GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Engineering

Level: Diploma

Branch Fabrication Technology

Course / Subject Code: DI03055031

Course / Subject Name Plant Equipment Erection and Maintenance

w.e.f. Academic Year:	2024-25
Semester:	3rd
Category of the Course:	PCC

Prerequisite:	-
Rationale:	For satisfactory performance of any plant / industry, it is necessary that all the plant equipment should be in a good working condition. Corrosive environment and wear produce adverse effect on the performance of the plant equipment, so it is necessary to perform various maintenance activities in the plant / industry. In a process plant / industry, proper functioning of different plant equipment depends on its appropriate foundation, erection and installation. Maintenance of the plant equipment plays a vital role for achieving qualitative and competitive product. This course develops theoretically and hands on skills of maintenance of various plant equipment. This course also develops safety consciousness among the students for the industrial environment. It gives knowledge about different health & safety acts and rules implemented by government in industry.

Course Outcomes:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
01	Describe static and rotary plant equipment.	U
02	Describe foundation, erection and installation procedure for given machine/equipment.	U
03	Select suitable corrosion prevention method according to working environment of plant equipment.	A
04	Use appropriate tools for maintenance of given plant equipment.	A
05	Apply industrial safety rules to avoid accident.	A

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+(PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial/ Practical		
L	T	PR	C	ESE (E)	PA(M)	PA(I)	ESE (V)	
3	0	2	4	70	30	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	**Plant Equipment** 1.1 Definition of Plant 1.2 Classification chart of plants 1.3 Classification of Plant equipment 1.4 Boilers 1.4.1 Definition as per IBR 1.4.2 Classification Chart 1.4.3 Difference between Fire tube and Water tube Boiler 1.4.4 Factors affecting for selection of boiler 1.4.5 Constructional figure and Working of Cochran Boiler 1.4.6 Constructional figure and Working of Lancashire boiler 1.4.7 Constructional figure and Working of High Pressure LaMount Boiler 1.4.8 List of different Mountings and Accessories of Boiler and their Functions 1.5 Valves – Definition, types, construction and its function 1.6 Cooling tower – Definition, construction and its function 1.7 Pumps 1.7.1 Definition 1.7.2 Classification 1.7.3 Applications 1.7.4 Working of Reciprocating Pump 1.7.5 Construction/ working of Centrifugal Pump 1.7.6 Installation of Centrifugal Pump 1.7.7 Priming 1.7.8 Gear Pump 1.7.9 Difference between Centrifugal and Reciprocating pump 1.8 Air Compressors 1.8.1 Definition 1.8.2 Classification chart 1.8.3 Construction & working of Reciprocating Air Compressor 1.8.4 Construction & working of Centrifugal Air Compressor	15	33

	1.8.5 Applications of compressed air 1.9 Fans & Blowers 1.9.1 Definition of Fan 1.9.2 Definition of Blower 1.9.3 Difference between Fan & Blower 1.9.4 Types of Fan 1.9.5 Types of Blower 1.9.6 Industrial applications of Fan & Blower		
2.	**Foundation, Erection and Installation** 2.1 Design and planning of foundation 2.1.1 Definition of foundation 2.1.2 Effect of the proper foundation 2.1.3 Function of foundation 2.1.4 Types of foundation 2.1.5 Design consideration of foundation 2.1.6 Foundation materials 2.1.7 Concrete mixture for industrial equipment 2.1.8 Foundation size and plan of industrial equipment 2.1.9 Types of foundation bolts 2.2 Erection & Installation of equipment 2.2.1 Definition of Erection 2.2.2 Erection Procedure 2.2.3 Erection equipment 2.2.4 Definition of Installation 2.2.5 Installation procedure of machine / equipment 2.2.6 Grouting, alignment and acceptance test for industrial equipment	10	22
3.	**Corrosion & its Prevention in process plant** 3.1 Definition of corrosion 3.2 Principle of surface corrosion 3.3 Factors affecting the corrosion 3.4 Types of corrosion 3.5 Corrosion prevention methods 3.6 Selection of corrosion prevention method 3.7 Corrosion control in chemical / petro chemical plant 3.8 List of painting codes and standards applicable to process plant	07	16

	equipment		
4.	**Maintenance in Process Plant** 4.1 Definition of maintenance and maintenance engineering 4.2 Aims of maintenance programme 4.3 Functions of maintenance department 4.4 Responsibilities of maintenance department 4.5 Types of maintenance 4.6 Tools used for maintenance 4.7 Wear and Lubrication 4.7.1 Wear – Definition, types, causes and its effects 4.7.2 Wear reduction methods 4.7.3 Lubricant – Definition, types and applications 4.7.4 Lubrication methods 4.8 Recovery methods and their applications	08	18
5.	**Industrial Safety** 5.1 Accident: - Causes, Types, Results and Control. 5.2 Mechanical and electrical hazards-types, causes and preventive steps/procedure. 5.3 Salient points of Factories act 1948 for health and safety 5.4 Salient points of The Gujarat Factories Rules, 1963, Chapter IV – Safety 5.5 Safety colour codes 5.6 Fire prevention and firefighting, equipment and methods. 5.7 Accident report 5.8 Duties of safety inspector and fire inspector	05	11
	Total	**45**	**100**

