held on its seat by closed coil helical spring. The maximum lift of the valve is 10 mm. design a suitable compression spring of spring index 5 and providing an initial compression of 35mm. the maximum shear stress in the material of the wire is limited to 500N/mm^2 . the modulus of rigidity of the spring material is 80000 N/mm^2 .
Calculate :
a) diameter of spring wire, b) mean coil diameter, c) number of active turns, and d) Pitch of the coil. [10]

b) Explain the following terms used for helical spring. [8]
1) Wahl factor
2) Active and inactive coils.
3) Spring Index
4) Spring rate

OR

Q.10 (a) A concentric spring consists of two helical compression spring having the same free length. The composite spring is subjected to a maximum force of 2000N. the wire and mean coil diameter of the outer spring are 10 and 80 mm respectively. The numbers of active coils in inner and outer springs with G = 81370N/mm$^{2.}$
Calculate :
1) Force transmitted by each spring,
2) Maximum deflection of the spring and
3) maximum torsional shear stress induced in each spring. [10]

b) Draw a neat sketch of multi leaf spring and show its essential parts. Also explain nipping of leaf spring. [8]

Q.11 (a) Explain the procedure for the selection of wire ropes from manufacturer's catalogue. [6]

b) A pulley of 1000mm diameter is driven by an open type flat belt from a 25kW 1440 r.p.m . electric motor. The pulley on the motor shaft is 250mm diameter and the centre distance between the two shaft is 2 m.The allowable tensile stress for the belt material is 2 n/mm^2 and the coefficient of friction between the belt and pulley is 0.28. The density of belt material is 900 kg/m^3 . if the width of the belt is 125mm, determine:

1) The thickness of the belt,
2) The length of the belt, and
3) The initial tension required in the belt. [10]

OR

Q.12 (a) a compressor is to run at 250 r.p.m. and requires 90 kW. The drive is provided by V belts from an electric motor running at 750 r.p.m. the diameter of the pulley on the compressor shaft is restricted to 1 meter whereas the centre distance between the pulleys is limited to 1.75 meter. The belt speed should not exceed 1600m/min. Determine the number of V belts required to transmit the power if each belt has a cross sectional area of 375 mm^2 , density 1000 kg/m^3 and an allowable tensile stress of 2.5 MPa. The groove angle of the pulley is 35°.
The coefficient of friction between the belt and the pulley is 0.25.
Also calculate the length of each belt. [12]

b) How wire ropes are designated? State their applications. [4]

UNIVERSITY OF PUNE

[4363]-114

T. E. (Mechanical)

INDUSTRIAL ENGINEERING AND TECHNOLOGY MANAGEMENT

(2008 Course)

Total No. of Questions : 12 **[Total No. of Printed Pages :4]**

[Time : 3 Hours] **[Max. Marks : 100]**

Instructions :

(1) Answer any three questions from Section I and three questions from Section II

*(2) Answers to the **two sections** should be written in **separate books**.*

(3) Neat diagram must be drawn wherever necessary.

(4) Black figures to the right indicate full marks.

(5) Use of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.

(6) Assume suitable data, if necessary.

SECTION-I

Q1.

a) What is meant by scientific management? Explain in brief various functions of management. [8]

b) Define material handling. Explain the role of material handling principles in improving the productivity of a firm. [8]

OR

Q2.

a) Explain the concept of managerial grid model for categorizing the leaders. [6]

b) Differentiate between product layout and process layout. [5]

c) Describe the factors to be considered while finalizing the plant location with suitable illustration. [5]

Q3.

a) The observed times and the performance ratings for the five elements are given. Compute the standard time, assuming rest and personal allowance 12% and contingency allowance as 3% of the basic time. [8]

Element:	1	2	3	4	5
Observed time (min)	0.25	0.6	0.5	0.15	0.12
Performance rating	85	80	90	85	80

b) Discuss the two handed process chart in industrial engineering. [4]
c) What are therbligs? Give any six therbligs with symbols. [4]

OR

Q4.

a) Define method study. Explain the procedure for method study. [8]
b) Describe in brief the different types of allowances used while determining Standard time. [4]
c) Explain with examples method study symbols for recording the facts. [4]

Q5.

a) What is Inventory? Explain various costs involved with Inventory. [6]
b) What is demand forecasting? Explain Moving Average Method for demand forecasting. [6]
c) Explain the importance of Production Planning and Control for a typical industry. [6]

OR

Q6.

a) A manufacturer has to supply his customers 6000 units of his product per year. Shortages are not permitted. Inventory carrying cost accounts Rs 1.2 per unit per annum. The set up cost per run is RS. 100. Find: [10]
1) Economic Order Quantity 2) optimum no. of orders per annum

3) Minimum annual inventory cost & 4) Optimum period of supply per optimum order.

b) Explain briefly ABC analysis used in Industries. [4]
c) Compare techniques CPM and PERT. [4]

SECTION-II

Q7.

a) Explain the impact of Technological Development on society and business, give proper examples. [6]
b) Explain the significance of technology and management. [6]

c) Discuss role of government in Technology development. [4]

OR

Q8.

a) Explain process technology and product technology. [8]
b) Discuss the process of Managing Research and Development activities with neat block diagram. [8]

Q9.

a) List the various methods of Technology Acquisition. Explain any two in detail. [8]
b) Explain in brief the following. [8]
   1) Growth cures.
   2) Technology Monitoring.

OR

Q10.

a) Explain in brief (Any Two) [10]
   1) Technology leadership and followership.
   2) Morphological Analysis
   3) Mission Flow diagram.
b) What do you mean by technology assessment? [6]

Q11.

a) Explain why there is need to integrate the business strategy and technology strategy. [6]
b) Explain the steps involved in formulating technology planning. [6]
c) Explain the concept of technology diffusion. [6]

OR

Q12. Write short notes on the following: (any three) [18]

1) S-Shaped curve of Technology Adoption.
2) Technology transfer and its categories.
3) Status of IPR Activities in India.
4) Foreign Direct Investment (FDI).

[Total No. of Questions: *12*] **[Total No. of Printed Pages:** *4*]

UNIVERSITY OF PUNE

[4363]-119

T. E. (*Mechanical*) Semester-II

Examination – 2013

Mechatronics (2008 Course)

[Time: *3* **Hours]** **[Max. Marks: 100]**

Instructions:

1 *Answer any three questions from each section.*
2 *Answers to the* ***two sections*** *should be written in* ***separate answer-books****.*
3 *Neat diagrams must be drawn wherever necessary.*
4 *Assume suitable data, if necessary.*
5 *Use of Scientific calculator is allowed.*

SECTION –I

Q.1 A Explain in brief Sensitivity, Accuracy and Precision with suitable example for each. 10

B An RTD $\alpha_0 = 0.0037$ at $T_0 = 50°C; R(50°C) = 350\ Ohm.$ find $R(75°C)$ 6

OR

Q.2 A Explain with a neat sketch the load cells along with its applications. 6

B A strain gauge and bridge circuit are used to measure the tension force in a steel bar. The steel bar has a cross sectional area of 50mm^2. The strain gauge has a nominal resistance of 120Ω and GF of 2. The bridge is supplied with 10V. when the bar is unloaded, the bridge is balanced so the output is 0 V. then force is applied to the bar, and the bridge voltage goes to 0.0005 V. find the force on the bar.(Young's Modulus of steel is 2.1×10^5 N/mm^2, assume Poisson's ratio=0.3) 10

Q. 3 A Calculate the capacitance of an air gap parallel plate capacitor with plates (25mm × 25mm) & a plate separation of 1mm. Calculate the change in capacitance when movable plate is displaced 0.4 mm farther from fixed plate. (Given: $\in_0 = 8.854 \times 10^{-12}$) 8

B Explain in brief the DC motor as an electro mechanical system. 10

OR

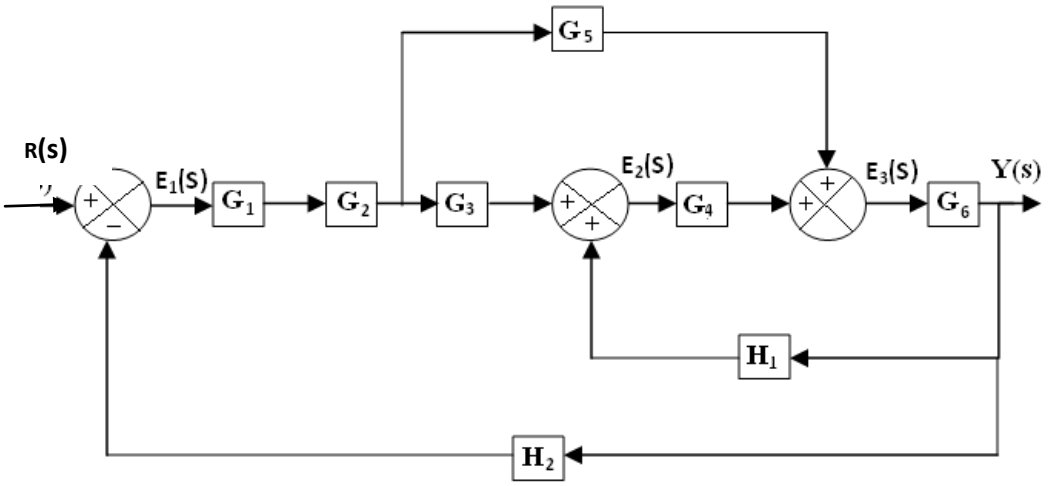
Q. 4 A An LVDT with a secondary voltage of 5 V has a range of ± 1 inch. Find 10

(i) Linear Range
(ii) The output voltage when the core is -0.75 inch from the centre.
(iii) Calculate the core movement from the centre when output voltage is +3V DC.

