

GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

COURSE CURRICULUM
COURSE TITLE: PLANT MAINTENANCE AND SAFETY
(Code: 3341906)

Diploma Programme in which this course is offered	Semester in which offered
Mechanical Engineering, Mechatronics Engineering	4th Semester

1. RATIONALE

Maintenance of equipment in industries is very critical issue to ensure quality and quantity of production. Industries are not able to survive and progress if proper maintenance of equipment is not done. In the absence of proper maintenance, industries are busy in every day fire fighting to repair the breakdowns and manage production in very unsafe manner. This course provides information about wear, corrosion, lubrication, preventive maintenance; decision tree to diagnose faults, important provisions of factory act, alignment of equipment etc. This course also provides basic knowledge and skills regarding maintenance problems, their causes and remedies in industries.

2. COMPETENCY

The course content should be taught and implemented with the aim to develop different types of skills so that students are able to acquire following competency:

- **Manage maintenance operations satisfactorily by following safety rules.**

3. COURSE OUTCOMES

The theory should be taught and practical should be carried out in such a manner that students are able to acquire different learning out comes in cognitive, psychomotor and affective domain to demonstrate following course outcomes.

- Recognize troubles in mechanical elements.
- Assemble, dismantle and align mechanisms in sequential order.
- Carry out plant maintenance using tri-bology, corrosion and preventive maintenance.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				Total Marks
L	T	P		C	ESE	PA	ESE	
3	0	2	5	70	30	20	30	150

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

5. COURSE DETAILS

Unit	Major Learning Outcomes	Topics and Sub-topics
Unit – I Fundamentals of maintenance engineering	1a. Appreciate the need of maintenance in industry 1b. Describe functions 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.
	1a. Calculate service life of equipment	1.5 Maintenance cost & its relation with replacement economy. 1.6 Service life of equipment.
Unit – II Wear and Corrosion and their prevention	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.	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.
	2c. Describe reasons of corrosion for given case.	2.5 Definition, principle and factors affecting the corrosion. 2.6 Types of corrosion.
	2d. Explain methods of corrosion prevention.	2.7 Corrosion prevention methods.
Unit – III Fault tracing	3a. Develop decision trees to diagnose faults in equipment.	3.1 Fault tracing-concept and importance. 3.2 Decision tree-concept, need and applications. 3.3 Sequence of fault finding activities, show as decision tree. 3.4 Draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipments like: i. Any one machine tool. ii. Pump iii. Air compressor. iv. Internal Combustion engine. v. Boiler. vi. Electrical motors. 3.5 Types of faults in machine tools and

Unit	Major Learning Outcomes	Topics and Sub-topics
		their general causes.
Unit – IV Periodic and preventive maintenance	4a. Carry out periodic inspection in mechanical systems.	4.1 Periodic inspection-concept and need. 4.2 Degreasing, cleaning and repairing schemes.
	4b. Overhaul of mechanical components and electrical motor.	4.3 Overhauling of mechanical components. 4.4 Overhauling of electrical motor. 4.5 Common troubles and remedies of Electric motor. 4.6 Repair complexities and its use.
	4c. Plan preventive maintenance of major mechanical systems.	4.7 Definition, need, steps and advantages of preventive maintenance. 4.8 Steps/procedure for periodic and preventive maintenance of: i. Machine tools. ii. Pumps. iii. Air compressors. iv. Diesel generating (DG) sets. 4.9 Program and schedule of preventive maintenance of mechanical and electrical equipments. 4.10 Advantages of Preventive maintenance. 4.11 Repair cycle-concept and importance.
Unit – V Industrial safety	5a. Describe different types of accidents and hazards.	5.1 Accident - causes, types, results and control. 5.2 Mechanical and electrical hazards- types, causes and preventive steps/procedure.
	5b. Describe salient points of Factories act 1948.for health, and safety. 5c. Describe Fire prevention and fire fighting, equipment and methods.	5.3 Describe salient points of Factories act 1948.for health and safety-, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc. 5.4 Safety colour codes. 5.5 Fire prevention and fire fighting, equipment and methods.
Unit – VI Recovery, reconditioning and	6a. Select appropriate recovery method for machine elements	6.1 Definition of recovery, reconditioning and retrofitting. 6.2 Methods of recovery and their applications. 6.3 Selection criteria of recovery methods.

Unit	Major Learning Outcomes	Topics and Sub-topics
retrofitting	6b. Explain reconditioning and retrofitting process.	6.4 Reconditioning - process, features and advantages. 6.5 Retrofitting - concept, need and applications.
Unit – VII Installation, erection and commissioning of equipments	7a. Explain foundation and erection of equipment in plant. 7b. Prepare test chart of given equipment	7.1 Design and planning of foundation. 7.2 Erection and commissioning of equipment. 7.3 Alignment and testing of equipment.

