Total No. of Questions : 10]

SEAT No. :

P42

[Total No. of Pages : 4

[5871]-542

B. E. (Mechanical / Mechanical Sandwich)

MECHANICAL SYSTEM DESIGN

(2015 Pattern) (Semester - II)

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

Instructions to the candidates:

1) ***Answer Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8, Q.9 or Q.10.***
2) ***Neat diagrams must be drawn wherever necessary.***
3) ***Figures to the right indicate full marks.***
4) ***Assume suitable data, if necessary.***

Q1) a) Draw speed ray diagram for the following structural formulae i) 2(3)3(1) ii) 2(1)3(2) The minimum output speed is 160 r.p.m. and the maximum output speed is 1000 r.p.m. The motor shaft speed is 1440 r.p.m. **[6]**

b) Explain methods of representing frequency distribution. **[4]**

OR

Q2) a) Draw the systematic structure diagrams and identify the optimum structure diagram for the following structural formulae: i) z = 2(1)2(2)3(4) ii) z = 2(1)2(6)3(2) iii) z = 2(2) 2(1) 3(4) **[6]**

b) Define design tolerance (DT) and natural tolerance (NT) in statistical design. State what happens when NT=DT, NT>DT and DT>NT. **[4]**

Q3) a) Differentiate between Angle of Repose and Surcharge Angle? **[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/m3. If the belt speed is 2m/sec, determine the required belt width. Take surcharge factor = 0.1. **[6]**

OR

P.T.O.

Q4) a) State the appropriate guidelines for selection of material handling system **[4]**

b) A flat horizontal belt conveyor is to be used for transporting material with mass density of 3 ton/m^3. The belt is 750mm wide and has speed of 2.75 m/s Determine capacity of conveyor if surcharge angle is 25° ($k = 2.35*10^{-4}$). **[6]**

Q5) a) Derive Clavarino's equation for thick cylinder subjected to an internal pressure. **[8]**

b) A cylindrical pressure vessel shell of inside diameter 1500mm is subjected to an internal pressure of 2 MPa. The shell as well as heads is made of low alloy steel with an ultimate tensile strength of 450/N mm^2. The double welded butt joints which are spot radio graphed is used to fabricate the vessel. The corrosion allowance is 3 mm. Determine the thickness of the cylindrical shell and the thickness of the head if the head are:

i) Flat

ii) Plain formed

iii) Torispherical with crown radius of 1125 mm

iv) Semi-elliptical, with ratio of major axis to minor axis as 2

v) Conical, with semi-cone angle of 30^0. Efficiency = 0.85. **[10]**

OR

Q6) The following data refers to single acting hydraulic cylinder. **[18]**

Pressure of hydraulic fluid	= 10 MPa
Operating force available at the piston rod	= 15 KN
Friction due to piston ring and stuffing box	= 10% of operating force
Thickness of cylinder flange	= 10mm
Thickness of cylinder head	= 8 mm
Cylinder and, cylinder head material	= FG200
Modulus of elasticity for FG200	= 100 GPa
Thickness of Zinc gasket	= 3 mm
Modulus of elasticity for zinc	= 83 GPa
Number of bolts	= 4
Preload in each bolt	= 2.8 KN

Bolt material = FeE400

Modulus of elasticity for FeE 400 = 207 GPa

Factor of safety for cylinder = 5

Factor of safety for bolts = 6

Standard diameter of cylinder = 20, 30, 40, 50,60 mm

Standard Thickness of cylinder = 2, 4, 5, 6, 7, 8, 10mm

Standard diameter of bolts = 8,10,12,14,16,18,20,22 mm

Determine: i) Inner diameter of cylinder ii) Thickness of cylinder

iii) Diameter of bolts

Q7) a) What is the difference between centre and overhung crankshafts? **[6]**

b) The following data is given for the cap and bolts of the big end of the connecting rod:

Engine speed = 1500rpm

Length of connecting rod = 0.320m

Length of stroke = 0.140m

Mass of reciprocating parts = 1.75kg

Length of crank pin = 54mm

Diameter of crank pin = 38mm

Permissible tensile stress for balts and bending stress for cap 120N/mm^2.

Calculate the nominal diameter of bolts and thickness of cap for the big end. **[10]**

OR

Q8) The following data is given for a four- stroke diesel engine : **[16]**

Cylinder bore = 250 mm

Length of stroke = 300mm

Speed = 600 rpm

Indicated mean effective pressure = 0.6 MPa.

Mechanical efficiency = 80 %

Maximum gas pressure = 4 MPa

Fuel consumption = 0.25 kg per BP per hr.

Higher calorific value of fuel = 44000 KJ/kg

Assume that 5% of total heat developed in the cylinder is transmitted by the piston. The piston is made of gray C.I FG 200 (Sut = 200 N/mm^2 and K = 46.6 W/m/°C) and the factor of safety is 5. The temperature difference between the center and the edge of the piston head is 220°C.

i) Determine the thickness of piston head by strength consideration and thermal consideration.

ii) State whether the ribs are required, If so calculate the number and thickness of ribs.

iii) State whether a cup is required in the top of piston head, If so calculate the radius of the cup

Q9) a) What is adequate design and optimum design? Explain with suitable examples. **[6]**

b) A helical compression spring is to be designed for a specified maximum force F. The spring should have stiffness 'K' and factor of safety based on yield strength in shear is 4. Design the spring for minimum weight. Neglect effect of inactive coils.Assume wahl's factor- K_w **[10]**

OR

Q10) A line shaft required to transmit power of 40KW at 425 rpm and the torsional stiffness of the shaft is 120N.m/Degree. Required factor of safety is 1.2. Design the shaft using maximum shear stress theory for minimum weight. Use above given material properties. What will be the change in design for minimum cost? **[16]**

Material	Density kg/m^3	Tensile Strength MPa	Modulus of Rigidity MPa	Material cost, C (Rs/N)
M1	7800	550	82000	20
M2	2800	180	27000	38
M3	1800	120	17000	550

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