Total No. of Questions :10]

SEAT No. :

P3272

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B.E. (Mechanical)

MECHANICAL SYSTEM DESIGN

(2015 Course) (Semester-II) (End Sem.) (402048)

Time : 2.30 Hours] *[Max. Marks : 70*

Instructions to the candidates:

1) ***Figures to the right indicate full marks.***
2) ***Use of electronic calculator is allowed.***
3) ***Assume suitable data if necessary.***

Q1) a) Briefly explain max loss of economic cutting speed. **[6]**

b) Explain the following terms used in statistical analysis: **[4]**

i) Mean

ii) Variance

iii) Standard deviation

iv) Median

OR

Q2) a) A 2×2 drive is required for transmitting speeds starting from 400rpm with G.P ratio of 1.4. Draw suitable structural diagram **[6]**

b) Differentiate between Normal distribution curve & standard Normal distribution curve **[4]**

Q3) a) What are the objectives of material handling system? **[4]**

b) A belt conveyor is to be designed to carry the bulk material at rate of 300 $\times 10^3$ kg/hr at a conveyor speed of 10km/hr. If the mass density of bulk material is 800kg/m^3 & angle of repose = 15°, Material factor for plies, K1=2, Belt tension & arc of contact factor K2 =63, No. of plies of belt = 4.

Determine **[6]**

i) width of belt

ii) The diameter & length of drive pulley.

OR

P.T.O.

Q4) Following data refers to a horizontal belt conveyor use for conveying a coal in a thermal power plant: Capacity of conveyor M=300×10^3Kg/hr **[10]**

Belt Speed, V = 2m/s

Density of coal = 8829 N/m^2

Surcharge factor for belt C=0.0725

Number of plies for belt Z_p =3

Material factor for plies, K1 = 2,

Belt tension & arc of contact factor K2 = 63,

Center distance between snub pulleys = 255m

Center distance between drive and tail pulley =260m

Pitch of carrying run idlers = 1m

Pitch of return run idlers = 2.5m

Determine,

i) Standard belt width

ii) Reduction ratio of gear reducer and

iii) Number of carrying and return run idlers

Standard belt width (mm); 500, 600, 750, 800, 900, 1000, 1200, 1400, 1600

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

b) A hydraulic cylinder with closed ends is subjected to an internal pressure of 15 MPa. The inner and outer diameters of the cylinder are 200mm and 240mm respectively, the cylinder material is cast iron FG300. Determine the factor of safety used in design. If the cylinder pressure is further increased by 50% what will be the factor of safety? **[10]**

OR

Q6) A pressure vessel subjected to a design pressure of 0.75 MPa, consist of a cylindrical shell with an inner diameter of 2m and thickness of 10mm. It is provided with a nozzle of inner diameter 300mm and thickness 10mm. The corrosion allowance is 2mm, while the weld joint efficiency is 0.85. The yield strength of the material for the shell and the nozzle is 210 N/mm^2. The extension of the nozzle inside and outside the vessel is 15mm. 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 10 mm thickness. Take factor of safety 1.5. **[18]**

Q7) a) What are the functions of Piston? and What are the design requirements of piston. **[6]**

b) The cylinder of a four stroke diesel engine has the following specifications:

Cylinder bore = 150mm

Maximum gas pressure = 3Mpa

Allowable tensile stress = 50 N/mm^2

Determine the thickness of cylinder wall. Also, calculate the apparent and net circumferential and longitudinal stresses in cylinder wall. (Assume poissons ratio as 0.25) **[10]**

OR

Q8) The following data is given for a four-stroke diesel

engine : Cylinder bore = 250 mm

Length of stroke = 300

mm 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/ºC) and the factor of safety is 5. The temperature difference between the center and the edge of the piston head is 220ºC.

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 **[16]**

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

b) A tensile bar of length 500 mm is subjected to constant tensile force of 3000N. If the factor of safety is 2, design the bar diameter, using Johnson's method with the objective of minimizing material weight using optimum material from the list given below. **[10]**

Material	**Density (Kg/m^3)**	**Cost (Rs./kg)**	**Yield strength (N/mm$^{2)}$**
Mat 1	7800	28	400
Mat 2	2800	132	150
Mat 3	4500	2200	800

OR

Q10) A thin spherical pressure vessel is subjected to an internal pressure of 10 N/mm^2. The mass capacity of the empty vessel should not exceed 200kg. If the factor of safety based on yield strength is 1.5, design the pressure vessel with the objective of maximizing the gas storage capacity, out of the following materials.

Material	Mass Density, kg/m^3	Yield strength S_{yt} (MPa)
Mat 1	7800	450
Mat 2	2800	150
Mat 3	4500	800
Mat 4	1800	100

[16]