Total No. of Questions : 10]

SEAT No. :

P3886

[Total No. of Pages : 4

[5561]-542

B.E. (Mechanical/Machanical Sandwich)

MECHANICAL SYSTEM DESIGN

(2015 Pattern) (Semester - II) (402048)

Time : 3 Hours] *[Max. Marks : 70*

Instructions to the candidates:

1) ***Answer Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8, Q9 or Q10.***
2) ***Neat diagrams must be drawn wherever necessary.***
3) ***Figures to the right side indicate full marks.***
4) ***Assume Suitable data if necessary.***

Q1) a) State and explain the parameters used in kinematic design of gearbox. **[6]**

b) Explain design and natural tolerances. **[4]**

OR

Q2) a) Draw the structure and gear box diagrams for the following equations of twelve speed gear box and determine the maximum transmission range for each equation for R 5 Series. $\phi = \sqrt[5]{10}$. **[6]**

i) Z = 2(6) 2(1) 3(2)

ii) Z = 2(3) 2(6) 3(1)

iii) Z = 2(6) 2(3) 3(1)

b) Define the following terms: **[4]**

i) Population

ii) Sample

iii) Random variables

Also explain the concept of reliability based design

Q3) a) Explain the steps involved in belt conveyor analysis? **[4]**

b) A three idler through belt, horizontal conveyor is to be used used for transporting 500 ton/hr of coal having weight density 8000 N/m^3. The surcharge factor 'c' for three idler through belt is 0.1. If the belt speed is 100 m/min. Select the standard belt width for conveyor belt. Available standard belt width is : 400, 450, 500, 650, 750, 800, 900, 1000, 1200, 1400, 1600, 1800, 2000 mm. **[6]**

OR

P.T.O.

Q4) a) Explain the concept of containerization. **[4]**

b) A three idler, troughed belt, horizontal conveyor is to be used for transporting 500 ton of iron per hour having mass density of iron ore is 1700 kg/m^3. If the belt speed is 2m/sec, determine the required belt width. Take surcharge factor = 0.1. **[6]**

Q5) a) Explain, with the help of neat sketches, the different types of formed heads used as end closures in cylindrical pressure vessels. **[8]**

b) A high pressure compound cylinder consists of a inner and outer diameters of 300 mm and 400 mm OD respectively. It is jacketed by an outer cylinder of 500 mm outside diameter. The tubes are assembled by a shrinking process in such a way that the maximum principal stress induced in any tube is limited to 100 N/mm^2. Calculate the shrinkage pressure and original dimensions of the tube assuming E = 210 GPa. **[10]**

OR

Q6) A pressure vessel consists of a cylindrical shell with an inner diameter of 1500 mm and thickness of 20mm. It is provided with a nozzle of inner diameter 250 mm and thickness 15 mm. The yield strength of the material for the shell and the nozzle is 200 N/mm^2 and the design pressure is 2.5 Mpa. The extension of the nozzle inside the vessel is 15 mm. The corrosion allowance is 2mm, while the weld joint efficiency is 0.85. Neglecting the area of welds, determine whether or not a reinforcing pad is required for the opening. If so, determine, the dimensions of the pad made from a plate of 15 mm thickness. **[18]**

Q7) a) Explain the buckling of connecting rod? Why I section preferred for connecting rod? **[6]**

b) The following data is given for the piston of four stroke diesel engine. Cylinder bore = 100mm, Material of piston rings = grey cast iron, Allowable tensile stress = 90N/mm^2 **[10]**

Allowable radial pressure on cylinder wall = 0.035MPa

Thickness of piston head = l6mm

Number of piston rings = 4

Calculate:

i) Radial width of piston rings;

ii) Axial thickness of piston rings;

iii) Gap between the free ends of piston ring before assembly and after assembly;

iv) Wwidth of top land;

v) Width of ring grooves;

vi) Thickness of piston barrel; and

vii) Thickness of barrel at open end.

OR

Q8) The following data is given for the connecting rod of a diesel engine. **[16]**

Cylinder bore = 85 mm

Length of connecting rod = 350mm

Maximum gas pressure = 3 MPa

Factor of safety against buckling failure = 5

(l/d) ratio for piston pin bearing = (1.5)

(l/d) ratio for crank pin bearing = (1.25)

Allowable bearing pressure for piston pin bearing = 13MPa

Allowable bearing pressure for crank pin bearing = 11MPa.

length of stroke = 140 mm

Mass of reciprocating parts = 1.5 kg

Engine speed = 2000 rpm

Thickness of bearing bush = 3 mm

Material of cap = 40 C8 (S_{yt} = 380 N/mm^2)

Material of bolts=Alloy steel (S_{yt} = 450N/mm^2)

Factor of safety for cap and bolts = 4 and 5 respectively.

Density of connecting rod = 7800 kg/m^3

Determine:

a) Dimensions of the cross-section of connection rod.

b) Dimensions of small and big and of bearings.

c) Nominal diameters of bolts for the cap.

d) Thickness of cap; and

e) Magnitude of whipping stress.

Q9) a) Differentiate between optimum designs problems with normal specifications and redundant specifications. **[6]**

b) A cantilever beam is to function as a spring subjected to varying load of ± 120N. Following materials are available. **[10]**

Material	Density Kg/m^3	Cost Rs./Newton	Fatigue Strength, MPa
M 1	8450	120	24
M 2	8020	120	42
M 3	7830	80	38

The length of the cantilever is 350 mm and width to height ratio is 6:1, factor of safety is 2. Design the cantilever for optimum cost. Specify the material, cross section dimensions and the cost for selected design.

OR

Q10) The optimum material and dimensions for a machine shaft subjected to twisting moment of 3 KNm and desiring a torsional stiffness of 100Nm/degree, so as to have a minimum weight of the shaft. Following materials are available. Factor of safety = 2. **[16]**

Material	Mass density Kg/m	Yield strength MPa	Modulus of rigidity GPa	Material factor $\varrho G/S_{yt}^2$
Mg. Alloy	1760	225	16	5.53×10^{-4}
Plastic	1200	55	2	8.533×10^{-4}
Ti-Alloy	3600	910	42	1.825×10^{-4}
Steel	7650	1380	84	3.374×10^{-4}

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