2014

Design of Automotive Systems

Time Alloted : 3 Hours *Full Marks : 70*

The figure 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 any ten of the following: 10x1=10

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

a) Elliptical
b) Rectangular
c) I-section
d) L-section

ii) Mitre gears are-

a) Right angled bevel gears, having the same number of teeth
b) Spur gears of equal diameter
c) Helical gear of same module
d) none of the above

iii) 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

iv) 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

v) In case of a multiple disc clutch, if n_1 discs are used in the driving shaft and n_2 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) $n_1 - n_2$

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

a) Same
b) Greater
c) Lower
d) could be anything

vii) 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

viii) 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

ix) The ball bearings are usually made from

a) low carbon steel
b) medium carbon steel
c) high speed steel
d) chrome nickel steel

x) 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

GROUP - B
(Short Answer Type Questions)

Answer any *three* of the following. 3x5=15

2. What do you understand by 'fluctuation of energy" and maximum "fluctuation of energy"?
3. Explain the different causes of gear tooth failures and suggest possible remedies to avoid such failures.
4. A single plate clutch, effective on both sides is required to transmit 25 kW at 3000 r.p.m. Determine the outer and inner diameters of frictional surface if the coefficient of friction is 0.255, ratio of diameters is 1.25 and the maximum pressure is not to exceed 0.1 N/mm2. Also, determine the axial thrust to be provided by springs. Assume the theory of uniform wear.
5. State the function of the following for an internal combustion engine piston:
   a) Ribs;
   b) Piston rings;
   c) Piston skirt; and
   d) Piston pin
6. The conical valve of I.C engine is 60 mm in diameter and is subjected to a maximum gas pressure of 4N/mn2. The safe stress in bearing for the valve material is .6 Mpa. The valve is made of steel for which k=0.42.Find the thickness of the valve.

GROUP - C
(Long Answer Type Questions)

Answer any *three* of the following. 3x15=45

7. In a spur gear drive, the driving bronze spur pinion rotates at 600 r.p.m. It drives a cast iron gear at transmissions ratio of 4:1.

   The allowable static stress for the bronze pinion and cast iron gear are 80 MPa and 100MPa respectively. The pinion has 24 standard 20° full depth involutes teeth of module 8mm. The face width of both the gears is 90mm.Find the power that. can be transmitted from the stand point of strength. Take velocity factor

   Cv = 3/ (3+v) and tooth form factor Y = 0.154 - (0.912/T).

   Given σ_{es} = 600Mpa, $E_p = E_g$ = 2x 10^5Mpa.

   (15)

8. An otto cycle engine develops 50 kW at 200 r.p.m. The change of speed from the commencement to the end of power stroke must not exceed 0.5% of mean speed on either side. Design a suitable rim section having width four times the depth so that the hoop stress does not exceed 4Mpa.The work done during power stroke is 1.4 times the work done during the cycle and density of rim materials is 7200Kg/m^3.

   (15)

9. Design a cast iron piston for a single acting four stroke engine for the following data:

   Cylinder bore = 100 mm;

   Stroke = 125 mm;

   Maximum gas pressure = 5 N/mm^2 ;

   Indicated mean effective pressure = 0.75 N/mm^2;

   Mechanical efficiency = 80%;

   Fuel Consumption = 0.15 kg per brake power per hour;

   Higher calorific value of fuel = 42 x 10^3 kJ/kg; Speed = 2000 r.p.m.

   Any other data required for the design may be assumed.

   (15)

10. i) Mention four important types of gears and discuss their applications, the materials used for them and their construction.

    ii) The following particulars of a single reduction spur gear are given: Gear ratio = 10:1 Distance between centers =660 mm approximately; Pinion transmits 500 kW at 1800 r.p.m.; Involute teeth of standard proportions (addendum = m) with pressure angle of 22.5°;

    Permissible normal pressure between teeth = 175 N per mm of width. Find:

    a) The nearest standard module if no interference is to occur;

    b) The number of teeth on each wheel;

    c) The necessary width of the pinion.

    6+(3x3)

11. The areas of the turning moment diagram for one revolution of a multi-cylinder engine with reference to the mean turning moment, below and above the line, are

    -32, +408, - 267, + 333, - 310, +226, -374, +260 and -244 mm^2.

The scale for abscissa and ordinate are:

1 mm= 2.4° and 1 mm = 650 N-m respectively.

The mean speed is 300 r.p.m. with a percentage speed fluctuation of ±1.5%. If the hoop stress in the material of the rim is not to exceed 5.6 MPa, determine the suitable diameter and cross-section for the flywheel, assuming that the width is equal to 4 times the thickness. The density of the material may be taken as 7200 kg/m³. Neglect the effect of the boss and arms.