Name:	
Enrolment No:	

UPES
End Semester Examination, December 2024

Programme Name : B.Tech (Fire and Safety Engineering) **Semester** : V
Course Name : Principles of Engineering Design **Time** : 03 hrs
Course Code : HSFS 3002 **Max. Marks:** 100
Nos. of page(s) : Two
Instructions: Assume any missing data. Your answer should be precise and to the point.

SECTION A
(6 Marks *5 = 30 Marks)

S. No.		Marks	CO
Q 1	A cylindrical tank used for storing LPG (liquefied petroleum gas) has a diameter of 4.2 meters and a wall thickness of 22 mm. The tank is designed to withstand an internal pressure of 550 kPa. Calculate the maximum stress in the tank wall.	6	CO1
Q 2	What is the role of safety relief valves in preventing fire incidents in pressurized systems?	6	CO1
Q 3	How do climate factors (like high humidity or extreme temperatures) impact fire safety design in different regions?	6	CO1
Q 4	Explain the following terms those are responsible for the most possible mechanical failure: i. Fatigue ii. Wear iii. Creep iv. Buckling	6	CO1
Q 5	Calculate the minimum wall thickness of a pressure vessel designed to handle an internal pressure of 8 MPa, with a radius of 1.5 m and an allowable stress of 200 MPa.	6	CO1

SECTION B
(15 Marks * 3 = 45 Marks)

Q 6	i.	Design a horizontal cylindrical tank to store 270,000 liters of flammable liquid. The tank will be in a facility where it is exposed to possible fire hazards. The tank material is carbon steel, and it will be equipped with a pressure relief valve and a fire-resistant coating.	10	CO3
	ii.	What are the codes and standards commonly used in firefighting equipment design?	5	
Q 7	i.	A vertical storage tank with a diameter of 5.5 meters is designed to store flammable chemicals. The tank has a height of 14 meters and is pressurized at 200 kPa. The safety relief valve is required to handle a maximum flow rate of vapors of 100 m³/h in the case of overpressure.	10	CO3
	ii.	List out the types of tank heads. Briefly explain how they ensure the integrity, safety, and functionality of the tank.	5	
Q8	i.	A flanged joint in a pressure vessel is subjected to an internal pressure of 4 MPa. The flange has a diameter of 400 mm, and the material used for the flange and bolts has a yield strength of 200 MPa. The diameter of the bolts used to fasten the flange is 30 mm. Calculate the stress in the bolts and determine if the joint can safely handle the internal pressure.	10	CO5
	ii.	Why are welded joints preferred over riveted joints in modern firefighting equipment?	5	

	SECTION C		
	(25 Marks * 1 = 25 Marks)		

Q 9	1. Incident Scenario Overview -
	
	A large industrial facility producing chemical solvents experienced a catastrophic fire due to the mechanical failure of a **pump's shaft seal** in its firewater suppression system. The incident occurred during routine operations and resulted in significant property damage, downtime, and environmental impact.
	
	   i. What were the primary causes of the fire in this case?
	   ii. What role did maintenance play in this mechanical failure?
	   iii. Discuss the importance of real-time monitoring in critical fire safety systems.
	2. A mechanical system has two pulleys with diameters 0.5 m and 0.15 m, and the center distance is 1 meter. Determine the length of the open belt.
	3. Two gears are connected in a system where the driver gear has 30 teeth, and the driven gear has 90 teeth. If the driver gear rotates at 600 RPM, what is the speed of the driven gear?
		12
		
		8
		
		5
			CO4