

**GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT**

**COURSE CURRICULUM**

**COURSE TITLE: PLANT MAINTENANCE AND SAFETY.**

**Code: (3341906)**

<b>Diploma Programme in which this course is offered</b>	<b>Semester in which offered</b>
<b>Mechanical Engineering</b>	<b>4<sup>th</sup> semester</b>

**1. RATIONALE.**

This subject provides knowledge regarding maintenance problems, their causes and remedies in industries. It is concern with competencies development for solving maintenance problems. By learning this subject, student will be able to diagnose faults in machineries of plant so that s/he can analyse and resolve it using various maintenance techniques to retain its operational condition for long period of time.

**2. COMPETENCY.**

- Diagnose faults in machineries of plant and solve the problems using various maintenance techniques to retain its operational condition.

**3. COURSE OUTCOMES.**

1. Recognize troubles in mechanical elements.
2. Assemble, dismantle and align mechanisms in sequential order.
3. Carry out plant maintenance using tribology, corrosion and preventive maintenance.

**4. TEACHING AND EXAMINATION SCHEME.**

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
L	T	P		Theory Marks		Practical Marks		Total Marks
L	T	P	C	ESE	PA	ESE	PA	
3	0	2	5	70	30	20	30	

**Legends: L** -Lecture; **T** -Tutorial/Teacher Guided Student Activity; **P** -Practical; **C** - Credit; **ESE**-End Semester Examination; **PA** -Progressive Assessment

**5. COURSE DETAILS.**

<b>Unit</b>	<b>Major Learning Outcomes</b>	<b>Topics and Sub-topics</b>
<b>Unit – I</b> <b>Fundamentals of maintenance engineering.</b>	1a.Appreciate the need of maintenance in industry 1b.Aware about the duties of maintenance department	1.1 Definition and aim of maintenance engineering. 1.2 Primary and secondary functions and responsibility of maintenance department. 1.3 Types of maintenance. 1.4 Types and applications of tools used for maintenance.
	1c. Calculate service life of equipment	1.5 Maintenance cost & its relation with replacement economy. 1.6 Service life of equipment.
<b>Unit – II</b> <b>Tribology.</b>	2a.Explain causes, effects and reduction methods of wear.	2.1 Wear- types, causes , effects 2.2 Wear reduction methods
	2b. Select appropriate lubricants and lubrication method for given parameters.	2.3 Lubricants-types and applications. 2.4 Lubrication methods –General sketch, working and applications. i. Screw down grease cup. ii. Pressure grease gun. iii. Splash lubrication. iv. Gravity lubrication. v. Wick feed lubrication. vi. Side feed lubrication. vii. Ring lubrication.
<b>Unit – III</b> <b>Corrosion and its prevention.</b>	3a. Identify reasons of corrosion for given case.	3.1 Definition, principle and factors affecting the corrosion. 3.2 Types of corrosion.
	3b.Explain methods of corrosion prevention.	3.3 Corrosion prevention methods.
<b>Unit – IV</b> <b>Fault tracing.</b>	4a. Diagnose faults in equipment using decision tree.	4.1 Fault tracing-concept and importance. 4.2 Decision tree-concept, need and applications. 4.3 Sequence of fault finding activities, show as decision tree. 4.4 Draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipments like: i. Any one machine tool.

Unit	Major Learning Outcomes	Topics and Sub-topics
		ii. Pump iii. Air compressor. iv. Internal Combustion engine. v. Boiler. vi. Electrical motors. 5.5 Types of faults in machine tools and their general causes.
<b>Unit – V</b>  <b>Periodic and preventive maintenance.</b>	5a. Carry out periodic maintenance in mechanical systems.	5.1 Periodic inspection-concept and need. 5.2 Degreasing, cleaning and repairing schemes.
	5b. Overhaul of mechanical components and electrical motor.	5.3 Overhauling of mechanical components. 5.4 Overhauling of electrical motor. 5.5 Common troubles and remedies of electric motor. 5.6 Repair complexities and its use.
	5c. Carry out preventive maintenance of major mechanical systems.	5.7 Definition, need, steps and advantages of preventive maintenance. 5.8 Steps/procedure for periodic and preventive maintenance of: i. Machine tools. ii. Pumps. iii. Air compressors. iv. Diesel generating (DG) sets. 5.7 Program and schedule of preventive maintenance of mechanical and electrical equipments. 5.8 Advantages of Preventive maintenance. 5.9 Repair cycle-concept and importance.
<b>Unit – VI</b>  <b>Industrial safety.</b>	6a. Describe different types of accidents and hazards.	6.1 Accident - causes, types, results and control. 6.2 Mechanical and electrical hazards- types, causes and preventive steps/procedure.

