Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

B.E. Sem-Vth Examination December 2010

Subject code: 151905 Subject Name: Machine Design-I

Date: 20 /12 /2010 Time: 03.00 pm - 05.30 pm

Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** What are the advantages of nested spring? Prove that equal strength nested springs having the same solid length and deflection would have the same spring index. Also show that in this case, the ratio of the load shared by outer and inner spring is given by $F_o/F_i = d_o^2/d_i^2$ **07**

Where F_i = Force taken by inner spring

F_o = Force taken by outer spring

d_o = Diameter of wire for outer spring

d_i = Diameter of wire for inner spring

(b) A semi-elliptic leaf spring consists of two extra full length leaves and eight graduated length leaves, including the master leaf. The center to center distance between the two eyes of the spring is 1 m. The maximum force acting on the spring is 10 kN and the width of the leaf is 50 mm. The spring is initially preloaded in such a way that when the load is maximum, the stresses induced in all the leaves are equal to 350 N/mm^2. The modulus of elasticity of the leaf material is 2.07×10^5 N/mm^2. Determine : **07**

(i) The thickness of leaves.

(ii) The deflection of the spring at maximum load.

Q.2 **(a)** What are the major principles in the design of casting? **07**

(b) What are the salient features used in the design of forging? Explain. **07**

OR

(b) Determine the maximum load using the Soderberg equation for the simply supported 50 mm diameter beam, cyclically centrally loaded as shown in fig. 1. The ultimate strength is 690 N/mm^2, the yield strength is 400 N/mm^2 and the factor of safety is 1.5. Use a size correction factor as 0.85 and a surface finish factor of 0.9 **07**

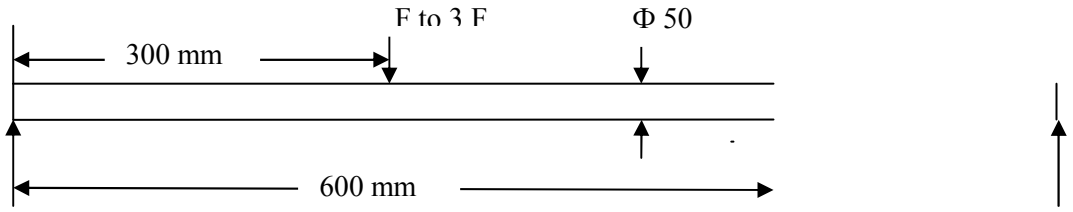

Fig. 1

Q.3 **(a)** A pulley of 0.9m diameter transmits 7.5 kW power at 200 rpm. Find the width of a leather belt if maximum tension is not to exceed 14.5 N per mm width. The tension in the tight side is twice that in the slack side. Also determine the dimensions of the various parts of the flat belt pulley, assuming it to have six arms. The arms are of C.I. for which tensile stress may be taken as 15 N/mm^2. The diameter of the shaft is 35 mm. **07**

(b) Explain in brief the design procedure for v-belt drives. **07**

OR

Q.3 **(a)** A chain drive with double strands of 16B type has a pitch of 25.4 mm. It is used to transmit power between a 15 tooth driving sprocket rotating at 700 rpm and a 60 tooth driven sprocket. For the drive conditions, a service factor of 1.3 can be used. Find **07**

(i) The power that can be transmitted by the drive.

(ii) The approximate length and the corrected length of the chain, if the centre distance between the sprockets is 475 mm.

Use the following data:

At 700 rpm, for chain 16B, power rating is 27.73 kW

No. of strands	The multiple strand factor K_1
1	1.0
2	1.7
3	2.5
4	3.3

No. of teeth	Tooth correction factor K_2
15	0.85
60	2.80

(b) (i) What do you mean by a 6 x 9 rope? **01**

(ii) Discuss the uses and construction of wire rope. **03**

(iii)How a wire rope is most likely to fail? **03**

Q.4 **(a)** It is required to select a ball bearing suitable for a 50 mm diameter shaft rotating at 1500 rpm. The radial and thrust loads at the bearing are 4500 N and 1600 N respectively. The value of X and Y factors are 0.56 and 1.2 respectively. Select a proper ball bearing from the following table for the rating life of 22500 hr. the inner ring rotates and the service factor is 1. **07**

Bearing No.	6010	6210	6310	6410
C(N)	21600	35100	61800	87100

(b) The following data refer to 360^0 hydrodynamic journal bearing: **07**

Radial load = 3.2 kN

Journal speed = 1490 rpm

Journal diameter =50 mm

Bearing length = 50 mm

Radial clearance = 0.05mm

Viscosity of lubricant = $25x10^{-3}$ Pa.s

Calculate:

(i) Co-efficient of friction, (ii) Power lost in friction,

(iii) Minimum oil film thickness, (iv) Amount of oil flow

The following table may be referred to,

l/d	h_o/c	S	f(r/c)	Q/(rcNL)	Q_s/Q
1	0.6	0.264	5.79	3.99	0.497
	0.4	0.121	3.22	4.33	0.680

OR

Q.4 **(a)** The piston rod of a hydraulic cylinder exerts an operating force of 10 kN. The friction due to piston packing and stuffing box is 10 % of the operating force. The pressure in the cylinder is 10 N/mm^2. The cylinder is made of C.I. having allowing tensile stress of 40 N/mm^2. Determine the diameter and thickness of the cylinder. **07**

(b) A high pressure cylinder consists of a steel tube with 20 mm and 35 mm as inner and outer diameters respectively. It is jacketed by outer steel tube with 50 mm outer diameter. The tubes are assembled by shrinking process in such a way that the maximum tensile stress induced in any tube is limited to 100 N/mm^2. Calculate the shrinking pressure and original dimensions of the tubes. E = $2.0x10^5$ N/mm^2. **07**

Q.5 **(a)** A single plate clutch with both sides effective is to transmit 7.5 kW at 900 rpm. The axial pressure is limited to 0.07 N/mm^2. The co-efficient of friction may be taken as 0.25. The ratio of face width to mean radius is 0.25. Determine the outer and inner radii of clutch plate. **07**

(b) In the above problem [Q.5(a)] the clutch is engaged by six springs of spring index as 6. The disengaging force is 12 % greater than the force to hold the clutch in engagement and the clutch is disengaged by 3 mm. Design the spring. Take working shear stress of 420 MPa and modulus of rigidity is $0.8x10^5$ N/mm^2. **07**

OR

Q.5 **(a)** A centrifugal clutch transmitting 15 kW at 900 rpm consists of four shoes. The speed at which engagement begins is ¾th of the running speed. The inner radius of the drum is 150 mm while the radius of the center of gravity of the shoe in engaged position, is 120 mm. the co-efficient of friction is 0.25. Calculate the mass of each shoe. **07**

(b) (i) Explain what do we understand by preferred numbers. **02**

(ii) What is self energizing brake? When a brake becomes self locking? **02**

(iii)Explain briefly the procedure for determining the required operating force for a double block brake, knowing the required braking torque and the diameter of the brake drum. **03**

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