Student Exam No._____

Ganpat University

B. Tech. Semester: V Mechatronics Engineering

CBCS Regular Examination November – December 2014

2MC503 - Design of Machine Elements

[Time: 3 Hour] [Total marks: 70]

Instructions:

(1) Attempt all questions.
(2) Figure to the **right** indicate full marks.
(3) Assume suitable data if necessary.
(4) Only scientific calculator is allowed.
(5) Draw neat sketch wherever essential.

SECTION-I

Que.1 Explain following.

(A) Explain overseas standards (e.g., ASTM, DIN, SAE, AISI) for ferrous materials. [4]
(B) What are the salient features used in the design of forgings? Explain. [4]
(C) Enlist theories of failure and explain maximum shear stress theory. [4]

OR

Que.1 Explain following.

(A) Draw and describe stress strain diagram for mild steel. [4]
(B) State and explain the design considerations of welded assemblies. [4]
(C) Write ergonomic considerations in machine design. [4]

Que.2 Explain following.

(A) Explain various factors for correcting endurance limit. [4]
(B) A machine part shown in **Fig.-1** is subjected to a completely reversed load cycle of 20 kN. The notch sensitivity can be assumed as 0.7. Determine the life of the component, if the factor of safety is 0.6. Assume Ultimate tensile strength as 400 MPa. The surface factor is 0.7, size factor is 0.85 and the calculations are expected at 50% reliability. The theoretical stress concentration factor for shoulder section is 2.3 and for hole section is 2.25. [7]

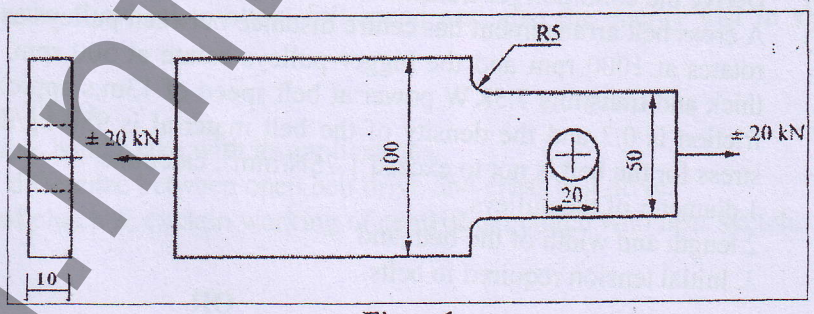

Fig. – 1

OR

Que.2 Explain following.

(A) What is dynamic loading? Explain different types of dynamic stresses with neat sketches. [4]
(B) A stepped steel shaft ABCDE supported in bearings as shown in **Fig-2**, is subjected to a non-rotating force of 4000 N. Shaft is rotating and is machined from steel with an ultimate tensile strength of 500 MPa. Taking surface finish factor as 0.8, size factor as 0.85, reliability factor as 0.897 for 90% reliability. Find the expected life of the shaft using the factor of safety as 1.25, if all the fillets are of 3 mm radius. Take value of the theoretical stress concentration factor as 1.68 and notch sensitivity as 0.78. [7]

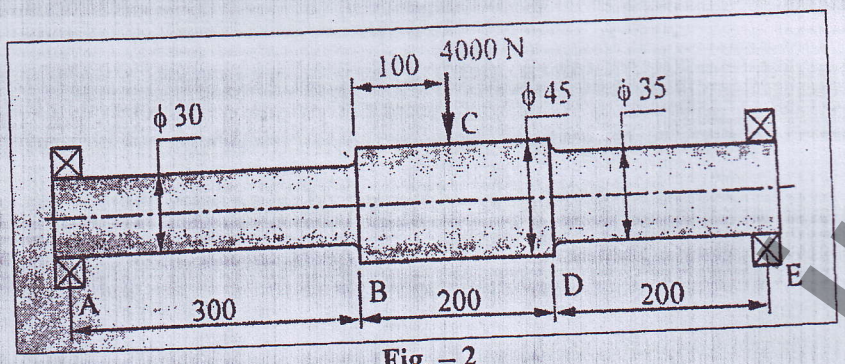

Fig. – 2

Que.3 Explain following.

