Reg. No. :

Question Paper Code: 44703

B.E. / B.Tech. DEGREE EXAMINATION, NOV 2019

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. The stress which vary from a minimum value to a maximum value of the same nature (i.e. tensile or compressive) is called

    (a) Repeated stress   (b) Yield stress
    (c) Fluctuating stress   (d) Alternating stress

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 transverse fillet welded joints are designed for

    (a) Tensile strength   (b) Compressive strength
    (c) Bending strength   (d) Shear strength

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 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. 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 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 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)

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Or

(b) 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)

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 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)
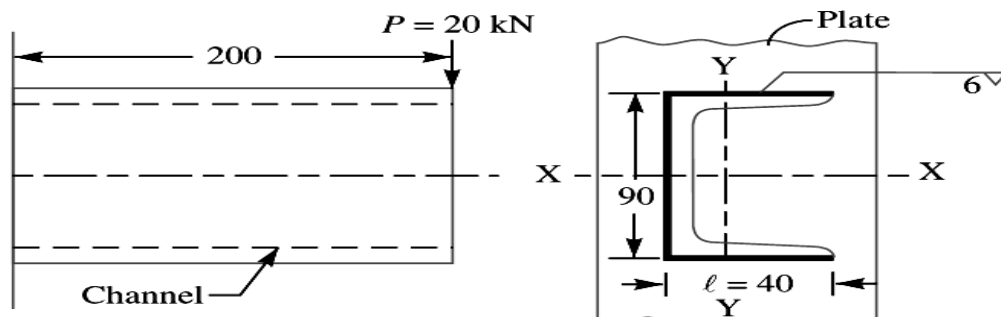
All dimensions in mm.

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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/mm²*. 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 intercepted areas between the output torque curve and the mean resistance line a turning moment diagram for a multi cylinder engine, taken in order from one end are as follows: -35, + 410, - 285,+ 325, -335, + 260, - 365,+285, - 260 *mm²*. The diagram has been drawn to a scale of 1 *mm* = 70 *N-m* and 1 *mm* = 4.5°. The engine speed is 900 *r.p.m* and fluctuation in speed is not to exceed 2 % of the mean speed. Find the mass and cross-section of the flywheel rim having 650 *mm* mean diameter. The density of the material of the flywheel may be taken as 7200 *kg/m³*. The rim is rectangular with the width 2 times the thickness. Neglect effect of arms, etc. (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/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) A Full journal bearing of 50 *mm* diameter and 100 *mm* long has a bearing pressure of 1.4 *N/mm²*. 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°*C* may be taken as 0.011 *kg/m²*. The room temperature

is 35°*C*.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°*C*.Take specific heat of the oil as 1850 *J/kg/°C*. (16)

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