B. Tech. Sem - VIII (Mechanical Engg.) (2014 COURSE) (CBCS) :
WINTER - 2018

SUBJECT: OPTIMUM DESIGN

Day: Thursday
Date: 15/11/2018

W-2018-2653

Time: 02.30 PM TO 06.30 PM
Max. Marks: 60

N.B:

1) All questions are **COMPULSORY.**
2) Figures to the right indicate **FULL** marks.
3) Assume suitable data if necessary.
4) Use of non- programmable **CALCULATOR** is allowed.

Q.1 A worm gear pair is designated 2/30/10/8. Calculate **(10)**

i) The dimensions of worm and worm gear.
ii) The centre distance.
iii) The reduction ratio.

OR

Derive an expression for beam strength of straight bevel gears.

Q.2 Calculate the number of teeth on the gears on last shaft for multispeed gear box having structural formula 3(1) 2(3) and speed steps as 120, 169.2, 238.57, 336.39, 474.3, 668.77 rpm. Assuming all pinions to have 20 number of teeth and module of 5 mm. Take speed of motor = 770 rpm. **(10)**

OR

Draw the structure and speed diagram for a gear box having operating speed range from 56 rpm to 1000 rpm. Use R4 series, with standard speeds. The gear box is connected to a motor driven by a pair of pulleys. Assume the motor speed to be 1440 rpm. Draw the gear box layout diagram.

Q.3 The recommended class of a transition fit between the recesses and the spigot of a rigid coupling is $60H_6\,j_5$. Assuming that the dimension of the two components are normally distributed and that the specified tolerance is equal to the natural tolerance, determine the probability of interference fit between the two components. The tolerances in microns are as below. **(10)**

Diameter	H_6	j_5
60	+19	+06
	-00	-07

For area under standard normal distribution curve, use values from table below

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	0.4912	0.4953	0.4974	0.4980

OR

It is observed from a sample of 400 pins produced on an automatic CNC machine that their diameters are normally distributed with a mean 20.5 and a standard deviation of 0.02 mm. If the rejection is limited to 20 pins. Determine the design tolerance. Assume the process is centered around the mean.

P.T.O.

Q.4 A horizontal class 1 cylindrical pressure vessel of inside diameter 1600 mm is subjected to an internal pressure of 1.2 MPa. The shells as well as heads are made of low alloy steel with yield strength of 200 N/mm^2. The corrosion allowance is 3mm. Determine the thickness of the cylindrical shell and the thickness of head if the heads are: **(10)**

i) Flat head
ii) Plain formed head
iii) Torispherical head with crown radius of 2000 mm
iv) Semielliptical with ratio of major axis to minor axis as 2
v) Conical with semi-cone angle of 30^0

OR

A cylindrical pressure vessel is made of stainless steel. Assuming the following data, determine the thickness of the vessel shell. Inner diameter = 1.5 m, Design pressure = 0.44 MPa, permissible stress in the material = $130N/mm^2$ weld joint efficiency = .85% Assuming both ends are closed and external forces as well as corresponding stresses are negligible determine the resultant stress in the shell.

Q.5 A tensile bar of length 500 mm is subjected to constant tensile force of 3000 N. 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 in table. **(10)**

Material	Density Kg/m^3	Cost (C) ₹/Kg	S_{yt} N/mm^2
Steel	7800	28	400
Aluminum Alloy	2800	132	150
Titanium Alloy	4500	2200	800

OR

A cantilever beam is to function as a spring subjected to varying load of $\pm 100N$ following materials are available

Material	Density Kg/m^3	Cost (C) ₹/Newton	Fatigue strength MPa
M_1	8450	100	17
M_2	8020	100	37.5
M_3	7830	60	32

The length of the cantilever is 250mm and width to height ratio is 5:1 factor of safety is 1.5, Design the cantilever for optimum cost, specify the material, cross section dimensions and the cost for selected design.

Q.6 Explain with suitable example how DFMA helps in optimizing development time and cost. **(10)**

OR

What is value engineering? Explain their importance in product design process and economics.

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