Unit	Major Learning Outcomes	Topics and Sub-topics
	6b. Follow safety precautions.	6.3 Safety awareness-need and ways to impart. 6.4 Safety colour codes. 6.5 Methods of safe guarding machines and equipments. 6.6 Fire prevention and fire fighting methods. 6.7 Duties of fire and safety officer.
<b>Unit – VII</b> <b>Recovery, reconditioning and retrofitting.</b>	7a. Select appropriate recovery method for machine elements	7.1 Definition of recovery, reconditioning and retrofitting. 7.2 Methods of recovery and their applications. 7.3 Selection criteria of recovery methods.
	7b. Explain reconditioning and retrofitting process.	7.4 Reconditioning - process, features and advantages. 7.5 Retrofitting - concept, need and applications.
<b>Unit – VIII</b> <b>Installation, erection and commissioning of equipments.</b>	8a. Plan foundation and erection of equipments in plant. 8b. Understand acceptance test chart of equipments.	8.1 Design and planning of foundation. 8.2 Erection and commissioning of equipments. 8.3 Alignment and testing of equipments.

## 6 SUGGESTED SPECIFICATION TABLE WITH HOURS & MARKS (THEORY)

Unit	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Fundamentals of maintenance engineering.	4	3	4	0	7
II	Tribology.	4	2	2	3	7
III	Corrosion and its prevention.	4	2	2	3	7
IV	Fault tracing.	6	2	2	6	10
V	Periodic and preventive maintenance.	10	3	3	8	14
VI	Industrial safety.	5	3	3	3	9
VII	Recovery, reconditioning and retrofitting.	5	2	3	4	9

VIII	Installation, erection and commissioning of equipments.	4	2	3	2	7
<b>Total</b>		<b>4 2</b>	<b>19</b>	<b>22</b>	<b>29</b>	<b>70</b>

**Note:** This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

**General Notes:**

- a. If midsem test is part of continuous evaluation, unit numbers I, II,III, IV and V (Up to point number 5.6 only) are to be considered.
- b. Ask the questions from each topic as per marks weightage. Numerical questions are to be asked only if it is specified. Optional questions must be asked from the same topic.

**7. SUGGESTED LIST OF EXERCISES/PRACTICALS.**

The practical/exercises should be properly designed and implemented with an attempt to develop different types of cognitive and practical skills (**Outcomes in cognitive, psychomotor and affective domain**) so that students are able to acquire the competencies.

Following is the list of practical exercises for guidance.

*Note: Here only outcomes in psychomotor domain are listed as practical/exercises. However, if these practical/exercises are completed appropriately, they would also lead to development of Programme Outcomes/Course Outcomes in affective domain as given in a common list at the beginning of curriculum document for this programme. Faculty should refer to that common list and should ensure that students also acquire those Programme Outcomes/Course Outcomes related to affective domain.*

S. No.	Unit Number	Practical Exercises (Outcomes' in Psychomotor Domain)	Hrs. required
1	I	<b>PREPARATORY ACTIVITY:</b> Study and demonstrate use of various types of tools. (Fix spanners, box spanners, ring spanners, allen keys, types of pliers, screw drivers, bearing puller, etc.).	02
2	II	<b>MEASUREMENT OF WEAR:</b> Measure wears of anyone of the following. a. Machine guide ways.	02

		<ul style="list-style-type: none"> <li>b. Shaft –sleeve.</li> <li>c. Piston –cylinder.</li> <li>d. Bearing.</li> </ul>	
3	III	<p><b>CORROSION:</b></p> <p>Each student will collect corroded component from field and identify the types of corrosion and possible causes. Student will also suggest prevention methods.</p>	02
4	IV	<p><b>FAULT TRACING AND DECISION TREE:</b></p> <p>Identify fault with the help of decision tree for <b>any two</b> items from following.</p> <ul style="list-style-type: none"> <li>a. Internal combustion (IC) engine.</li> <li>b. Boiler.</li> <li>c. Pump.</li> <li>d. Machine tool.</li> <li>e. Air compressor.</li> <li>f. Electric motor.</li> </ul>	04
5	V	<p><b>MAINTENANCE OF MECHANICAL BASED EQUIPMENT/DEVICE/MACHINE.</b></p> <p>Maintenance of <b>any two</b> from following. Batch may be divided in to two groups and each group may be given one case.</p> <ul style="list-style-type: none"> <li>a. Head stock.</li> <li>b. Tail stock.</li> <li>c. Feed box.</li> <li>d. Indexing head.</li> <li>g. Internal combustion (IC) engine.</li> <li>h. Pump.</li> </ul> <p>(Dismantle of given case, observe rules, follow sequence of dismantling operations, cleaning, inspection, measuring deviations , recovery methods, testing and assembling).</p>	08
6	V	<p><b>PREVENTIVE MAINTENANCE:</b></p> <p>Prepare a preventive maintenance schedule of the typical workshop.</p>	02
7	VI	<p><b>SAFETY:</b></p>	02

