Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

B. E. Vth Semester–Examination – Nov-Dec- 2011

Subject code: 152503

Subject Name: Design of M/C Elements-I

Date:26/11/2011 **Time: 02:30 pm – 05:00 pm**

Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Use of Design Data Book is permitted.**

Q.1 **(a)** Design a spur gear reducer to transmit 27.5KW power at 1550 rpm. The speed reduction is 3. Working life of the gear is 10,000 hours. **10**

(b) What do you understand by Stress concentration? Define and differentiate between 'form stress factor' and 'stress concentration factor'. **04**

Q.2 **(a)** Design a multiplate clutch from following data. **07**

Power transmitted	: 3.5KW
Speed	: 1500 rpm
Maximum outside diameter of plate	: 100mm
No. of springs	: one at centre
Spring compression for disengagement	: 2mm
For spring force variation of	: 15%
Allowable shear stress for spring steel	: 400 N/mm^2
Modulus of rigidity for spring steel	:8.3X10^4
Co-efficient of friction for material	: 0.25
Pressure of lining	: 0.25 N/mm^2

(b) A steel rod is to be subjected to reversed axial load of 150 KN. Find the diameter of the rode for the factor of safety of 2. Neglect column action. The material has an ultimate tensile strength as 1090 N/mm^2, Yield stress as 920 N/mm^2 and Endurance limit as 540 N/mm^2.Other correction factors are: **07**
Theoretical stress concentration factor: 2.5
Notch sensitivity: 0.8

OR

(b) Derive an expression for minimum number of teeth required on a pinion to avoid interference when it gears with rack. **07**

Q.3 **(a)** Design a V-belt drive from the following data: **10**

Motor power	: 4 KW
Motor speed	: 1200 rpm
Speed reduction	: 4
Belt width	: 17 mm
Belt thickness	: 11 mm
Belt area	: 140mm^2
Minimum pulley diameter	: 175 mm
Density of belt	: 1.5X10^{-5} N/mm^3
Endurance limit for belt	: 10 N/mm^2
Modulus of elasticity for belt	: 90 N/mm^2
Center distance	: 900 mm.

Calculate the maximum stress in belt, number of belts required and design the V-pulley.

(b) The leaf spring has 12 numbers of leaves, two of which are full length leaves. The supports are 1.2m apart and the central band is 80mm wide. The central load is to be taken as 4000 N with a permissible stress of 350 N/mm^2,E = $0.21x10^6$ N/mm^2, Determine (i) the thickness and width of the steel spring leaves. The ratio of the total depth to the width of the spring is 3. (ii) Deflection of the spring. **04**

OR

Q.3 **(a)** Design a helical compression spring for an engine valve from the following data: **07**

Maximum load : 1050 N
Minimum load : 850 N
Lift of the valve : 4 mm
Spring index : 5
Allowable stress : 470 N/mm^2
Modulus of rigidity : $8X10^4$ N/mm^2

(b) The internal expanding double-shoe brake is shown in figure (i). The face width of the friction lining is 40 mm and the maximum intensity of normal pressure is limited to 1 N/mm^2. The coefficient of friction is 0.32. The angle θ_1 can be assumed to be zero. Calculate: (i) the actuating force P; and (ii) the torque absorbing capacity of the brake **07**

Q.4 **(a)** Design a worm gear drive to transmit 26 KW power from worm at 1440 rpm to the worm wheel. The speed of the worm wheel should be 40 rpm. **10**

(b) Enumerate the advantages and limitations of flat belt drive. **04**

OR

Q.4 **(a)** Design a connecting rod of an I.C. engine using following data: **10**

Piston diameter: 150 mm
Piston stroke: 200mm
Connecting rod length:350 mm
Maximum Engine speed:3800 rpm
Maximum gas pressure = 35 N/mm^2
Weight of reciprocating parts 25 N

The cross section of the connecting is to be chosen of I shape with depth = 6t and width = 4t where t = thickness of the flanges and the web of the 'I' section. The material for the rod is forged steel having σ_y = 580 N/mm^2.Take Rankine's constant = 1/6400 and factor of safety = 7. Check the cross section for whipping stresses.

