GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)
Semester-I

Course Title: Electrical and Mechanical Workshop Practice
(Course Code: C316401)

Diploma programme in which this course is offered	Semester in which offered
Renewable Energy	First

1. RATIONALE

Workshop practice is the backbone of the real industrial environment which helps to develop and enhance relevant technical hands-on skills required by the operator and /or supervisor working in the various engineering industries and workshops. This course intends to impart knowledge of basic workshops such as fitting, sheet metal, plumbing, Earthing, Electrical protective devices, tool and plants use for maintenance to be perform during his/her duties in industry. Students are able to perform various operations using hand tool, equipment and machineries in various shops. Working in workshop develops the attitude of group working and safety awareness.

2. COMPETENCY

The purpose of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Prepare simple jobs as per given specification using appropriate tools, instruments and equipment following safe working and good housekeeping practices.
- Identify and use of various electrical Tools, instruments and safety devices

3. COURSE OUTCOMES (COs)

The practical exercises, the underpinning knowledge and the relevant soft skills associated with the identified competency are to be developed in the student for the following Course Outcomes (COs) achievement:

a) Use the preliminary safety measures while working in different shops of engineering workshop.
b) Select the appropriate Electrical and Mechanical tools/equipment required for specific job.
c) Perform various fitting and sheet metal operations to produce simple jobs. d)Use various tools for performing plumbing operations.
d) Solder different electrical and electronics components using of appropriate tools
e) Follow safe practices to prevent accidents/ hazards to personnel and environment
f) Select different types of wires, Cables, Switches and accessories

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In			Total Credits	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	IoTur)	P	(L+TC+ P/2	CA	ESE	CA	ESE	
0	0	4	2	0	0	25*	25	50

(*): For this practical only course, 25 marks under the practical CA has two components i.e. the assessment of micro-project, which will be done out of 10 marks and the remaining 15 marks are for the assessment of practical. This is designed to facilitate attainment of COs holistically, as there is no theory ESE.

Legends: L-Lecture; T – Tutorial/Teacher Guided Theory Practice; P -Practical; C – Credit, CA - Continuous Assessment; ESE -End Semester Examination.

5. SUGGESTED PRACTICAL EXERCISES

The following practical outcomes (PrOs) are the sub-components of the COs. Some of the PrOs marked '*' are compulsory, as they are crucial for that particular CO at the 'Precision Level' of Dave's Taxonomy related to 'Psychomotor Domain'.

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
1	Perform mock drill practice for various safety equipment and common workshop tools.	**I**	**2**
2	**Fitting shop:** Prepare one simple fitting job with following operations • Marking operation as per drawing • punching operation as per drawing • filing operation as per drawing • chamfering operation as per drawing	**II**	**4***
3	Prepare job with following operations: • drilling operation as per drawing • tapping operation as per drawing	**II**	**4***
4	**Sheet metal shop:** Perform various joining operations like soldering, brazing etc.	**III**	**2**
5	Prepare the report with sketch, specifications and applications of demonstrated sheet metal tools.	**III**	**2**
6	Prepare sheet metal utility job using following operations: • Cutting and Bending • Edging • Soldering • Riveting.	**III**	**6***

7	**Plumbing shop:** Demonstration of different plumbing tools and pipe fittings.	**IV**	**4**
8	Prepare the report with sketch, specifications and applications of demonstrated plumbing tools and pipe fittings.	**IV**	**2**
9	Prepare following plumbing job as per given drawing: • T joint pipe fitting job • elbow joint pipe fitting	**IV**	**4**
10	Perform following measurement using appropriate instrument • Voltage, current, power, power factor	**V**	**2**
11	Demonstrate and use multimeter, clamp meter, Insulation tester for miscellaneous measurement	**V**	**2**
12	Demonstrate and use Insulation tester for insulation resistance measurement • 1 & 3 Phase Induction motor • Transformer • Cable • Domestic and Industrial wiring	**V**	**2**
13	Demonstrate and Measure power through bidirectional energy	**V**	**2**
14	Identify and Use of various tools used in electrical workshop.	**V**	**2**
15	Identify different types of components like diode, SCR, Transistor, TRIAC, IGBT, MOSFET and solder it on PCB	**V**	**2**
16	Perform cable gland termination for various type of cables	**VI**	**2**
17	Demonstrate various type of cable joint and its process	**VI**	**2**
18	Identify and measure the size of different wires and cable using standard wire gauge and micrometer.	**VI**	**2**
19	Demonstrate function and test following protective device • Fuse, MCB, MCCB, RCCB, ELCB	**VI**	**4**
20	Demonstrate and use various personal protective equipment	**VI**	**2**
21	Demonstrate following types of earthing and collect permissible value of earth resistance for difference type of installations • Plate type, Pipe type, Rod type	**VII**	**2**
22	Measure earth resistance of existing earthing using earth tester	**VII**	**2**
23	Demonstrate and use portable fire extinguishers for following type of fire • Type A, Type B, Type C, Type D	**VII**	**2**
TOTAL			**60**