B Explain capacitive and inductive principles used in position sensing. 8

Q. 5 A Derive the model equation of a rotational mechanical system with torsional stiffness, damping and mass moment of inertia 6

B Use block diagram reduction to simplify the block diagram shown in figure Q 5 (b) below into a single block relating Y(s) to R(s) 10



OR

Q. 6 A Explain in brief ADC and DAC 8

B Use block diagram algebra to reduce the block diagram shown if fig Q 6 (b) 8

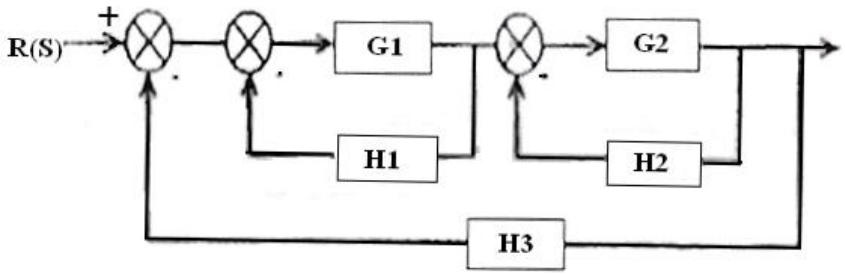


Figure Q 6 (b)

SECTION II

Q. 7 A Explain open loop and closed loop control system with suitable example each showing input and output 8

B Construct the block diagram for resistance, capacitance and inductance arranged in series with voltage E applied across them. Comment whether it is open loop or closed loop. 8

OR

Q. 8 A Explain the terms process load and process equation. 8

B A controller outputs 0 to 5 V DC to control the heater from 10 W to 100 W with linear dependence. Calculate 8

i) The voltage corresponding to 55 W

ii) This value of voltage expressed as % of controller output

Q. 9 A Define proportional plus Derivative (PD) controller along with mathematical equation. Explain the reason why derivative controller is added to proportional. 6

B Figure Q 9 (b) shows an error time graph. Sketch the PD controller output w.r.t time Kp = 5%/%, KD = 0.5 %/s and m(0) = 30% 10

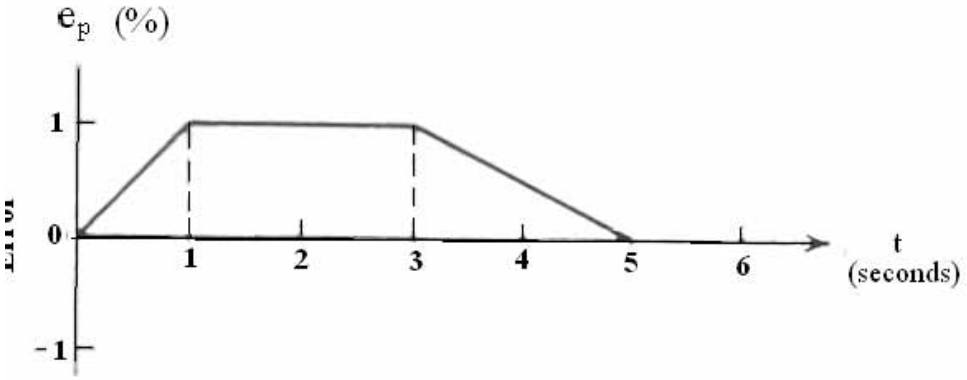


Figure Q 9 (b)

OR

Q. 10 A Define Proportional Band, Integral action time derivative action time. 8

B Explain the term Offset error in proportional control. Which mode of controller is used to minimize the offset error and why? 8

Q. 11 A Explain the difference in Timers and Counters used in PLC programming with a suitable example each. 6

B Consider a washing machine with in-flow valve (Q1), drain-flow valve (Q2), switch for door used to input cloths (I3), load switch to sense cloths in machine (I4), and washing motor (Q3). Develop a plc ladder program for following objectives. 12

i) The cycle is ON when START (push-to-ON) (I1) button is pushed and will continue ON till STOP (push-to-OFF) (I2) button is pushed.

ii) The cycle shall be stopped as where it is when door is opened (Door switch is OFF)

iii) When door is closed (Door switch is on) and cloths are fed (Load switch is ON) in-flow is started for 1 minute.

iv) When in-flow is stopped, and door is closed washing motor is ON and will continue to be on for 5 minutes.

v) When washing motor is stopped, drain-flow opens and continues to be open for 3 minutes

Mention the input and outputs and which input is connected to which PLC input terminal

Write the Boolean equation of each rung.
Draw ladder diagram with Ex ON, Ex OFF and PLC output symbol
(Do not show switches in the ladder program)

OR

Q. 12 A Explain advantages of PLC ladder program over ladder program 6

B Consider a tank with inflow valve V1 and outflow valve V2 connected to a tank at top and bottom respectively. The level high (LH) and level low (LL) floats switches mounted at top and bottom to indicate the level. Develop a PLC ladder program for the following objectives 12

i) When LL is OFF and LH is OFF, the V1 should be ON
ii) V1 shall continue to be ON till LH is ON
iii) When LL and LH is ON, V1 should be OFF and V2 should be ON
iv) V2 should continue to be ON till LL is OFF.

Mention the input and outputs and which input is connected to which PLC input terminal
Write the Boolean equation of each rung.
Draw ladder diagram with Ex ON, Ex OFF and PLC output symbols
(Do not show switches in ladder program)

Total No. of Questions : 12 **[Total No. of Printed Pages :7]**

(4363)-116

T.E. (Mechanical Engg)

Examination - 2013

(2008 Pattern)

Machine Design-II.

[Time: 4 Hours] **[Max. Marks: 100]**

Instructions:

(1) Use of logarithmic tables slide rule, Mollier charts, Electronic packet calculator and steam tables is allowed.
(2) Answers to the 02 section should be written in separate answer books.
(3) Figures to the right indicate full marks.
(4)Neat diagrams must be drawn whenever necessary.
(5) Answer 3 Question from Section I and 3 Question from Section II.

Section I

Q1. a) Using the constant $k=60.8\times10^6$ in the Stribeck's equation, compute the static capacity of a single row deep groove ball bearing series 208 with 9 balls having a diameter of 12mm. [4]

b) A shaft with centrally mounted helical pinion is supported by deep groove ball bearing at both ends. The center distance between the bearings is 100mm. The shaft transmits 5kW power at 3000r.p.m. The pitch circle diameter of the pinion is 80 mm. The normal pressure angle and helix angle are 20° and 19° of 95%. Calculate the dynamic basis capacity of the bearing which takes up the axial thrust, so that it can be selected from the manufacture's catalogue based on a reliability of 90%. [14]

Assume:

Shock load factor=1.25,
Radial factor=0.56
Thrust factor=1.2

$L=4.48\ L_{10}\left(\log_e\left(\frac{1}{R}\right)\right)^{\frac{1}{1.5}}$ Where L, is life with reliability R and L_{10} is rated life with reliability 90%.

OR

Q2. a) What is preloading of bearing? How it is achieved? [4]

b) A ball bearing operates with the following work cycle: [14]

Element No.	Element Time %	Radial Load kN	Thrust Load kN	Radial Factor 'X'	Thrust Factor 'Y'	Race rotating	Service factor	Speed r.p.m.
1.	40	10	3	0.56	2	Inner	1	400
2.	30	5.5	1	1	0	Outer	1.25	800
3.	30	No Load	No Load	-	-	Inner	-	600

If the expected life of the bearing is 12000 hours with a reliability of 95% calculate the basic dynamic load rating of the bearing so that it can be selected from the manufacturer's catalogue based on 90% reliability.

$L=4.48\ L_{10}\left(\log_e\left[\frac{1}{R}\right]\right)^{\frac{1}{1.5}}$ Where L, is life with reliability R and L_{10} is rated life with reliability 90%.

Q3. a) Following data is given for a full hydrodynamic bearing:

Journal diameter=100mm
Bearing length=50mm
Journal speed=1500rpm
Viscosity of lubricant=30cP
Minimum film thickness=15 microns
Specific gravity of lubricants=0.86
Specific heat of lubricants=2.09kJ/kg°C
The fit between the journal and bearing=H_7e_7

Calculate: [16]

i) Load carrying capacity of the bearing,

ii) Side Leakage; and

iii) temperature rise, considering the effect of side leakage.

Using the following data:

Diameter in mm	Tolerance, mm	
	H_7	e_7
100	+0.035	-0.072
	+0.000	-0.107

Table 1: Dimensional performance parameter for 360° journal bearing for I/d=0.5

$\frac{h_2}{c}$	S	$\binom{r}{c}$f	$\frac{Q}{r\ c\ ns\ 1}$	$\frac{Qs}{Q}$
0.9	4.31	85.6	3.43	0.173
0.8	2.03	40.9	3.72	0.318
0.6	0.779	17.0	4.29	0.552
0.4	0.319	8.10	4.85	0.730
0.2	0.0923	3.26	5.41	0.874
0.1	0.0313	1.60	5.69	0.939

OR

Q4. a) What is infinitely long and short journal bearing? State conditions and write Reynold's equation for long and short journal bearing. [8]

b)Write a note on- i) Additive for mineral oils.

ii) Properties of bearing materials. [8]

Q5. a) Explain the following with reference to design of components subjected to fluctuating stresses:

i) Goodman Line,

ii) Soderberg Line. [4]

b) A cantilever beam of circular cross section, made of alloy steel 30Ni4CrI (S_{ut}=1500 N/mm^2) is fixed at one end subjected to a completely reversed force of 1000 N at the free end. The force is perpendicular to the axis of beam. The distance between the fixed and free end of the cantilever beam is 400mm.The theoretical stress concentration factor and notch sensitivity are 1.33 and 0.85 respectively. The surface finish factor and size factor are 0.79 and 0.85 respectively. The temperature and reliability factor are 0.975 and 0868 respectively. The desired life of the beam is 50000 cycles. If the required factor of safety is 1.5, determine the diameter of the beam. [12]

OR

Q6. A stepped shaft is subjected to a uniform torque of 200 N-m and a completely reversed bending moment of 500 N-m at the step. The shaft is made of cold drawn steel with ultimate tensile strength of 650 N/mm^2 and yield strength of 380N/mm^{2}the theoretical stress concentration factor for bending and torsion are 2 and 1.6 respectively.