		Demonstrate use of fire fighting and safety related equipments.	
8	VIII	<b>TEST CHART:</b> Prepare test chart of newly installed or repaired machine tool.	02
9	ALL	<b>MINI PROJECT AND PRESENTATION:</b>  a. Identify mechanical based any one equipment / device / machine at institute level which requires maintenance. b. Prepare general sketch. c. Perform fault tracing and prepare the decision tree. d. Dismantle. Write the sequence of dismantling. Also describe the steps. List the tools used for this activity. e. Attend necessary maintenance tasks. Write the tasks performed. f. Assemble, test and if necessary, modify. Write the steps. g. Prepare power point presentation. Present the project. This must include photographs / movies of group working on project.	04
10	ALL	<b>INDUSTRIAL VISIT:</b> Arrange visit to nearby automobile workshop/machine shop.	-
		Total	28

**Notes:**

- a. Term work report must not include any photocopies, printed manual/pages, litho, etc. It must be hand written / hand drawn by student only. However photographs/movies of actual performance by batch students and photographs of device/s undertaken for maintenance may be allowed by teacher.
- b. Term work report content of each experience should also include following.
  - i. The specifications of machines / equipments / devices / tools /instruments / items/ elements which is / are used to carry out and to check experience.
  - ii. Sequence of dismantling and assembling.

- iii. Steps / process description to execute experience.
- iv. Observations.
- c. Mini project and presentation topic/area has to be assigned to the student in the beginning of the term by batch teacher. This may be assigned individually or in the group of maximum 4 to 6 students.
- e. For 20 marks ESE, students are to be assessed for competencies achieved. They should be given following tasks:
  - i. Identify different tools.
  - ii. Make decision tree for given case.
  - iii. Assemble and dismantle parts of given device.

### 8. SUGGESTED LIST OF STUDENT ACTIVITIES.

Sr. No.	Activity
1	Monitor functionality of machine element and try to judge fault in it.

### 9. SPECIAL INSTRUCTIONAL STRATEGIES.

Sr. No.	Unit	Unit Name	Strategies
1	I	Fundamentals of maintenance engineering.	Demonstrate and explain use of tools.
2	II	Tribology.	Show worn out parts. Also discuss reasons.
3	III	Corrosion and its prevention.	Show corroded parts. Also discuss reasons.
4	IV	Fault tracing.	Show movie. Demonstrate the steps.
5	V	Periodic and preventive maintenance.	Show movie. Demonstrate the steps.
6	VI	Industrial safety.	Demonstrate and explain use of safety equipments. Industrial visit.
7	VII	Recovery, reconditioning and retrofitting.	Show movie. Demonstrate the steps. Industrial visit.
8	VIII	Installation, erection and commissioning of equipments.	Show movie. Demonstrate the steps. Industrial visit.

### 10. SUGGESTED LEARNING RESOURCES.

#### (A) List of Books:

Sr no.	Title of Books	Author	Publication
1.	Maintenance Engineering.	Higgins & Merrow	
2.	Maintenance Engineering.	H.P.Garg	S. Chand and Company.

3.	Maintenance of Machine Tools.	Gilbirg & Merrow	
4.	Pump-hydraulic Compressors	Audels.	McGrew Hill Publication.
5.	Foundation Engineering	Winterkorn, Hans.	
6.	Manuals Of Machine Tool And Auto mobile Vehicles	-	-
7.	Corrosion handbook	-	-

**(B) List of Software/Learning Websites:**

1. [www.mt-online.com](http://www.mt-online.com)
2. [www.pmxpert.com](http://www.pmxpert.com)
3. [www.nptel.iitm.ac.in](http://www.nptel.iitm.ac.in)
4. [en.wikipedia.org](http://en.wikipedia.org)
5. [webstore.ansi.org/preventive-maintenance](http://webstore.ansi.org/preventive-maintenance)
6. [www.mapcon.com](http://www.mapcon.com)

**(C) List of equipments:**

- a. Tool kit.
- b. Fire extinguishers.
- c. Lubricants.
- d. Cotton waste.
- e. Kerosene.
- f. Measuring instruments.

**11. COURSE CURRICULUM DEVELOPMENT COMMITTEE****Faculty Members from Polytechnics:**

1. Prof. R B Patel, Govt. Polytechnic, Himatnagar.
2. Prof. A M Patel, B.S.Patel Polytechnic, Kherva.
3. Prof. K.P.Patel, B.S.Patel Polytechnic, Kherva.

**Coordinator and Faculty Members from NITTTR Bhopal**

1. **Prof. Vandana Somkuwar, NITTTR Bhopal**