

**Day and Date: Saturday, 10.12.2022**

**Time: 10.00 am to 12.00 pm**

Seat No:

**Max. Marks- 50**

**Instructions:**

- Question No. 1&2 is compulsory.
- Figure to the right indicate full marks.
- Assume suitable data if necessary
- Use scientific calculator if necessary.

BT	CO's	Q.No.		Marks
		<b>Q.1</b>	<b>All Questions are compulsory</b>	<b>20</b>
<b>2</b>	<b>CO1</b>	<b>a</b>	Explain design pressure	<b>6M</b>
<b>3</b>	<b>CO2</b>	<b>b</b>	A pressure vessel of internal diameter 1500mm operates at 5 Kg/cm <sup>2</sup> . A vessel has to be provided a nozzle 100mm internal diameter. The nozzle is welded to the shell wall and does not project inside the vessel. Permissible stress of the material is 1020 Kg/cm <sup>2</sup> . Determine the reinforcement required for the nozzle. Corrosion allowance is 1 mm. Welded joint efficiency is 85%. The design pressure is 10% excess than operating pressure.	<b>7 M</b>
<b>3</b>	<b>CO3</b>	<b>c</b>	Describe mechanical design of tall vessel	<b>7 M</b>
		<b>Q.2</b>	<b>All Questions are compulsory</b>	<b>10</b>
<b>3</b>	<b>CO4</b>	<b>a</b>	Describe double pipe heat exchanger <b>OR</b> Classify the various types of evaporators	<b>4</b>
<b>3</b>	<b>CO4</b>	<b>b</b>	Determine the shell diameter and shell thickness of shell and tube heat exchanger- Data: <b>Shell Side:</b> No. of shells-1, No. of passes-1, Fluid-liquid, Working pressure-0.33 N/mm <sup>2</sup> , Design pressure-0.5 N/mm <sup>2</sup> Temp. Inlet-30°C, Temp. outlet-50°C, MOC-Carbon steel,	<b>6</b>

			corrosion allowance- 3mm <b>Tube Side:</b> MOC- SS304, No. of tubes- 54, O.D. 18mm, Lenth- 12m, Pitch square- 25mm, Fluid- Gas, Working pressure- 19 N/mm <sup>2</sup> , Design pressure- 21.5 N/mm <sup>2</sup> , Inlet temperature- 150°C, Outlet temperature- 55°C, permissible stress- 100.6 N/mm <sup>2</sup> , $\beta=0.7$	
		<b>Q.3</b>	<b>All Questions are compulsory</b>	<b>10</b>
<b>3</b>	<b>CO5</b>	<b>a</b>	Explain classifications of reaction vessels	<b>3</b>
<b>3</b>	<b>CO5</b>	<b>b</b>	How calculate the thickness of half coil & channel type jacket OR How to calculate the total power required for agitator	<b>7</b>
		<b>Q.4</b>	<b>Attempt any two out of three questions</b>	<b>10</b>
<b>2</b>	<b>CO6</b>	<b>a</b>	Explain Radiography test	<b>5</b>
<b>2</b>	<b>CO6</b>	<b>b</b>	Describe in detail Ultrasonic test	<b>5</b>
<b>2</b>	<b>CO6</b>	<b>C</b>	Describe in detail non-destructive inspection & testing of offshore structure	<b>5</b>

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Seat No:

**Time:** .....

**Max. Marks- 50**

**Answer Key**

BT	CO's	Q.No.		Marks
		<b>Q.1</b>	<b>All Questions are compulsory</b>	<b>20</b>
<b>2</b>	<b>CO1</b>	<b>a</b>	<p>Case 1: On the outside of the vessel atmospheric pressure and the inside vacuum corresponds to P bar (absolute) pressure. Design pressure = (1- P) bar or more and can be up to 1 bar depending upon the reliability of the control system &amp; safety.</p> <p>Case 2: Inside atmospheric pressure and external pressure above atmospheric. design pressure = maximum external gauge pressure + 5% extra as in case of (a)</p> <p>Case 3: Internal pressure below atmosphere and external pressure above atmosphere. Design pressure = <math>P_o + 0.05 P_o + (1-P_i)</math> or more and can be up to <math>(1.05 P_o + 1)</math> bar from safety consideration.</p> <p>Where, <math>P_i</math> = absolute pressure inside the vessel in bar; &amp; <math>P_o</math> = maximum external gauge pressure in bar;</p>	<b>6M</b>
<b>3</b>	<b>CO2</b>	<b>b</b>	<p><math>t_s=5.77\text{mm}=6\text{mm}</math> <math>t_n=1.3182=3\text{mm}</math> <math>AB=200\text{mm}</math> <math>AD=14.42\text{mm}</math> <math>A=577\text{mm}^2</math> <math>A_s=23\text{mm}^2</math> <math>A_o=50.45\text{mm}^2</math> Extra Area available for compensation=<math>503\text{mm}^2</math></p>	<b>7 M</b>
<b>3</b>	<b>CO3</b>	<b>c</b>	Design of longitudinal stresses-	<b>7 M</b>

			<p>A] Axial stress due to internal pressure</p> <p>B] Axial stress due to dead loads</p> <p>i) Due to weight of vessel, ii] Due to weight of liquid, iii) Due to insulation, iv) Due to weight of attachments</p> <p>C] Due to Wind load</p> <p>D] Due to Seismic</p>	
		<b>Q.2</b>	<b>All Questions are compulsory</b>	<b>10</b>
<b>3</b>	<b>CO4</b>	<b>a</b>	<p>A double pipe heat exchanger is a type of pipe that has a central conductive barrier that prevents both flowing liquids and an adjoining pipe from creating an annulus shape. The outer half of the pipe acts as a conductor, while the inner half carries the working fluid. The resulting heat exchange occurs through the inner tube. The hot flow goes through the inner tube while the cold flow goes through the outer shell.</p> <p style="text-align: center;"><b>OR</b></p> <p>Climbing Film Evaporator.</p> <p>Short-tube Vertical Evaporator.</p> <p>Basket-type Evaporator.</p> <p>Long-tube Vertical Evaporator.</p> <p>Plate Evaporators.</p> <p>Horizontal Tube Shell-Side Evaporator</p>	<b>4</b>
<b>3</b>	<b>CO4</b>	<b>b</b>	<p><math>a=625\text{mm}^2</math></p> <p><math>a_n=67500\text{mm}^2</math></p> <p><math>D=350\text{mm}</math></p>	<b>6</b>
		<b>Q.3</b>	<b>All Questions are compulsory</b>	<b>10</b>
<b>3</b>	<b>CO5</b>	<b>a</b>	Batch , Semi-batch, Continuous stirred tank reactor, Plug Flow reactor	<b>3</b>
<b>3</b>	<b>CO5</b>	<b>b</b>	<p style="text-align: center;"><b>OR</b></p> <p>total power required for agitator-Formulae and graph</p>	<b>7</b>
		<b>Q.4</b>	<b>Attempt any two out of three questions</b>	<b>10</b>

<b>2</b>	<b>C06</b>	<b>a</b>	Radiography test- Diagram and working	<b>5</b>
<b>2</b>	<b>C06</b>	<b>b</b>	Ultrasonic test- Diagram and working	<b>5</b>
<b>2</b>	<b>C06</b>	<b>C</b>	non-destructive inspection & testing of offshore structure	<b>5</b>