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Question Paper Code: 45703

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)

- The stress which vary from a minimum value to a maximum value of the same nature (i.e. tensile or compressive) is called
 - Repeated stress
 - Yield stress
 - Fluctuating stress
 - Alternating stress
- The bending stress in a curved beam is
 - Zero at the centroidal axis
 - Zero at the point other than centroidal axis
 - Maximum at the neutral axis
 - Minimum at the neutral axis
- 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*
 - twice
 - four times
 - eight times
 - sixteen times
- A keyway lowers
 - The strength of the shaft
 - The rigidity of the shaft
 - Both the strength and rigidity of
 - The ductility of the material the shaft of the shaft
- The transverse fillet welded joints are designed for
 - Tensile strength
 - Compressive strength
 - Bending strength
 - Shear strength

6. The transverse fillet welded joints are 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. 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 the various phases of design process.
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 the objective of the nipping in the leaf spring?
15. Distinguish flywheel and a governor.

PART - C (5 x 16 = 80 Marks)

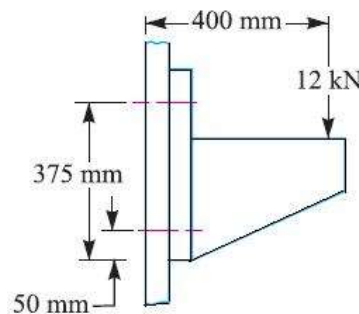
16. (a) A bar 3 m long is made of two bars, one of copper having $E = 105 \text{ GN/m}^2$ and the other of steel having $E = 210 \text{ GN/m}^2$. Each bar is 25mm broad and 12.5mm thick. This compound bar is stretched by a load 50 KN. Find the increase in length of the compound bar and the stress produced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

Or

- (b) A 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 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)

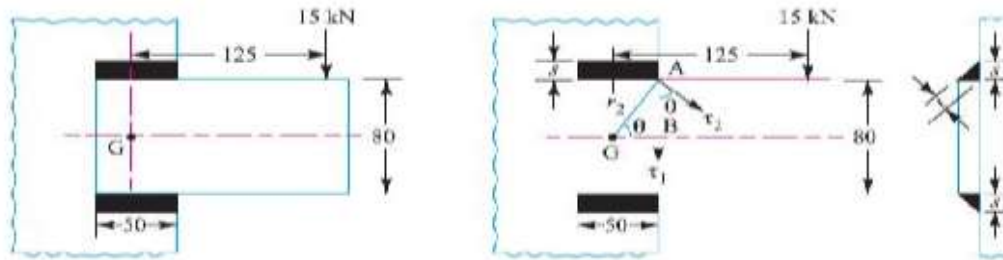
Or

- (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) 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 12kN 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)



Or

- (b) A Bracket carrying a load of 15 kN is to be welded as shown in figure. Find the size of weld required if the allowable shear stress is not to exceed 80 Mpa. (16)



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 of 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. (16)