Notch sensitivity=0.96

Size factor=0.85

Reliability factor=0.865

Surface finish factor=0.9

If the factor of safety is 1.5, determine the diameter of the shaft corresponding to the expected life of 15000 cycles and also infinite life. [16]

Section II

Q7. a) Discuss energy considerations in Brakes. [4]

b) A cone clutch is used to transmit 28.75kw at 1440rpm. Coefficient of friction is 0.183 and allowable pressure is 0.15N/mm^2. Semi cone angle is 12.5° and the mean radius is twice the face width. Assuming uniform pressure conditions determine.

i) Dimensions of cone.

ii) Force required for engaging the clutch

iii) Force required for disengaging the clutch, if any. [12]

OR

Q8. a) Why uniform wear condition holds good for friction clutches? [4]

b) A block brake with a short shoe is shown in Fig. 8b. It is designed so that the product p×V is limited to 2.

Where p= normal pressure between friction lining and the brake drum.

V= peripheral velocity of brake drum.

The coefficient of friction between the brake drum and the friction lining is 0.2. The cable drum is connected to the brake drum by means of a pair of spur gears. The brakedrum rotates four times as fast as the cable drum. The Permissible Intensity of pressure on friction lining is 1MPa.

Calculate: i) The magnitude of brake shoe force F

ii) The area of friction lining.

iii) The uniform velocity at which the mass can be lowered. What happens at higher speed. [12]

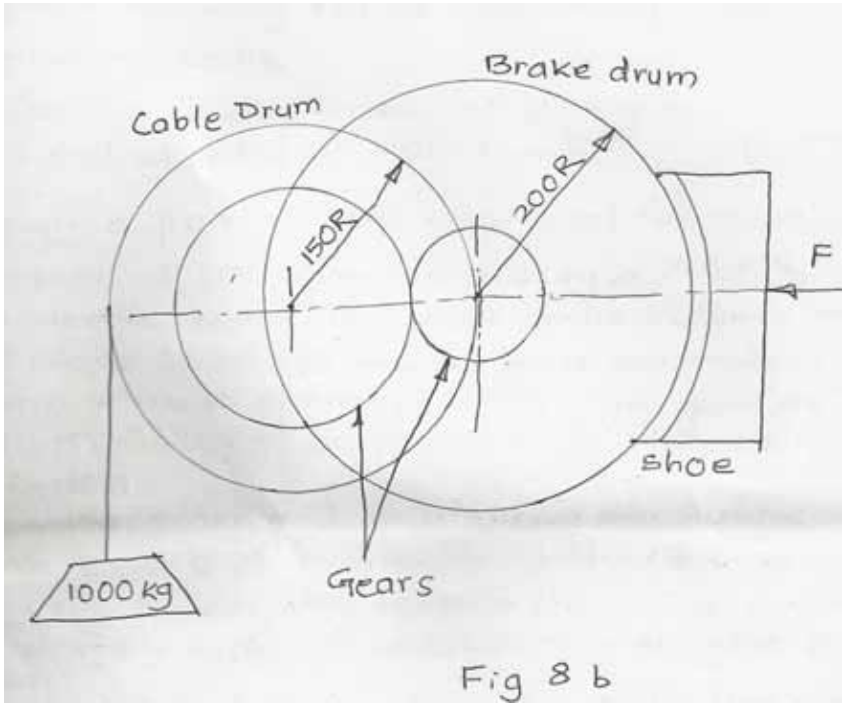


Fig. 8b

Q9. a) Explain following terms (any two)

i) Hunting tooth.

ii) Crowing of gear tooth.

iii)Leading edge of helical gear. [4]

b) Design a pair of gear used for running a compressor at 300 rpm driven by a 7.5kW, 1200 rpm electric motor. The center distance between the needs to be 250mm. the gears are made of 50C4 having ultimate strength 700MPa. Take service factor as 1.5, factor of safety as 2. Initially using velocity factor,

i) Design the gear and specify their dimensions.

ii) Assume Grade 6 of manufacture and find exact dynamic load using Buckingham's equation.

iii) Find available factor of safety for the designed pair in bending.

iv) Using the obtained factor of safety specify the required surface hardness. [12]

Use following data:

Pressure angle 20°

Lewis from factor Y=0.484- $\frac{2.87}{Z}$

For Grade 6 e=8+0.63 [m+0.25$\sqrt{2r}$]

Velocity factor C_v= $\frac{6}{6+V}$

Dynamic load P_d= $\frac{21V(bce+Pt\ max)}{21V\sqrt{ebc+Pt\ max}}$

Deformation factor = 11400 N/mm^2

Standard module, mm

1, 1.25, 1.5, 2.0, 2.5, 3.0, 4.0, 5.0, 6.0, 8.0, 10, 12, 16, 20

Determine the module based on beam strength.

OR

Q10. a) A pair of helical gear is used to transmit 10kW power from an automotive multi plate clutch to a constant mesh gear box. The clutch rotates at 7200 rpm which further reduces the speed of gear box input shaft to 2600 rpm. Taking number of teeth on pinion as 20, normal pressure angle 20°, helix angle 25°, design the gear pair. The material for gear may be taken as 40 C8 with ultimate tensile strength 600MPa and surface hardness 300BHN. Using factor of safety & service factor of 2 & 1.5 & considering velocity factor initially.

i) Design the gear pair

ii) Use Grade 4of manufacture & determine available factor of safety.

iii) Explain how the all types of gear tooth failure in this case be avoided?

Use the following data

Y=0.484- $\frac{2.87}{Z'}$ For Grade 4, e= 3.2+0.25 (m+0.25$\sqrt{d}$)

$P_d = \frac{21V(Ceb\ cos^2\psi + Pt)}{21+\sqrt{(ceb\ cos^2\psi + pt)}}$; C= 11400N/mm^2 [16]

Q11. a) With neat sketch, discuss the force analysis of bevel gears. [4]

b) Obtain an expression for beam strength of bevel gear in the following form

$S_b = mb6_bY\left[1 - \frac{b}{Ao} + \frac{b^2}{3A^2o}\right]$ [6]

c) A pair of straight bevel gears with 20° pressure angle consists of 20 teeth pinion meshing with 30 teeth gear. The module is 4mm while the face width is 20mm. The pinion & gear material has a surface hardness of 400 BHN. The pinion rotates at 720rpm and receives 3kW power from a motor. Taking service factor of 1.5 and Barth's factor for dynamic loading determine the factor of safety in pitting. [8]

OR

Q12. a) Explain the following terms for the worm & worm wheels.

i) Diameter quotient

ii) Self locking worm

iii) Rubbing velocity [6]

b) Why the soft material like phosphor bronze is chosen for worm gear and alloy steel for worm. [4]

c) A worm gear box with an effective surface area of 1.5m^2 is operating is still air with a heat transfer coefficient of 15W/m^2°C. The temperature rise of lubricant is limited to 60° C. The worm gears are designated as 1/30/10/8. The worm shaft is rotating at 1440rpm and the normal pressure angle is 20°. Calculate the power rating based on thermal consideration for the drive. [8]

[Total No. of Questions: *12*] **[Total No. of Printed Pages:** *3*]

UNIVERSITY OF PUNE

[4363]-117

T. E. (*Mechanical*)(Automobile) Examination - 2013

Metrology And Quality Control (2008 Course)

[Time: *3* **Hours]** **[Max. Marks: 100]**

Instructions:

1 *Answer any three questions from each section.*
2 *Answers to the* ***two sections*** *should be written in* ***separate answer-books***.
3 *Neat diagrams must be drawn wherever necessary.*
4 *Black figures to the right indicate full marks.*
5 *Assume suitable data, if necessary.*

SECTION -I

Q.1	A	Explain the different types errors in measurement.	6
	B	What is the difference between Alignment test & performance test? Explain with neat sketch any four such tests on a Lathe machine.	10

OR

Q.2	A	Describe with neat sketches of autocollimator & sine bar.	8
	B	Explain with sketch the principle and working of sigma comparator? State its advantages & limitations.	8
Q. 3	A	Design a plug gauge for checking hole 70H8 Use $\bar{z}=0.45\sqrt[3]{D}+0.001D$, IT 8=28i. Diameter steps 50-80mm.	8
	B	Different between primary & secondary texture.	4
	C	Explain application of optical flat to check surface contours with suitable examples.	6

OR

Q. 4	A	Describe with neat sketch Tomlinson surface Recorder.	6
	B	What are optical flat? How are patterns of fringes interpreted?	4
	C	A shaft of 35 ± 0.004mm is to be checked by means of GO-NOGO gauge Design the dimensions of the gauge required.	8
Q. 5	A	Show that the best wire size for measuring effective diameter of thread is given by $d=\left(\frac{P}{2}\right)\sec\left(\frac{\theta}{2}\right)$ where p = pitch of the thread θ=Thread angle	6
	B	Sketch & describe the Parkinson's gear tester	4
	C	Write a short note on computer controlled co-ordinate measuring machine.	6

OR

Q. 6 A Describe use of Devid Brown tangent comparator for gear measurement calculate the dimension of the Base tangent length over 3 teeth with module of 2.5mm, 20^{O} Pressure angle & 30 teeth. 8

B Write short notes on (any two) 4×2
i) Lasers in metrology
ii) Floating carriage micrometer
iii) Constant chord method for gear tooth thickness

SECTION II

Q. 7 A What is cost of Quality? Explain different types of cost of quality. 6

B Explain Turan's Trilogy approach with diagram. 5

C Explain the concept of Quality circle & their structure, advantages & limitations. 5

OR

Q. 8 A Explain the seven Quality tools. 6

B Explain in detail Quality characteristics. 6

C Describe malcom national Quality awards. 4

Q. 9 A Explain Quality function Development & its benefits on TQM. 6

B Explain ISO 9000 Quality system standards. 5

C Describe the concept & uses of Kaizen & JIT 5

OR

Q. 10 Write short notes on 4×4
i) FMECA
ii) ISO 14000
iii) Quality Audit
iv) Quality Assurance

Q. 11 A Define following elements and show quality region on OC curve. 5
i) Producers risk iii) AOQ
ii) Consumer's risk iv) LTPD

B Following data shows values of sample mean $\overline{x}$ and range R for 10 samples of size 5 each. Calculate control limits for mean chart and rang chart determine whether the process is under control or not. 7

Sample No.	1	2	3	4	5	6	7	8	9	10
$\overline{x}$	31.8	34	30.8	35	33	33.8	35.8	34	33	33.8
R	4	2	5	5	19	4	14	7	9	5

Component specification limits 40.37 ± 0.1
Take $A_2 = 0.577$, $D_3 = 0$, $D_4 = 2.110$.

