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Paper Code : AUE-605A

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 maximum shear stress theory is used for
   a) brittle materials
   b) ductile materials
   c) plastic materials
   d) non-ferrous materials.

ii) The resistance to fatigue of a material is measured by
   a) elastic limit b) Young's modulus
   c) ultimate strength d) endurance limit size.

iii) The most suitable for resisting heavy load under slow speed is
   a) hydrodynamic bearing
   b) ball bearing
   c) roller bearing
   d) hydrostatic bending.

iv) A Jew clutch is a
   a) positive clutch b) friction clutch
   c) centrifugal clutch d) cone clutch.

v) 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.

vi) The temperature rise in the brake lining depends on
   a) mass of the brake drums
   b) braking time
   c) heat dissipation capacity of the brake lining
   d) all of these.

vii) Due to the centrifugal force acting on the rim, the flywheel arms will be subjected to

a) tensile stress b) compressive stress

c) shear stress d) none of these.

viii) The maximum fluctuation of speed is the

a) difference of minimum fluctuation of speed and the mean speed

b) difference of the maximum and minimum speed

c) sum of the maximum and minimum speeds

d) variations of speed above and below the mean resisting torque line.

ix) 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) 2·5 D and 3 D,

where D = Diameter of the piston.

x) The backlash for spur gears depends upon

a) module b) pitch line velocity

c) tooth profile d) both (a) and (b).

GROUP – B

(Short Answer Type Questions)

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

2. Explain the various types of cylinder liners.

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

4. Explain why worm gear reduction units are not preferred over other types of gear boxes for transmitting large power. What are the materials for worm and worm wheel ? Explain why dissimilar materials are used for manufacturing worm and worm wheel.

5. The conical valve of an I.C. engine is 60 mm in diameter and is subjected to a maximum gas pressure of 4 N/mm^2. The safe stress in bending for the valve material is 46 MPa. The valve is made of steel for which k = 0·42. The angle at which the valve disc seat is tapered is 30°.

Determine :

(i) thickness of the valve head.

(ii) stem diameter

(iii) maximum lift of the valve.

6. Determine the maximum, minimum and average pressure in a plate clutch when the axial force is 4 kN. The inside radius of the contact surface is 50 mm and the outside radius is 100 mm. Assume uniform wear.

GROUP – C

(Long Answer Type Questions)

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

7. a) Prove that tensile stress in the Flywheel rim, due to the centrifugal force is $\sigma_t = \rho v^2$.

   b) A single cylinder, single acting, fourstroke oil engine develops 20 kW at 300 r.p.m. The work done by the gases during the expansion stroke is 2·3 times the work done on the gases during the compression and the work done during the suction and exhaust strokes is negligible. The speed is to be maintained within ± 1%. Determine the mass moment of inertia of the flywheel.

8. A gear drive is required to transmit a maximum power of 22·5 kW. The velocity ratio is 1 : 2 and r.p.m. of the pinion is 200. The approximate centre distance between the shafts may be taken as 600 mm. The teeth has 20° stub involute profiles. The static stress for the gear material (which is cast iron) may be taken as 60 MPa

and face width as 10 times the module. Find the module, face width and number of teeth on each gear. Check the design for dynamic and wear loads. The deformation or dynamic factor in the Buckingham equation may be taken as 80 and the material combination factor for the wear as 1·4.

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

   b) A multi-disc clutch has three discs on the driving shaft and two on the driven shaft. The inside diameter of the contact surface is 120 mm. The maximum pressure between the surface is limited to 0·1 N/mm^2. Design the clutch for transmitting 25 kW at 1575 r.p.m. Assume uniform wear condition and coefficient of friction as 0·3. 5 + 10

10. a) How the bevel gears are classified ? Explain with neat sketches.

    b) A pair of helical gears are to transmit 15 kW. The teeth are 20° stub in diametral plane and have a helix angle of 45°. The pinion runs at 10·000 r.p.m. and has 80 mm pitch diameter. The gear has 320 mm pitch diameter. If the gears are made of cast steel having allowable static strength of 100 MPs; determine a suitable module and face width from static strength considerations and check the gears for wear, given σ_{es} = 618 MPa.

5 + 10

11. a) Explain the various types of cylinder liners.

b) A fourstroke diesel engine has the following specifications :

Brake power = 5 kW; Speed = 12000 r.p.m.;

Indicated mean effective pressure = 0·35 N/mm^2;

Mechanical efficiency = 80%.

Determine :

i) bore and length of the cylinder;

ii) thickness of the cylinder head

iii) size of studs for the cylinder head. 5 + 10