Seat No:- _____

Ganpat University
B. Tech. Sem. VI Mechanical Engineering
Regular Examination May/June-2013
2ME605 - Design of Machine Elements

[Time: 3 Hour] [Total marks: 70]

Instructions:
(1) Attempt all questions.
(2) Right figure indicate full marks.
(3) Assume suitable data if necessary.
(4) Only scientific calculator is allowed.

SECTION-I

Que.1 Attempt the followings.

(a) What is endurance strength of material? How it is differ from endurance limit. Also explain stress concentration factor. **[4]**

(b) A bar of steel has following properties: **[8]**
Corrected endurance strength = 275 MPa
Tensile yield strength = 415 MPa
Ultimate tensile strength = 550 MPa
If it is subjected to an alternating torsional stress of ± 205 MPa, find the expected life of the component. Assume that the S-N curve for torsional loading as a straight line drawn from $0.8\sigma_{out}$ at 10^3 cycles to $\sigma_{\sigma e}$ at 10^6 cycles on a log-log paper. Also assume that $\sigma_{\sigma u} = 0.577\sigma_{ut}$ and $\sigma_{\sigma e} = 0.577\ \sigma_e$.

OR

Que.1 Attempt the followings

(a) Enlist the mathematical approaches to predict fatigue failure and explain the mathematical approach in which the yield strength of the material is considered as a criterion to predict the fatigue failure. **[4]**

(b) A cantilever beam of circular cross-section, made of cold drawn steel having ultimate tensile strength of 550 N/mm^2, is fixed at one end and is subjected to completely reversed force of 15 kN at the free end. The force is perpendicular to the axis of the beam. The distance between the fixed and free end of the cantilever beam is 200 mm. The theoretical stress concentration factor and the notch sensitivity at the fixed end are 1.35 and 0.85 respectively. The surface finish factor is 0.80. The expected reliability is 90%, for which the reliability factor is 0.897. The values of size factor are as follows: **[8]**

Diameter 'd' in mm	Size Factor
$d \leq 7.5$	1.00
$7.5 < d \leq 50$	0.85
$d > 50$	0.75

If the factor of safety is 2.0, determine the diameter of the beam for infinite life.

Que.2 Attempt the followings.

(a) Prove that the centrifugal tension produced in the open belt drive is depends upon the mass of the belt per unit length and the belt speed. **[4]**

(b) The following data for a V-belt drive connecting a 30 kW motor to the compressor. **[8]**

	Motor pulley	Compressor Pulley
Pitch diameter, mm	225	900
Speed, rpm	1400	360
Pulley groove angle, deg	38	38

The center distance between the pulleys is 1000 mm and the cross sectional area of a single belt is 237 mm^2. The coefficient of friction between the belt and pulley is 0.2. If the density

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of the belt material is 0.97 gm/cc and the allowable tension per belt is 800 N. Calculate:

(1) The number of belts required and

(2) The pitch length of belt.

OR

Que.2 Attempt the followings.

(a) Derive the equation for exact belt length of open belt drive with neat sketch without consideration of approximation. [4]

(b) A V- belt is used to transmit 30 kW power from an electric motor running at 1440 rpm to a machine running at 480 rpm. The centre distance between the input and output shafts is 1000 mm. The pulley groove is 38° and the coefficient of friction between the belt and pulley is 0.2. The density of belt material is 1000 kg/m^3 and the allowable tensile stresses for the belt is 1.53 N/mm^2. The cross-section dimensions of the v-belt are as follows: [8]

Width of the belt at top = 37 mm

Width of the belt at bottom = 19 mm

Thickness of the belt = 25 mm

Determine the pulley diameters and the minimum number of belts required.

Que.3 Attempt the followings.

(a) A shaft runs at 80 rpm and drives another shaft at 150 rpm through belt drive. The diameter of the driving pulley is 600 mm. Determine the diameter of the driven pulley in the following cases: [3]

(i) Neglecting belt thickness,

(ii) Taking belt thickness as 5 mm,

(iii)Assuming for case (ii) a total slip of 4%.