(b) Sketch and discuss types of End Fixity conditions of column. **04**

Q.5 **(a)** Figure (ii) shows a bracket fixed on a steel column by means of 3 bolts. Calculate the size of the bolts used if the permissible tensile and shear stresses are 70 and 50 N/mm^2 respectively. The load P = 35,000 N acts vertically at a distance of e = 350 mm from the face of column. The centre lines of the bolts are l_1 = 30 mm and $l_2 = l_3$ =300mm from the lower edge of the bracket. **07**

(b) The following data refers to a diesel engine: **07**

Cylinder diameter: 175mm
Stroke : 275 mm
Speed: 400 mm
Maximum explosion pressure : 3.5 N/mm^2
Allowable stress for cylinder material : 22 N/mm^2
Allowable stress for cylinder head material: 17 N/mm^2
Allowable stress for bolt material : 55 N/mm^2
Stiffness coefficient for gasket material : 0.6
Initial tightening load on each bolt : 25,000 N

Calculate: (i) Thickness of cylinder and flange, (ii) Thickness of cylinder cover and (iii) Number and size of bolts.

OR

Q.5 **(a)** A guide pulley is supported by the bracket as shown in figure (iii), if P = $15x10^3$ N. calculate the diameter of bolts if there are 6 bolts symmetrically arranged. Take θ =30°, and allowable stress, σ_t = 40 N/mm^2 for bolt. **07**

(b) Explain the various types of ends used for pressure vessel giving practical application. **04**

(c) Explain the stress distribution in thin and thick walled pressure vessels. **03**

****

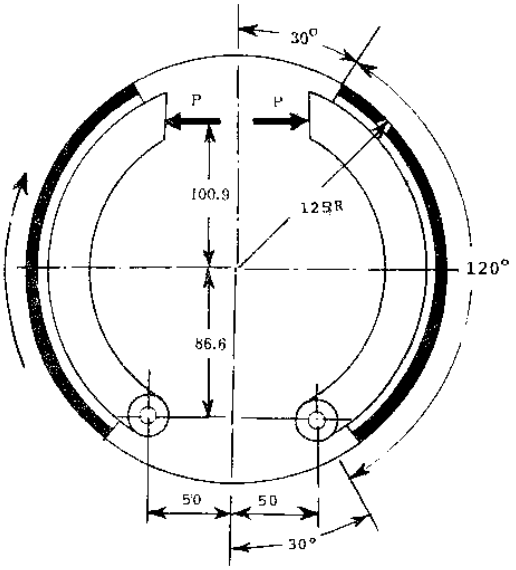

Figure (i) Q.3 (b) OR

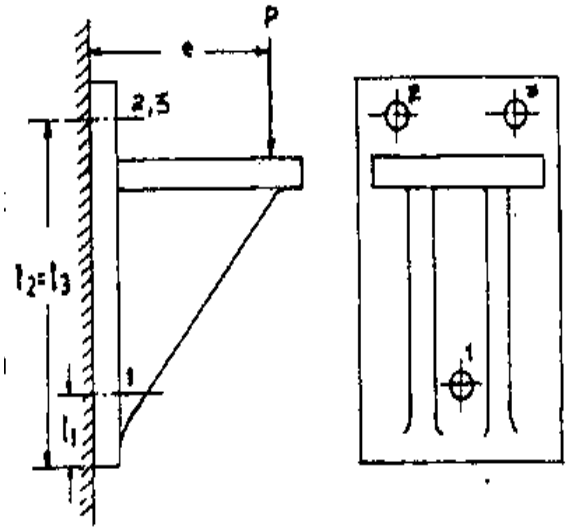

Figure (ii) Q.5 (a)

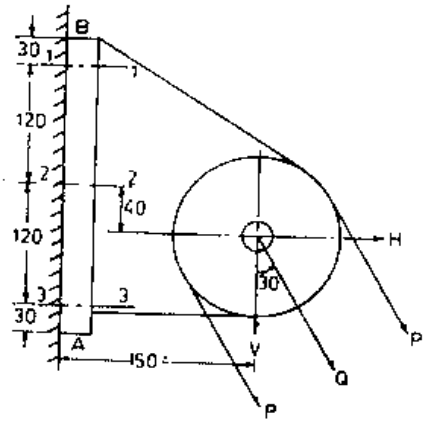

Figure (iii) Q.5 (a) OR

Note: All dimensions are in mm