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Question Paper Code: 44703

B.E. / B.Tech. DEGREE EXAMINATION, NOV 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. 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. 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 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 springs mostly used in watch is
- (a) Helical spring (b) Conical spring
(c) Laminated spring (d) Flat spiral spring
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. 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. Why a hollow shaft has greater strength and stiffness than solid shaft of equal weight?
13. List the different stresses setup in a bolt due to initial tightening.
14. What is spring index?
15. State the required properties of bearing materials.

PART - C (5 x 16 = 80 Marks)

16. (a) A bar 3 m long is made of two bars, one of copper having $E = 105 \text{ GN/m}^2$ and the other of steel having $E = 210 \text{ GN/m}^2$. Each bar is 25mm broad and 12.5mm 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)

Or

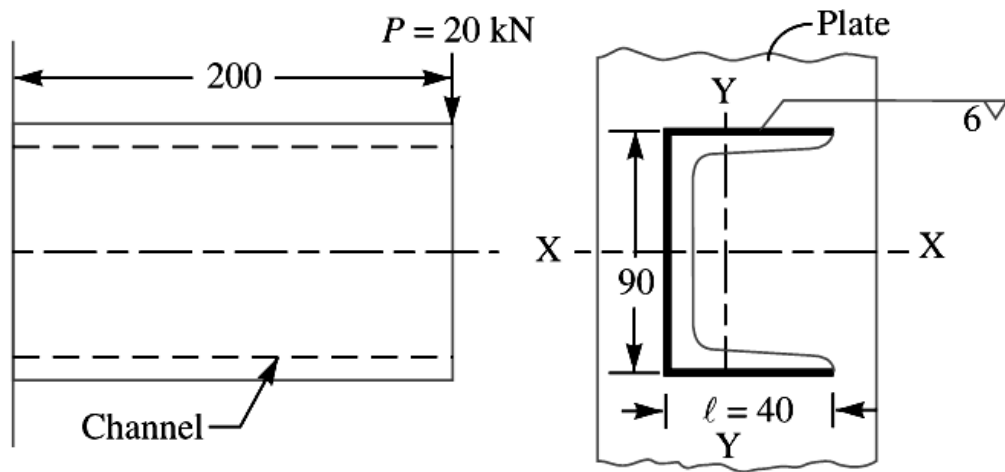
- (b) A machine component is subjected to a flexural stress which fluctuates between $+300 \text{ MN/m}^2$. Determine the value of minimum ultimate strength according to 1. Gerber relation; 2. Modified Goodman relation; and 3. Soderberg relation. Take yield strength = 0.55 Ultimate strength, Endurance 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°C . (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 $200 \text{ mm} \times 10 \text{ mm}$ 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 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 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) 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)

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.

