Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V • EXAMINATION – WINTER 2013

Subject Code: 152503 Date: 04-12-2013

Subject Name: Design of Machine Elements - I

Time: 10.30 am - 01.00 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 PSG Design Data Book is Permissible.**

Q.1 **(a)** Design a parallel helical gear from the following data: **10**
Power to be transmitted: 18 KW, Speed of Input Shaft: 1200 rpm, Speed of Output Shaft: 200 rpm, Helix Angle: 30º, Pressure Angle: 20º full depth teeth.

(b) Explain different types of failure of gear teeth. **04**

Q.2 **(a)** A rod made of steel is to be subjected to varying axial load of 30 KN compressive to 40 KN tensile. Determine the required diameter of the rod using a factor of safety as 2. The following data may be used: **07**
Ultimate tensile strength of steel: 1090 N/mm^2, Yield stress: 920 N/mm^2, Endurance limit; 540 N/mm^2, Theoretical stress concentration factor: 2.5, Notch Sensitivity: 0.8

(b) Design a helical compression spring for an engine valve from the following data: **07**
Maximum Load: 1650 N, Minimum Load: 1150 N, Lift of the Valve: 6 mm, Spring Index::5, Allowable stress: 500 N/mm^2, Modulus of Rigidity: 8×10^4 N/mm^2.

OR

(b) Define the following terms: **07**
(i) Spring Rate, (ii) Free Length, (iii) Solid Length, (iv) Spring Index, (v) Active and Inactive coil, (vi) Stress factor (vii) Nipping of Spring.

Q.3 **(a)** The following data refers to a Diesel engine: **07**
Cylinder diameter: 250 mm, Stroke : 350 mm, Speed: 400 rpm, Maximum explosion pressure: 3.75 N/mm^2, Allowable shear stress for cylinder material: 22 N/mm^2, Allowable shear stress for cylinder head material: 18 N/mm^2, Allowable shear stress for bolt material: 55 N/mm^2, Stiffness co-efficient for Gasket material: 0.6, Initial Tightening load on each bolt: 22000 N, Constant C_1: 0162, Pitch Circle diameter: 250mm, Pitch of the bolt: Four times the core diameter of bolt.
Calculate: (i) Thickness of cylinder and flange, (ii) Thickness of cylinder cover and (iii) Number and size of bolts.

(b) A cone clutch has a cone pitch angle of 10º, mean diameter of 300 mm and face width of 100 mm, the co efficient of friction is 0.2, The assumption of uniform wear is exits, the average pressure on lining is 0.07 N/mm^2 for a speed of 500 rpm. **07**
Determine: (i) Force required for engage the clutch and (ii) Power that can be transmitted.

Design a suitable spring for the clutch if the disengagement factor is 12% greater than the force to hold the clutch in engagement and clutch is disengage by 3 mm deflection of spring. Take allowable shear stress in the spring is equal to 400 N/mm^2.

OR

Q.3 **(a)** The internal expanding brake is shown in figure (i) having following particulars: **07**
Drum inner diameter: 300 mm, Face width of both shoes: 37 mm, Coefficient of friction for lining: 0.35, Maximum pressure: 1.07 N/mm^2.
Determine: (i) the actuating force and (ii) braking capacity.

(b) A hollow rod 450 mm long is made of mild steel. Its one end is connected to the valve lever and other end carries a roller using a pin joints. It carries a maximum compressive load 3.5 KN. Assuming factor of safety 4 and applying Rankine's formula design the push rod cross section assuming the ratio of inside to outside diameter of 0.7. Take Yield crushing stress of 380 N/mm^2 for mild steel and Rankine's constant a = 1/7500. **07**

Q.4 **(a)** Design a connecting rod of an I.C. Engine using following data: **10**
Piston Diameter: 150mm, Piston Stroke: 200mm, Connecting rod length:350mm, Maximum Engine speed: 4000 rpm, Maximum Gas pressure: 37.5 N/mm^2, Weight of reciprocating parts: 20 N, Rankine's constant = 1/6400,
The cross section of the connecting rod is to be chosen of I shape with depth = 6t and width = 4t where t is the thickness of flange and web of I section. The material of rod is forged steel having σ_y = 560 N/mm^2

(b) Explain stress concentration and methods to reduce stress concentration. **04**

OR

Q.4 **(a)** For a Flat belt drive following data is given: **10**
Motor power: 5.5 KW, Speed of the motor:1440 rpm, Speed of driven pulley: 450 rpm, Maximum peripheral speed of the belt: 16 m/sec, Load factor: 1.2, Density of belt: 0.98 gm/cc, Diameter of pulley(smaller) to thickness of belt ratio: 35, Endurance limit for belt material: 4 N/mm^2, Modulus of elasticity: 100 N/mm^2, Factor of safety: 10, Ultimate strength of belt: 25 N/mm^2, Centre distance: 2800 mm, co-efficient of friction: 0.2
Determine belt size design C.I. driving pulley. Assume suitable stresses.

