

**Time : 3 Hours**

**Total Marks : 80**

1. Question one is compulsory
2. Attempt any three from Q.2 to Q.6
3. Use of ASME, TEMA, API code is permissible.
4. Assume data wherever necessary
5. Figure to the right indicate full marks.

- Q.1 Attempt any four of the following 20
- a) Classify heat exchangers with reference to shell types
  - b) Draw a vessel diagram showing pad plate, saddle and base plate.
  - c) Write a note on P & ID.
  - d) What are the factors to be considered for selection of agitators?
  - e) State the names of NDT techniques used in pressure vessel and explain any one.

- Q.2 a) State the names of all the sections in ASME boiler pressure vessel code 12
- a) Write following specifications of SA -515 grade 60. 08
1. Tensile strength
  2. Yield strength
  3. Maximum thickness
  4. Chemical composition for maximum thickness

- Q.3 a) By using ASME code, calculate thickness of a 6 % torispherical head, 2:1 ellipsoidal head 12

Material of construction	SA 515 grade 70
Design temperature	400°C
Design pressure	20 bar
Inside diameter	2000 mm
Height	3000 mm
Corrosion allowance	1.5 mm
Radiography	Full
Allowable stress	101 MPa

- b) Describe with suitable diagrams static and rotary equipments. 08

- Q.4 a) A propeller operating at 350 rpm speed in a vessel of 1200 mm diameter with following data: Design shaft based on equivalent bending and critical speed. 12

Internal pressure in a vessel	0.3 N/mm <sup>2</sup>
Specific gravity of liquid in vessel	1.1

Diameter of agitator	300 mm
Power number	0.9
Overhang of shaft from bearing support	1500 mm
Shaft material	Steel
Permissible shear stress	50 N/mm <sup>2</sup>
Elastic limit in tension	250 N/mm <sup>2</sup>
Modulus of elasticity	2 x 10 <sup>5</sup> N/mm <sup>2</sup>

b) Sketch different types of support used for process equipment.

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Q.5 a) A cylindrical skirt support is to be designed for the vessel with the data given below: 10

Shell diameter	600 mm
Overall height of vessel and skirt	12 m
Vessel design pressure	0.4 N/mm <sup>2</sup>
Weight of the vessel with its attachment and contents	35000N
Empty weight of the vessel	20000N
Wind pressure	1225N/m <sup>2</sup>
Permissible stress for shell and skirt material	
1. Tensile stress	95 N/mm <sup>2</sup>
2. Compressive stress	42 N/mm <sup>2</sup>
Permissible bending stress for base bearing plate material	175 N/mm <sup>2</sup>
Permissible stress for bolt material	140 N/mm <sup>2</sup>
Permissible compressive for concrete foundation	4N/mm <sup>2</sup>

b) State different types of heads (end closures) and draw sketch of each type.

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Q.6 Attempt any four

20

- Design consideration in process equipment design
- Write a note on post weld heat treatment.
- Draw a neat sketch of a vessel showing different type weld joint categories.
- Describe procedure of rectangular tank.
- State the names of different type of flanges used and draw a neat sketch of each.