C Explain the following types of sampling 4
i) systematic sampling
ii) cluster sampling

OR

Q. 12 A Differentiate between single sampling, double sampling & multiple sampling plan. 6

B Table given below shows the number of defective founn in inspection of 10 lots of 100 items each. 6

2 Determine the control limit for P-chart and state whether the process is in control. 6

Lot No.	1	2	3	4	5	6	7	8	9	10
No. of defectives	6	3	1	4	3	0	5	5	2	3

C For the data calculate the sample size & AOQ for a single sampling plan. 4
i) Probability of acceptance for 0.4% defective in a lot is 0.558
ii) Lot size N = 20,000 units
iii) $np' = 1.5$
iv) Defective found in the sample are not to be replaced.

UNIVERSITY OF PUNE

[4363]-112

T. E.(Mechanical)Examination - 2013

HEAT TRANSFER (302042)

(2008 Pattern)

[Total No. of Questions:12] **[Total No. of Printed Pages :6]**

[Time : 3 Hours] **[Max. Marks : 100]**

Instructions :

*(1) Answer **three questions** from each section .*

*(2) Answers to the **two sections** should be written in **separate answer-books**.*

(3) Black figures to the right indicate full marks.

(4) Neat diagrams must be drawn wherever necessary.

(5) Use of electronics pocket calculator is allowed.

(6) Use of external data books is not allowed.

(7) Assume suitable data, if necessary.

SECTION I

UNIT-I

Q1 a) Explain in brief the analogy between heat flow and electricity with its significance. [4]

b) An immersion water heater of surface area $0.1m^2$ and rating 1 kW is designed to operate fully submerged in water. Estimate the surface temperature of the heater when the water is at 40°C and $h_{water} = 300W/m^2K$. If this heater is by mistake used in air at 40°C with $h_{air} = 9W/m^2$ [4]

K, what will be the surface temperature?

c) Derive a general three dimensional heat conduction equation in Cartesian coordinate system. Reduce it as 1) Poisson equation, 2)Fourier equation, 3) Laplace equation. [10]

OR

Q2 a) A brick wall (k=1.5W/mK) 0.20 m thickness separates hot combustion gases of a furnace from outside ambient air which is at 25°C. the outer surface temperature of brick wall is found to be 100°C. if natural convection heat transfer coefficient on the outside surface of brick wall is 25 $W/m^2 K$, ε =0.85, calculate inner surface temperature of brick wall. [8]

b) Explain the significance of i. Thermal Diffusivity, ii. Thermal Conductivity, iii. Overall heat transfer coefficient [6]

c) Explain different types of Insulating materials [4]

UNIT-II

Q3 a) Define Critical radius of insulation. Explain why an insulated small diameter wire has a higher current carrying capacity than an uninsulated one. [8]

b) A plane wall of thickness 0.1 m and k=25 W/mK, having uniform volumetric heat generation of 0.3 MW/m^3 is insulated on one side and is exposed to a fluid at 92°C. the convective heat transfer coefficient between the wall and the fluid is 500 $W/m^2 K$. Determine: i) the maximum temperature in the wall, ii) temperature at the surface exposed to the fluid, iii) draw the temperature profile [8]

OR

Q4 a) An electrical conductor of 10mm diameter insulated by PVC (k=0.18 [8]

W/mK) is located in air at 30° C having convective heat transfer coefficient of 7.8 W/m^2 K. if surface temperature of base conductor is 85°C, find i. Current carrying capacity of conductor when 2mm thick insulation is provided (take resistivity of conductor = 70 $\mu\Omega$ cm), ii. Critical insulation thickness, iii. Max. current carrying capacity, iv. % increase in current carrying capacity by providing critical insulation.

b) A steel pipe (k=50 W/mK) of 100 mm I.D and 110 mm O.D is to be covered with two layers of insulation each having thickness of 50 mm. The thermal conductivity of first insulation material is 0.06 W/mK and that of the second is 0.12 W/mK. Estimate heat loss per meter length of pipe when temperature of inside tube surface is 523 K and that of surface is 323 K. if order of insulation is reversed, calculate change in heat loss with all other conditions kept unchanged. Comment on results. [8]

UNIT-III

Q5 a) Pin fin are provided to increase the heat transfer rate from a hot surface. Which of the following arrangement will give higher heat transfer rate: i) 6 fins of 10 cm length or ii) 12 fins of 5 cm length Take k_{fin} = 200 W/m°C, h= 20W/m^2 °C, Cross section area of fin=2 cm^2 perimeter = 4cm, fin base temp=230 ° C, Surrounding air temp=30°C. For analysis, use fin with insulated tip condition. [6]

b) Explain difference between fin efficiency and fin effectiveness [4]

c) A mercury thermometer is being used for measuring temperature of a fluid which changes within a time period less than 3 seconds. State the suitability of this arrangement by assuming bulb of thermometer a sphere of 1mm diameter having k=10W/mK, $\propto$ =5x10^{-5} m^2/s, h=10 W/m^2K. find [6]

diameter of thermocouple junction used for the same purpose in same environment. $K_{thermocouple}$ =90 W/mK, $\propto_{thermocouple}$ =25x10^{-5} m^2/s.

OR

Q6 a) State assumptions made in lumped capacitance method. Using this method derive the following relation$(T-T_a)/(T_i - T_a) = e^{-(Bi\ Fo)}$ with usual notations. [8]

b) Fins are more effective, when provided on the surface for which film heat transfer coefficient is smaller. Explain. [4]

c) Explain difference between Biot number and Nusselt number [4]

Q7 a) Explain how electrical network can be applied to solve radiation heat transfer problems. [6]

b) Two large parallel planes 'A' and 'D' are maintained at temperature of 1500K and 600K respectively. Their emissivities are 0.9 and 0.4 respectively. Two radiation shields, 'B' with emissivity=0.5 and 'C' with emissivity=0.2 are inserted in between them, such that A, B, C and D are placed one after the other. Calculate. i. Heat transfer rate without radiation shield, ii. Heat transfer rate with radiation shield, iii. Temperature attained by planes 'B' and 'C'. [10]

OR

Q8 a) Write the statements and mathematical expressions of the following laws in radiation heat transfer. i. Planck's law, ii. Wien's law, iii. Kirchhoff's law, iv. Lambert's cosine rule. [8]

b) Define Radiosity and Irradiation. [4]

c) Determine the rate of heat loss by radiation from a steel tube of outside [4]

diameter 70 mm and 3m long at a temperature of 227°C if the tube is located within a square brick conduit of 0.3 m side and at 27°C. take $\in$ steel=0.79 and $\in$ brick=0.93

UNIT-V

Q9 a) Define Prandtl number and give its significance. Give its relation with Thermal boundary layer and velocity boundary layer. Also give its value for liquid metals, heavy oils, water and air. [10]

b) A hot plate 1mx0.5m at 130°C is kept vertically in still air at 20°C. find i. Heat Transfer coefficient, ii. initial rate of cooling the plate in °C/min. Assume 0.5 m side is vertical and heat transfer takes place from both the sides of the plate. Use: $Nu=0.59\ (GrPr)^{1/4}$ At 75°C, the properties of air are: ρ =1.07 kg/m^3, v=19.1x10^{-6} m^2/s. Cp=1007 J/kg K, k=0.029 W/mK, mass of plate=20 kg, specific Heat of plate=400 J/kg K [6]

OR

Q10 a) Draw neat diagrams to show directions of natural convection fluid flow (development of thermal boundary layers) when: [8]

i. Plate is kept vertical and surrounding fluid temperature is higher than plate

ii. cylinder is kept horizontal and surrounding fluid temperature is lower than cylinder

iii. Plate is horizontal and surrounding fluid temperature is lower than the plate

iv. cylinder is vertical and surrounding fluid temperature is lower than the cylinder

b) Air at 2 bar pressure and 200°C is heated as it flows at a velocity of [8]

10 m/s through a tube with diameter of 3 cm with constant heat flux maintained at the wall with wall temperature 20°C above air temperature along all length of tube. Calculate: i. Heat transfer per unit length of tube, ii. increase in bulk temperature of air over 4 m length of tube.

Properties of air at 200°C are Pr=0.681, μ =2.57 x 10^{-5} kg/ms, k= 0.0386 W/mK, Cp=1.025 kJ/kg K. Use: Nu=0.023 $(Re)^{0.8}$ $(Pr)^{0.8}$

UNIT-VI

Q11 a) Explain phenomenon of nucleate boiling. List the factors that affect nucleate boiling. [8]

b) Write a note on Forced Convection Boiling [6]

c) Write a note on Heat Transfer Augmentation Techniques [4]

OR

Q12 a) Establish expression for LMTD for counter flow heat exchanger with usual notations. [8]

b) In a tube type parallel flow heat exchanger hot water at 80°C is cooled to 65°C by cold water entering at 20°C and leaving at 35°C. what would be the exit temperature if the flow rate of water is doubled? [10]

UNIVERSITY OF PUNE

[4363-113]

T.E.(Mechanical / Automobile) Examination May 2013

Theory of Machines-II

(2008 pattern)

Time-Three hours **Maximum Marks-100**

[Total No. of Question=12] **[Total no. of printed pages= 7]**

Instructions:

(1)Answer 3 questions from section I and 3 questions from section II.

(2)Answer to the TWO sections should be written in separate answer books

(3)Neat diagrams must be drawn whenever necessary.

(4)Figures to the right indicate full marks.

(5)Use of logarithmic tables slide rule,Mollier charts,electronic pocket calculator and steam tables is allowed.

(6)Assume suitable data whenever necessary.

