MARKING GUIDE FOR INDUSTRIAL PIPING SYSTEM FINAL EXAM

Section A /40 Marks

1. A piping system is a network of interconnected pipes, fittings, valves, and other components used to transport fluids (liquids or gases) from one location to another. **/2 Marks**
2. Components of a piping system are: Pipes, fittings, compressors/pumps, valves, tank, pressure gauges, …**/5 Marks (1 Mark for each component)**
3. Fittings are used to connect and join different sections of pipes. Common fittings include elbows (used for changing direction), tees (used for branching), couplings (used for joining pipes together), and valves (used to control the flow of fluids). **/4 Marks (1 Mark for each one)**
4. Valves are used to control the flow of fluids within a piping system. They can be **opened** or **closed** to allow or restrict the passage of liquids or gases. **/2 Marks**
5. Pipe insulation helps prevent **heat loss** or **gain from the fluid** being transported in the pipes. It also reduces the risk of condensation, protects against freezing, and improves energy efficiency in the system. **/5 Marks**
6. Pipe supports are used to **provide stability** and **prevent excessive movement or sagging of pipes**. They help **distribute the weight** of the pipes and **maintain their alignment**. **/4 Marks**
7. **Answer: /6 Marks**

Laminar flow refers to a type of fluid motion in which the fluid particles **move smoothly and orderly along well-defined paths or layers**. In laminar flow, t**he fluid moves in parallel layers without significant mixing between adjacent layers** whereas Turbulent flow refers to a type of fluid motion characterized **by chaotic, irregular, and highly dynamic movement of fluid particles**. In turbulent flow, **the fluid particles move in a random fashion, creating eddies, vortices, and swirls throughout the flow field**. **(1 mark for each characteristic)**

8. **Answer: /3 Marks**

The stress experienced by the pipe can be calculated using the formula:

Stress = Pressure x Diameter / (2 x Wall Thickness) **/1 Marks**

Assuming the wall thickness is 0.01 meters,

The stress would be:

Stress = 200 psi x 0.5 meters / (2 x 0.01 meters) = **5000 psi** **/2 Marks**

9. Answer/3 Marks

The total head loss in the piping system can be calculated using the Darcy-Weisbach equation:

Head Loss = Friction Factor x (Length / Diameter) x (Velocity^2 /2 x Gravity) **/1 Marks**

Head Loss = 0.02 x (50 meters / 0.2 meters) x (0.5 $m^3/s)^2$ / (2 x 9.81 m/s^2) = **25.53 meters/2 Marks**

10. Answer: /3 Marks

The velocity of water in the pipe can be calculated using the formula:

Velocity = Flow Rate / (π x (Diameter / 2)^2) **/1 Marks**

Velocity = 0.1 m^3/s / (π x (0.3 meters / 2)^2) = **0.571 m/s. /2 Marks**

11. Piping system preventive maintenance is a proactive approach **to maintaining and preserving the functionality** and **reliability of a piping system** whereas a piping system breakdown maintenance refers to **the planned activities** and **procedures carried out to identify, address,** and **rectify issues or failures in a piping system**. **/5 Marks**

12. Challenges which happens after maintenance of a piping system are :Corrosion, Erosion, Leakage, Fluid restriction, Misaligned Pipes, Contamination, Improper Valve Operation, Equipment Damage, Insufficient Lubrication, System Imbalance, Human Error and Incomplete Documentation **/5 Marks(1 Mark for each challenge)**

Section B: Attempt any two questions/ 20 Marks

13. Answer: /10 Marks

a) The Darcy-Weisbach equation is widely used for calculating pressure drop in pipes, especially for turbulent flow. **/2 Marks**

b) Parameters are: the pressure drop (ΔP) to the friction factor (f), pipe length (L), pipe diameter (D), average velocity (V), and fluid density (ρ). **6 Marks(1 mark for each parameter)**

c) ΔP=f*(L/D)*(ρ*V^2/2g) **2 Marks**

14. Answer: /10 Marks

a) The pump head is defined as the maximum lifting height that a pump is able to transmit to the pumped fluid **/2 Marks**

b) To calculate the pump head, we can use the equation:

Pump Head = $(V_2^2 - V_1^2) / (2 * g) + (Z_2 - Z_1)$ **/1 Marks**

Substituting the given values:

Pump Head = $((5^2) - (0^2)) / (2 * 9.81) + (5 - 10)$

Pump Head is = 1.27 meters **/2 Marks**

c)

Ha: Geodetic suction height

Hm: Geodetic delivery height

H: Geodetic head

1: Suction pipe

2: Delivery pipe **/5 Marks**

15. Answer: /10 Marks

a) Five variables/parameters to put into consideration in the selection of pipe are the following: **5 Marks (1 Mark for each parameter)**

- ✓ Material Compatibility
- ✓ Pressure and Temperature Ratings
- ✓ Fluid Characteristics
- ✓ Installation Method

- ✓ Environmental Factors
- ✓ System Design Requirements
- ✓ Cost Considerations
- ✓ Regulatory Compliance

b) Examples of ferrous and non-ferrous metal pipes: **1 Mark for each example**

Ferrous: Carbon Steel Pipe, Cast Iron Pipe and Stainless Steel Pipe **/2 Marks**

Non-ferrous: Copper Pipe, Aluminum Pipe, Brass Pipe, Titanium and Lead pipes**/3 Marks**

16. Answer: /10 Marks (1 Mark for each correct answer)

1 and e, 2 and g, 3 and a, 4 and c, 5 and i, 6 and b, 7 and d, 8 and j, 9 and f, 10 and h