MAINTENANCE ENGINEERING
(MECH 4141)

Time Allotted : 2½ hrs **Full Marks : 60**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and
any 4 (four) from Group B to E, taking one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A

1. Answer any twelve: **12 × 1 = 12**

Choose the correct alternative for the following

(i) Which type of maintenance aims to fix equipment only when it breaks down unexpectedly?
(a) Preventive maintenance (b) Predictive maintenance
(c) Breakdown maintenance (d) Reliability centered maintenance.

(ii) What maintenance approach involves regular inspections and scheduled repairs to prevent equipment failures?
(a) Condition monitoring (b) Predictive maintenance
(c) Reliability centered maintenance (d) Total productive maintenance.

(iii) What metric measures the efficiency of maintenance processes by calculating the ratio of actual production time to planned production time?
(a) Mean time between failures (MTBF) (b) Mean time to repair (MTTR)
(c) Overall equipment effectiveness (OEE) (d) Reliability index (RI)

(iv) What is the primary goal of maintenance activities in an organization?
(a) Increasing production output (b) Reducing downtime and costs
(c) Maximizing employee satisfaction (d) Enhancing marketing strategies.

(v) What is the primary goal of maintenance scheduling and planning?
(a) Minimizing downtime (b) Maximizing production output
(c) Reducing maintenance budgets (d) Ignoring equipment maintenance.

(vi) Engineering stores are responsible for
(a) storing only raw materials
(b) storing maintenance and repair supplies
(c) selling surplus equipment
(d) conducting equipment inspections.

(vii) Which cost component is considered in life cycle costing?
(a) Initial purchase cost (b) Maintenance cost
(c) Disposal cost (d) All of the above are typically considered.

(viii) What is the primary purpose of cladding in industrial applications?
(a) Aesthetics enhancement   (b) Strengthening materials
(c) Protecting against corrosion   (d) Reducing weight.

(ix) What is the primary benefit of using vibration monitoring devices?
(a) Aesthetics improvement   (b) Predictive maintenance
(c) Noise reduction   (d) Reducing maintenance budgets.

(x) What is a common maintenance task for bearings?
(a) Replacing lubrication with water   (b) Over-tightening the bearings
(c) Cleaning and re-greasing   (d) Ignoring maintenance.

Fill in the blanks with the correct word

(xi) NDT techniques are used to detect defects without causing _____ to the tested material.

(xii) Couplings are used to connect two shafts and transfer _____ in a machine.

(xiii) Torque wrenches are used to apply precise _____ to fasteners.

(xiv) The _____ curve illustrates the failure pattern of equipment over its lifecycle.

(xv) _____ is a continuous process of monitoring equipment to assess its performance and health in real-time.

Group - B

2. (a) What is TPM? What are the objectives of TPM? What are the benefits of implementing TPM in an organization? Explain how autonomous maintenance is implemented.   *[(CO2)(Remember/LOCQ)]*

(b) ABC Manufacturing Pvt. Ltd. operates a production line that produces pep rivets. The production line ran for 480 minutes in a day. During this time, there were 30 minutes of lunch break, 30 minutes of planned maintenance, unplanned downtime of 20 minutes due to equipment breakdowns, and 10 minutes stoppage for first piece inspection checks. The total quantity of pep rivets produced in that time was 30,000 units, while the machine was set to produce 5,000 units per hour. Overall Equipment Effectiveness (OEE) of ABC Manufacturing's production line for that day was 70%. Calculate the number of pieces that were rejected approximately on that shift.   *[(CO2)(Evaluate/HOCQ)]*

6 + 6 = 12

3. (a) Define the following terms with respect to maintenance Engineering. (i) MTBF (ii) MTTR (iii) MDT (iv) Predictive maintenance (v) Hazard rate.
     [(CO1)(Remember/LOCQ)]

(b) The reliability of 100 non repairable timing belts is measured. All the belts are subjected to reliability test. The test data are given below.

Time of Failures(hr)	No. of belts failed
0	0
350	2
450	9
550	21

650	40
750	19
850	8
950	1

Calculate MTBF using traditional method and Weibull hazard method.

[(CO1)(Evaluate/HOCQ)]

5 + 7 = 12

Group - C

4. (a) Explain the importance of maintenance planning and scheduling in an industrial setting. Provide examples of how effective planning and scheduling can impact equipment reliability and operational efficiency. *[(CO3)(Analyse/IOCQ)]*

   (b) Compare and contrast centralized and decentralized maintenance organizational structures. Discuss the advantages and disadvantages of each structure and provide examples of industries where each type is commonly used. *[(CO3)(Remember/LOCQ)]*

   6 + 6 = 12

5. (a) Discuss the relationship between the maintenance budget and cost control. Explain how a well-structured maintenance budget can aid in cost control efforts and contribute to overall cost reduction strategies in an organization.

   [(CO4)(Analyze/IOCQ)]

   (b) What is the definition of engineering stores, and what is its primary purpose within an industrial or maintenance context? How does effective inventory management contribute to the efficient operation of engineering stores, and what are some key strategies to achieve optimal inventory levels?

   [(CO4)(Remember/LOCQ)]

   6 + 6 = 12

Group – D

6. (a) Write short notes on: feeler gauge, spirit level, liquid penetrant test

   [(CO5)(Remember/LOCQ)]

   (b) Explain different types of oxy-acetylene flames and their uses. Write the desirable properties of lubricants. *[(CO5)(Remember/LOCQ)]*

   4 + 8 = 12

7. (a) Match the box A with the box B

A	B
Lubricant	Vibrations
Magnetic particle testing	Viscosity
Balancing	Horizontality
Feeler gauge	Fixing nuts
Spirit level	Cracks
Torque Wrench	Tappet clearance for valve operation

[(CO5)(Remember/LOCQ)]

(b)   Describe briefly why balancing is required in machineries. What is the difference between static balancing and dynamic balancing?   *[(CO5)(Remember/LOCQ)]*

6 + 6 = 12

Group - E

8.   (a)   What are the key maintenance tasks for gear drives, and how does maintenance impact gear drive reliability?   *[(CO6)(Remember/LOCQ)]*

     (b)   Describe the steps involved in repairing cracks in machine bed made of cast iron. Why is it crucial to address such cracks promptly?   *[(CO6)(Remember/LOCQ)]*

6 + 6 = 12

9.   (a)   Describe the maintenance practices for couplings, brakes, belts, and chain drives, emphasizing their role in equipment reliability.   *[(CO6)(Remember/LOCQ)]*

     (b)   Explain the methods and considerations for repairing worn-out shafts, keyways, and bush bearings in machinery. How does proper repair contribute to equipment longevity?   *[(CO6)(Remember/LOCQ)]*

6 + 6 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	74	12.5	13.5

Course Outcome (CO):

After completion of the course, the students will be able to:
CO1   Identify the difference between repair and maintenance, their types and applications
CO2   Implement TPM in an organization and evaluate overall equipment effectiveness
CO3   Design a Maintenance organization and workout maintenance and resource planning
CO4   Evaluate maintenance cost and prepare maintenance budget
CO5   Select suitable maintenance tools and tackles and preferred lubrication system
CO6   Apply appropriate maintenance procedures with suitable tools and equipments.

LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question.