Code : 021821

B.Tech. 8th Semester Exam., 2017

Mechanical System Design

Time : 3 hours   Full Marks : 70

Instructions :

   (i)   *The marks are indicated in the right-hand margin.*

   (ii) *There are NINE questions in this paper.*

   (iii) *Attempt FIVE questions in all.*

   (iv) *Questions No. 1 is compulsory.*

   (v) *Standard Design Data book is allowed. Assume any missing data suitably.*

1. Fill in the blanks/select correct answer for any seven of the following: 14

   (i) The skirt of piston

     (a) is used to withstand the pressure of gas in the cylinder

     (b) acts as a bearing for the side thrust of the connecting rod

     (c) is used to seal the cylinder in order to prevent leakage of the gas past the piston

     (d) none of above

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   (ii) In designing a connecting rod, it is considered like .....for buckling about X-axis.

     (a) both ends fixed

     (b) both ends hinged

     (c) one end fixed and the other end hinged

     (d) one end fixed and the other end free

   (iii) 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

   (iv) When the length of the journal is equal to the diameter of the journal, then the bearing is said to be a

     (a) short bearing

     (b) long bearing

     (c) medium bearing

     (d) square bearing

   (v) A bearing is designated by the number 405. It means that a bearing is of

     (a) light series with bore of 5 mm

     (b) medium series with bore of 15 mm

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(c) heavy series with bore of 25 mm

(d) light series with width of 20 mm

(vi) In helical gears, the distance between similar faces of adjacent teeth along a helix on the pitch cylinders normal to the teeth, is called

    (a) normal pitch

    (b) axial pitch

    (c) diametral pitch

    (d) module

(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) In order to have smooth operation in chain drive, the minimum number of teeth on the smaller sprocket, for moderate speeds, should be

    (a) 15

    (b) 17

    (c) 21

    (d) 25

(ix) Factor of safety for fatigue loading is the ratio of

    (a) elastic limit to the working stress

    (b) Young's modulus to the ultimate tensile strength

    (c) endurance limit to the working stress

    (d) elastic limit to the yield point

(x) In static loading, stress concentration is more serious in

    (a) brittle materials

    (b) ductile materials

    (c) brittle as well as ductile materials

    (d) elastic materials

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

Cylinder bore = 100 mm ; Stroke = 120 mm ; Maximum gas pressure = 4 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 = 42×10^3 kJ/kg ; Speed = 2000 r.p.m.

Any other data required for the design may be assumed.

                                        14

3. Determine the dimensions of an 1-section connecting rod for a Diesel engine from the following data:

Diameter of the piston = 85 mm; Mass of the reciprocating parts = 1.5 kg; Length of the connecting rod from centre to centre = 350 mm; Stroke length = 140 mm; R.P.M. = 2000; Compression ratio = 4:1 ; Maximum explosion pressure = 3 N/mm². Take a factor of safety of 5 for the design. The density of material of the rod may be taken as 7800 kg/m³ and the allowable stress in the bolts as 90 N/mm² and in cap as 95 N/mm². Use Rankine formula for which the numerator constant may be taken as 330 N/mm² and the denominator constant 1/7500.   14

4. 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 cast iron gear material 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.   14

5. A four stroke oil engine developing 75 kW at 300 r.p.m. is to have the total fluctuation of speed limited to 5%. The work done during the power stroke is found to be

1.3 times the average work done during the whole cycle. The turning moment diagram can be approximated as a triangle during the power stroke. Maximum torque is 1.5 times the mean torque Assume that the hoop stress in the fly wheel and the bending stress in the arms should not exceed 25 MPa. Design a cast iron flywheel.   14

6. Design a roller chain to transmit power from a 20 kW motor to a reciprocating pump. The pump is to operate continuously 24 hours per day. The speed of the motor is 600 r.p.m. and that of the pump is 200 r.p.m.   14

7. A journal bearing is to be designed for a centrifugal pump for the following data:

Load on the journal = 12 kN; Diameter of the journal = 75 mm; Speed = 1440 r.p.m;

Atm. temperature of the oil = 16°C ; Operating temperature of the oil = 60°C;

Absolute viscosity of oil at 60°C = 0.023 kg/m-s.

Give a systematic design of the bearing.   14

8. A four stroke diesel engine has the following specifications:

Brake power = 7.5 kW; Speed = 1000 rpm; Indicated mean effective pressure = 0.35 N/mm², Maximum gas pressure = 3.5 N/mm², Mechanical efficiency = 80%.

Determine : i) Bore and length of the cylinder; ii) Thickness of the cylinder head; and iii) Size of studs for the cylinder head. 14

9. The hydraulic press, having a working pressure of water as 16 N/mm² and exerting a force of 80 kN is required to press materials upto a maximum size of 800 mm × 800 mm and 800 mm high, the stroke length is 80 mm. Design the following parts of the press:

   (i) Ram;

   (ii) Cylinder; and

   (iii) Pillars   14

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