Suggested Specification Table with Marks (Theory) :

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
37 %	48 %	15 %	-	-	-

Where R:Remember;U:Understanding; A:Application, N:Analyze and E:Evaluate; C:Create (as per Revised Bloom's Taxonomy)

Note: *This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks and marks at different taxonomy levels (of R, U and A) in the question paper may vary slightly from above table.*

References/Suggested Learning Resources:

(a) Books:

Sr. No.	Title of Book	Author	Publication with place, year and ISBN
1	Structural steel: fabrication & erection	S. K. Saxena& R. B. Asthana	Somaiya Publication Pvt. Ltd. ISBN 81-7039-207-1
2	D. L. Material of P.M.& S.M-504	-	C.E.C., C.T.E., Gandhinagar
3	Elements of Mechanical Engineering	P. S. Desai & S. B. Soni	Atul Prakashan, Ahmedabad ISBN – 81-89736-02-7
4	Elements of Mechanical Engineering	N. M. Bhatt & J. R. Mehta	Mahajan Book Depot, Ahmedabad
5	Corrosion Engineering	Mars G. Fontana	Tata McGraw-Hill Publishing Company Limited, ISBN:- 0-07-021463-8
6	Maintenance Engineering Handbook	Higgins & Morrow	McGraw Hill Publication ISBN 0-07-028755-4
7	Maintenance Engineering	H. P. Garg	S. Chand and Company Ltd. ISBN :
8	Pump-hydraulic Compressors	Audels.	McGraw Hill Publication
9	Foundation Engineering Handbook	Winterkorn, Hans.	Chapman & Hall London
10	Corrosion handbook	-	-
11	Engineering Chemistry with experiments	Sunita Rattan	S. K. Katariya & Sons
12	Pump Operation and Maintenance	Tyler G. Hicks, BME	Tata McGraw-Hill Publishing Company Limited, ISBN 0-07-099349-1
13	Pumps Principles & Practices	Board of Editors	Jaico Publishing House ISBN 978-81-7992-897-4
14	Valves Principles & Practices	Board of Editors	Jaico Publishing House ISBN 978-81-7992-895-0
15	Factories act 1948 for health and safety	-	-
16	The Gujarat Factories Rules, 1963	-	-

(b) Open-source software and website:

1. https://youtu.be/elUIbOnJc7c
2. https://youtu.be/H1AsPLYCyWk
3. https://youtu.be/UYMDm4yB1QA
4. https://youtu.be/4eMNFBB1StQ
5. https://youtu.be/gYyg8m9mntg
6. https://youtu.be/uVPp8wml9iU
7. https://youtu.be/lKBqTOgOQTM
8. https://youtu.be/2__g1Fntx4o
9. https://youtu.be/f58SW0Hwcf0
10. https://youtu.be/o7jb6VhzhqY
11. https://youtu.be/Vd8Kvz39msQ
12. https://youtu.be/g163n8rB3mM
13. https://youtu.be/5OxdXq91TV0

Suggested Course Practical List:

Sr. No.	List of Practical	No. of Hours
1	Prepare list of tools and equipment required for erection and maintenance work.	02
2	Perform maintenance activity for given static plant equipment.	02
3	Perform maintenance activity for given rotary plant equipment.	02
4	Perform vertical alignment of given object using plumb-bob	02
5	Perform levelling of given object using spirit level.	02
6	Perform levelling and mark points on wall of a building using transparent water tube.	02
7	Study different types of corrosion and describe its remedies for given object.	02
8	Perform corrosion prevention exercise for a given job.	04
9	Study various recovery methods to maintain / repair wear parts of machine/equipment.	02
10	Perform maintenance activity of bench vice.	02
11	Perform maintenance activity of given lathe chuck.	02
12	Study foundation plan and foundation bolt of industrial equipment.	02
13	Demonstrate various personal protective equipment and use of fire fighting and safety related equipment.	02
14	Prepare a typical accident report for given plant accident situation.	02
	Total	**30**

Note :

i. *More **Practical Exercises** can be designed and offered and can be changed by the respective course teacher to develop the industry relevant skills/outcomes to match the COs. The above table is only a suggestive list.*

ii. *Boiler suit, safety shoes, other safety items& hand tools are compulsory while attending laboratory and has to be brought by students.*

