

Seat No.: _____

Enrolment No. _____

GUJARAT TECHNOLOGICAL UNIVERSITY

PDDC SEM-V Examination-Nov-2011

Subject code: X51903

Date: 24/11/2011

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 are preferred number series? Explain with suitable example. State their advantages and applications. **07**
- (b) What is the importance of wear considerations in design? Explain the procedure to minimize the wear. **07**
- Q.2** (a) Prove the condition for maximum power transmission capacity of belt drive. **07**
- (b) Two shafts whose centres are 1 m apart are connected by a V-belt drive. The driving pulley is supplied with 100 kW and has an effective diameter of 300 mm. It runs at 1000 r.p.m. while the driven pulley runs at 370 r.p.m. The angle of groove on the pulleys is 40° . The permissible tension in 400 mm² cross-sectional area belt is 2.1 MPa. The density of the belt is 1100 kg/m³. The coefficient of friction between the belt and pulley is 0.28. Estimate the number of belts required. **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) Wahl's Stress factor
- (b) Design a helical spring for a spring loaded boiler safety valve with the following data: **08**
Diameter of valve seat = 90 mm
Blow off pressure = 1 N/mm²
Maximum valve lift = 5 mm at 1.1 N/mm² pressure
Spring index = 6
Permissible shear stress in wire = 400 N/mm²
Modulus of rigidity = 83×10^3 N/mm².

OR

- Q.3** (a) Differentiate between thin and thick cylinders. State their applications. **06**
- (b) A receiver of the reciprocating compressor consists of a cylindrical shell of 1000 mm length and 500 mm inner diameter. It is closed by hemispherical ends. The air pressure is limited to 40 bar. The efficiencies of the welded joints for the shell and ends are 0.9 and 0.8 respectively. If the allowable tensile stress is 80 N/mm², determine: **08**
- (i) the thickness of the cylindrical shell
 - (ii) the thickness of the hemispherical end and
 - (iii) the storage capacity of the receiver.

[P.T.O.]

- Q.4 (a)** The semi-cone angle in cone clutches is usually 12.5° . Justify the statement giving reasons. **04**
- (b)** A multiple disc clutch transmits 75 kW of power at 2000 rpm. Coefficient of friction for the friction surfaces is 0.2. Axial intensity of pressure is not to exceed 180 kN/m^2 . Internal radius is 100 mm and is 0.8 times the external radius. Find the number of plates needed to transmit the required torque. Assume uniform wear conditions. **10**

OR

- Q.4 (a)** What do you mean by a self-energizing brake and a self-locking brake? **04**
- (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)** The following data refers to a hydrodynamic full journal bearing: **09**

Diameter of the bearing = 50 mm

Length of the bearing = 100 mm

Allowable bearing pressure = 1.2 N/mm^2

Speed of journal = 1000 rpm

Viscosity of oil = $0.011 \text{ kg/m} \cdot \text{sec}$

Temperature of the oil film = 75°C

The room temperature = 35°C

Specific heat of the oil = $1850 \text{ J / kg } ^\circ \text{C}$

Ratio of the journal diameter to the diametral clearance = 1000

Heat dissipation coefficient = $300 \text{ W/m}^2 / ^\circ \text{C}$

Take minimum film thickness $\frac{1}{4}$ th of diametral clearance.

Calculate :

1. Load W which can be supported by bearing.
2. Power lost due to friction
3. Attitude of the bearing and eccentricity.
4. The heat generated.
5. The amount of artificial cooling required.
6. The mass of the lubricating oil required, If the difference between the outlet and inlet temperature of oil is 10°C .

Whether bearing is working under hydrodynamic condition or not? Assume bearing modulus = 14.

OR

- Q.5 (a)** Write the comparison of rolling contact bearing and sliding contact bearing. **05**

- (b)** SKF 6306 ball bearing with inner ring rotation has 10 seconds work cycle as follows: **09**

	For 2 sec.	For 8 sec.
Radial load	3640 N	2730 N
Axial load	1820 N	0
RPM	900	1200
Type of load	Light shock	Steady load

For SKF bearing static capacity, $C_o = 14600 \text{ N}$ and dynamic capacity, $C = 22000 \text{ N}$. Find the expected average life of the bearing.