Total No. of Questions : 10]

SEAT No. :

P1961

[Total No. of Pages : 4

[5059] - 543
B.E. (Mechanical)
MECHANICAL SYSTEM DESIGN
(2012 Pattern) (Semester - VIII)

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) Write the procedure for kinematic design of multispeed gear box for machine tools. **[6]**

b) How the standard normal distribution curve differ than normal distribution curve. **[4]**

OR

Q2) a) A machine tool requires six speed gear box. which having a 160 rpm minimum and 1000 rpm maximum speed, when the motor shaft speed is 1440 rpm. **[4]**

b) A particular type of rolling contact bearing has a normally distributed time to failure with a mean of 10,000 hours and a standard deviation of 750 h. If there are 100 such bearings fitted at a time, how many may be expected to fail within the first 11000h? **[6]**

Z	0	1	2	3	4	5
1.3	0.4032	0.4049	0.4066	0.4082	0.4099	0.4115

Q3) a) Give the advantages, disadvantages and applications of conveyors as material handling equipment. **[4]**

b) A belt conveyor is to be designed to carry the bulk material at the rate of 350 ton/hour with the following detail's : weight density of material = 16700 N/m^3, Angle of repose = 15°, belt speed = 120 m/min, material factor for plies k_1 = 2.0, Belt tension and arc of contact factor k_2 = 70, No. of plies for the belt = 4, C = 0.075, S = 80 mm, determine i) width of belt ii) diameter and length of drive pulley. **[6]**

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OR

Q4) a) Describe with neat sketch the procedure to calculate the power requirement for belt conveyors. **[4]**

b) Following data refers to a horizontal belt conveyor used for transporting iron ore-capacity of conveyor = 300×10^3 kg/hour, belt speed = 180 m/minute, density of coal (ρ) = 7848 N/m^3, Number of plies for belt(Z_p) = 3, material factor for plies (k_1) = 2, Belt tension and arc of contact factor for belt (k_2) = 60, Electric motor speed = 1440 rpm, centre distance between snub pulleys, (d_1) = 200m, centre distance between drive and tail pulley (d_2) = 240m. Pitch of carrying run idlers, (t_c) = 1m, Pitch of return run idlers (t_r) = 2.5m. Surcharge factor = 0.0725 determine : **[6]**

i) Width of belt

ii) Reduction ratio of gear reducer

iii) The number of carrying and return run idlers.

Q5) a) i) What are the types of end closure for cylindrical pressure vessel?**[4]**

ii) What are the methods of prestressing the cylinder? **[4]**

b) i) Derive the Lame's equation. Explain under what conditions it is used? **[5]**

ii) An air receiver consisting of a 500 mm diameter cylinder closed by hemi-spherical ends, is made of steel FeE 200 and the factor of safety is 2.5. The operating pressure is limited to 3MPa. Treating the receiver as a thin cylinder, calculate the thickness of the cylinder wall and the hemispherical ends. Neglect the effect of welded joints. **[5]**

OR

Q6) a) The hydraulic cylinder 400 mm bore operates at a maximum pressure of 5 N/mm^2. The piston rod is connected to the load and the cylinder to the frame through hinged joints. Design (1) cylinder (2) piston rod (3) hinge pin. The allowable tensile stress for cast steel cylinder and end cover is 80 MPa and for piston rod is 60 MPa. Take τ = 45 N/mm^2 for hinge pin Draw the hydraulic cylinder with piston & piston rod.**[8]**

b) i) A high pressure cylinder consists of a steel tube with inner and outer diameters of 20 mm and 40 mm respectively. It is jacketed by an outer steel tube having an outer diameter of 60 mm. The tubes are assembled by a shrinking process in such a way that maximum principal stress induced in any tube is limited to 100 N/mm^2. Calculate the shrinkage pressure and original dimensions of the tube E = 207 kN/mm^2. **[5]**

ii) Explain with neat sketches the different types of formed heads used as end closures in cylindrical pressure vessels. **[5]**

Q7) a) Explain the step by step procedure for designing of piston of IC engine. **[6]**

b) Determine the dimension of the cross section of the connecting rod for a diesel engine with following data : **[10]**

σ_c = 275 N/mm^2

Cylinder bore = 100mm Maximum gas pressure = 4 MPa

Length of connecting rod = 350mm Factor of safety = 5

OR

Q8) a) Explain the step by step procedure for designing of crank pin of IC engine. **[6]**

b) Cylinder of four stroke diesel engine has following specifications :

Cylinder bore = 145mm Factor of safety = 5

Cylinder material = FG200 Poisson's ratio = 0.25

Maximum gas pressure = 3.5MPa Re boaring allowance = 3mm

Determine thickness of cylinder wall and calculate stresses in the cylinder wall. **[10]**

Q9) a) Differentiate between adequate and optimum design. Also explain different types of equations that are used in 'Johnson's method of optimum design'. **[6]**

b) A tensile bar of length 450mm is subjected to constant tensile force of 4000N. If the factor safety is 1.5, design the bar diameter, using Johnson's method, with the objective of minimizing material weight using optimum material from the list given in **Table 1**. **[10]**

Material	Density (ρ)Kg/m^2	Cost (c) Rs/Kg	Syt N/mm^2
Steel	7800	28	400
Aluminium Alloy	2800	132	150
Titanium Alloy	4500	2200	800

Table 1

OR

Q10)a) Write a short note on design for manufacturing and assembly. **[6]**

b) In lightweight equipment, a shaft is required to transmit 45KW power at 480 RPM. Required stiffness of shaft is 90N-m/ Degree. Factor of safety based on S_{ys} is 2.

Using max shear stress theory of failure design the shaft with the objective of minimum weight by using optimum material from the list given in Table 1 above. **[10]**

Assume G = 70000 N/mm^2 for all materials.

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