SECTION-I

Q.1 (a)Explain Friction in turning pair. (4)

(b)Derive an expression for frictional torque of a collar thrust bearing assuming uniform pressure & uniform wear theory. (6)

(c)A single plate clutch,effective on both sides,is required to transmit 25 KW at 3000 r.p.m..Determine the outer and inner radii of frictional surface if the coefficient of friction is 0.225,the ratio of radii is 1.25 and the maximum pressure is not to be exceed $0.1\times10^{6}N/m^{2}$ .Also determine the axial thrust to be provided by springs. Assume uniform wear theory. (8)

OR

Q.2 (a)Write s short note on Epicyclic train Dynamometer. (6)

(b)Explain Multiple clutch with the help of neat sketch. (4)

(c)A differential band brake,as shown in fig.01 has an angle of contact of 225^0 .The band has compressed woven lining and bears against a cast iron drum of 350 diameter. The brake is to sustain a torque of 350 N-m and the coefficient of friction between the band and the drum is 0.30,find the necessary force for clockwise rotation of the drum. (8)

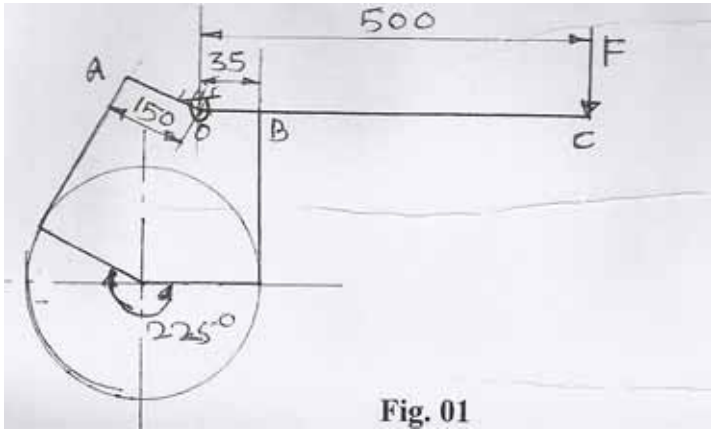


Fig. 01

Q.3 (a)Draw the profile of a cam ,offset 20mm to the right of the centre of the cam shaft.The base circle diameter is 75 mm and the diameter of the roller is 10mm.The follower is to move outward a distance 40mm with S.H.M. In 140^0 of the cam rotation to dwell for 40^0 of cam rotation to move inward with 150^0 of cam rotation with uniform acceleration and retardation ,acceleration being 2/3 of retardation.Calculate the maximum velocity and acceleration of the follower during outstroke if the camshaft rotates at 90 rpm. (16)

OR

Q.4 (a)Write a short note on cam jump phenomenon. (4)

(b)What do you mean by advanced can curves?Explain. (4)

(c)Derive expressions for displacement ,velocity and acceleration for circular arc cam operating a flat faced follower:(i)When the contact is on the circular flank. (8)

Q.5 (a)Write a short note on -(i)Hunting of governor and (ii)Governor effort & Governor power. (8)

(b)Derive from the first principles an expression of the gyroscopic couple. (8)

OR

Q.6 (a)A porter governor has all the four arms of 300 mm each. All the upper arms as well as the sleeve arms are pivoted on the axis of rotation. The mass of each governor ball is 1 Kg. The mass on sleeve is 20Kg find the speed of rotation when the ball rotates at a radius of 150mm. (8)

(b)A ship is pitching a total angle of 15^0 ,the oscillation may be taken as simple harmonic and the complete period is 32 seconds. The turbine rotor mass is 600Kg,its radius of gyration is 450mm and it is rotating at 2400 r.p.m.Calculate the maximum value of gyroscopic couple set by the rotor and its effect,when the bow is descending and the color is rotating clockwise looking from aft. What is the maximum angular acceleration to which the ship is subjected to while pitching? (8)

SECTION-II

Q.7 (a)Explain 'Conjugate action' in gearing. How involute profile satisfies the law of gearing? (8)

(b)Two 20^0 involute gears in mesh have a gear ratio of 2 and 20 teeth on the pinion. The module is 5mm and the pitch line speed is 1.5 m/s. assuming addendum to be equal to one module,find

(i)Angle turned by pinion when one pair of teeth is in mesh,and

(ii)Maximum velocity of sliding. (10)

OR

Q.8 (a)Explain the following term with reference to interference in the gears. (4)

(i)Rack shift (ii)Fouling

(b)Compare the cycloidal and involve gear tooth profile. (4)

(c)Following data relate to two meshing involute gears.

1.Number of teeth on the gear wheel=60

2.Pressure angle= 20^0

3.Gear ratio=1.5

4.Speed of the gear wheel=100rpm

5.Module=8mm

The addendum on each wheel is such that the path of approach and the path of recess on each side are 40 % of the maximum possible length each.Determine the addendum for the pioion and the gear and the length of arc of contact. (10)

Q.9 (a)A pair of single gear is required to give a speed reduction of 4:2:1.the gears are to have a normal module of 3mm, a pressure angle of 20^0 and a helix angle of 30^0 .If the shaft cetre lines are to be approximately 400mm apart ,determine the number of teeth on each wheel and exact centre distance.(8)

(b)Two spiral gears in mesh have the following data.

1.Angle of friction= 6^0

2.Normal pitch=20mm

3.Shaft angle= 55^0

4.Speed ratio=3

5.Approximate centre distance =400mm

6.Spiral angle of pinion= 25^0

Determine (i)exact centre distance (ii)number of teeth in each wheel, and (ii)efficiency of the drive. (8)

OR

Q.10 (a)A three start worm has pitch diameter of 80mm and a pitch of 20mm.It rotates at 600 rpm and drives a 40 tooth worm gear.If coefficient of friction is 0.05 , find

1.The helix angle of the worm

2.The speed of the gear

3.The centre distance

4.The efficiency and maximum efficiency. (10)

(b)Show various forces acting on the tooth of bevel gear. (6)

Q.11 (a)Explain the working principle of the following:(i)Reverted gears, (ii)Humpage gear. (6)

(b)The pitch circle diameter of annular gear in the epicyclic gear train shown in Fig.1 is 425 mm and the module is 5mm.When the annular gear 3 is stationary ,the spindle A makes one revolutions in the same sense as the sun gear 1 for every 6 revolutions of the driving spindle carrying the sun gear. All the planet gears are of the same size. Determine the number of teeth on all the gears. (10)

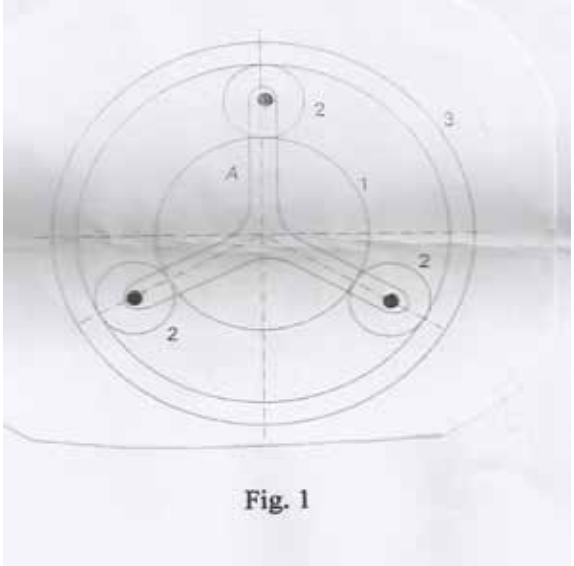


Fig. 1

OR

Q.12 In the gear drive shown in the fig 2.,the driving shaft A rotates at 300rpm in the clock wise direction,when seen from the left hand side. The shaft B is the driven shaft. The casing C is held stationary. The wheels E and H are keyed to the central vertical spindle and wheel F can rotate freely on this spindle. The wheels K and L are rigidly fixed to each other and rotate together freely on a pin fitted on the underside of F. The wheel L meshes with internal teeth on the casing C. The number of teeth on the different gears is indicated within the bracket.

Determine the number of teeth on gear C and speed and direction of rotation of shaft B. (16)

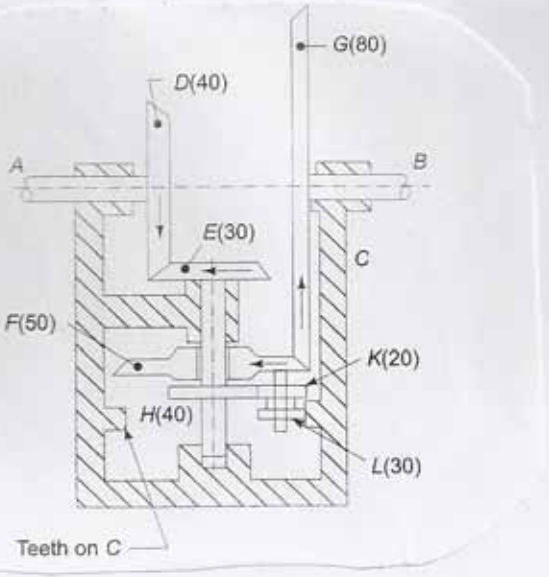


Fig.2

UNIVERSITY OF PUNE

[4363-115]

T.E.(Mechanical / Automobile Engineering)Examination,

April-May 2013

Computer Oriented Numerical Methods

(2008 pattern)

Time-Three hours **Maximum Marks-100**

[Total No. of Question=12] **[Total no. of printed pages= 5]**

Instructions:

(1)Answer three questions from Section-I and three questions from Section-II.

(2)Answers to the two sections should be written in separate answer books.

(3)Neat diagram must be drawn necessary.

(4)Figures to the right indicate full marks.

(5)Use electronic Pocket calculator is allowed.

(6)Assume suitable data wherever necessary.

SECTION-I

Q.1 (a)Find a real root of $2x - \log_{10} x = 7$ correct to four decimal places using iteration method. (8)

(b)Draw a flowchart for Simpson's 3/8 rule of integration. (8)

OR

Q.2 (a)Draw a flowchart for modified Newton Raphson method. (6)

A circular shaft having 1 meter length has varying radius 'r' as follows.

