AJEENKYA
D Y PATIL UNIVERSITY

End Term Examinations (April 2019)

School: School of Engineering **Program: B-Tech Mechatronics**

Course: Machine Design **Course Code: MTE305**

Semester: VI **Max Marks: 50** **Duration (mins): 150**

A. Attempt any 3 questions 8 marks each: (24)

1. Explain the criterion for design against static loading. Also, explain the distribution of stresses due to bending moment and sign conventions in a straight beam.
2. Write a note on Soderberg and Goodman lines.
3. Write a note on theories of elastic failure. Elaborate Maximum shear stress theory.
4. What is a power screw? Explain the torque requirement for lifting the load. Give a brief detail of the self-locking screw condition.
5. Write a note on “Shaft design on strength basis”.
   Develop the simple equations by applying the principal stress theory and maximum shear stress theory to a transmission shaft subjected to combined bending and torsional moments.
6. Write a note on types of rolling contact bearings and explain the principle of self-aligning bearing.

B. Attempt any 2 questions 10 marks each: (20)

1. A helical compression spring, made of circular wire, is subjected to an axial force, which varies from 2.5 kN to 3.5 kN. Over this range of force, the deflection of the spring should be approximately 5 mm. The spring index can be taken as 5. The spring has square and ground ends. The spring is made of patented and cold drawn steel wire with ultimate tensile strength of 1050 N/mm^2 and modulus of rigidity of 81370 N/mm^2. The permissible shear stress for the spring wire should be taken as 50% of the ultimate tensile strength. Design the spring and calculate
   a. wire diameter;
   b. mean coil diameter;

c. number of active coils;
d. total number of coils;
e. solid length of the spring;
f. free length of spring;
g. required spring rate; and
h. actual spring rate

2. A 45 mm diameter shaft is made of steel with a yield strength of 400 MPa. A parallel key of size 14 mm wide and 9 mm thick made of steel with a yield strength of 340 MPa is to be used. Find the required length of key, if the shaft is loaded to transmit the maximum permissible torque. Use maximum shear stress theory and assume a factor of safety of 2.

3. A rod of a linkage mechanism made of steel 40C11 (S_{ut} = 550 N/mm^2) is subjected to a completely reversed axial load of 100 kN. The rod is machined on a lathe and the expected reliability is 95%. There is no stress concentration. Determine the diameter of the rod using a factor of safety of 2 for an infinite life condition.

4. A forged steel bar, 50 mm in diameter is subjected to a reversed bending stress of 250 N/mm^2. The bar is made of steel 40C8 (S_{ut} = 600 N/mm2). Calculate the life of the bar for a reliability of 90%.

C. Attempt the following question 6 marks: (06)

Two plates, subjected to a tensile force of 50kN, are fixed together by means of three rivets as shown in below figure. The plates and rivets are made of plain carbon steel 10C4 with a tensile yield strength of 250 N/mm^2. The yield strength in shear is 50% of the tensile yield strength and the factor of safety is 2.5. Neglecting stress concentration, determine:

(i) diameter of the rivets and
(ii) thickness of the plates.