UPES
End Semester Examination, December 2024

Programme Name : B.Tech (Fire and Safety Engineering) **Semester** : III
Course Name : Fluid Mechanics **Time** : 03 hrs
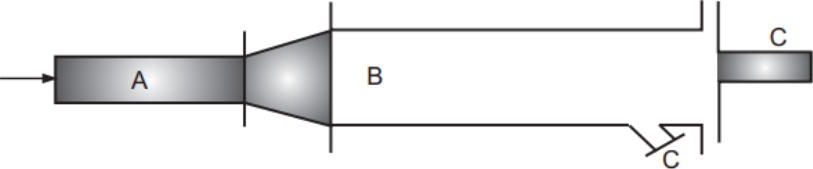**Course Code** : MECH 2081 **Max. Marks:** 100
Nos. of page(s) : Two
Instructions: Assume suitable data wherever necessary. Your answer should be precise and to the point.

SECTION A
(6 Marks *5 = 30 Marks)
Answer all question

S. No.		Marks	CO
Q 1	i. A fluid has a specific gravity of 0.90 . Determine its density in kg/m³ ii. Identify the type of flow if the Reynold's number is 4250.	3 3	CO1
Q 2	Write the expression used to represent Bernoulli equation, and what does each term represent?	6	CO1
Q 3	i. Explain the importance of fluid mechanics in fire safety engineering with examples. ii. What is the importance of knowing the flash point of flammable liquids in fire safety engineering?	3 3	CO1
Q 4	In a fire fighting piping system layout, various pipe diameters are used depending on the system's requirements. (a) List the typical pipe diameters used in firefighting systems. (b) Explain the factors that influence the selection of pipe diameters in a fire fighting system.	3 3	CO1
Q 5	Fill in the blank space: i. A fluid is called _____ if it has no resistance to shear stress. ii. The SI unit of viscosity is _____. iii. _____ is the most common fluid in fire safety applications.	2 2 2	CO1

SECTION B
(15 Marks * 3 = 45 Marks)
Answer any three questions

Q 6	(a) A fire sprinkler delivers water at a constant flow rate of 0.76 m³/hr through an opening with a diameter of 13 mm.
	  i. Calculate the velocity of water exiting the sprinkler.
	  ii. If the diameter of the opening is reduced to 10 mm due to some blockage, what will be the new velocity of the water?
	Assume the flow rate remains constant and neglect any losses.
	(b) A safety valve in a fire suppression system is set to open at a gauge pressure of 12.2 psi. The atmospheric pressure is 14.7 psi. What is the absolute pressure at which the valve will open?
		8
		
		7
			CO2

Q 7	Fire in a building produces hot smoke that needs to be vented through an exhaust duct. The smoke at the inlet of the duct is at a pressure of 120,000 Pa and has a velocity of 3.0 m/s. The duct is located 12 meters above the inlet, and the smoke exits with a velocity of 10.0 m/s.		CO2

	i. Given that the density of the smoke is 1.2 kg/m³, calculate the pressure at the outlet of the duct using the Bernoulli equation.	10		
	ii. Show all your calculations.	5		
Q8	(a) A food processing facility requires a water-based sprinkler system to cover an area of 1200 m². The recommended water discharge density is 12 liters/min/m² for this type of occupancy. Calculate the total water flow rate needed for the sprinkler system.	7	CO3	
	(b) How does knowledge of fire and safety engineering contribute significantly to achieving the SDGs and building a sustainable future?	8		
Q 9	(a) How does the density of water affect the hydrostatic pressure at the base of a fire sprinkler system?	3		
	(b) Water flows through the piping system as shown in Fig. An equal quantity of water flows through each of the pipes C. The flow through pipe A is 14 m³/h. Calculate:			
	i. mass-flow rate in each pipe	6		
	ii. the average velocity in each pipe A, B and C	6	CO3	

Given:
Dia pipe A = 45 mm, Dia pipe B = 85 mm and Dia Pipe C = 25 mm

SECTION C
(25 Marks * 1 = 25 Marks)

Q 10	(a) A tragic fire occurred on the night of November 15, 2024, at the Neonatal Intensive Care Unit (NICU) of Maharani Laxmi Bai Medical College in Jhansi, Uttar Pradesh, resulting in the deaths of at least 10 newborns and injuries to 16 others. Based on the knowledge and your understanding of this incidence, highlight your thoughts on the following:	6+7		
	i. What were the main causes of the fire at the Jhansi Hospital?			
	ii. In the context of Fire Safety Engineering, how can hospitals better implement a fire safety system?		CO5	
	(b) Which codes and standards govern the hydraulic calculations for fire protection systems such as sprinklers, standpipes, and fire pumps?	6		
	(c) **"Nothing happens suddenly"** This statement encourages mindfulness and deeper analysis of the processes leading to any event, reminding us to stay attentive to the journey rather than just the outcome. What is your opinion?	6		