B.E. Mechanical Engineering – 4th Year 2nd Semester, 2024 Examination

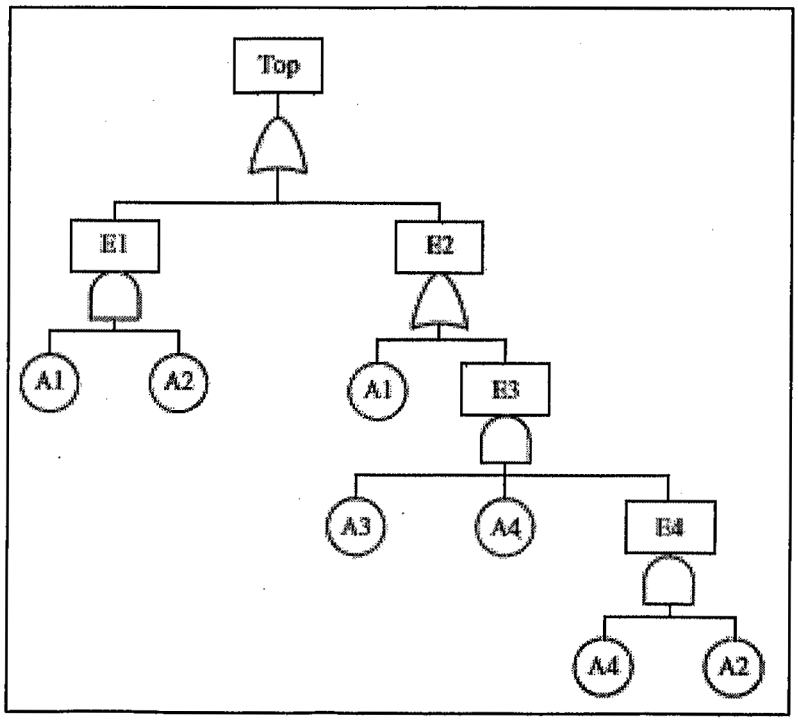
Maintenance and Safety Engineering (HONS.)

Time: Three Hours **Full marks:** 100

Answer *Any Five* questions

1. (a) A manufacturer performs an Operational Life Test (OLT) on ceramic capacitors and finds that they exhibit constant failure rate (used interchangeably with hazard rate) with a value of 3 × 10−8 failures/h. What is the reliability of a capacitor after 10^4 hours? Calculate the MTTF of the capacitor. In order to accept a large shipment of these capacitors, the user decides to run a test for 5000 hours on a sample of 2000 capacitors. How many capacitors are expected to fail during the test? Derive all formulae used.
   (b) What are advantages of TPM? [15+5]

2. (a) How is FTA useful in maintenance and safety engineering?
   (b) Assume that $P(A_i) = 0.001$. $P(A_i)$ is the probability that Event A_i occurs (probability of its failure). Calculate P(Top). [5+15]



3. (a) What are drawbacks of centralized maintenance?

   (b) Why is the importance of maintenance management control indices? Mention two indices of the same.

   (c) What are features of condition-based maintenance?

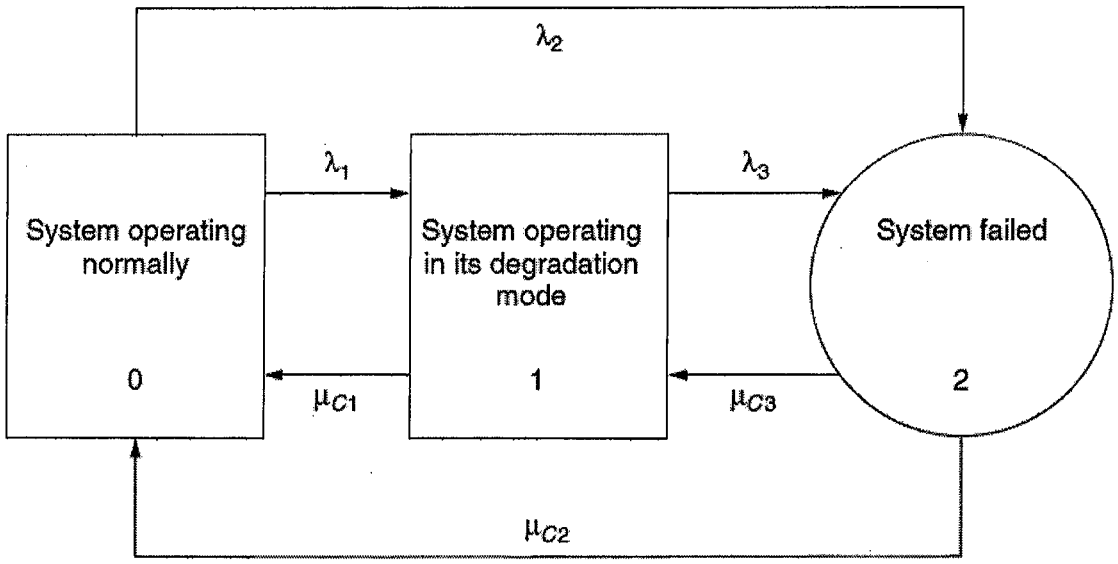
   (d) How is AI and Big Data useful for maintenance engineering. [5+(2+5)+4+4]

4. (a) How do you identify needs of Preventive Maintenance?

   (b) What are advantages of Preventive Maintenance over Corrective Maintenance?

   (c) Name different types of Corrective Maintenance. Explain any two.

   (d) The following figure represents a system that can either be operating normally, operating in degradation mode, or failed completely. Corrective maintenance is initiated from degradation and completely failed modes of the system to repair failed parts



Assume, $\lambda_1 = 0.002$ failures per hour, $\lambda_2 = 0.003$ failures per hour, $\lambda_3 = 0.001$ failures per hour, $\mu_{c1} = 0.006$ repairs per hour, $\mu_{c2} = 0.004$ repairs per hour, and $\mu_{c3} = 0.008$ repairs per hour. Calculate the value of the system full steady-state availability. [4+4+4+8]

5. (a) What is the inner meaning of safety? Explain different costs of accident?

   (b) State the classification of causes of accident. Mention three causes of each of classifications.

   (c) What are responsibilities of safety executive officer. [(4+5)+6+5]

6. (a) State and explain 5S principle of house keeping in safety.
   (b)Mention six principles to prevent accident.
   (c) How is different plant layouts important in safety engineering? [6+6+8]

7. Write short notes on ***any four***: [5 X 4 = 20]
   (a) Bath Tub Curve
   (b) FMEA
   (c) Hierarchy of control in safety
   (d) Human Error in safety
   (e) Predictive maintenance
   (f) Types of equipment record