Note

I. More Practical Exercises can be designed and offered 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. The following are some sample 'Process' and 'Product' related skills (more may be added/deleted depending on the course) that occur in the above listed Practical Exercises of this course required which are embedded in the COs and ultimately the competency

Sr. No.	Sample Performance Indicators for the PrOs	Weightage in %
1.	Safety instructions	10
2.	Job sample drawing	10
3.	Selection of tool/equipment	20
4.	Sequence of operations and procedure / technique	30
5.	Time limit	10
6.	Dimensional accuracy	10
7.	Oral test	10
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specifications for the PrOs is a guide to procure them by the administrators to usher in uniformity of practical in all institutions across the state.

Sr. No.	Equipment Name with Broad Specifications	PrOs No

1	**Fitting Shop** Bench vices 50/100/150 mm. Hand vice, Machine vice Marking table Surface plate Angle plate Universal scribing block Scriber Marking gauge Fitting tables Tri square Right angle Combination set V block with clamps C clamps Set of needle files Ball pane Hammer - 750 Gms. Pair of outside spring caliper- 250 mm. Pair of Inside spring caliper 150 mm. Vernier caliper Micrometer outside & inside Bevel protractor Odd leg caliper Files (smooth & rough)-round, flat, safe edge, square, knife edge, triangular, half round One pair of dividers Hacksaw frame with blade 12" * 300 mm. Centre punch Dot punch Prick punch Letter punch-Number punch	2, 3, 4 & 5
	Flat chisel 20 mm. Set of sorted twist drills, taps and dies (with holders/wrench) Set of spanners-Fix, Ring, box, Allen and Adjustable Set of screw drivers-sorted Scraping tool Set of pliers Filler and radius gauge etc.	

2	**Sheet Metal Shop** Rubber Mallet Wooden Mallet Slip 12", 10" Slip ordinary Half-moon stake Side stake Exiting stake Cross stake Funnel stake Tea & bottom stake Stake holding stand Combination pliers S.W.G Hand riveting m/c Spinning hath 6' with die Power hydraulic press m/c Riveting m/c Round stake Soldering and Brazing kits etc.	2, 6, 7 & 8
3	**Plumbing Shop** Various samples of pipe fittings-like joints, elbows, tees, unions, bend, nipples, couplers, reducers, four ways etc. of Metal and PVC Water taps, plug, ferule Pipe bending machine manual/hydraulic Pipe vice Pipe wrenches Pipe spanners Set of spanners-Fix, Ring, box, Allen and Adjustable. Set of screw drivers-sorted Set of chisels Hammers Teflon taps, cotton thread Set of dies and holders Hacksaw, pipe cutter Adhesive for PVC pipe fittings etc.	2,7,8,9
4	**Tools for maintenance and troubleshooting** Pliers, nose plier, wire stripper, cramping tools, lug press machine, wire gauge etc.	14,16,17,18
5	**Measuring Instruments** Voltmeter, A-meter, Multimeter, clamp meter, Insulation tester, earth tester	10,11,12, 13
6	**Protective devices** ELCB, MCB, MCCB, Fuse, RCB, ELCB tester, portable fire extinguishers	19,20,21, 22, 23

7. AFFECTIVE DOMAIN OUTCOMES

The following sample Affective Domain Outcomes (ADOs) are embedded in many of the abovementioned COs and PrOs More could be added to fulfill the development of this course competency.

a) Follow safe practices.
b) Practice good housekeeping.
c) Demonstrate working as a leader/a team member. d) Maintain tools/equipment. d) Follow ethical practices.

