Student Exam No. _____

Ganpat University

B.Tech SEM V Mechatronics Engineering

Regular Examination November / December 2012

2MC503 Design of Machine Elements

Duration: 3hr **Marks: 70**

Instructions:

1. Assume suitable data if necessary.
2. Write your answer to the point and precisely.
3. Draw neat and clean sketch.

SECTION - 1

Q.1 **Attempt following questions**

(a) A plate made of steel 20C8 (Ultimate tensile strength = 440 N/mm^2) in hot rolled and normalized condition is shown in **Figure A.** It is subjected to a completely reversed axial load of 30 KN. The notch sensitivity factor can be taken as 0.8 and the expected reliability is 90%. The factor of safety is 2. Determine the plate thickness for infinite life. **[07]**

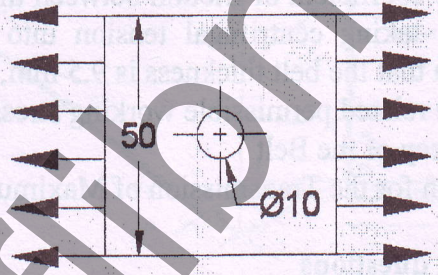

Figure. – A

(b) Explain Goodman Method for combination of stress **[03]**

(c) Define Fatigue and Endurance limit **[02]**

OR

Q.1 **Attempt following questions**

(a) A cantilever beam made of cold drawn carbon steel of circular cross section as shown in **Figure B.** is subjected to a load which is varies from –F to 3F. Determine the maximum load that this member can withstand for an indefinite life using a factor of safety as 2. The theoretical stress concentration factor is 1.42 and the notch sensitivity is 0.9. Assume the following values – **[09]**

Ultimate stress = 550 MPA
Yield Stress = 470 MPA
Endurance limit = 275 MPA
Size Factor = 0.85
Surface Finish Factor = 0.89

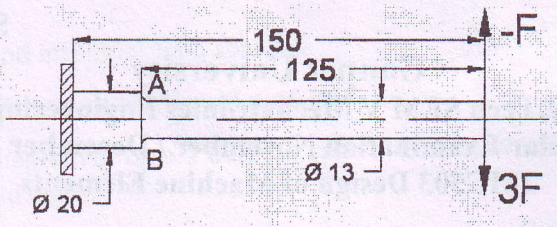

Figure – B.

(b) Explain Method of Reducing Stress Concentration. **[03]**

Q.2 **Attempt following questions**

(a) A leather belt 9 mm X 250 mm is used to drive a cast iron pulley 900 mm in diameter at 336 rpm. If the active arc on the smaller pulley is 120^0 and the stress in tight side is 2 MPa. Find the power capacity of the belt. The density of leather may be taken as 980 kg/m^3, and the Coefficient of friction of leather on cast iron is 0.35. **[07]**

(b) Explain Centrifugal Tension and derive $T_c = mv^2$ **[04]**

OR

Q.2 **Attempt following questions**

(a) A flat belt is required to transmit 30 KW from a pulley of 1.5 m effective diameter running at 300 rpm. The angle of contact is spread over 11/24 of the circumference. The coefficient of friction between the belt and pulley surface is 0.3. Determine, taking centrifugal tension into account, width of belt required. It is given that the belt thickness is 9.5 mm, density of its material is 1100 kg/m^3 and the related permissible working stress is 2.5 MPa. **[06]**

(b) Define Slip and Creep of the Belt **[02]**

(c) Derive the condition for the Transmission of Maximum Power **[03]**

Q.3 **Attempt following questions**

(a) A machine component is subjected to a flexure stress which fluctuates between + 300 MN/m^2 and – 150 MN/m^2. Determine the value of minimum ultimate strength according to **[07]**

1. Gerber Relation
2. Modified Goodman Relation
3. Soderberg Relation

Take Yield Strength = 0.55 X Ultimate Strength,
Endurance Strength = 0.5 X Ultimate Strength and Factor of Safety = 2.

(b) Two Pulley, one 450 mm diameter and the other 200 mm diameter on parallel shaft 1.95 m apart are connected by crossed belt. Find the length of the belt required and the angle of contact between the belt and each pulley. **[05]**
What power can be transmitted by the belt when the larger pulley rotates at 200 rev/min, if the maximum permissible tension in the belt is 1 KN, and the coefficient of friction between the belt and pulley is 0.25?

