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

Question Paper Code: 41753

B.E. / B.Tech. DEGREE EXAMINATION, NOV 2016

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 design of shafts made of brittle materials is based on

   (a) Guest's theory (b) Rankine's theory
   (c) St. Venant's theory (d) Von Mises Theory

3. Two shafts *A* and *B* are made of the same material. The diameter of the shaft *A* is twice as that of shaft *B*. The power transmitted by the shaft *A* will be _____ of shaft *B*

   (a) twice (b) four times (c) eight times (d) sixteen times

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. The parallel fillet welded joint is designed for _____

(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 cross-section of the flywheel arms is usually

(a) elliptical (b) rectangular (c) I-section (d) L-section

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. The ball bearings are usually made from

(a) low carbon steel (b) medium carbon steel
(c) high speed steel (d) chrome nickel steel

PART - B (5 x 2 = 10 Marks)

11. List the various phases of design process.

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

13. How is a bolt designated?

14. What is spring index?

15. State the required properties of bearing materials.

PART - C (5 x 16 = 80 Marks)

16. (a) A mild steel shaft of 50 *mm* diameter is subjected to a bending moment of 2000 *N-m* and a torque *T*. If the yield point of the steel in tension is 200 *MPa*, find the maximum value of this torque without causing yielding of the shaft according to 1. The maximum principal stress; 2. The maximum shear stress; and 3. The maximum distortion strain energy theory. (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) A solid circular shaft is subjected to a bending moment of 3000 *N-m* and a torque of 10000 *N-m*. The shaft is made of 45*C*8 steel having ultimate tensile stress of 700 *MPa* and a ultimate shear stress of 500 *MPa*. Assuming a factor of safety as 6, determine the diameter of the shaft. (16)

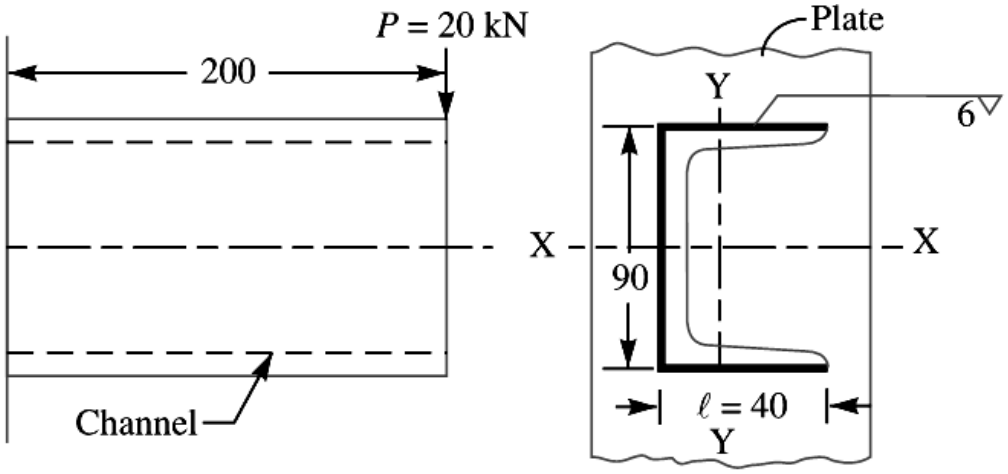
Or

(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) Find the maximum shear stress induced in the weld of 6 *mm* size when a channel, as shown in figure, is welded to a plate and loaded with 20 *kN* force at a distance of 200 *mm*. (16)



All dimensions in mm.

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) The areas of the turning moment diagram for one revolution of a multi-cylinder engine with reference to the mean turning moment, below and above the line, are – 32, + 408, – 267, + 333, – 310, + 226, – 374, + 260 and – 244 mm^2. The scale for abscissa and ordinate are: 1 *mm* = 2.4° and 1 *mm* = 650 *N-m* respectively. The mean speed is 300 *r.p.m*. with a percentage speed fluctuation of ± 1.5%. If the hoop stress in the material of the rim is not to exceed 5.6 *MPa*, determine the suitable diameter and cross-section for the flywheel, assuming that the width is equal to 4 times the thickness. The density of the material may be taken as 7200 kg / m^3. Neglect the effect of the boss and arms. (16)

20. (a) The load on the journal bearing is 150 *kN* due to turbine shaft of 300 *mm* diameter running at 1800 *r.p.m*. Determine the following : 1. Length of the bearing if the allowable bearing pressure is 1.6 N/mm^2, and 2. Amount of heat to be removed by the lubricant per minute if the bearing temperature is 60°*C* and viscosity of the oil at 60°*C* is 0.02 *kg/m-s* and the bearing clearance is 0.25 *mm*. (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)

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