

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 from the following given data: **08**

Power = 14.5 kW
Machine pulley speed = 360 r.p.m.
Centre distance between pulley = 1000 mm
Load rating for belt = 0.023 kW per mm per width per ply at 180° arc of contact at 10 m/sec belt speed
Motor speed = 1440 r.p.m.
Load factor = 1.2
Open belt drive
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 (bellievelle) 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
No. of main leaves = 2
No. of springs sharing the load = 2
MPa
Thickness of leaf = 10 mm
[σ_{bending}] for pin material = 120 MPa
Width of clamp = 100mm
Total no. of leaves = 12
[σ_{bending}] for spring material = 300 MPa
G = 0.84 x 10⁵ MPa
[σ_{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

$[\tau]$ for spring material = 417 MPa

$G = 0.814 \times 10^5$ 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**

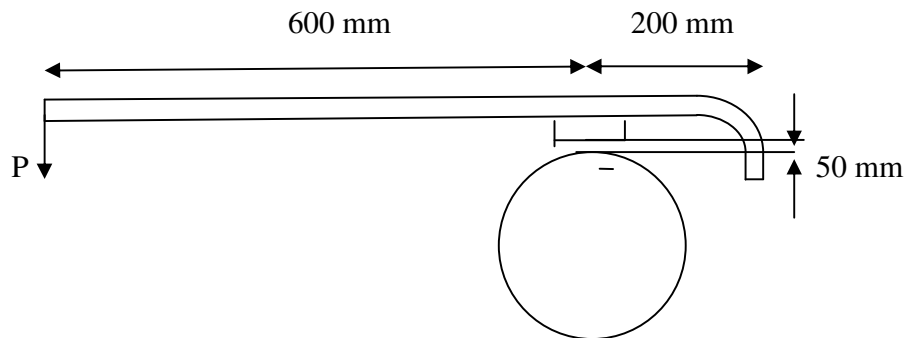


figure-1

- (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 $\sigma_{ut} = 500$ MN/m², $\sigma_{yp} = 300$ MN/m². 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 $\sigma_{ut} = 560 \text{ MN/m}^2$, $\sigma_{yp} = 420 \text{ MN/m}^2$ 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.

- 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° 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/mm²

Absolute Viscosity of lubricant = 0.011 kg/m-sec at 75°C operating temperature

Room temperature = 35 °C Inlet temperature of the oil = 10 °C

Specific heat of the oil = 1850 J/kg °C Heat dissipation Coefficient = 280W/ m²/°C

Calculate: (i) the amount of artificial cooling required (ii) the mass of the lubricating oil required.
