Reg. No. :

Question Paper Code: 45703

B.E. / B.Tech. DEGREE EXAMINATION, MAY 2018

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. 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

5. The parallel fillet welded joint is designed for _____

    (a) Tensile strength   (b) Compressive strength

    (c) Bending strength   (d) Shear strength

6. The transverse fillet welded joints are designed for

    (a) Tensile strength   (b) Compressive strength

    (c) Bending strength   (d) Shear strength

7. The cross-section of the flywheel arms is usually

    (a) Elliptical   (b) Rectangular   (c) I-section   (d) L-section

8. The stress in the full length leaf is _____% more than the stress induced in the graduated leaf

    (a) 50%   (b) 25%   (c) 40%   (d) 0%

9. The bearing used to connect the big end of connecting rod to crank Shaft is

    (a) Needle roller bearings   (b) Tapered roller bearings

    (c) Sliding contact bearings   (d) Cylindrical roller bearings

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. List the different stresses setup in a bolt due to initial tightening.

14. What is spring index?

15. Distinguish flywheel and a governor.

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 bar 3 *m* long is made of two bars, one of copper having $E = 105$ GN/m^2 and the other of steel having $E = 210$ GN/m^2.Each bar is 25*mm* broad and 12.5*mm* thick. This compound bar is stretched by a load 50 *KN*. Find the increase in length of the compound bar and the stress produced in the steel and copper. The length of the copper as well as of steel bar is 3 *m* each. (16)

17. (a) A Shaft Supported at the ends in ball bearing carries a straight tooth spur gear at its mid span and is to transmit 7.5 *KW* at 300 *r.p.m*. The pitch circle diameter of the gear is 150 *mm*. The distance between the centre line of bearing and gear are 100 *mm* each. If the shaft is made of steel and the allowable shear stress is 45 *MPA* determine the diameter of the shaft. Show in a sketch how the gear will be mounted on the shaft. also indicate the ends where the bearing will be mounted ? and the pressure angle of the gear may be taken as 20^oC. . (16)

Or

(b) 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)

18. (a) 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)

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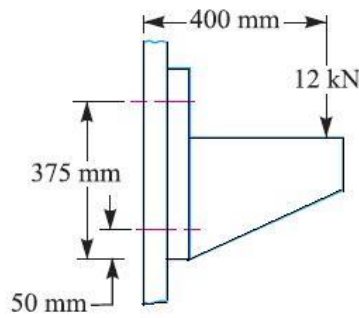
Or

(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)
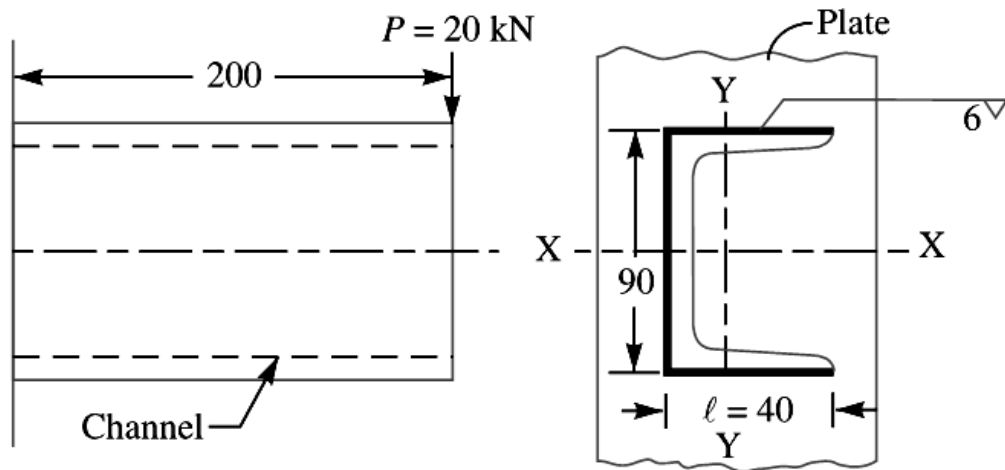
All dimensions in mm.

19. (a) A 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/mm²*, Find the axial load which the spring can the deflection per active turn. (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 *mm²*. 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 / m³*. Neglect the effect of the boss and arms. (16)

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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/mm²*, 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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