(b) Explain stress distribution in thick and thin walled pressure vessels. **04**

Q.5 **(a)** A guide pulley is supported by the bracket as shown in figure (ii), if P = 12.5 KN, calculate the diameter of bolts if there are 6 bolts symmetrically arranged. Take $\theta = 30^o$ and allowable stress σ_t = 30 N/mm^2 for bolt. **07**

(b) Compare Involute and Cycloidal tooth profile of gear. **07**

OR

Q.5 **(a)** Figure (iii) shows a cast iron bracket fixed to steel structure by means of 4 bolts. It carries a vertical load of 30 KN at a distance of 450 mm from the centre of gravity of the bolt as shown. Calculate the diameter of the bolt if σ_t = 60 N/mm^2 for the bolt material. The distance are L_1 = 80 mm and L_2 = 220 mm. **07**

(b) Design suitable V-belts required for a drive from the following data: **07**
Motor power: 80 KW, Motor Speed: 1000 rpm, Driver pulley speed 600 rpm, Approximate centre distance: 1100 mm, Co-efficient of friction: 0.3, Safe stress for belt material: 4 N/mm^2, Angle of pulley groove 40º, Maximum belt velocity: 25 m/sec, Service factor: 1.2, Length factor: 0.92, Arc contact factor: 0.93.

Neglect centrifugal tension and determine the size and number of belts.

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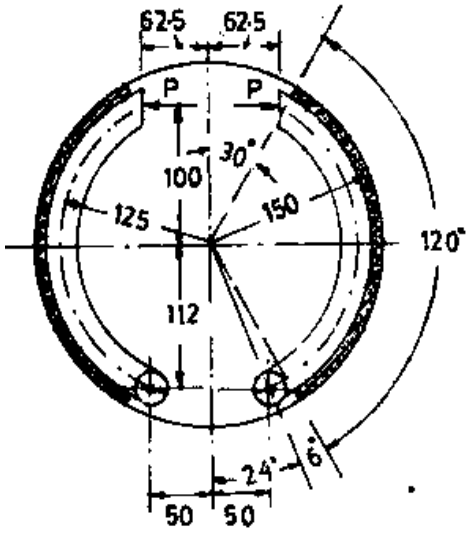

Figure (i), Q.3 (a) OR

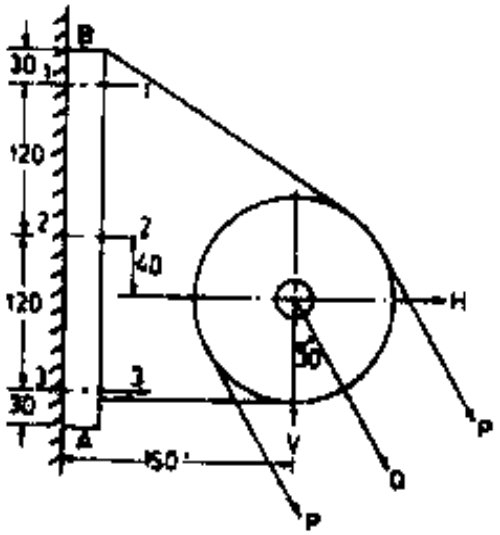

Figure (ii), Q.5 (a)

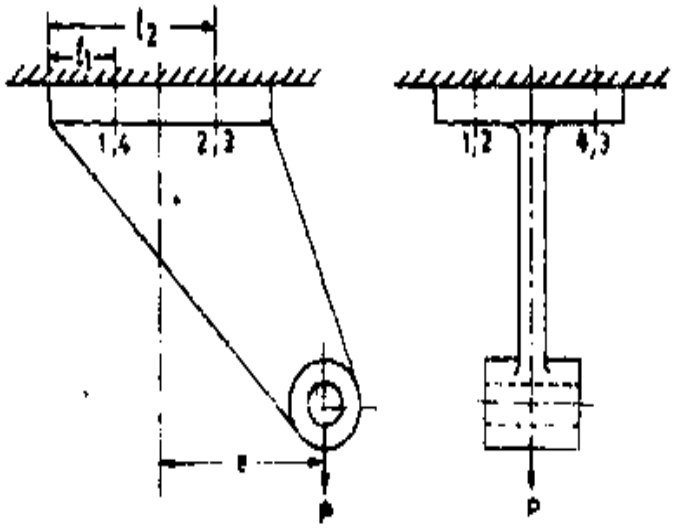

Figure (ii), Q.5 (a) OR