X(m)	0	0.25	0.5	0.75	1
r(m)	1	0.9896	0.9589	0.9089	0.8415

(b)An axial pull of 300 KN is applied at one end of the shaft whose modulus of elasticity is $200*10^9 N/m^2$ .The axial elongation of the shaft （Δ） is given by ,

$\Delta x=(P/E)\int_0^1 (1/A)*dx$ .Where A is cross sectional area of shaft.Determine elongation of shaft over the entire length by Simpson'3 rule. (10)

Q.3 (a) Draw flowchart for Lagrange' Interpolation method. (6)

(b)Find polynomial passing through points (0,1)(1,1)(2,7)(3,25)(4,61)(5,121) using Newton's Interpolation formula and hence find y and dy/dx at x=0.5 (10)

OR

Q.4 (a)The values of x,y & y' are given below .Use Hermit Interpolation to find values of y at x=0.25. (10)

x	y	y'
0	0	0
1	1	1

(b)Find dy/dx & d^2y/dx^2 at 0.4 from the following given values of x & y. (6)

x	0.1	0.2	0.3	0.4	0.5
y	-2.3	-1.6	-1.2	-0.91	-0.69

Q.5 (a)From the table below for what value of x,y is minimum?Also find the value of y. (10)

x	3	4	5	6	7	8
y	0.205	0.2400	0.2590	0.2620	0.2500	0.2240

(b)Draw Flowchart for Lagrange's Interpolation. (8)

OR

Q.6 (a)Find the cubic polynomial which takes the following value. (10)

x	0	1	2	3
f(x)	1	2	1	10

Hence the otherwise evaluate f(4).

(b)Draw a flowchart for Newton's Forward Difference Method. (8)

SECTION -II

Q.7 (a)Draw a flowchart for logarithmic curve fitting. (8)

(b) In some determinations of the value v of carbon dioxide dissolved in a given volume of water at different temperatures θ ,the following pairs of values were obtained. (8)

θ	0	5	10	15
v	1.80	1.45	1.18	1.00

Obtain by the method of least square, a relation of the form $v=a+b\theta$ which best fits to these observations.

OR

Q.8 (a) The pressure and volume of a gas are related by the equation $pV^{\gamma}=k$,

γ and k being constants.Fit this equations for the following set of observations. (10)

$P(kg/cm^2)$	0.5	1	1.5	2	2.5	3
V(liters)	1.62	1	0.75	0.62	0.52	0.46

(b)Why least square error regression method is preferred over other methods of linear regression ?Also explain why squaring of error is carried out,if squaring of error is not done what will be effect on curve fitting equation. (6)

Q.9 (a)Using Runge-Kutta method of fourth order,solve $\frac{dy}{dx}=y^2-x^2/y^2+x^2$ with $y(0)=1$ at x=0.2,0.4. (10)

(b)Explain predictor and corrector method to solve ordinary differential equation and also draw corresponding flow chart. (6)

OR

Q.10 (a) The second order ODE is transformed into pair of first-order ODEs as in (10)

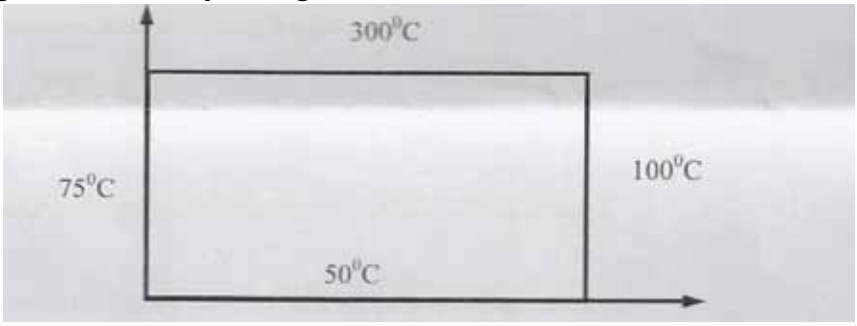
$$\frac{dy}{dt}=z \qquad y(0)=2$$

$$\frac{dz}{dt}=0.5\text{x}-y \qquad z(0)=0$$

Estimate the value of z and y at x=0.2 with step size of 0.1

(b)What is meant by order of Runge -Kutta method?And compare RK methods 2^{nd} order ,3^{rd} order and 4^{th} order graphically. (6)

Q.11 (a)Consider a plate $2.4\text{m} \times 3.0\,m$ that is subjected to the boundary conditions shown below.Find the temperature at the interior at the nodes using a square grid with a length of 0.6 m by using the direct method. (6)



(b)What is difference between implicit method and explicit method for better convergence and stability which is best suitable. (6)

OR

Q.12 (a) Consider a steel rod that is subjected to a temperature of 100^0 C on the left end and 25^0 C on the right end .If the rod is of length 0.5 m,use the implicit method to find the temperature distribution in the rod from t=0 and t=9seconds. Use $\Delta x = 0.01\text{m}$ and $\Delta t = 3\,sec$. (12)

(b)Draw a flow chart for Crank Nicholas method for solution of parabolic partial differential equation. (6)

UNIVERSITY OF PUNE
[4363]-118
T. E. Mechanical/Mech SW Examination –2013
TURBO MACHINES
(2008 Course)

[Total No. of Questions:12] **[Total No. Printed Pages:7]**
[Time : 3 Hours] **[Max. Marks : 100]**

Instructions :

1) *Attempt q. No. 1 or q. no2, Q. No. 2, Q. No. 3 or Q. No. 4, Q. No. 5 or Q. No. 6 from Section I and Q No. 7 or Q. No. 8, Q. No. 9 or Q. No. 10. Q. No. 11 or Q No. 12 from section II.*
2) *Answer **any three** questions from each I and three questions from section II*
3) *Answers to the **two sections** should be written in **separate answer-books**.*
4) *Neat diagrams must be drawn wherever necessary.*
5) *Black figures to the right indicate full marks.*
6) *Use of electronic pocket calculator is allowed.*

SECTION – I

Q.1 a) Show that, in case of jet striking the flat plate mounted on wheel, efficiency shall be maximum when the tangential velocity of wheel is half that of the jet. [8]

b) A jet of water having a velocity of 30 m/s, strikes a series of radial curved vanes mounted on a wheel which is rotating at 300 r.p.m. The jet makes an angle of 30^0 with the tangent to the wheel at inlet and leaves the wheel with a velocity of 5m/s at an angle of 130^0 to the tangent to the wheel at outlet. Water is flowing from outward in a radial direction. The outer and inner radii of the wheel are 0.5m and 0.25m respectively. [8]

Determine :

i) Vane angles at inlet and outlet
ii) Work done per unit weight of water
iii) Efficiency of wheel

OR

Q.2 a) Obtain an expression for the work done per second by water on the runner of Pelton wheel and also find the relation between jet speed and bucket speed for maximum efficiency. [8]

b) A Pelton wheel is working under a gross lead of 400m. The water is supplied through penstock of diameter 1 m and length 4 km from reservoir to the Pelton wheel. The coefficient of friction for the penstock is given as 0.008. The jet of water of diameter 150 mm strikes the buckets of the wheel and gets deflected through an angle of 165^{o}. The relative velocity of water at outlet is reduced by 15% due to friction between inside surface of the bucket and water. If the velocity of the buckets is 0.45 times the jet velocity at inlet and mechanical efficiency as 85% [8]

Determine :

i) Power given to the runner
ii) Shaft power
iii) Hydraulic efficiency and overall efficiency

Q.3 a) The following data is given for a Francis Turbine Net heat H = 70m ; Speed N = 600 r.p.m.; Shaft power = 367.875 kW ; η_0 =85% η_h = 95% ; flow ratio = 0.25; breadth ratio = 0.1 ; outer diameter of the runner = 2 x inner diameter of the runner. The thickness of vanes occupy 10% of circumferential area of the runner. Velocity of flow is constant at inlet and outlet and discharge is radial at outlet. [10]

Determine :

i) Guide blade angle
ii) Runner vane angles at inlet and outlet
iii) Diameters of runner at inlet and outlet
iv) Width of wheel at inlet

b) What is specific speed of a turbine? State its significance and derive an [8]

expression for the same.

OR

Q.4 a) A Propeller reaction turbine of runner diameter 4.5 m is running at 40 r.p.m [10]

The guide blade angle at inlet is 145° and runner blade angle at outlet is 25° to the direction of vane. The axial flow area of water through runner is $25m^{2.}$

If the runner blade angle at inlet is radial, determine:

i) Hydraulic efficiency of the turbine
ii) Discharge through turbine
iii) Power developed by the turbine
iv) Specific speed of the turbine

b) A conical type draft tube, attached to Francis turbine has an inlet diameter [8] of 3 m and its area at outlet is 20 m^2. The velocity of water in inlet, which is set 5 m above tail race level, is 5 m/s. Assuming the loss in draft tube equal to 5% of velocity head at outlet, find:

i) The pressure head at top
ii) Total head at top taking tail race level as datum
iii) Power of water at runner outlet
iv) Power of water at turbine outlet
v) Power lost in draft tube.

Q.5 a) An impulse turbine has 3 similar stages of the same mean diameter an [10] geometry; each stage develops 500 kW. The peripheral speed of the rotor blades at the mean diameter is 100 m/s; the whirl components of the absolute velocities at entry and exit of the rotor are c_{y2} = 200 m/s and c_{y3} = 0 respectively. The nozzle angles at exit are equal to $\alpha_2 = 65^o$.

