53 (FPT 504) MDPE

2017

MECHANICAL DESIGN OF PROCESS EQUIPMENT

Paper : FPT 504

Full Marks : 100

Time : Three hours

The figures in the margin indicate full marks for the questions.

PART-A

*Answer **any three** questions.*

1. *(a)* What is Machine Design ? What are the basic procedures of design of machine element ? Explain. 2+8

   (b) What are the basic requirements of machine elements ? Discuss. 10

2. *(a)* What is bonding stress ? Discuss with diagram. 10

(b) A hollow shaft is required to transmit 500kW power at 120rpm. The maximum torque is 25% greater than the mean torque. The shaft is made of plain carbon steel 45C8 $\left(S_{y\pi} = 380\, N/mm^2\right)$ and the factor of safety is 3·5. The shaft should not twist more than 1·5° in a length of 3m. The internal diameter of shaft is 3/8 times of external diameter. The modulus of rigidity of shaft material is 80kN/mm^2. Determine the external diameter of shaft on the basis of its shear strength and on the basis of permissible angle of twist. 5+5

3. (a) What is stress-strain diagram ? Explain with diagram. What are the properties that can be obtained from tension test ? Explain. 5+5

(b) What is break-even point ? Discuss with diagram. 10

4. Write short notes on : ***(any four)*** 4×5=20

(i) Fixed cost and Variable cost

(ii) Hooke's law

(iii) Factor of safety

(iv) Classification of pressure vessel

(v) Young's modulus

(vi) Double pipe heat exchanger (DPHE).

PART-B

*Answer **any two** questions.*

1. It is required to design a cotter joint to connect two steel rods of equal diameter. Each rod is subjected to an axial tensile force of $50kN$. Design the joint and specify its mean dimensions.
   (use plain carbon steel of grade 3068 $\left(S_{y\pi} = 400\,N/mm^2\right)$). 20

2. *(a)* What is joint efficiency factor ? Discuss different types of joint. 2+4

   (b) A power vessel is to be designed for the maximum operating pressure of $500kN/m^2$. The vessel has a nominal diameter of $1{\cdot}2m$ and length of $2{\cdot}4m$. The vessel is made of IS 2002-1962 grade 2B quality steel having allowable design stress of 118 MN/m^2 of working temperature $250°C$. The corrosion allowance in suggested to $2mm$ for the life spent expected for the vessel. The vessel is to be fabricated according to 'Class 2' of Indian standard specification (medium operation and double welded butt joint with full penetration) which stipulate the weld joint efficiency of 0·85. 7+7

3. A shaft transmits $20kN$ power and rotates at $500\,rpm$. The material of shaft is 50C4 $\left(S_{y\pi} = 460\,N/mm^2\right)$ and factor of safety is 2.

(a) Determine the diameter of shaft on the basis of shear strength.

(b) Determine the diameter of shaft on the basis of its torsional rigidity, if the permissible angle of twist is 3° per meter length and modulus of rigidity of shaft material is $79300N/mm^2$.

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