(b) Explain the strength of parallel fillet welds with suitable sketch and expression for the same. [4]

(c) A steel plate, 100 mm wide and 10 mm thick, is joined with another steel plate by means of a single transverse and double parallel fillet welds as shown in **Fig. 1.** The strength of the welded joint should be equal to the strength of the plates to be joined. The permissible tensile and shear stresses for the weld material and the plate are 70 N/mm^2 and 50 N/mm^2, respectively. Find the length of each parallel fillet weld. Assume the tensile force acting on the plates as static. [4]

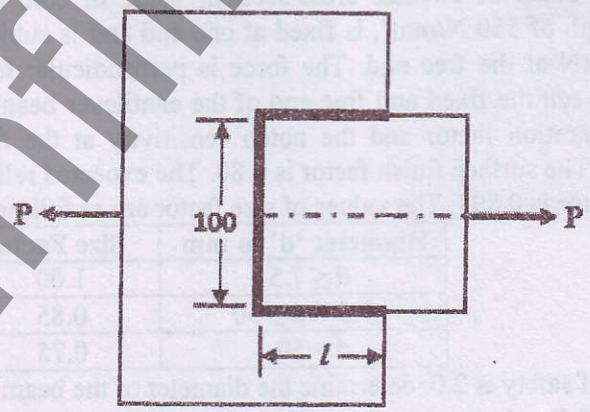

Fig. 1

SECTION - II

Que.4 Attempt the followings.

(a) A plate clutch having the rate of wear is uniform over the entire contacting surface then derive that the torque transmitting capacity of the plate clutch is dependent on co-efficient of friction, axial force and friction radius of contacting surface. [4]

(b) A solid disk type cast iron flywheel of diameter 450 mm and width 90 mm is rotating at 1440 rpm. It is brought to the rest by means of a brake in 1.5 second. The mass of the brake drum assembly is 2.5 kg. The mass of the brake drum assembly is 2.5 kg. The specific heat [8]

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of the cast iron brake drum is 460 J/kg °C. Assuming that the total heat generated is absorbed by the brake drum assembly, calculate the temperature rise of the brake drum.

OR

Que.4 Attempt the followings.

(a) Explain the self emerging brake with neat sketch showing forces acting on it and also explain the self locking brakes. [4]

(b) A cone clutch with asbestos friction lining is used to transmit 30 kw power at 1440 rpm. The coefficient of friction between the contacting surfaces is 0.2 while the permissible intensity of pressure is 0.35 N/mm^2. The semi-cone angle is 12.5°. The mean radius of the friction surface is twice the face width. Assuming the uniform pressure condition, determine: [8]

(i) The dimensions of the friction surface and

(ii) The axial force required to engage the clutch.

Que.5 Attempt the followings.

(a) Derive the expression of disengagement force for cone clutch with neat sketch. [4]

(b) Explain the Lame's equation used to determine the wall thickness of the pressure vessel. [4]

(c) The piston rod of a hydraulic cylinder exerts an operating force of 10 kN. The friction due to piston packing and stuffing box is equal length to 10% of operating force. The pressure in the cylinder is 10 MPa. The cylinder is made of cast-iron FG 200 and the factor of safety is 5. Determine the diameter and thickness of the cylinder. [4]

OR

Que.5 Attempt the followings.

(a) Write short note on Caliper disc brake. [4]

(b) A high pressure cylinder consists of a steel tube with inner and outer diameter of 20 mm and 40 mm respectively. It is jacketed by an outer steel tube with an outer diameter of 60 mm. The tubes are assembled by shrinking process in such a way that maximum principal stress is limited to 100 N/mm^2. Calculate the shrinkage pressure and original dimensions of the tube. [8]

Que.6 Attempt following.

(a) A single plate friction clutch has a friction surface having an outer diameter of 300 mm and an inner diameter of 200 mm. If the coefficient of friction is 0.3 and the axial force is 1 kN, determine the frictional torque capacity of the clutch based on: [3]

(a) Uniform pressure theory and

(b) Uniform wear theory.

(b) Explain the importance of ergonomic consideration in design. [4]

(c) It is required to standardize eleven shafts from 100 to 1000 mm diameter. Specify their diameters. [4]

END OF PAPER

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