The steam at the exit of the first stage has P_2 = 8.0 bar, $t_2 = 200^oC$. Determine for the first stage

i) mean diameter of the stage for a speed of 3000 r.p.m
ii) mass flow rate of steam
iii) isentropic enthalpy drop for an efficiency of 69%

iv) rotor blade angles
v) the blade height of the nozzle and rotor blade at exit.

b) How are steam turbines classified? Give a list of types of steam turbines used in various applications. [6]

OR

Q.6 a) A 50% reaction stage of a gas turbine has the following data : [10]

Entry pressure and temperature $P_1 = 10$ bar, $T_1 = 1500$ K

Speed = 1200 r.p.m., mass flow rate of the gas = 70 kg/S,

Stage pressure ratio and efficiency $\rho_r = 2.0$, efficiency $\eta_{st} = 87\%$

Fixed and moving blade exit angles = 60^o

Assume optimum blade to gas speed ratio. Take $\gamma = 1.4$, $C_p = 1.005$ KJ/Kg K for the gas

Determine:

i) Flow coefficient
ii) Mean diameter of the stage
iii) Power developed
iv) Pressure ratio across fixed and rotor blade rings
v) Hub tip ratio of the rotor
vi) Degrees of reaction at hub in tip

b) Explain briefly four method which can be employed for improving thermal efficiency of steam turbine power plant. [6]

SECTION – II

Q.7 a) The stagnation pressure ratio across a gas turbine stage is 2.0 and the initial and final stagnation temperatures of the gas are 600^oC and 500^oC respectively. The absolute velocity of the gas both at entry and exit is 120 m/S. Determine [10]

i) Total to total efficiency
ii) Total to static efficiency
iii) Work done per kg of gas
iv) Mass flow rate of gas to develop 10 MW

b) What are the advantages of closed circuit gas turbine power plant over open [6]

circuit gas turbine power plant? Give three practical examples where closed circuit gas turbine plants are used.

OR

Q.8 a) A small gas turbine plant has a output of 1 MW at a maximum to minimum temperature ratio of 5 and pressure ratio of 25. The overall turbine and compressor efficiencies are 85% and 82% respectively. The compressor draws air at 300 K; the properties of gas may be assumed to be the same as that of air. Determine : [10]

i) The mass flow through the turbine
ii) Thermal efficiency of the plant
iii) Efficiencies of reversible Joule cycle and Carnot cycle between the same temperatures.

b) What are the various methods employed for improving the efficiency and output of a constant pressure gas turbine power plant? [6]

Q.9 a) What do you man by manometric head, manometric efficiency, mechanical efficiency and overall efficiency of a centrifugal pump? [8]

b) A centrifugal pump having outer diameter equal to two times inner diameter. and running at 1200 r.p.m. works against a total head of 75 m. The velocity of flow through the impeller is constant and equal to 3 m/s. The vanes are set back at width at an angle of 30^o at outlet. If the outer diameter of the impeller is 600 mm and width at outlet is 50 mm, determine : [10]

i) Vane angle at inlet
ii) Work done per second by impller
iii) Manometric efficiency

OR

Q10 a) What is priming of centrifugal pump and why it is necessary? [4]

b) Draw and discuss the operating characteristics of a centrifugal pump. [6]

c) The outer diameter of an impeller of a centrifugal pump is 400 mm and [8]

outlet width is 50 mm. the pump is running at 800 r.p.m. and is working against a total head of 15 m. The vane angle at outlet is 40^o and manometric efficiency is 75% Determine :

i) Velocity of the flow at outlet
ii) Velocity of water leaving the vane
iii) Angle made by the absolute velocity at outlet with the direction of motion.
iv) Discharge

Q.11 a) An axial compressor stage has following data [10]

Temperature and pressure at entry ------ 300K, 1 bar

Degree of reaction---------- 50%

Mean blade ring diameter---------- 36 cm

Rotational speed---------- 18000r.p.m.

Blade height at entry---------- 6 cm

Air angles at rotor and stator exit--------- 25^o

Axial velocity---------- 180 m/s

Work done factor---------- 0.88

Stage efficiency---------- 85%

Mechanical efficiency---------- 96.7%

Determine:

i) Air angles at the rotor and stator entry
ii) The mass flow rate of air
iii) The power required to drive the compressor
iv) The loading coefficient
v) The pressure ratio developed the stage
vi) The Mach number at the rotor entry

b) How do stalling and surging take place in centrifugal compressor stages? [6]

How does it affect the performance of compressor? Suggest methods to minimize.

OR

Q.12 a) Derive the following relation for efficiencies and degree of reaction of axial compressor [8]

$$\eta_{st} = R\,\eta_R + (1-R)\,\eta_D$$

Calculate the value of the stage efficiency of 50% reaction compressor stage with the following efficiencies of the blade rows.

$$\eta_R = 0.849 \text{ and } \eta_D = 0.849$$

b) Draw velocity triangles at entry and exit for following axial compressor stages. [8]

i) $R = 1/2$

ii) $R = 1$

iii) $R > 1$

[Total No. of Questions: 12] **[Total No. of Printed Pages:8]**

UNIVERSITY OF PUNE
[4363]-120
T. E.(MECHANICAL) May Examination - 2013
REFRIGERATION AND AIRCONDITIONNING
(302051) (2008 Course)

[Time: 3 Hours] **[Max. Marks: 100]**

Instructions:

1 *Answers to the two sections should be written in separate answer-books.*
2 *Black figures to the right indicate full marks.*
3 *Your answer will be valued as a whole*
4 *Neat diagrams must be drawn wherever necessary.*
5 *Use of electronic pocket refrigeration tables, calculator and steam tables is allowed. Psychometric chart.*
6 *Assume suitable data, if necessary.*
7 *Answer any three questions from Section I and any three questions from Section II*

SECTION –I

Q.1 A) State (minimum four) different application of refrigeration and explain any one of them. [3]

B) Refrigerator working on reversed Carnot cycle within the temperature limits 36^{o}C and -20^{o}C has R 152a vapor as a working medium. Find work of compression, work of expansion, refrigerating effect, heat rejected per kg of refrigerant and COP of the cycle. Show the cycle on P-h, T-s diagram with parameters. If actual refrigerator has COP of 0.78 of the maximum how much will be power consumption per ton of refrigeration capacity? Use following R 125a data. [8]

t^oC	p bar	v_g m^3/kg	h_f kJ/kg	h_g kJ/kg	s_f kJ/kgk	s_g kJ/kgk
-20	1.211	0.2514	168.43	493.26	0.8768	2.1599
36	8.159	--	264.19	529.8	1.2251	2.0842

C) With a schematic diagram explain the working of Vortex tube. State its applications. [5]

OR

Q.2 A) Explain deviation of actual / practical VCC from simple saturated VCC with P-h, T-s diagrams. [6]

B) Domestic refrigerator of 1/8 ton refrigeration (TR) capacity has COP half that of Carnot COP. Outside air temperature is 40 ^oC while freezer is maintained at – 10^oC. Assuming 5^oC temperature difference is required on both sides determine the power consumption. [6]

C) State and explain the limitations of reversed Carnot cycle with vapor and gas as working medium. [4]

Q. 3 A) Sketch actual vapor compression cycle on P-h and T-s diagram and explain all processes briefly. [8]

B) Simple saturated VCC using R134a has capacity of 2TR. Evaporator and condenser temperatures are – 18^oC and 40^oC respectively. Calculate mass flow rate of refrigerant, COP of system, heat rejected in condenser and power consumption. What will be effect on COP and power consumption if liquid vapor heat exchanger is placed in the system? Vapor enters the heat exchanger as dry saturated and leaves at 12^oC. Use following [10]

properties. Specific heat of R 134a vapor is 0.823kJ/kg K and specific heat R 134a liquid is 1.145 kJ/kgK . Show the cycle on P-h and T-s diagram with important parameters.

t^oC	P bar	v_g m^3/kg	h_f kJ/kg	h_g kJ/kg	s_f kJ /kgK	s_g kJ /kgK
-18	1.446	0.13592	176.23	387.79	0.9104	1.7396
40	10.166	--	256.41	419.43	1.1905	1.7111

OR

Q. 4 A) In a simple saturated vapor compression cycle using R22 condenser and evaporator temperatures are 40^oC and 0^oC respectively. For the refrigerating capacity of 15 TR, calculate [10]

i) mass flow rate (kg/s)

ii) power consumption (k W)

iii) COP

iv) volume flow rate (m^3 / s)

v) discharge temperature (^oC)

vi) condenser capacity (k W). Show cycle on P-h and T-s diagram.

Use following properties. Specific heat of R22 vapor is 0.67 kJ/ kgK.

t^oC	P bar	v_g m^3/kg	h_f kJ/kg	h_g kJ/kg	s_f kJ /kgK	s_g kJ /kgK
0	4.976	0.0471	200.0	405.36	1.000	1.7518
40	15.335	0.151	249.08	415.95	1.1666	1.6995

B) Describe with sketch working of single effect ammonia-water vapor absorption system [8]

Q. 5 A) Comment on the following properties of refrigerant as section criteria-1) Condenser and evaporator pressure 2) [6]

Normal boiling point 3) Action with water, oil and other material used 4) Thermal conductivity.

B) R-22 plant has two evaporators 1) at -30°C, refrigerating capacity 30,000 kJ/h and 2) at -25°C refrigerating capacity 45,000 kJ/h. Vapor leaves the evaporator with 6 degree of superheat. Condenser temperature is 35°C and there is no sub-cooling. The vapors are superheated by 10 degree in suction line. A single acting for cylinder compressor has Speed 930rpm, volumetric efficiency = 72% and bore / stroke ratio 1.25. Calculate the dimensions of cylinder, power consumption and COP. Use Chart. Show cycle on P-h diagram with parameters. [10]

OR

Q. 6 A) What are different alternative refrigerants for R12 and R22? Why do they need replacement? [6]

B) R-22 plant of capacity 150 kW is working between the condenser and evaporator temperatures 40°C and -30°C respectively. There is no sub-cooling of the refrigerant and vapor enters the compressor in dry saturated state. Find power consumption, COP, and mass flow rate [10]

i) when one stage is used and

ii) when two stage compression with flash inter cooling is used. Use Chart

SECTION II

Q. 7 A) Explain the followings : [6]

i) Relative humidity

ii) Humidity Ratio

iii) Wet blub temperature

B) 10 cmm air at 37°C dry blub, 24% saturation, is drawn through a desert cooler having an adiabatic saturation efficiency of 75% What is the final dry blub and RH, and how much water is required in kg/h? [6]

C) What is human comfort? In brief explain the factors influencing the human comfort. [4]

OR

Q. 8 A) Explain the working of Air washer with neat schematic and show all the possible processer on psychometric chart. [6]

B) In an air conditioning system air at a flow rate of 2kg/s enters the cooling coil at 25°C and 50% RH and leaves the cooling coil 11°C and 90% RH. The apparatus dew point of the cooling coil is 7°C. Find [6]

a) The required cooling capacity of the coil,

b) Sensible Heat Factor for the process, and

c) By-pass factor of the cooling coil.

