MANIPAL INSTIT MANIPAL (A constituent unit of MAHE, Manipal)

MANIPAL INSTITUTE OF TECHNOLOGY

III SEMESTER B.TECH. (AUTOMOBILE ENGINEERING)

MAKE UP EXAMINATIONS, DEC 2018

SUBJECT: AUTOMOTIVE STRUCTURES AND DESIGN [AAE 2152]

REVISED CREDIT SYSTEM (27/12/2018)

Time: 3 Hours

MAX. MARKS: 50

Instructions to Candidates:

- ✤ Answer ALL the questions.
- Missing data **IF ANY** may be suitable assumed and clearly mentioned.
- Usage of design data handbook provided is permitted
- 1A. A steel shaft 35 mm in diameter and 1.2 m long held rigidly at one end has a hand wheel 500 mm in diameter keyed to the other end. The modulus of rigidity of steel is 80 GPa. What load applied to tangent to the rim of the wheel produce a torsional shear of 60 MPa? How many degrees will the wheel turn when this load is applied?
- 1B. A hollow shaft of 40 mm outer diameter and 25 mm inner diameter is subjected to a twisting moment of 120 N-m, simultaneously, it is subjected to an axial thrust of 10 kN and a bending moment of 80 N-m. Calculate the maximum compressive and shear stresses.
- 1C. A circular shaft is acted upon by a combination of loadings: an applied torque that produces a constant shear stress of 56 MPa, an axial force that produces a constant normal stress of 70 MPa, and a bending moment that produces a completely reversed normal stress of ±140 MPa. Determine the factor-of-safety using the Goodman theory for combined loading.
- 2A. A cylindrical shaft made of steel of yield strength 700 MPa is subjected to static loads consisting of bending moment 10 kN-m and a torsional moment 30 kN-m. Determine the diameter of the shaft using two suitable theories of failure, and assuming a factor of safety of 2. Take E = 210 GPa, Poisson's ratio = 0.25.
- 2B. A circular bar of 500 mm length is supported freely at its two ends. It is acted upon by a central concentrated cyclic load having a minimum value of 20 kN and a maximum value of 50 kN. Determine the diameter of bar by taking a factor of safety of 1.5, size effect of 0.85, surface finish factor of 0.9. The material properties of bar are given as: ultimate strength of 650 MPa, yield strength of 500 MPa and endurance strength of 350 MPa.

- 3A. A horizontal nickel steel shaft rests on two bearings, A at the left and B at the right end and carries two gears C and D located at distances of 250 mm and 400 mm respectively from the center line of the left and right bearings. The pitch diameter of the gear C is 600 mm and that of gear D is 200 mm. The distance between the centerline of the bearings is 2400 mm. The shaft transmits 20 kW at 120 r.p.m. The power is delivered to the shaft at gear C and is taken out at gear D in such a manner that the tooth pressure Ftc of the gear C and FtD of the gear D act vertically downwards. Find the diameter of the shaft, if the working stress is 100 MPa in tension and 56 MPa in shear. The gears C and D weighs 950 N and 350 N respectively. The combined shock and fatigue factors for bending and torsion may be taken as 1.5 and 1.2 respectively
- 3B. For the above gear-pinion arrangement, from the determined values in Q.3A, (3) draw the force diagram, reaction diagram, SFD and BMD using line diagram approach.
- 4A. A 50 mm diameter solid shaft is welded to a flat plate as shown in Fig.4A. (3) If the size of the weld is 15 mm, find the maximum normal and shear stress in the weld.
- 4B. Write short notes on the following: (4)i) fusion welding ii) thermit welding iii) gas welding iv) electric arc welding
- 4C. Explain with neat sketch Bolts of Uniform Strength
- **5A.** An eccentrically loaded lap riveted joint is to be designed for a steel bracket. (6) Show that in the eccentrically loaded riveted joint the resultant shear load, on the rivet, $R = \sqrt{(Ps)^2 + F^2 + 2}$. Ps. F. Cos θ

where θ = Angle between the primary or direct shear load (Ps) and secondary shear load (F).

5B. Fig. 5B shows a welded joint subjected to an eccentric load of 20 kN. The (4) welding is only on one side. Determine the uniform size of the weld on the entire length of two legs. Take permissible shear stress for the weld material as 80 MPa.



(3)