The ADOs are best developed through the laboratory/field-based exercises. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

i. 'Valuing Level' in 1st year
ii. 'Organization Level' in 2nd year.
iii. 'Characterization Level' in 3rd year.

8. UNDERPINNING THEORY

The major underpinning theory is given below based on the higher level UOs of Revised Bloom's taxonomy that are formulated for development of the COs and competency. If required, more such UOs could be included by the course teacher to focus on attainment of COs and competency.

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
Unit – I **Workshop Introduction & Safety**	1a. Sketch general workshop layout 1b. Follow the preliminary safety rules in workshop including the dressing and behavioral safety manners 1c. Recognize the importance of keeping the workshop clean and tidy 1d. Demonstrate an awareness of the workshop safety rules written in the safety contact	1.1. Workshop layout 1.2. Importance of different sections/shops of workshop 1.3. Introduction to workshop safety 1.4. Personal safety 1.5. Use of tools 1.6. Workshop cleanliness 1.7. Fire precautions 1.8. Safety undertaking (See Annexure-1)
Unit – II **Fitting Shop**	2a. Appreciate the importance of fitting operations in engineering works 2b. Select the proper fitting material for the job undertaken 2c. Identify and use various tools/equipment used in fitting shop 2d. Prepare a simple job according to the specifications	2.1. Introduction 2.2. Fitting tools: 2.2.1. Holding tools, 2.2.2. Striking tools, 2.2.3. Cutting tools, 2.2.4. Measuring, Marking and Testing tools etc. 2.3. Fitting operations: 2.3.1. Method of filing, 2.3.2. Marking, 2.3.3. Sawing,

		2.3.4. Chipping etc. 2.4. Materials used in fitting shop 2.5. Preparation of fitting job 2.6. Safe and correct practices Note: List of Major Equipment / Instruments of this lab mentioned above under the Point 6 at Serial No. 1.
Unit– III **Sheet Metal Shop**	3a. Appreciate the importance of sheet metal operations in engineering works 3b. Select the proper sheet material for the job undertaken 3c. Identify and use various tools/ equipment used in sheet metal shop 3d. Prepare a simple job according to the Specifications	3.1. Introduction 3.2. Metals used in sheet metal work 3.3. Hand tools 3.4. Sheet metal joints 3.5. Soldering 3.6. Brazing 3.7. Preparation of sheet metal job 3.8. Safe and correct practices Note: List of Major Equipment / Instruments of this lab mentioned above under the Point 6 at Serial No. 2.
Unit– IV **Plumbing Shop**	4a. Appreciate the importance 4b. of plumbing operations in engineering works 4c. Select proper grade and type of different pipes required for the job undertaken 4d. Identify and use various tools/ equipment used in plumbing shop 4e. Prepare a simple job according to the specifications	4.1 Introduction 4.2 Types of pipes 4.3 Pipe fittings including valves 4.4 Plumbing tools 4.5 Pipe joints 4.6 Preparation of plumbing job 4.7 Safe and correct practices Note: List of Major Equipment / Instruments of this lab mentioned above under the Point 6 at Serial No. 4.
Unit-V **Tools & Measuring Instruments**	5a. Use of Various electrical tools. 5b. Identify various types of electronics components. 5c. Measure electrical parameters using measuring instruments.	5.1. Introduction 5.2. Tool required for maintenance (i.e. Pliers, Nose Plier, Cutter, Screw Driver, Test Lamp, Series Lamp etc.) 5.3. Soldering of electronics component (i.e. Diode, SCR, Transistor, DIAC, TRIAC, IGBT etc.) 5.4. Measuring Instruments Voltmeter, Ammeter, Wattmeter, multimeter, Clamp on Meter, 5.5. Bidirectional measurement (Energy meter)

		5.6. Insulation Tester.
Unit– VI **Cables and Protective devices**	6a. Identify different type of cables and wires 6b. Select safety devices for various types of protections.	6.1. Types of Cables 6.2. Lugs, Glands and its termination 6.3. Electrical Protective devices 6.3.1 Fuse 6.3.2 MCB 6.3.3 MCCB 6.3.4 ELCB
Unit– III **Earthing and Fire safety**	7a. Use of different types of earthing. 7b. Identify and use of portable fire extinguishers	7.1. Need Of Earthing 7.2. Types of Earthing 7.2.1. Pipe Earthing 7.2.2. Plate earthing 7.2.3. Chemical Earthing 7.2.4. Coil earthing 7.3. Measurement of earth resistance 7.4. Fire and Safety rules 7.5. Portable fire extinguishers and its applications.