(A) Find degrees of freedom for following mechanisms shown in **Fig.-3** using kutzbach Justify criterion. **[4]**

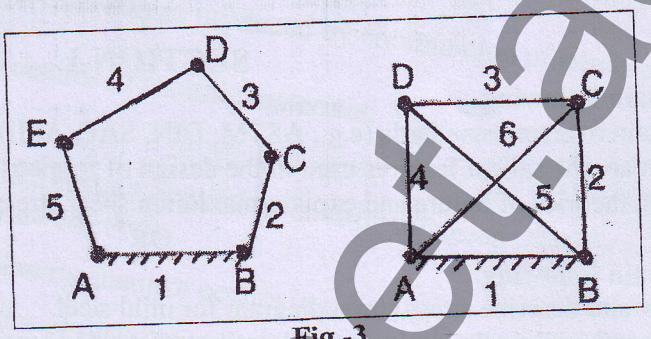

Fig.-3

(B) A shaft is required to transmit 1 MW power at 240 rpm. The shaft must not twist more than 1° on a length of 15 diameters. If the modulus of the rigidity for the material of the shaft is 80 GPa, find the diameter of the shaft and shear stress induced. **[4]**

(C) What do you understand by torsional rigidity and lateral rigidity? Explain. **[4]**

SECTION – II

Que.4 Explain following.

(A) Derive the condition for transmission of maximum power with both approaches? **[5]**

(B) A cross belt arrangement has centre distance between pulleys as 1500 mm .The small pulley rotates at 1000 rpm and the bigger pulleys rotate at 500 rpm. The flat belt used is 6 mm thick and transmits 7.5KW power at belt speed of 13m.s approximately. The co efficient of friction is 0.3 and the density of the belt material is 950 kg/m^3. If the permissible tensile stress for the belt is not to exceed 1.75N/mm^2, calculate. **[6]**

1.diameter of the pulleys,

2.length and width of the belt ,and

3. Initial tension required in belts.

OR

Que.4 Explain following.

(A) Explain the design of arms of cast iron pulleys. **[5]**

(B) A flat belt is required to transmit 30kw from a pulley of 1.5m effective diameter running at 300rpm.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 the belt required. It is given that the belt thickness is 9.5 mm, density of its material is 1100 kg/m and the related permissible working stress is 2.5 MPa. **[6]**

Que.5 Explain following.

(A) Derive the equation of torque transmitting capacity for single plate clutch using all possible approaches. [5]

(B) In a simple band brake as shown in **Fig.-4**, the length of lever is 440 mm. The tight end of the band is attached to the fulcrum of the lever and the slack end to a pin 50 mm from the fulcrum. The diameter of the brake drum is 1 m and the arc of contact is 300°. The coefficient of friction between the band and the drum is 0.35. The brake drum is attached to a hoisting drum of diameter 0.65 m that sustains a load of 20 kN. Determine; [7]

1. Force required at the end of lever to just support the load.
2. Required force when the direction of rotation is reversed.
3. Width of steel band if the tensile stress is limited to 50 N/mm.

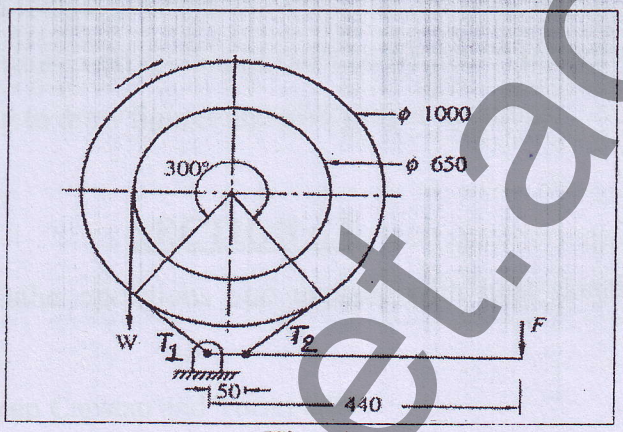

Fig. -4

OR

Que.5 Explain following.

(A) Explain internal expanding brake. [5]

(B) The contact surfaces in a cone clutch have an effective diameter of 80 mm. The semi angle of the cone is 15° and co-efficient of friction is 0.3. Find the torque required to produce slipping of the clutch if the axial force applied is 200N. The clutch is employed to connect an electric motor running uniformly at 900 rpm with a flywheel which is initially stationary the flywheel has a mass of 14 kg and its radius of gyration is 160 mm. Calculate the time required for the flywheel to attain full speed and also the energy lost in slipping of the clutch. [7]

Que.6 Explain any TWO. [12]

(A) Explain simple band brake with its applications.

(B) Explain the difference between open belt drive and cross belt drive.

(C) Enlist type of clutch & explain working of centrifugal clutch with neat sketch.

END OF PAPER