Assume the barometric pressure to be 1 atm. Assume the condensate water to leave the coil at ADP (h = 29.26kJ/kg)

C) Explain the followings : [4]

i) Bypass Factor

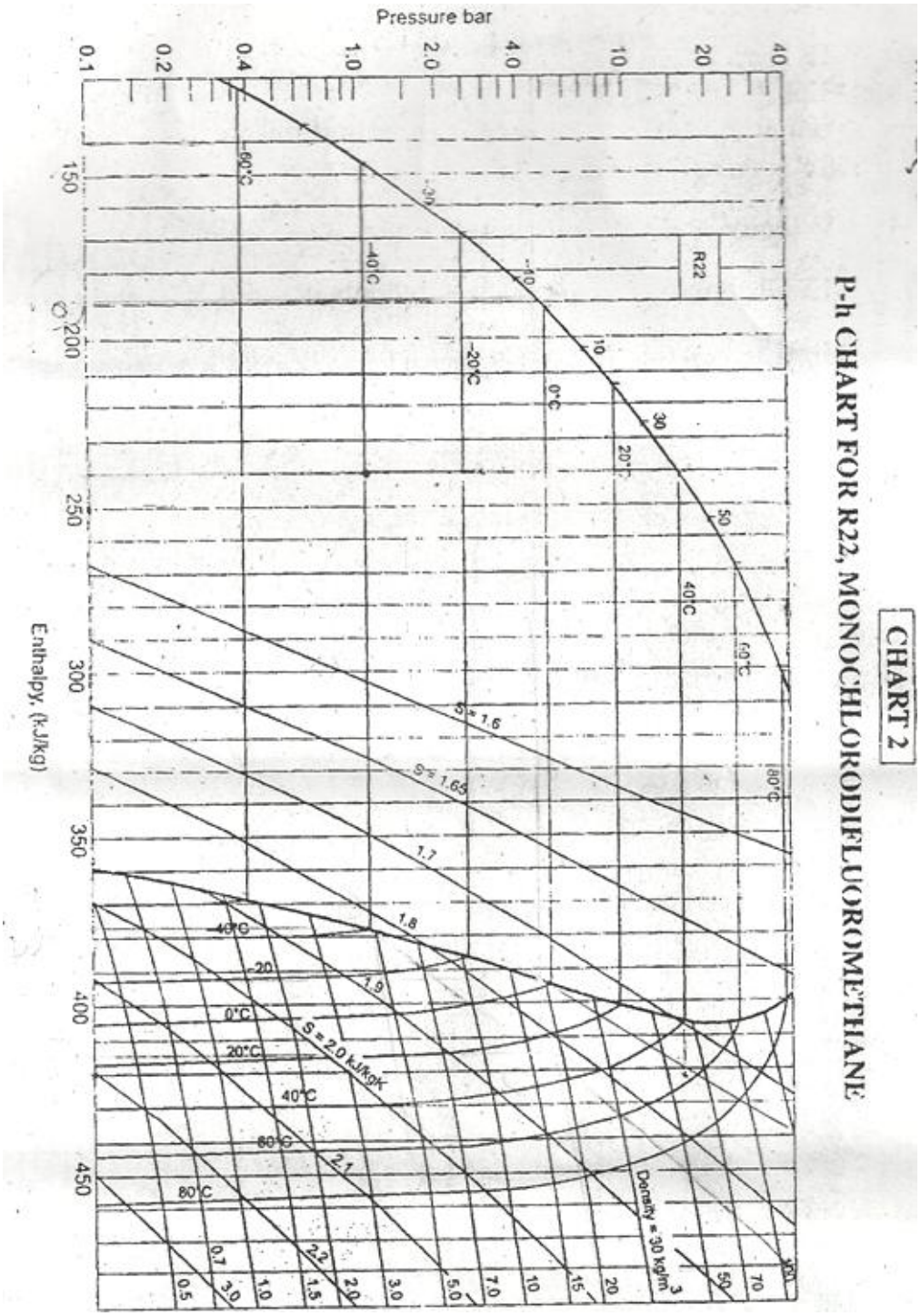
ii) ADP

Q. 9 A) Explain All air systems with its merits and demerits over other types of systems. [7]

	B)	With suitable sketch, discuss the working of Thermostatic Expansion Valve	[7]
	C)	What is infiltration and ventilation load?	[4]
		OR	
Q. 10	A)	What are the different types of evaporators used in Refrigeration and Air conditioning plant? With neat sketch, explain the working of flooded evaporator.	[6]
	B)	Write short note on : VRF system	[6]
	C)	When neat sketch explain the working of AHU.	[6]
Q.11	A)	A circular duct of 400 mm is selected to carry air in an air conditioned space at a velocity of 440m/min to keep the noise at desired level If this duct is to be replaced by rectangular duct of aspect ratio of 1.5, find the size of the duct for equal friction method when 1) Velocity of air in two ducts is same and 2) 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	[6]
	B)	What are the desirable properties of ideal duct materials? List few material for duct. What is equivalent diameter of duct?	[6]
	C)	Write short note on : CA/MA storages	[4]
		OR	
Q. 12	A)	Describe the various methods of food preservation?	[6]
	B)	Explain the static regain method of duct design.	[6]

C) What do you mean by Cold Chain? [4]

Q.5 & Q.6



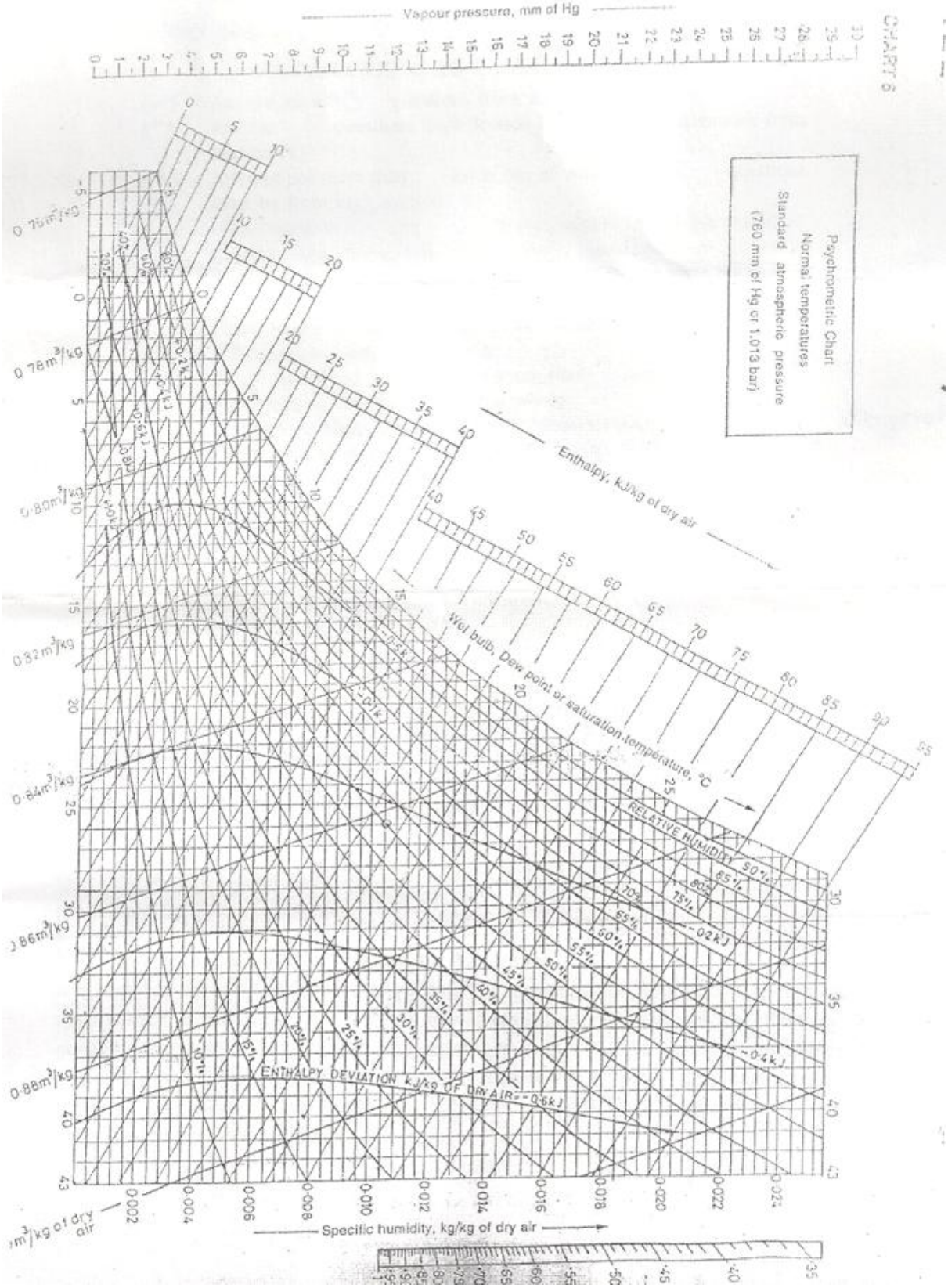


CHART 6
Psychrometric Chart
Normal temperatures
Standard atmospheric pressure
(760 mm of Hg or 1.013 bar)
Vapour pressure, mm of Hg
Enthalpy, kJ/kg of dry air
Wet bulb, Dew point or saturation temperature, °C
RELATIVE HUMIDITY 90%
ENTHALPY DEVIATION kJ/kg OF DRY AIR
Specific humidity, kg/kg of dry air
m³/kg of dry air