A   **Reg. No. :** [ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]

Question Paper Code: 55703

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

Fifth Semester

Mechanical Engineering

15UME503 - DESIGN OF MACHINE ELEMENTS

(Regulation 2015)

(Approved data book are permitted)

Duration: Three hours   Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. Ability of a material to undergo large permanent deformation in   CO1- R
   tension is called

   (a) Toughness   (b) Stiffness   (c) Plasticity   (d) Hardness

2. Select the theory of failure for an aluminum component under steady   CO1- R
   loading

   (a) Principal stress theory   (b) Principal strain theory

   (c) Strain energy theory   (d) Maximum shear stress theory

3. The angle of twist for a transmission shaft is inversely proportional to   CO2- R

   (a) Shaft diameter   (b) Shaft diameter^2 (c) Shaft diameter^3 (d) Shaft diameter^4

4. A key connecting a flange coupling to a shaft is likely to fail in   CO2- R

   (a) Shear   (b) Tension   (c) Torsion   (d) Bending

5. In fillet welded joint weakest area of weld is   CO3- R

   (a) Throat   (b) Root   (c) Face   (d) Toe

6. When a nut is tightened by placing a washer below it, the shank of bolt is subjected to   CO3- R

    (a) Direct shear stress   (b) Torsional shear stress

    (c) Tensile stress   (d) Compressive stress

7. When a helical spring is cut into two equal halves, stiffness of each of the resulting spring will be   CO4- R

    (a) Unaltered   (b) Double   (c) One half   (d) One fourth

8. The cross section of the flywheel arm(or spoke) is   CO4- R

    (a) I section   (b) Rectangular   (c) Elliptical   (d) Circular

9. In radial bearings, the load acts   CO5- R

    (a) Along the axis of rotation   (b) Perpendicular to the axis of the rotation

    (c) Parallel to the axis of rotation   (d) Inclined to the axis of rotation

10. Whipping stress in due to   CO5- R

    (a) Vibration of crank shaft   (b) Reciprocating motion of piston

    (c) Inertia force on connecting rod   (d) Obliquity of connecting rod

<div align="center">PART – B (5 x 2= 10Marks)</div>

11. State the three modes of failure occur in mechanical components.   CO1- R

12. List the reasons for using hollow shaft than solid shaft in transmission of power   CO2- U

13. What is meant by caulking?   CO3- R

14. State the reasons for using cast Iron flywheel.   CO4- R

15. List the application areas of sliding bearing and rolling bearing.   CO5- U

<div align="center">PART – C (5 x 16= 80Marks)</div>

16. (a)   A transmission shaft carries a pulley midway between the two bearings. The bending moment at the pulley varies from 200Nm to 600Nm,as the torsional moment in the shaft varies from 70Nm to 200Nm. The frequencies of variation of bending and torsional moments are equal to the shaft speed. The shaft is made of steel Fe400(S_{ut}=540N/mm^2 and S_{yt}=400N/mm^2).The corrected endurance limit of the shaft is 200N/mm^2.Determine the diameter of the shaft using FOS of 2.   CO1- App   (16)

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Or

(b) A mass of 50Kg drops through 25mm at the center of a 250mm long simply supported beam. The beam has square cross section. It is made of steel 30C8 (S_{yt}=400N/mm^2) and FOS is 2. The modulus of elasticity is 207GPa.Determine the dimension of the cross section of the beam.   CO1- App   (16)

17. (a) A shaft of 1m long is supported by two bearings 500mm apart. The pulley 1 of 250mm diameter is attached on the left extreme side of the shaft whereas the pulley 2 of 500mm diameter is attached on the right extreme side of the shaft. The masses of pulley 1 and 2 are 10 and 30kg respectively. The belt tensions act vertically downward and the ratio of belt tensions on the tight side to slack side of each pulley is 2.5:1. The shaft is made of plain carbon steel 40C8 (S_{yt}=380N/mm^2) and the FOS is 3. Estimate suitable diameter of the shaft. If the permissible angle of twist is 0.5° per meter length, calculate the shaft diameter on the basis of torsional rigidity. G=79300N/mm^2 .   CO2- App   (16)

Or

(b) Design a muff coupling to connect two steel shafts transmitting 25kW power at 360rpm. The shafts and key are made of plain carbon steel 30C8 (S_{yt}=S_{yc}=400N/mm^2). The sleeve is made of grey cast iron FG200 (S_{ut}=200N/mm^2). The factor of safety for the shafts and key is 4. For sleeve, the factor of safety is 6 based on ultimate strength.   CO2- App   (16)

18. (a) It is required to design a knuckle joint to connect two circular rods subjected to an axial tensile force of 50kN. The rods are co-axial and small angular movement between their axes is permissible. Design the joint and specify the dimensions of its components and select suitable materials for the parts.   CO3- App   (16)

Or

(b) A steel plate, 100mm wide and 10mm thick is joined with another steel plate by means of a single transverse and double parallel fillet welds. The strength of the welded joint should be equal to the strength of the plates to be joined. The permissible tensile and shear stresses for the weld materials and the plates are 70 and 50N/mm2 respectively. Find the length of each parallel fillet weld. Assume tensile force acting on the plates as static.   CO3- App   (16)

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19. (a) A railway wagon moving at a velocity of 1.5m/s is brought to rest CO4- App (16)
by a bumper consisting of two helical springs arranged in parallel.
The mass of the wagon is 1500kg. The springs are compressed by
150mm in bringing the wagon to rest. The spring index is 6. The
springs are made of oil hardened and tempered steel wire
(G=81370N/mm2). The constants A and m can be taken as 1855
and 0.187 respectively. The permissible shear stress is 50% of the
ultimate stress. Design the spring.

Or

(b) The turning moment diagram of a multi cylinder engine is drawn CO4- App (16)
with a scale of (1mm=1°) on the abscissa and (1mm=250Nm) on
the ordinate. The intercepted areas between the torque developed
by the engine and the mean resisting torque of the machine, taken
in order from one end are -350,+800,-600,+900,-550,+450 and -
650mm^2. The engine is running at a mean speed of 750rpm and
coefficient of speed fluctuations is limited to 0.02. A rimmed
flywheel made of grey cast iron FG200 (density 7100kg/m^3) is
provided. The spokes, hub and shaft are assumed to contribute
10% of the required moment of inertia. The rim has rectangular
cross section and the ratio of wide to thickness is 1.5. Determine
the dimensions of the rim.

20. (a) Following data is given for a 360° hydrodynamic bearing: radial CO5- App (16)
load is 3.2kN,journal speed is 1490rpm,l/d ratio is 1,unit bearing
pressure is 1.3MPa,radial clearance is 0.05mm and viscosity of
lubricant is 25cP. Assuming that the total heat generated in the
bearing is carried by the total oil flow in the bearing. Design the
bearing with flow requirement of 1liter/min.

Or

(b) A single row deep groove ball bearing is subjected to a radial CO5- App (16)
force of 8kN and a thrust force of 3kN. The shaft rotates at
1200rpm. The expected life L_{10h} of the bearing is 20000hr. The
minimum acceptable diameter of the shaft is 75mm. Select
suitable ball bearing for this application.

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