Total No. of Questions : 12]

SEAT No. :

P1702

[Total No. of Pages : 5

[4859]-43

B. E. (Mechanical Engineering)

MECHANICAL SYSTEM DESIGN

(2008 Course) (Semester-II)

Time : 4Hours] *[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) Write Clavarino' s equation and explain terms involved in it? **[4]**

b) Explain with two examples each of thick and thin cylinders? **[4]**

c) A high pressure cylinder consists of steel tube with inner and outer diameters of 20mm and 35mm respectively. It is jacketed by outer steel tube with an outer diameter 50mm. The tubes are assembled by shrinking process in such a way that maximum principal stress induced in any tube is limited to 115Mpa . Calculate the interference pressure and original dimensions of tubes. Assume E=207000 N/mm^2. **[8]**

OR

Q2) a) Explain the different types of end closures for the pressure vessels? **[6]**

b) A cylindrical pressure vessel of 1100mm inner diameter is provided with a nozzle of 155mm inner diameter and 10mm thickness. Protruding lengths of nozzle inside and outside the vessel are 15mm and 20mm respectively and it is made up of seamless tube. The thickness of shell is 10mm. Internal pressure in the shell is 3MPa. The corrosion allowance is 1.5mm. Permissible tensile stress for shell and nozzle material is 200MPa. Design the dimensions of reinforcing pad if required. The reinforcing material is of same quality as that of the shell and is available in thickness of 10mm. (Take weld efficiency as 85%). **[10]**

P.T.O.

Q3) Design a connecting rod I section for an engine with following details: **[16]**

a) Cylinder bore:150mm.

b) Length of Connecting -rod:450mm.

c) Maximum gas pressure:6MPa.

d) Overall width to height ratio of 'I' cross section as *4t* to *5t* where 't'is the uniform thickness of cross section.

e) Compressive yield stress=330N/mm^2.

f) Factor of safety=6.

OR

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

Cylinder bore = 100mm

Length of stroke = 125mm

Speed = 2000 rpm

Brake mean effective pressure= 0.65Mpa

Maximum gas pressure = 5Mpa

Fuel consumption=0.25 kg per BP per h

Higher calorific value of fuel = 42000 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/^{o}C). Temperature difference between center and the edge of piston head is 220^{o}C.

a) Calculate thickness of piston head by strength consideration.

b) Calculate thickness of piston head by thermal consideration.

c) Decide on the criteria that decides piston head thickness.

d) Decide if ribs are required.

e) If yes, calculate number and thickness of piston ribs.

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

g) If yes, calculate radius of cup.

Q5) a) What are the types of Optimum design ? Defferentiate between them? **[6]**

b) A tensile bar of length 300mm is subjected to constant tensile force of 7500N. If the factor of safety is 4, design the bar diameter, using Johnson's method of optimum design, with the objective of minimizing material weight using optimum material from the list given below. **[12]**

Material	Density(p) kg/m^3	Cost(c) Rs/kg	Syt N/mm^2
Steel	7800	28	400
Aluminum alloy	2800	132	150
Titanium Alloy	4500	2200	800

OR

Q6) Slove the problem from the question 5(b), if the cross sectional diameter of the tension bar should not be less than 10mm. **[18]**

SECTION-II

Q7) a) A rigid coupling is assembled with recommended fit 60 H_6-j_5 between the recess and the spigot. The dimensions of the two components are normally distributed and the specified tolerance is equal to the natural tolerance. Determine the probability of interference fit between the two components.The tolerances in micron are as follows: **[10]**

Diameter,(mm)	H_6		j_5	
	e_s	e_i	e_s	e_i
60	+19	0	+6	-7

The areas under the standard normal distribution curve from zero to z are as follows;

z	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0
Area	0.4192	0.4452	0.4641	0.4772	0.4861	0.4918	0.4953	0.4974	0.4987

b) Explain the basic principles of DFMA. **[6]**

OR

Q8) a) A batch of spindles to be used in machine tool, are to be designed for a mean torque transmitting capacity of 15N-m. The spindles are subjected to a mean load torque of 10 N-m. The torque transmitting capacity as well as the load torque is normally distributed with a standard deviation of 2 N-m and 2.5 N-m respectively. Estimate the percentage of spindles likely to fail. The areas under the standard normal distribution curve from zero to z are as follows; **[10]**

z	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0
Area	0.3413	0.3849	0.4192	0.4452	0.4641	0.4772	0.4861	0.4918	0.4953	0.4974	0.4987

b) Explain ergonomic considerations in design for display and controls with suitable sketch ? **[6]**

Q9)a) Organize in a tabulated form comparison between different gear box design progressions? **[6]**

b) Describe the basic considerations in design of drives? **[6]**

c) Draw the struture diagram and gear box arrangement for following equations of a six speed gear box :(i) z=2(1) 3(2), (ii) z=2(3) 3(1), (iii) z=3(1) 2(3) , (iv) z=3(2) 2(1). **[4]**

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 80 mm.

Q11) a) Explain with neat sketch any one tension take up device used in belt conveyor? **[6]**

b) What is sag in conveyors belts ? How it is kept in within permissible limit? **[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 650 mm. Determine the capacity of the conveyor , if the belt speed is 1.75 m/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) State and explain the objectives of material handling system? **[4]**

b) Describe different types of idlers and their characteristics using neat sketches? **[6]**

c) Design a belt conveyor to carry material at the rate of $3x10^5$ kg/ hr with the following details. Bulk density of material is 800 kg/m^3, angle of bulk material surcharge is 15^0, 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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