Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE SEM-V Examination-Nov/Dec.-2011

Subject code: 151905 **Date: 01/12/2011**

Subject Name: Machine Design-I **Time: 2.30 pm -5.00 pm**

Total marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Illustrate your answer with neat sketches wherever required.**

Q.1 **(a)** What is standardization? Give its applications in mechanical engineering. State the benefits of standardization. **07**

(b) What is the importance of wear considerations in design? Explain the measures to minimize the wear. **07**

Q.2 **(a)** 11 kW, 1440 rpm motor is used to transmit power through V belt drive having following details. **07**

Each belt has area of cross section = 140 mm^2

Groove angle for pulley = 38^0

Density of belt material = 1350 kg/m^3

Diameter of pulley on motor shaft = 140 mm

Speed ratio = 2:1

Centre distance = 400 mm

Maximum permissible stress for belt = 2.5 MPa

Coefficient of friction between belt and pulley = 0.25

Find the number of belts required and pitch length of the belt.

(b) Determine the percentage increase in power capacity made possible in changing over from a flat pulley to a V belt drive. The diameter of the flat pulleys is the same as the pitch circle diameter of the V belt grooved pulleys. The pulley rotates at the same speed as the grooved pulley. The belt materials are the same and they have the same cross sectional area, with coefficient of friction for both as 0.3. The groove angle of the V belt pulley is 60^0 and the angle of contact for both the cases is 150^0. **07**

OR

(b) Draw the sketch of bush roller chain. Write step by step design procedure for design of bush roller chain with necessary design equation. **07**

Q.3 **(a)** Explain the terms related to helical spring: **06**

(1) Spring rate (2) Free length (3) Spring index (4) Stress factor

(b) Calculate the dimensions of a helical spring for a safety valve from the following data : **08**

Valve diameter = 65 mm,

Maximum pressure when the valve blows off freely = 0.73 N/mm^2,

Valve lift when pressure rises from 0.7 to 0.73 N/mm^2 = 3.5 mm,

Maximum allowable stress = 550 N/mm^2, Spring index = 6,

Modulus of rigidity = 8.3×10^4 N/mm^2.

OR **[P.T.O.**

Q.3 **(a)** Sketch and explain the different types of ends used for pressure vessels. **06**

(b) A single acting cast iron hydraulic cylinder to enable a thrust of 50 kN has maximum piston speed of 0.15 m/min. Oil is supplied to cylinder through vane pump having capacity of 10×10^{-4} lit/rev and running at 2800 rpm. Find the thickness of the cylinder based on Lame's theory. Assume pump efficiency as 85 % and $\sigma_t = 20$ N/mm^2. **08**

Q.4 **(a)** The semi-cone angle in cone clutches is usually 12.5^0. Justify the statement giving reasons. **04**

(b) A multiple disc clutch is to transmit 4 kW at 750 rpm. Available steel and bronze discs are 40 mm inner radius and 70 mm outer radius are to be assembled alternately in appropriate numbers. The clutch is to operate in oil with an expected coefficient of friction of 0.1 and maximum allowable pressure is not to exceed 350 kPa. Assume uniform wear condition to prevail and specify the number of steel (driving) and bronze (driven) discs required. Also determine what axial force is to be applied to develop the full torque. **10**

OR

Q.4 **(a)** What do you mean by a self-energizing brake and a self-locking brake? **04**

Q.4 **(b)** Describe with the help of neat sketch the principle of operation of an internal expanding shoe brake. **10**

Q.5 **(a)** Explain the performance of a hydrodynamic bearing with the curve of μ versus Z.N / p. **05**

(b) Design a journal bearing for a centrifugal pump for given specifications: **09**

Diameter of journal = 75 mm
Speed of journal = 1440 rpm
Load on journal = 11.5 kN
Permissible bearing pressure = 0.7 to 1.4 N/mm^2 (Range)
L/d ratio = 1 to 2, Ambient temperature = 25^0 C.
Z.N / p = 28.5 (where p is MPa), Operating temperature = 70^0 C.
Viscosity of lubricant = 0.025 kg/m-sec.

OR

Q.5 **(a)** Explain the factors affecting selection of antifriction bearings. **05**

(b) A ball bearing is operating on a work cycle consisting of three parts: **09**

- a radial load of 3000 N at 1440 rpm for one quarter cycle,
- a radial load of 5000 N at 720 rpm for one half cycle and
- a radial load of 2500 N at 1440 rpm for remaining cycle.

The expected life of the bearing is 10000 hours. Calculate the dynamic load carrying capacity of the bearing.
