Total No. of Questions : 12]

SEAT No. :

P1530

[Total No. of Pages :5

[4759] - 42
B.E. (Mechanical Engineering)
MECHANICAL SYSTEM DESIGN
(2008 Pattern) (Semester - II)

Time : 4 Hours] *[Max. Marks : 100*

Instructions to the candidates:

1) ***Answers to the two Sections should be written in separate answer books.***
2) ***Answer three questions from each section.***
3) ***Neat diagrams must be drawn wherever necessary.***
4) ***Figures to the right indicate full marks.***
5) ***Use of Calculator is allowed.***
6) ***Assume suitable data, if necessary.***

SECTION - I

Q1) a) Using neat sketches where required, describe and derive the expressions for the principal stresses in a thin cylindrical pressure vessel with no joints subjected to internal pressure and explain which among them will be the design criterion for determining wall thickness. **[8]**

b) Determine the inside diameter of shell and the crown radius of the torispherical heads if the thickness of the shell and the torispherical heads of a cylindrical pressure vessel are 12mm and 16mm respectively. The vessel operating at 2.0 MPa pressure is entirely made of 270N/mm^2 yield strength material with weld joint efficiency 0.7 and corrosion allowance of 2mm. **[10]**

OR

Q2) a) Using neat sketches where required, describe and derive the expressions for the principal stresses in a thick cylindrical pressure vessel with no joints subjected to internal pressure. **[8]**

b) The maximum tensile stress induced in a pressure cylinder consisting of an inner cylinder of 300mm ID and 400mm OD is 100N/mm^2. The vessel is jacketed by outer cylinder of 500mm OD. Calculate the shrinkage pressure and the difference between the inner cylinder OD and the jacket ID before assembly assuming E = 210kN/mm^2. **[10]**

P.T.O.

Q3) a) Explain with neat sketches procedure for design of center crankshaft at top dead center position. **[6]**

b) Design an exhaust valve for a horizontal diesel engine using following data: **[10]**

Cylinder bore = 350mm

Length of stroke = 400 mm

Engine speed = 600 rpm

Maximum gas pressure = 4.0 N/mm^2

Seat Angle = 45°

Mean velocity of gas through port (v_p) = 50 m/s

For steel valve, k = 0.42, σ_b = 50 N/mm^2

Determine:

i) Diameter of valve port

ii) Diameter of valve head

iii) Thickness of valve head

iv) Diameter of valve stem

v) Maximum lift of valve

OR

Q4) Following data is given for a single cylinder four stroke diesel engine: **[16]**

Cylinder bore = 100mm

Length of stroke = 125 mm

Speed = 2000 rpm

Brake mean effective pressure = 0.65MPa

Maximum gas pressure = 5 MPa

Fuel consumption = 0.25 kg per BP per h

Higher calorific value of fuel = 42,000 kJ/kg

Assume that piston transmits 5% of total heat developed in cylinder. Permissible stress of piston material is 37.5 N/mm^2 (k = 46.6 W/m/ºC). Temperature difference between center and the edge of piston head is 220ºC.

i) Calculate thickness of piston head by strength consideration

ii) Calculate thickness of piston head by thermal consideration

iii) Decide on the criteria that decides piston head thickness

iv) Decide if ribs are required

v) If yes, calculate number and thickness of piston ribs

vi) Decide whether a cup is required at the top of piston head

vii) If yes, calculate radius of cup.

Q5) a) Explain Johnson's method of optimum design in detail. **[6]**

b) An exhaust valve mechanism helical coiled spring is initially compressed with a preload of 500N and the valve lift is 40mm. Design the spring with modulus of rigidity 90GPa and Wahl's shear stress factor as 1.14 such that the torsional shear stress in spring will not exceed 700 MPa. The spring would weigh minimum with the condition $P_{max} = 2P_{min}$ and have the outside diameter fixed at 60mm when optimized. **[10]**

OR

Q6) a) Explain methodologies of optimum and adequate Design in detail with suitable examples. **[6]**

b) Design a tensile bar of 200 mm length to carry 5 kN tensile load that would cost the least among the following candidate materials: **[10]**

Material	Density (kg/m^3)	Cost (Rs/N weight)	S_{yt} (MPa)
Steel	7500	16	130
Al alloy	3000	32	50
Ti alloy	4800	480	90
Mg alloy	2100	32	20

SECTION- II

Q7) a) Describe design considerations in controls using neat sketches. **[8]**

b) Two components A and B are assembled with the overall dimension 40 ± 0.9mm as shown in Fig-1. Specify dimensions for component B if the overall dimension as well as individual component dimensions are normally distributed and natural tolerances are equal to design tolerances. **[8]**

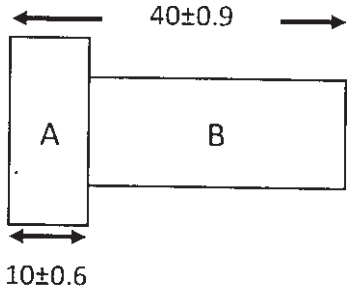

Fig-1

OR

Q8) a) Describe the design principles in welding using neat sketches. **[8]**

b) The diameters in a sample of 100 bolts are normally distributed with 10.5mm mean and 0.02 mm standard deviation. Determine the specified tolerances if the process is centered and only 95 bolts are accepted. Draw a neat figure and use Area under the normal curve from 0 to Z as, **[8]**

Z	0	1	2	3	4	5	6	7	8	9
1.9	0.4713	0.4719	0.4726	0.4732	0.4738	0.4744	0.4750	0.4756	0.4761	0.4767

Q9) a) Organize in a tabulated form comparison between different gear box design progressions. **[5]**

b) Describe the basic considerations in design of drives. **[5]**

c) Draw the structure diagram and gear box arrangement for following equations of a six speed gear box: **[6]**

i) z = 2(1) 3(2),

ii) z = 2(3) 3(1),

iii) z = 3(1) 2(3),

iv) z = 3(2) 2(1).

OR

Q10) A two stage, nine speed gear box is connected to a motor running at 720 rpm through a belt drive. The gear box is to have a minimum speed of 31.5 rpm and a maximum speed of 500 rpm. Using standard spindle speeds, **[16]**

a) Draw the structure and speed diagram

b) Draw the gear box layout

c) Determine the number of teeth on each gear

d) Draw percentage deviation diagram and check if design is within permissible limits.

e) Select diameter of pulleys for belt drive based on R20 series with diameter beginning from 80mm.

Q11) a) Describe in detail belt conveyers and their types using neat sketches. **[6]**

b) Describe in detail using neat sketches loading and unloading methods in conveyer systems. **[6]**

c) A horizontal belt conveyor transports material of mass density 1200 kg/m^3. The surcharge factor for the flat belt drive is 0.16 and the belt width is 650mm. Determine the capacity of the conveyor if the belt speed is 1.75m/s and the effective width b(in meters) of the material carried by the belt safely is given by the equation: b = 0.9B – 0.05; where B is the belt width in meters. **[6]**

OR

Q12) a) Explain the basic principles in selection of material handling equipment. **[5]**

b) Describe different types of idlers and their characteristics using neat sketches. **[5]**

c) Design a belt conveyor to carry material at the rate of 30×10^3 kg/hr with the following details. Bulk density of material is 800kg/m^3, angle of bulk material surcharge is 15°, belt speed is 10 km/hr, belt has 4 plies, material factor k_1 for plies is 2.0, belt tension and arc of contact factor k_2 is 63. Determine: **[8]**

i) Suitable belt width

ii) Drive pulley diameter and length

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