B.E. Mechanical Engineering – 4th Year 2nd Semester, 2023 Examination

Maintenance and Safety Engineering (HONS.)

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

Answer *Any Five* questions

(1) (a) Discuss the needs for maintenance.

(b) Define the following terms with example: *Maintenance, Maintenance engineering, Overhaul, Preventive maintenance.*

(c) Write a short note on engineering maintenance in the 21st century. [6+8+6]

2. (a) Describe a nine-step approach that can be used to manage a maintenance program.

(b) Discuss six important maintenance management principles.

(c) How is AI and Big Data useful for maintenance engineering. [10+6+4]

3. (a) Explain any two broad indicators in relation to maintenance management control indices.

(b) Discuss the following: Mean PM time, Maximum PM time, and Median PM time. [8+12]

4. (a) Three independent and identical machines form a parallel system. Each machine's times to failure are exponentially distributed with a mean time to failure of 150 h. The periodic PM is performed after every 75 h. Determine the system mean time to failure with and without performance of periodic PM.

(b) Assume that exponential mean time to failure and mean corrective maintenance time of a system are 2500 h and 4 h, respectively. Calculate the system steady-state availability. [12+8]

5. (a) What are the four major components of RCM?

(b) Describe the "Root-cause analysis" techniques used by proactive maintenance to extend equipment life.

(c) Define the following indexes associated with RCM:

- Emergency percentage index
- Maintenance overtime percentage index
- Equipment availability [4+6+10]

6. (a) A maintenance department annually uses 400 units of a specific engineering part and the yearly holding cost per unit is Rs 0.90 along with the setup or ordering cost of Rs 4 per order. Determine the following:
   - Optimal number of units per order
   - Expected time between orders
   - Expected number of orders per year

   (b) What is Pareto principle?

   (c) Describe the ABC classification approach. [10+4+6]

7. Write short notes on ***any four***: [5 X 4 = 20]

   (a) Comparison of Preventive vs Corrective Maintenance

   (b) Advantages of PM

   (c) Types of Corrective maintenance

   (d) Characteristics of Corrective maintenance

   (e) Proactive maintenance

   (f) Thermography