B. Tech. Sem - VIII (Mechanical Engg.) (2014 COURSE) (CBCS) :
SUMMER - 2019
SUBJECT: OPTIMUM DESIGN

Day: Tuesday
Date: 28/05/2019

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

S-2019-2918

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 transmits 3kW power at 1440 rpm and drives a gear having 60 teeth. The pitch circle diameter of worm is 90 mm and is triple started. The module of worm gear is 4 mm. The worm is right handed and rotates in clockwise direction when seen from left. Assuming worm is above the worm wheel, Calculate: **(10)**

i) The components of tooth force
ii) The efficiency of drive

Also sketch the arrangement showing components of tooth force.

OR

Derive an expression for Tredgold's approximation and minimum number of teeth on bevel pinion.

Q.2 A nine speed gear box is connected to a motor running at 720 rpm through 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. **(10)**

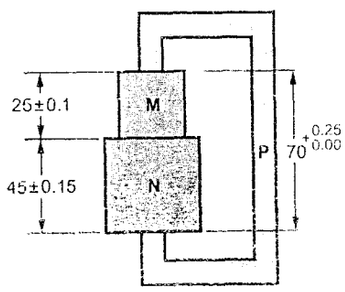
i) Select optimum structure and ray diagram.
ii) Draw the gear box layout.

OR

A multispeed gearbox is to be designed for speed varying from 200 rpm to 2000 rpm. Recommended series is R5. It is to be driven by a motor running at 2880 rpm. Design the optimum gearbox considering symmetric structure diagrams.

Q.3 An assembly of three components M, N and P is shown in fig. If the dimensions of the three components are normally distributed with design tolerance equal to the natural tolerance, determine the percentage of assemblies where interference is likely to occur. **(10)**

Z	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4
Area	0.4332	0.4452	0.4554	0.4641	0.4713	0.4772	0.4821	0.4861	0.4893	0.4918



P.T.O.

OR

A machine member made of plain carbon steel has mean yield strength of 250 MPa and standard deviation of 32 MPa. This member is subjected to a bending stress with a mean of 165 MPa and standard deviation of 18 MPa. Determine

i) Probability of failure and reliability of the machine member.
ii) The minimum factor of safety available
iii) The average factor of safety available

Assume normal distribution

Z	1.6	1.7	1.8	1.9	2.0	2.1	2.2
Area	0.4452	0.4554	0.4642	0.4821	0.4861	0.4893	0.4918

Q.4 Following data refers to a vertical pressure vessel **(10)**

i) Shell dimensions: 3m inside diameter and 6m shell length.
ii) Material: carbon steel with yield strength 225MPa.
iii) Corrosion rate: 0.05mm per month
iv) Minimum life: 80 months
v) Factor of safety: 1.5
vi) Working pressure: 0.75MPa
vii) Design pressure 10% extra
viii) Weld joint-double welded butt joint
ix) Spot radiographed
x) Ends- Torispherical with crown radius as 2.5m. Design the shell thickness and dished end thickness. Draw a neat sketch of pressure vessel with dimensions, weld lines and also indicate class of pressure vessel

OR

A cylindrical shell has an internal diameter of 2.5 m and is made of plain carbon steel with yield strength of 200 MPa. Double welded butt joints which are spot radiographed are used to fabricate the shell. Torispherical heads with a crown radius of 2 m knuckle radius of 120 mm are used as end closures. Operating pressure inside the shell is 0.75 MPa. Corrosion allowance is 3 mm. Determine the thickness of cylindrical shell and torispherical head. Also draw the neat sketch of pressure vessel with dimensions, weld lines.

Q.5 Design a tensile bar of length 200 mm to carry a tensile load of 5KN for minimum cost out of the following materials **(10)**

Material	Density Kg/m^3	Cost ₹/Kg	Yield strength MPa
Steel	7500	16	130
Al Alloy	3000	32	50
Ti Alloy	4800	480	90
Mg Alloy	2100	32	20

...2...

OR

A shaft is transmitting a torque of 900 N-m and is to have a rigidity of 90 N-m/degree. Assume a factor of safety of 1.5 based on yield strength. Design the shaft with minimum weight. What will be the change in design for minimum cost? Assume maximum shear stress theory of failure. Use following data for materials.

Material	Density Kg/m^3	Cost ₹/N	Yields strength MPa	Shear modulus GPa
M_1	8500	16	130	80
M_2	3000	32	50	26.7
M_3	4800	480	90	40
M_4	2100	32	20	16

Find out diameter and length of shaft for the same.

Q.6 Explain in detail legal and ethical issues in design with suitable example. **(10)**

OR

What is design for manufacturing and assembly? Describe its steps with suitable example.

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