Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE – SEMESTER V • EXAMINATION – WINTER – 2012

Subject code: 151905 **Date: 22-01-2013**

Subject Name: Machine Design - I

Time: 02:30 pm to 05:00 pm **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Assume suitable data if required.**
5. **Draw neat sketches where necessary.**
6. **Use of standard design data book is permitted.**

Q.1 **(a)** Select a HI-SPEED belt for a light machine tool form the following given data: **08**

Power = 14.5 kW Motor speed = 1440 r.p.m.

Machine pulley speed = 360 r.p.m. Load factor = 1.2

Centre distance between pulley = 1000 mm Open belt drive

Load rating for belt = 0.023 kW per mm per width per ply at 180^0 arc of contact at 10 m/sec belt speed

Preferable pulley sizes: 200,224,250,280,315,400,450,500,560,630,710,800,900,1000 mm

Arc of contact (degree)	120	130	140	150	160
Arc of contact factor	1.33	1.26	1.19	1.13	1.08

No. of ply	**Standard width of belt in mm**									
4-ply	40	44	50	63	76	90	100	112	125	152
5-ply	76	100	112	125	152					

(b) (i) Write a detailed note on stresses induced in a belt. **06**

(ii) Compare the belt and chain drive.

Q.2 **(a)** (i) Write a detailed note on disc (bellievele) springs. **06**

(ii) Explain the buckling of spring. How can it be prevented?

(b) Design a leaf spring completely from the following data for the rear axle of tractor of trolley: **08**

Load on rear axle of tractor of trolley = 10000 N

Span = 1200 mm Width of clamp = 100mm

No. of main leaves = 2 Total no. of leaves = 12

No. of springs sharing the load = 2 $[\sigma_{bending}]$ for spring material = 300 MPa

Thickness of leaf = 10 mm $G = 0.84 \times 10^5$ MPa

$[\sigma_{bending}]$ for pin material = 120 MPa $[\sigma_{bearing}]$ for pin material = 10 MPa

OR

(b) Design a helical compression spring completely from the following data for single plate clutch for an automobile: **08**

Spring force exerted by all springs = 2400 N
No. of springs = 8 Deflection of each spring = 15mm
Spring index = 8 [τ] for spring material = 417 MPa
G = 0.814 x 10^5 MPa

Q.3 **(a)** (i) What is the importance of p-v products in brake design? **06**
(ii) Explain the uniform wear concept used in clutch design.

(b) Design a single plate clutch considering uniform wear criterion and effective two pair of contacting surfaces from the following specification: **08**
Power to be transmitted = 40 kW Speed = 1560 r.p.m.
Service factor = 1.25 Permissible pressure for the lining = 0.4 MPa
Coefficient of friction = 0.30 Outer diameter is limited to 300 mm
Permissible stress for shaft material = 45 MPa

OR

Q.3 **(a)** A brake as shown in figure-1 is fitted with a C.I. brake shoe. The braking torsional moment is to be 346 N-m. The drum diameter is 360 mm diameter. The coefficient of friction is 0.30. Find (i) force P for counter clockwise rotation (ii) force P for clockwise rotation (iii) where must the pivot be placed to make the brake self energizing with counter clockwise rotation. **08**

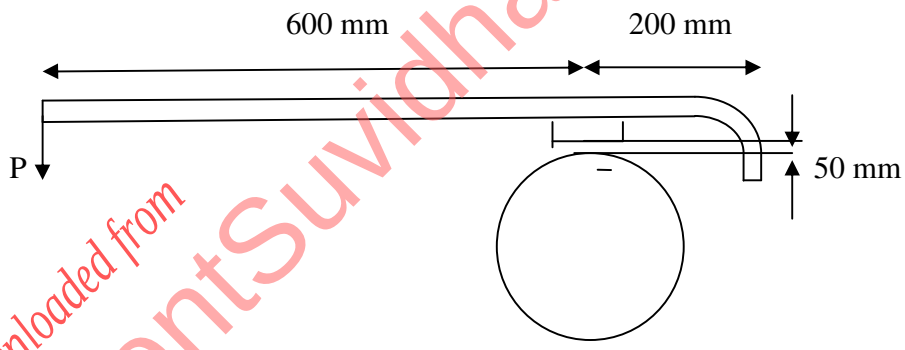

figure-1

(b) (i) Compare the simple band brake and differential band brake. **06**
(ii) List and explain the friction materials used in clutch.

Q.4 **(a)** A cold rolled steel transmission shaft is to be subjected to a fluctuating torque which varies from a -100 Nm to + 400 Nm. Determine the diameter of shaft using factor of safety 2.0 for the shaft material of take σ_{ut} = 500 MN/m^2, σ_{yp} = 300 MN/m^2 .Take surface condition modifying factor = 0.79, size factor = 0.85, load factor = 0.58, Stress concentration factor = 1 and reliability factor = 0.897. **07**

(b) Explain the following (any TWO): **07**
(i) Design for creep
(ii)Contact stresses
(iii) Assembly considerations in design
(iv) Factors affecting endurance strength of the materials

OR

Q.4 **(a)** Explain the following (any TWO): **07**
(i) Design for wear
(ii) Thermal considerations in design

(iii) Soderberg's diagram

(b) A hot rolled steel shaft is to be subjected to a torsional load that which varies from a 300 Nm clockwise to 100 Nm anticlockwise and bending moment at a critical section varies from a + 400 Nm to - 200 Nm. The shaft has uniform cross section and no keyway is present at the critical section. Determine the diameter of shaft, taking σ_{ut} = 560 MN/m^2, σ_{yp} = 420 MN/m^2 and factor of safety 1.5 for the shaft material .Take surface condition modifying factor = 0.62, Size factor = 0.85, Load factor = 0.58 for reversed torsional (for steel) and Load factor = 1 for reversed bending and Stress concentration factor = 1 . **07**

Q.5 **(a)** The following data refers to ball bearing work cycle: **08**

Sr. no.	Radial load (N)	Axial load (N)	Radial factor	Thrust factor	% time	Service factor	Speed in r.p.m.
1	4000	800	1	0	30 %	1.25	900
2	8000	3000	0.56	2	40 %	1	600
3	-	-	-	-	30 %	-	600

Calculate the dynamic load rating of the bearing, if the expected bearing life is 10000 hrs with reliability of 95 %.

(b) (i) Explain the autofrettage for pressure vessels. **06**
(ii) List and explain the factors affecting selection of pressure vessels materials.

OR

Q.5 **(a)** (i) Explain the static load capacity, dynamic load capacity and equivalent dynamic load capacity. **06**
(ii). List and explain the important pressure vessels materials.

(b) The following data refer to 360^0 hydrodynamic journal bearing: **08**

Journal speed = 900 rpm — End leakage factor = 0.002
Journal diameter =50 mm — Bearing length = 100 mm
Diametral clearance = 0.001 — bearing pressure = 1.4 N/mm^2
Absolute Viscosity of lubricant = 0.011 kg/m-sec at 75^{0}C operating temperature
Room temperature = 35 ^{0}C — Inlet temperature of the oil =10 ^{0}C
Specific heat of the oil = 1850 J/k/^{0}C — Heat dissipation Coefficient = 280W/ m^2/^{0}C
Calculate: (i) the amount of artificial cooling required (ii) the mass of the lubricating oil required.

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