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	Wear and Corrosion and their prevention.	8	4	4	6	14
III	Fault tracing	6	2	2	6	10
IV	Periodic and preventive maintenance	10	3	3	8	14
V	Industrial safety	5	3	3	3	9
VI	Recovery, reconditioning and retrofitting	5	2	3	4	9
VII	Installation, erection and commissioning of equipments	4	2	3	2	7
Total		42	19	22	29	70

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:

- If mid semester test is part of continuous evaluation, unit numbers I, II, III, and IV (Up to point number 4.6 only) are to be considered.
- 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 skills (**outcomes in psychomotor and affective domain**) so that students are able to acquire the competencies/programme outcomes. 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 certain outcomes in affective domain which would in turn lead to development of **Course Outcomes** related to affective domain. Thus over all development of **Programme Outcomes** (as given in a common list at the beginning of curriculum document for this programme) would be assured.

Faculty should refer to that common list and should ensure that students also acquire outcomes in affective domain which are required for overall achievement of Programme Outcomes/Course Outcomes.

S. No.	Unit Number	Practical Exercises (Outcomes' in Psychomotor Domain)	Hrs. required
1	I	Preparatory Activity: 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	Measurement of Wear: Measure wears of anyone of the following. a. Machine guide ways. b. Shaft –sleeve. c. Piston –cylinder. d. Bearing.	02
3	II	Corrosion: Each student will collect corroded component from field and identify the types of corrosion and possible causes. Student will also suggest prevention methods.	02
4	III	Fault Tracing and Decision Tree: Develop decision tree for location of fault for any two items from following- a. Internal combustion (IC) engine. b. Boiler. c. Pump. d. Machine tool. e. Air compressor. f. Electric motor.	04
5	IV	Maintenance of Mechanical Based Equipment/Device/Machine. Maintenance of any two from following. Batch may be divided in to two groups and each group may be given one case. a. Head stock. b. Tail stock. c. Feed box. d. Indexing head. g. Internal combustion (IC) engine. h. Pump. (Dismantle of given case, observe rules, follow sequence of dismantling operations, cleaning, inspection, measuring deviations , recovery methods, testing and assembling).	08

6	IV	Preventive Maintenance: Prepare a preventive maintenance schedule of any workshop having- air compressors, car washing pumps, tyre changer, lifts, welding machines, and wheel alignment.	02
7	V	Safety: Demonstrate use of fire fighting and safety related equipments.	02
8	VII	Test Chart: Prepare test chart of newly installed or repaired machine tool.	02
9	ALL	Mini Project And Presentation: 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	Industrial Visit: Arrange visit to nearby automobile workshop/machine shop.	-
Total Hours			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.
2.	Visit nearby Industry/plant/workshop/hospital and collect samples of periodic & preventive maintenance format.

9. SPECIAL INSTRUCTIONAL STRATEGIES (If any)

Sr. No.	Unit	Unit Name	Strategies
1	I	Fundamentals of maintenance engineering	Demonstrate and explain use of tools.
2	II	Wear and Corrosion and their prevention	Show worn out parts. Also discuss reasons. Show corroded parts. Also discuss reasons.
3	III	Fault tracing	Show movie. Demonstrate the steps.
4	IV	Periodic and preventive maintenance	Show movie. Demonstrate the steps. Show some sample formats.
5	V	Industrial safety	Demonstrate and explain use of safety equipments. Industrial visit.
6	VI	Recovery, reconditioning and retrofitting	Show movie. Demonstrate the steps. Industrial visit.
7	VII	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 Handbook	Higgins & Morrow	DA Information Services
2.	Maintenance Engineering	H.P.Garg	S. Chand and Company.
3.	Maintenance of Machine Tools	Gilbirg & Morrow	
4.	Pump-hydraulic Compressors	Audels.	McGrew Hill Publication.
5.	Foundation Engineering Handbook	Winterkorn, Hans.	Chapman & Hall London

6.	Manuals Of Machine Tool And Auto mobile Vehicles	-	-
7.	Corrosion handbook	-	-

(B) List of Software/Learning Websites:

- i. www.mt-online.com
- ii. www.pmxpert.com
- iii. www.nptel.iitm.ac.in
- iv. en.wikipedia.org
- v. webstore.ansi.org/preventive-maintenance
- vi. www.mapcon.com

(C) List of equipments:

- i. Tool kit.
- ii. Fire extinguishers.
- iii. Lubricants.
- iv. Cotton waste.
- v. Kerosene.
- vi. Measuring instruments.

11. COURSE CURRICULUM DEVELOPMENT COMMITTEE

Faculty Members from Polytechnics:

- **Prof. R B Patel**, Lecturer in Mechanical Engineering, Govt. Polytechnic, Himatnagar.
- **Prof. A M Patel**, Lecturer in Mechanical Engineering, B.S.Patel Polytechnic, Kherva.
- **Prof. K.P.Patel**, Head of Mechanical Engineering Department, B.S.Patel Polytechnic, Kherva.

Coordinator and Faculty Members from NITTTR Bhopal

- **Dr. Vandana Somkuwar**, Associate Professor, Department of Mechanical Engineering,
- **Prof. C.K. Chugh**, Professor, Department of Mechanical Engineering