List of Laboratory / Learning Resources Required:

No.	Equipment Name with Broad Specifications
1	Maintenance tool kit
2	Marking and Measuring instruments
3	Power and portable tools
4	Static and rotary plant equipment
5	Plumb-Bob
6	Spirit level
7	Transparent Water tube
8	Painting tools
9	Screw extractor
10	Welding machines
11	Metal spraying gun with gas welding equipment
12	Air compressor
13	Bench wise
14	Personal protective equipment
15	Fire fighting and safety related equipment

Suggested Project List:

1. **Creating Digital Portfolio:** Students should observe and collect photographs and images of industrial/domestic components/items/equipment etc. and make a report on it.
2. **Chart making:** Prepare chart / drawing of various static equipment, rotary equipment, foundation plan, installation - erection procedure, corrosion, maintenance, safety, etc. given by the subject teacher.
3. **Model Making:** Students should build 3D model of various object as per shape and dimension from thermocol, hardboard scrap, wooden scrap, plastic or metal scrap or drawing sheet etc.
   - Prepare a model of various types of process/power plant.
   - Prepare model of various types of static and rotary equipment.
   - Prepare a model of foundation for machine /equipment.
4. **Video Preparation:** Student have to prepare his/her video on demonstrating different maintenance tools, measuring instruments, different static and rotary equipment, erection equipment, maintenance activities performed in laboratory etc. given by the subject teacher.

5. **E-learning projects:** Students have to use internet and other online resources for preparation of report and/or download video on the topic given by the subject teacher within the syllabus or beyond the syllabus.
6. **Report preparation:** Student has to use different books, technical magazine, journals etc. for preparation of a report on the topic given by the subject teacher within the syllabus or beyond the syllabus.
7. **Power point presentation**: Students has to prepare a power point presentation of 10 to 15 slides on the topic given by the subject teacher within the syllabus or beyond the syllabus. In the end of presentation student has to ask at least 3 to 5 MCQ based question to identify the gain of listeners at the end presentation.
8. **Collect and study brochure** of different maintenance tools and accessories from local vendor/ online vendor.

Suggested Activities for Students:

1. Prepare solutions of different assignments given by subject faculty.
2. Report writing on various topics from syllabus and beyond syllabus.
3. Prepare sketchbook of Tools and Equipment required for Erection and Maintenance.
4. PPT presentation (10 minutes) on given Sub-topic of subject beyond the syllabus.
5. Prepare chart showing various static and rotary equipment.
6. Prepare a model of foundation plan for machine /equipment.
7. Prepare chart showing various types of corrosion and corrosion prevention methods.
8. Prepare chart showing various types of maintenance and maintenance activity.
9. Prepare chart showing various safety Rules/ guidelines to be followed in industry.
10. Show video/animation films of different process plants and discuss their operations and if possible show films related to erection commissioning of these plants.
11. Arrange visit to process plant and show various erections/commissioning and maintenance activities being carried out.
12. Perform maintenance activity of different laboratory equipment.

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ANNEXURE-1: SAMPLE SAFETY CONTRACT

(To be filled by the students and submitted to concerned faculty/staff)

-- Use for reference purposes only --

1. You have to read and sign the safety contract.
2. The safety contract says that you understand that safety is your responsibility.
3. The safety contract to be signed before you carry out any work in the laboratory and if you don't observe and obey the safety rules, you will not be allowed in the laboratory.

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Safety Contract

Date: _____

Name of Institute: _____

Name of Course with Code: Plant Equipment Erection and Maintenance (_____)

Name of Faculty/Staff with Designation: 1. _____

2. _____

3. _____

I RECOGNIZE THAT:

1. Safety is my responsibility when using a tool.
2. Safety regulations have been provided to me.
3. The possibility of accident and injury increases if I do not follow all the safety guidelines.
4. I must act responsibly to ensure my own safety & the safety of others in the work area.

I AGREE TO:

1. Never work in the shop without my faculty's/ Instructor's supervision.
2. Read and practice all the safety regulations that have been distributed to me in this course or have been posted in the work areas.
3. Act in a responsible manner at all times in the laboratory.
4. Follow all instructions given by the faculty/Instructor.
5. Immediately report any unsafe condition or activity to my faculty/Instructor.
6. Wear eye protection at all times when working with tools or working anywhere near someone who is using tools.
7. Cut or Tie back long hair, remove jewellery, secure loosed clothing, and wear boiler suit & safety shoes in the laboratory.
8. Clean all work areas and put equipment away before leaving the laboratory.

I, _____, have read and agree with all the safety instructions.

Particulars:

Programme : _____

Batch No. : _____

Enrollment No.: _____

Student Signature

_____