Module 1

1. Suggest a suitable design for a storage tank to store 250000 kg of benzene required in the production of alkyl benzene sulphonate. The storage tank will be filled to 90% of its capacity and maintained at atmospheric condition. Due to space limitations, maximum tank diameter which can be used is 3.6 m. material of construction is mild steel of density 7850 kg/m$^3$ and allowable stress 125 N/mm$^2$.

OR

2. An integral flange with a plain face for a heat Exchanger shell is required to be designed to the following specification

- Design pressure = 1 MN/m$^2$
- Design temperature = 160 $^\circ$C
- Flange material = IS 2004-1962 Class 2
- Bolting material is Cr/Mo
- Gasket material is asbestos composite
- Shell outside diameter = 1 m
- Shell inside diameter = 0.98 m
- Shell thickness = 0.1 m
- Allowable stress for flange material = 100 MN/m$^2$
- Allowable stress for bolting material = 138 MN/m$^2$

Module 2

3. Perform the mechanical design of the tall vertical vessel with following specifications:

- Maximum wind speed expected (upto 20 m) – 140 km/h
- Shell outside diameter – 2 m
- Shell length, tangent to tangent – 16 m
- Skirt height – 4 m
- Operating temperature – 300 $^\circ$C
Operating pressure – 0.7 MN/m²
Design temperature – 320 °C
Design pressure – 0.8 MN/m²
Shell material: IS 2002-1962 grade II B
Shell is double welded with Butt joint no stress soldering or radiographing.
Corrosion allowance – 3 mm
Tray spacing – 0.75 m
Top disengaging space – 1 m
Bottom separate space – 2.75 m
Weir height – 75 mm for all trays
Down comer clearance – 25 mm for all trays
Weight of each head – 7.5 KN
Tray loading excluding liquid – 1 KN/m²
Tray support rings – 60 X 60 X 10 mm angle
Insulation – 75 mm asbestos
Accessories: 1 lagged ladder
Design in accordance with IS code for unfired pressure vessel with class II vessel type.
Neglect seismic forces.

OR

4. Design a bracket support for a column of diameter 2m, height 4m with a ground clearance 1.2 m to be erected in the opening air where the maximum wind velocity is expected to be 140 km/h under inclement weather conditions. The maximum weight of the vessel along with the contents can be approximated as 25 tons. The permissible stresses for shell and support material are:

<table>
<thead>
<tr>
<th>Type</th>
<th>Stress</th>
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</thead>
<tbody>
<tr>
<td>Tension</td>
<td>14.29 kgf/mm²</td>
</tr>
<tr>
<td>Compression</td>
<td>12.48 kgf/mm²</td>
</tr>
<tr>
<td>Bending</td>
<td>15.75 kgf/mm²</td>
</tr>
</tbody>
</table>

(50 Marks)