Name : ....

Roll No. : ....

Invigilator's Signature : ....

CS/B.TECH(AUE-OLD)/SEM-5/AUE-501/2012-13

2012

DESIGN OF MECHANICAL SYSTEMS

Time Allotted : 3 Hours   *Full Marks :* 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

GROUP – A

(Multiple Choice Type Questions)

1.   Choose the correct answer from the given alternatives :

$$10 \times 1 = 10$$

   i)   Failure of a material is called fatigue when it fails

   a)   at the elastic limit

   b)   at the yield point

   c)   below the yield point

   d)   above the yield point.

   ii)   Factor of safety for fatigue loading is the ratio of

   a)   Elastic limit of the working stress to the tensile strength stress

   b)   Young's modulus to the ultimate

   c)   Endurance limit to the working

   d)   Elastic limit to the yield point.

iii) The design of shaft made of brittle materials is based on

    a)   Gust's theory   b)   Rankine's theory

    c)   St. Venat's theory   d)   Von Mises theory.

iv) Transmission shafts and machine shafts may be subjected to

    a)   Bending only   b)   Direct load only

    c)   Torsion only   d)   All of these.

v) The friction torque, with the assumption of uniform pressure, compared to uniform wear is

    a)   same   b)   greater

    c)   lower   d)   could be anything.

vi) In case of a multiple disc clutch, if 4 discs are used in the driving shaft and 3 discs are used as the driven shaft, then the number of pairs of contact surface will be

    a)   6   b)   7

    c)   8   d)   12.

vii) Lewis equation in spur gears is used to find the

    a)   tensile stress in bending

    b)   shear stress

    c)   compressive stress in bending

    d)   fatigue stress.

viii) If both the pinion and gear are made of the same material, then the power transmitting capacity is decided by

    a)   gear

    b)   pinion

    c)   pinion or gear

    d)   both pinion and gear.

ix) Ball bearings are usually made of

    a)   low carbon steel   b)   high speed steel

    c)   chrome steel   d)   high carbon steel.

x) Life of a ball bearing is inversely proportional to

    a) $(\text{load})^{1/3}$ b) $(\text{load})^{3}$

    c) $(\text{load})^{1/2}$ d) $(\text{load})^{2}$.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following.   3 × 5 = 15

2. Briefly discuss the various methods of reducing stress concentrations.

3. What information(s) do you obtain from Soderberg diagram ?

4. A hollow shaft has greater strength and stiffness than a solid shaft of equal weight. Explain.

5. Discuss about the various types of stress induced in a flywheel rim.

6. Explain with reference to a neat plot the importance of the bearings characteristic curve.

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following.   3 × 15 = 45

7. Design completely a CI flywheel, shaft and the key for securing the flywheel to the shaft, for a 4-stroke IC engine developing 150 kW at 200 r.p.m. The fluctuation of speed is 2.5% of the mean speed. The work done during the working stroke is 1.3 times than the average work done during the whole cycle. The maximum torque on the shaft is 2.5 times of mean torque. Take hoop stress in the flywheel rim as 6MPa.

8. a) Derive the frictional torque equation for uniform wear condition.

    b) A multiple disc clutch transmits 50 kW of power at 1400 r.p.m. Axial intensity of pressure does not exceed 0.15 N/mm ^{2} and the co-efficient of friction for the friction surfaces is 0.12. The inner radius of the disc is 80 mm and is 0.7 time the outer radius. Determine the number of disc required to transmit the given power. Assume uniform wear condition.

9. A pair of 20˚full depth spur gears is to transmit 3.5 kW with a transmission ratio of 2.5 to 1. The pinion operates at 1200 r.p.m. Forged steel having an allowable static stress of 100 MPa, and semi-steel of 60 MPa are selected for the pinion and the gear respectively. The gears are to be carefully cut. Determine the diameter, face width and the number of the teeth for minimum size and adequate strength. Consider dynamic loading and wear and check whether the design is satisfactory or not.

10. A band brake acts on the $\frac{3}{4}$th of circumference of the drum of 450 mm diameter. The brake provides a braking torque of 250 N-m. One end of the band is attached to the fulcrum pin of the lever and the other end to a pin 120 mm from the fulcrum. If the operating force is applied at 500 mm from the fulcrum, and the co-efficient of friction is 0.25, determine the operating force when the drum rotates in clockwise direction. Take permissible stress for tension and compression as 60 MPa, and shear as 50 MPa; for shaft, brake lever and pins. Bearing pressure between pin and lever is 7 MPa. Design the shaft, lever and pins.

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