Reg. No. : | | | | | | | | | | |

Question Paper Code: 41753

B.E. / B.Tech. DEGREE EXAMINATION, MAY 2017

Fifth Semester

Mechanical Engineering

14UME503 - DESIGN OF MACHINE ELEMENTS

(Regulation 2014)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. Factor of safety for fatigue loading is the ratio of

   (a) elastic limit to the working stress
   (b) Young's modulus to the ultimate tensile strength
   (c) endurance limit to the working stress
   (d) elastic limit to the yield point

2. The bending stress in a curved beam is

   (a) Zero at the centroidal axis (b) Zero at the point other than centroidal axis
   (c) Maximum at the neutral axis (d) Minimum at the neutral axis

3. A keyway lowers

   (a) The strength of the shaft
   (b) The rigidity of the shaft
   (c) Both the strength and rigidity of
   (d) The ductility of the material the shaft of the shaft

4. The sleeve or muff coupling is designed as a

   (a) thin cylinder (b) thick cylinder
   (c) solid shaft (d) hollow shaft

5. The shock absorbing capacity of a bolt may be increased by

(a) increasing its shank diameter
(b) decreasing its shank diameter
(c) tightening the bolt properly
(d) making the shank diameter equal to the core diameter of the thread

6. When a nut is tightened by placing a washer below it, the bolt will be subjected to

(a) tensile strength (b) compressive strength
(c) bending strength (d) shear strength

7. When helical compression spring is cut into halves, the stiffness of the resulting spring will be

(a) same (b) double (c) one-half (d) one-fourth

8. The springs mostly used in watch is

(a) Helical spring (b) Conical spring
(c) Laminated spring (d) Flat spiral spring

9. When the length of the journal is equal to the diameter of the journal, then the bearing is said to be a

(a) short bearing (b) long bearing
(c) medium bearing (d) square bearing

10. Which of the following is antifriction bearing?

(a) Journal bearing (b) Pedestal bearing
(c) Collar bearing (d) Needle bearing

PART - B (5 x 2 = 10 Marks)

11. List out the methods of reducing stress concentration factor.

12. Write down the Dunkerley's equation for the critical speed of the shaft.

13. How is a bolt designated?

14. What is the objective of the nipping in the leaf spring?

15. State the required properties of bearing materials.

PART - C (5 x 16 = 80 Marks)

16. (a) A machine component is subjected to a flexural stress which fluctuates between +300 MN/m^2.Determine the value of minimum ultimate strength according to 1.Gerber relation; 2. Modified Goodman relation; and 3. Soderberg relation Take yield strength = 0.55 Ultimate strength Endurance strength = 0.5 Ultimate strength; and factor of safety = 2. (16)

Or

(b) A 50 *mm* diameter shaft is made from carbon steel having ultimate tensile strength of 630 *MPa*. It is subjected to a torque which fluctuates between 2000 *N-m* to – 800 *N-m*. Using Soderberg method, calculate the factor of safety. Assume suitable values for any other data needed. (16)

17. (a) Design and draw a protective type of cast iron flange coupling for a steel shaft transmitting 15*kW* at 200 *r.p.m* and having an allowable shear stress of 40 *MPa*. The working stress in the bolts should not exceed 30 *MPa*. Assume that the same material is used for shaft and key and that the crushing stress is twice the value of its shear stress. The maximum torque is 25% greater than the full load torque. The shear stress for cast iron is 14 *MPa*. (16)

Or

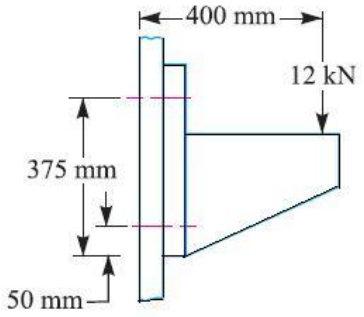
(b) A 45 *mm* diameter shaft is made of steel with a yield strength of 400 *MPa*. A parallel key of size 14 *mm* wide and 9 *mm* thick made of steel with a yield strength of 340 *MPa* is to be used. Find the required length of key, if the shaft is loaded to transmit the maximum permissible torque. Use maximum shear stress theory and assume a factor of safety of 2. (16)

18. (a) Design a lap joint for a mild steel flat tie-bar 200 *mm* × 10 *mm* thick, using 24 *mm* diameter rivets. Assume allowable stresses in tension and compression of the plate material as 112 *MPa* and 200 *MPa* respectively and shear stress of the rivets as 84 *MPa*. Show the disposition of the rivets for maximum joint efficiency and determine the joint efficiency. Take diameter of rivet hole as 25.5 *mm* for a 24 *mm* diameter rivet. (16)

Or

(b) For supporting the travelling crane in a workshop, the brackets are fixed on steel columns as shown in fig 1. The maximum load that comes on the bracket is 12*kN* acting vertically at a distance of 400 *mm* from the face of the column. The vertical face of the bracket is secured to a column by four bolts, in two rows (two in each

row) at a distance of 50 *mm* from the lower edge of the bracket. Determine the size of the bolt if the permissible value of the tensile stress for the bolt material 84 *Mpa*. Also find the cross-section of the arm of the bracket which is rectangular. (16)



19. (a) A mechanism used in printing machinery consists of a tension spring assembled with a preload of 30 *N*. The wire diameter of spring is 2 *mm* with a spring index of 6. The spring has 18 active coils. The spring wire is hard drawn and oil tempered having following material properties: Design shear stress = 680 *MPa*; Modulus of rigidity = 80 kN/mm^2. Determine: 1. The initial torsional shear stress in the wire; 2. spring rate; and 3. The force to cause the body of the spring to its yield strength. (16)

Or

(b) A helical spring is made from a wire of 6 *mm* diameter and has outside diameter of 75 *mm*. If the permissible shear stress is 350*Mpa* and modulus of rigidity 84 KN/mm^2, Find the axial load which the spring can the deflection per active turn. (16)

20. (a) A Full journal bearing of 50 *mm* diameter and 100 *mm* long has a bearing pressure of 1.4 N/mm^2. The speed of the journal is 900 *r.p.m* and the ratio of journal diameter clearance is 1000.The bearing is lubricated with oil whose absolute viscosity at the operating temperature of 75^oC may be taken as 0.011 kg/m^2. The room temperature is 35^oC.Find 1. The amount of the artificial cooling required, and 2. The mass of the lubricating oil required, if the difference between the outlet and inlet temperature of the oil at 10^oC.Take specific heat of the oil as 1850 $J/kg/^oC$. (16)

Or

(b) Select a single row deep groove ball bearing for a radial load of 4000 *N* and an axial load of 5000 *N*, operating at a speed of 1600 *r.p.m*. for an average life of 5 years at 10 hours per day. Assume uniform and steady load. (16)