SECTION – II

Q.4 **Attempt following questions**

(a) What are the important factors in Brake Design? **[04]**

(b) A differential band brake is shown in **Figure C.** A steel tape of 80 mm width and of 2mm thickness wraps around an angle of 225° on a CI drum. If co-efficient of friction between steel tape and CI drum is 0.22, and maximum stress in steel tape is not to excess 60 MPa, what is the torque capacity of the brake? What is the actuating force P on the lever? If the brake is self-locking, what distance OA on lever, will make the brake self-locking? **[08]**

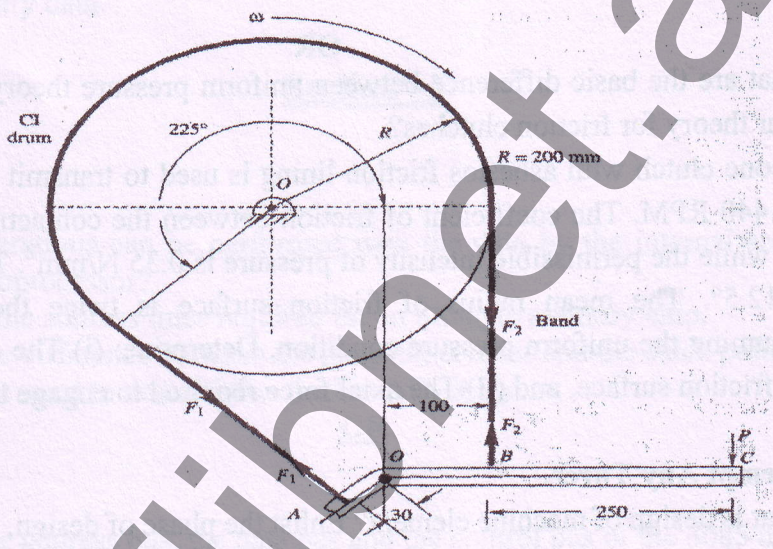

Figure C

OR

Q.4 **Attempt following questions**

(a) Is self-locking desirable? If so, under what conditions? **[04]**

(b) The hoisting system of the crane consists of a cable drum of mass 60 Kg, radius of gyration 0.2 m and radius 0.35 m, fitted to a cast iron brake drum of mass 20 Kg, radius of gyration 0.25 m and radius 0.425 m. The hoisting capacity of the crane is 20 kN at 3.2 m/s velocity. The braking is affected by a double block brake with each shoe subtending an arc of 40° on the brake drum. The brake has a capacity to bring the moving load to rest in 4 m of height. Here $\mu = 0.3$. Calculate: (i) The amount of heat generated in bringing the load to the rest; (ii) The temp. rise of brake drum, if the specific heat of the brake drum material is 400 J/Kg °C; and (iii) The dimensions of brake **[08]**

shoe, if an allowable pressure intensity is 1.0 N/mm^2.

Q.5 **(a)** What are the basic requirements of a good friction clutch? **[04]**

(b) In a multiple disc, clutch steel and bronze plates on driven and driver shafts transmit power 5 kW at 1000 RPM. Inner radius of the contacting surfaces is 0.6 times the outer radius. The clutch operates with an assumed coefficient of friction of 0.10. Average allowable pressure is 0.30 N/mm^2. If mean radius of clutch plates is 50 m, determine: (i) Total number of steel and bronze discs, and (ii) Actual maximum pressure for the designed clutch plates. Assume uniform wear theory. **[07]**

OR

Q.5 **(a)** What are the basic difference between uniform pressure theory and uniform wear theory for friction clutches? **[04]**

(b) A cone clutch with asbestos friction lining is used to transmit 30 kW power at 1440 RPM. The coefficient of friction between the contacting surfaces is 0.2 while the permissible intensity of pressure is 0.35 N/mm^2. The semi-cone is 12.5°. The mean radius of friction surface is twice the face width. Assuming the uniform pressure condition, Determine: (i) The dimensions of the friction surface, and (ii) The axial force required to engage the clutch. **[07]**

Q.6 **Attempt Any Three.** **[12]**

(a) What is design of machine element? Enlist the phase of design.

(b) Write the advantages of standardization.

(c) Consider the case of a clutch manufacturer, where he has to cover models running from 1.6 kW to about 10 kW at 1200 RPM.
Selecting the R10 series.

(d) Defines: (i) Links, (ii) Pair, (iii) Structure, (iv) Regid Link

END OF PAPER