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| **Name:**<br>**Enrolment No:** | |

**UPES**

**End Semester Examination, December 2023**

**Course: Hazard Identification & Computer Aided Risk Analysis** **Semester: VII**

**Program: B. Tech Fire & Safety Engineering** **Time: 03 Hrs.**

**Course Code: HSFS 4002** **Max. Marks: 100**

**Instructions: All questions are compulsory.**

**SECTION A**
**(5Qx4M=20Marks)**

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| Q1 | Fill in the blanks:<br>1. The intent to require employers to provide operating and maintenance personnel with all the necessary information to comply with process safety information requirements is called _____.<br>2. Emergency _____ and _____, enables employees to respond effectively in emergencies.<br>3. Outcome: Mitigating is a true relationship for _____ analysis.<br>4. The risk assessment analysis which uses the cause and preventive relationship is called _____ analysis. | **4** | **CO1** |
| Q2 | Illustrate through a short note, why employee participation is important for a successful process safety management system. | **4** | **CO3** |

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| Q3 | A maintenance officer joined a Chemical plant in Gujarat recently. He has extensive experience having previously worked in the chemical industry. On joining the company, he is made part of a risk analysis study of the plant. The risk analysis includes the identification and assessment of risks to the population who are exposed to because of hazards present. The study also includes a review of the effectiveness of the process safety management program. In order to determine the hazards, the safety officer is expected to be informed about all the process intricacies, and the mechanical aspects involved in the processes. However, the process manager, and the mechanical engineer, veterans of the plant having considerable influence with the management and the worker union do not cooperate with the maintenance officer. As such, during the risk analysis process, the maintenance officer is unable to help the safety officer for the issues related to mechanical status of the plant and process intricacies. Based on the above, state:<br>1. Elements of Process Safety Management (PSM) have been violated by the Process Manager and the Mechanical Engineer.<br><br>2. Given the fact that the maintenance officer is not aware of the intricacies, what will be the steps that the safety officer should undertake to complete the risk assessment successfully. | **(2+2) 4** | **CO3** |
| Q4 | In Visakhapatnam, an industrial port city in Andhra Pradesh state on India's east coast, a gas leak happened in a chemical plant from two 5,000-tonne tanks of liquid chemicals. According to a local police officer, it occurred as the plant was being restarted as coronavirus restrictions imposed in late March were eased. 10 people died and many were admitted to hospitals across the city with symptoms of vomiting etc.<br><br>The Factories Inspector has been tasked to find out the root cause for the incident and recommend corrective measures as well as penalties. If he were to undertake a risk analysis of the gas leak then which analysis method he will select from below.<br><br>1. Event Tree analysis<br>2. Fault Tree analysis<br><br>When answering the question, support it with proper reasoning as to why a particular tree analysis is suitable for the Factories Inspector depending on his objectives. | **(2+2) 4** | **CO3** |
| Q5 | Illustrate through a pictorial representation of the objectives, similarities, and dissimilarities between the tree analyses methods used for risk assessment. | **4** | **CO3** |
| | **SECTION B**<br>**(4Qx10M= 40 Marks)** | | |
| Q6 | Write an audit program for the following areas to be audited in the yearly safety risk assessment. | **(5+5) 10** | **CO3** |

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| | 1. Hazard Identification and Assessment<br>2. Hazard Prevention and Control<br><br>OR<br><br>Write a note on the objectives of a fault tree analysis. Identify the different gates used in the analysis and state their notations and logic statements. | | |
| Q7 | Consider that you have recently joined Pepsi bottling plant as a safety officer. The first task you have been assigned is to undertake a compliance audit of the plant. Write an audit checklist of 3 areas that you consider to be a priority in the audit program. Each area should have a minimum of 3 questions that you will be assessing as part of the audit. | **10** | **CO3** |
| Q8 | Explain for the ALOHA software the following:<br>1. Uses and application.<br>2. Applicability regimes.<br>3. Atmospheric options of input procedure. | **(3+3.5+3.5)<br>10** | **CO2** |
| Q9 | 1. Explain the formula for evaluating risk. Explain the rationale behind the method. Provide 1 example for each of the parameters used for evaluating risk.<br><br>2. Explain the three methods to calculate the accident statistics, and the methodology of calculation and the formula used for the 3 methods. Also state which method is considered more accurate. | **(5+5)<br>10** | **CO2** |
| **SECTION-C<br>(2Qx20M=40 Marks)** | | | |

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| Q10 | Consider the case of subsidence of earth in the place Joshimath. This is a region prone to earthquakes. Moreover, due to hydropower construction in the nearby area, a lot of explosion / blasting activities are likely. The team of safety specialists investigated the risk of subsidence of earth due to explosion / blasting activities. Both blasting and/or earthquake may damage the area (0.2/year and 1.5 x 10-2/year, respectively), however for the explosion to happen a source of ignition is necessary,<br>e.g. Planned explosion by construction team (frequency: 0.6/year). Geologists have predicted the possibility of earthquake 1/year; however because of precautions taken 99.9% of earthquakes will have minimum impact. There is also an unlikely possibility of a sabotage by terrorists during the blasting operations (2.5x10-4/year). Such activity could lead to multiple explosions.<br><br>Prepare and analyze a **fault tree** for a top event: "Subsidence of earth" and calculate its probability.<br><br>**OR**<br><br>Prepare and analyze an **event tree** by outlining the scenario mentioned below. Clearly articulate any assumptions and abbreviations. Additionally, distinctly present the outcomes beneath the analysis sequence diagram.<br><br>Situation: Gas outlet blocked.<br>Initial consequence: Process Safety Device (PSD) did not close the flow into separation.<br>Barrier 1: Process safety valve (PSVs) did not relieve pressure.<br>Barrier 2: Rupture disc did not open.<br>Barrier 3: Flares not working. | **20** | **CO4** |
| Q 11 | For the designated gates in the fault tree analysis, draw the notation, illustrate the gate's application, articulate the logical statement, and compile a truth table with a relevant example.<br>1. Voting Gate<br>2. Priority AND Gate<br>3. Inhibit Gate<br>4. XOR Gate<br>5. NOR | **(4*5) 20** | **CO3** |