Seat No.: _____   Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V • EXAMINATION – SUMMER • 2014

Subject Code: 151905   **Date: 26-06-2014**
**Subject Name: Machine Design - I**
Time: 10:30 am - 01:00 pm   **Total Marks: 70**
Instructions:
1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary and mention it clearly.**
3. **Figures to the right indicate full marks.**
4. **Draw neat sketches where necessary.**
5. **Use of standard design data book is permitted.**

Q.1	**(a)**	1. Discuss the pressure vessel materials.	**06**
		2. Explain pre-stressing of thick cylinders.	
	(b)	A high pressure cylinder consists of steel tube with 20 mm and 35 mm as inner and outer diameter 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 principal tensile stress in any tube is restricted to 100 MPa. Find the shrinkage pressure and original dimension of the tube. Also find distribution of principal stresses in compound cylinder.	**08**
Q.2	**(a)**	1. List and explain the factors affecting selection suitable clutch.	**06**
		2. Explain the importance of p-v product in break design.	
	(b)	The following data refers to a multi plate clutch:	**08**

Power to be transmitted = 4 kW   Speed = 750 r.p.m.
Outer radius of clutch plate = 70 mm   Inner radius of clutch plate = 40 mm
Permissible pressure for the lining = 0.35 MPa
Coefficient of friction = 0.10
Considering uniform wear criterion, calculate the number of bronze and steel plates required and the axial force required to keep the plate in contact.

OR

	(b)	A band brake shown in fig below is used to balance a torque of 980 N-m at the drum shaft. The drum diameter is 400 mm (rotating in clockwise direction) and the allowable pressure between lining and drum is 0.5 MPa. The coefficient of friction is 0.25. Design the steel band, shaft, brake lever and fulcrum pin, if all these elements are made from steel having permissible tensile stress 70 MPa and shear stress 50 MPa.	**08**

$\Theta = 120^{0}$

80 mm

600 mm
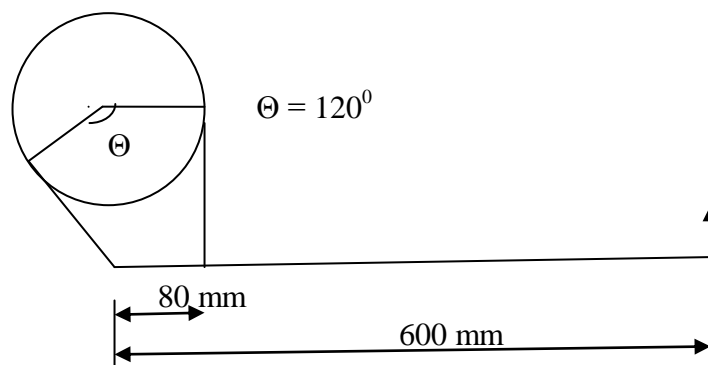
Q.3	**(a)**	1. Explain the importance of service factors and arc of contact factor in belt design.	**06**
		2. State the different belt tension adjustment devices and explain any one of them.	

(b) Select a simple roller chain drive to transmit 5 kW power 1400 r.p.m. from an   **08**
electric motor to a drilling machine.
Speed reduction = 3:1.   Approximate centre distance = 500 mm.
Service factor = 1.3   Assume moderate shock conditions.
number of teeth on pinion = 21
Also find no. of chain links and correct centre distance.

power rating (kW) of a simple roller chain

pinion speed(r.p.m.)	08A	08B	10A
1000	3.94	5.09	8.05
1400	5.28	6.81	11.18

OR

Q.3 **(a)** 1. State and explain the stresses induced in steel wires ropes.   **06**
2. State advantages of chain drives over belt drives.

(b) Design a V- belt drive from the following data :   **08**
Power to be transmitted = 7.5 kW
Motor speed = 1440 r.p.m.
Speed of driven pulley = 480 r.p.m
Centre distance between two pulleys = 1000 mm
Service factor = 1.3
Driver pulley diameter = 200 mm

Arc of contact (degree)	151	154	157	160	163
Arc of contact factor	0.93	0.93	0.94	0.95	0.96

Correction factor	belt pitch length (mm)		
for belt length	A	B	C
1.09	2480	3200	5380
1.10	2570	-	-
1.11	2700	3600	-

Q.4 **(a)** 1. State and explain the factors affecting selection of antifriction bearing.   **06**
2. Explain the bearing materials in detail.

(b) Design a journal bearing from the given specifications: Diameter   **08**
of journal = 50 mm   Speed of journal = 1800 rpm
Permissible bearing pressure = 1.4 N/mm^2
L/d ratio = 2   Ambient temperature = 35 ^{0}C.
Z.N / p = 28 (where p is MPa),   Operating temperature = 75 ^{0}C.
Temperature rise for oil is limited to 10 ^{0}C
Oil SAE10 Viscosity at 75 ^{0}C = 11 cp
Heat dissipation coefficient = 1232 W/ m^2 / ^{0}C
Specific heat of oil = 1760 J/Kg/ ^{0}C

OR

Q.4 **(a)** 1. Explain the thermal consideration in journal bearing design.   **06**
2. Explain the following:
Static load capacity, dynamic load capacity and equivalent load capacity.

(b) A single row deep groove ball bearing is subjected to a radial load of 8000 N and a **08** thrust load of 3000 N. The values of X and Y factors are 0.56 and 1.5 respectively. The shaft speed is 1200 r.p.m. and diameter of shaft is 75 mm. The bearing selected for this application is No.6315 (C = 112000 N).Find the life of the bearing with 90 % reliability and estimate the reliability for 20000 hr life.

Q.5 (a) Answer any two:
1. Explain buckling of spring in detail. **08**
2. Explain the designing for wear.
3. State and explain the factors affecting endurance strength of material.

(b) A machine component is subjected to fluctuating stress that varies from 40 to 100 **06** MPa. The corrected endurance limit stress for the machine component is 270 MPa. The ultimate tensile strength and yield strength of material are 600 and 450 MPa respectively. Calculate the factor of safety using 1. Gerber theory 2. Soderberg line and 3. Goodman line.

OR

Q.5 (a) Answer any two: **08**
1. Explain contact stresses and state its examples.
2. Write a detailed note on standardization.
3. Briefly explain the spring materials.

(b) Design a closed coil helical (neglecting the effect of stress concentration) spring **06** from the following data:
Maximum load = 2750 N
Minimum load = 2250 N
Axial deflection = 6 mm
Spring index = 5
Permissible shear stress = 420 MPa
Modulus of rigidity = 84 kN / mm^2

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