Name : ………………………………………………………

Roll No. : ………………………………………………………

Invigilator's Signature : …………………………………

CS/B.Tech/(AUE-NEW)/SEM-6/AUE-605A/2013

2013

DESIGN OF AUTOMOTIVE SYSTEM

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 alternatives for the following :

$10 \times 1 = 10$

    i)   The cross-section of the flywheel arms is usually

        a)   elliptical   b)   rectangular

        c)   I-section   d)   L-section.

    ii)   A spur gear with pitch circle diameter D has number of teeth T. The modulus is defined as

        a) $m = 1 + D/T$ b) $m = T/D$

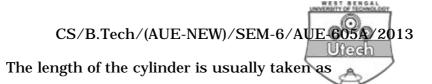   c) $m = D/T$ d) $m = DT.$

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iii) In case of a multiple disc clutch, if n_1 discs are used as the driven shaft, then the number of pairs of contact surface will be

a) $n_1 + n_2$

b) $n_1 + n_2 - 1$

c) $n_1 + n_2 + 1$

d) $n_1 - n_2$.

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

a) same

b) greater

c) lower

d) could be anything.

v) Life of a ball bearing is inversely proportional to

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

b) $(\text{load})^3$

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

d) $(\text{load})^2$

vi) The length of the piston usually varies between

a) D and $1.5\,D$

b) $1.5\,D$ and $2\,D$

c) $2D$ and $2.5\,D$

d) $2 \cdot 5\,D$ and $3\,D$.

vii) The length of the cylinder is usually taken as

    a) equal to the length of piston

    b) equal to the length of stroke

    c) equal to the cylinder bore

    d) 1.5 times the length of stroke.

viii) Ball bearings are usually made of

    a) low carbon steel   b) high speed steel

    c) chrome nickel steel   d) high carbon steel.

ix) The cylinders are usually made of

    a) cast iron or cast steel   b) aluminium

    c) stainless steel   d) copper.

x) In the rim type flywheel, the major mass is

    a) concentrated around the periphery

    b) concentrated at the centre

    c) concentrated at the arms

    d) concentrated at the mean radius.

GROUP – B
(Short Answer Type Questions)
Answer any *three* of the following. 3 × 5 = 15

2. Explain the different causes of gear tooth failures and suggest possible remedies to avoid such failures.

3. Make sketches to show the pressure distribution in a journal bearing with thick film lubrication in axle and along circumference.

4. A pair of straight teeth spur gears are transmitting power at a velocity ratio of 1/3. The module and teeth of driven gear are 60 and 5 mm. The driver gear rotates at 400 r.p.m. Find the no. of teeth, speed and linear velocity of driver gear.

5. A 100 mm long shaft running at 200 r.p.m. is supported on a step bearing. The bearing area is annular with 100 mm outside diameter and 40 mm inside diameter. The allowable average bearing pressure is 1 N/mm^2. Determine (i) axial load to be supported (ii) heat generated at the bearing.

6. State the function of the following for an internal combustion engine piston :

   a) Ribs

   b) Piston rings

   c) Piston skirt

   d) Piston pin.

GROUP – C
(Long Answer Type Questions)
Answer any *three* of the following.   3 × 15 = 45

7. The multiple cylinder engine is to run at constant load and at a speed of 600 r.p.m. on drawing the crank effort diagram to scale of 1mm = 250 N-m and 1mm = 3°, the area in sq mm above and below the mean torque line are as follows :

   + 160 mm^2, – 172 mm^2, + 168 mm^2, – 191 mm^2, + 197 mm^2, – 162 mm^2.

   The speed is to be kept within ± 1·5% of the mean speed of the engine. Calculate the necessary moment of inertia of the flywheel. Determine suitable dimension for cast iron flywheel rim. The breadth of rim is twice its radial thickness. The density of cast iron is 7000 kg/m^3; its working stress in tension is 6 MPa.

8. Design a pair of helical gears to transmit 15kW power. The teeth are 20° full depth involute in diametral plane and have a helix angle of 45°. The pitch diameters of pinion and gear are 80 mm and 320 mm. The pinion shaft rotates at 10000 r.p.m. The pinion and gear are made of cast steel having allowable static stress of 100 MPa. Assume the following :

   Face width (b) = 12.5 times module, velocity factor $C_v = 6/(6 + v)$, tooth form factor $Y = 0.154 – 0.912/T_E$, given σ_{es} = 600 MPa, $E_P = E_G = 2 \times 10^5$ MPa.

9. a) Explain the beam strength of gear teeth (Lewis equation) with diagram.

   b) A pair of 20° full depth involute bevel gears is transmitting power at right angle. The module and face width of the gears are 5 mm and 40 mm. The numbers of teeth on the pinion and gear are 30 and 48. The pinion and gear are made of cast steel. Take load stress factor (k) = 1.3. Determine the wear load of the bevel gear. 5 + 10

10. a) Derive the equation of friction torque according to uniform pressure theory.

    b) A multiple disc clutch, steel on bronze is to transmit 4 kW at 750 r.p.m. The inner radius of contact is 40 mm and outer radius of contact is 70 mm. The co-efficient of friction is 0.1. Average allowable pressure is 350 kPa. Determine the following :

       i) How many total discs of steel and bronze are needed ?

       ii) What actual axial force is required ? 6 + 9

11. A four stroke I.C engine has the following specifications;

Break power = 7.5 kW, speed 1000 r.p.m, indicated mean effective pressure 4 MPa, maximum gas pressure 3.5 MPa, mechanical efficiency = 80%. Determine (i) The dimension of the cylinder, if the length of stroke is 1.4 times the bore of the cylinder, (ii) wall thickness of the cylinder, if the hoop stress is 35 MPa, (iii) thickness of the cylinder head and the size of studs when the permissible stress for the cylinder head and stud materials are 45 MPa and 65 MPa respectively.

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