


Name:			
Enrolment No:			
<b>UPES</b> <b>End Semester Examination, December 2023</b>			
<b>Course: Safety &amp; Risk Engineering</b> <b>Program: B. Tech Fire &amp; Safety Engineering</b> <b>Course Code: HSFS 3035</b>		<b>Semester: V</b> <b>Time: 03 hrs.</b> <b>Max. Marks: 100</b>	
<b>Instructions: All questions are compulsory. Use of calculator is permitted.</b>			
<b>SECTION A</b> <b>(5Qx4M=20Marks)</b>			
S. No.		Marks	CO
Q1	Event Tree analysis and Fault Tree analysis are used in different industries for risk management purposes. Provide in one format the similarities, dissimilarities, outcome, and cause relationship for both the analyses tools.	4	CO3
Q2	Toxins enter the human body in 4 different ways. State these 4 different ways and provide a pictorial representation of toxicity after elapse of considerable time once toxins have set in the body. The pictorial representation should clearly demarcate the 4 different ways.	4	CO2
Q3	State the 14 elements of Process Safety Management (PSM) and define any 2 out of the 14 elements.	(1+3) 4	CO1
Q4	State True or False: 1. Fault tree analysis is outcome based whereas event tree analysis is cause based. 2. Ventilation is a type of Engineering control used for protection against chemicals. 3. Noise is a physical hazard. 4. Chemical hazards are an example of industrial health hazard.	4	CO1
Q5	State through a short note on the objectives of toxicological studies.	4	CO1
<b>SECTION B</b> <b>(4Qx10M= 40 Marks)</b>			
Q6	Analyze after stating the name of the common software used for consequence analysis. Describe the uses and applications of this software and the applicability scenarios. Assume that the software is being used in the chemical industry to answer this question.	10	CO4

	OR		
	Explain the engineering and administrative controls used for managing chemical hazards. Also provide a pictorial representation of the steps for transition to safer chemicals.		
Q7	Illustrate any <b>four</b> gates used in Fault Tree Analysis. Provide the logic statement for each of them, along with the truth table.	<b>(2.5*4) 10</b>	<b>CO3</b>
Q8	Write a note on common chemical hazards found in industry and their long-term and short-term health effects. Also state the different routes of exposure for entry into the human body of such chemicals.	<b>(3+3.5+3.5) 10</b>	<b>CO2</b>
Q9	Analyze through an audit program clearly stating <b>all the aspects</b> to be verified for the following areas: 1. Management Leadership 2. Worker Participation	<b>(5+5) 10</b>	<b>CO4</b>
<b>SECTION-C (2Qx20M=40 Marks)</b>			
Q10	<p>Construct an <b>event tree</b> based on the following situation. Clearly state your assumptions and abbreviations. Also, clearly write the outcomes below the analysis sequence diagram.</p> <p>Situation: Blow out in CPP. Initial consequence: Gas release. Barrier 1: Blow out disc not working. Barrier 2: Blow out preventor malfunction. Barrier 3: Water sprinkler system malfunction..</p> <p style="text-align: center;"><b>OR</b></p> <p>Construct a <b>fault tree</b> for a top event: “Landslide in a under construction tunnel” and calculate its probability for the below scenario.</p> <p>Consider a developing country in South Asia significantly investing in highway development. This country is in the Himalayan region, prone to earthquakes along the Himalayan Mountain fault lines. Also, since the country is bordering an enemy state, risk of non-state actors causing an sabotage such as explosion in the mountains is highly likely. The construction of road is currently taking place in the mountains and a tunnel is under construction for the particular stretch of the road. The team of safety specialists investigated the risk of explosion of the due to sabotage leading to a landslide in the tunnel. Also earthquake can damage the tunnel (0.2/year and <math>1.5 \times 10^{-2}</math>/year, respectively), however for the landslide to happen a source such as bomb explosion or heavy rain is necessary,</p>	<b>20</b>	<b>CO5</b>

	e.g. sudden cloud burst (frequency: 0.6/year). Secret service estimated frequency of a terrorist bomb attack as 1/year; however because of tough security 99.9% of attacks will be unsuccessful. There is also an unlikely possibility of a cyclone leading to heavy rainfall ( $2.5 \times 10^{-4}$ /year). Heavy rain will trigger landslides on all the stretches of the highway including the tunnel.		
Q 11	Analyze the <b>ten areas</b> which are a priority in the safety audit checklist. For each of the areas, include at least three checklist items that will be checked when audit fieldwork commences.	<b>(2*10) 20</b>	<b>CO4</b>