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching/ Practical Hours	Distribution of Theory			
			MaRks U Level		A Level	Total Marks
I	Workshop Introduction & Safety	**- Not Applicable -**				
II	Fitting Shop					
III	Sheet Metal Shop					
IV	Plumbing Shop					
V	Tools & Measuring Instruments					
VI	Cables and Protective devices					

VII	Earthing and Fire safety	
Total		

Legends: R=Remember, U=Understand, A=Apply and above (Revised Bloom's taxonomy)

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student- related cocurricular activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should perform following activities in group and prepare reports of about 5 pages for each activity. They should also collect/record physical evidences for their (student's) portfolio which may be useful for their placement interviews:

a) Prepare a list of specifications for various tools/measuring instruments/equipment/ machines used in the engineering workshop.
b) Undertake a market survey of local dealers for procurement of workshop tools/equipment/ machines and raw material.
c) Visit the local sheet metal trader /fabricator, collect all relevant information and submit the detailed report.
d) Conduct mock drill for fire safety.
e) Download movies showing correct practices for fitting, sheet metal work and plumbing.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a) Massive open online courses (MOOCs) may be used to teach various topics/sub topics.
b) Guide student(s) in undertaking micro-projects.
c) 'L' in section No. 4 means different types of teaching methods that are to be employed by teachers to develop the outcomes.
d) About 20% of the topics/sub-topics which are relatively simpler or descriptive in nature is to be given to the students for self-learning, but to be assessed using different assessment methods.
e) With respect to section No.10, teachers need to ensure to create opportunities and provisions for co-curricular activities.
f) Guide students on how to address issues on environment and sustainability (Hand operated tools are being used which are not consuming generated energy)
g) Guide students for using data manuals.
h) Arrange visit to nearby industries and workshops and use of videos/animations for understanding various workshop process.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project is group-based (group

of 3 to 5). However, in the fifth and sixth semesters, the number of students in the group should not exceed three.

The micro-project could be industry application based, internet-based, workshop-based, laboratorybased or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The duration of the microproject should be about 14-
16 (fourteen to sixteen) student engagement hours during the course. The students ought to submit micro-project by the end of the semester to develop the industry-oriented COs.

A suggestive list of micro-projects is given here. This has to match the competency and the COs. Similar micro-projects could be added by the concerned course teacher:

a) Prepare a utility job using various plumbing operations as per given drawing.
b) Prepare a utility job using various sheet metal operations as per given drawing.
c) Prepare circuit on PCB using electronics components
d) Prepare an extension board using protective device and accessories. **Note**:

- Utility job will be assigned by the teacher.
- Utility Job will be completed in a group of 4 to 5 students and students have to maintain lab work manual consist of job drawing, operations details, required raw materials, tools, equipments, date wise performance record.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	Workshop Practice	H.S. Bawa	McGraw Hill Education, Noida ISBN: 978-0070671195
2	A Textbook of Manufacturing Process (Workshop Technology)	J.K.Gupt and R.S. Kurmi	S.Chand and Co. New Delhi ISBN:81-219-3092-8
3	Introduction to Basic Manufacturing Process and Workshop Technology	Rajender Singh	New Age International, New Delhi ISBN: 978-81-224-3070-7
4	Electrical Workshop	R. P. Singh	I.K. International Publishing House Pvt. Ltd., ISBN: 9789381141205
5	Handbook of Electrical Engineering	S.L. Bhatia	Khanna Publication ISBN : 9788174090584

14. SOFTWARE/LEARNING WEBSITES

- http://www.abmtools.com/downloads/Woodworking%20Carpentry%20Tools.pdf
- http://www.weldingtechnology.org

- http://www.newagepublishers.com/samplechapter/001469.pdf
- http://www.youtube.com/watch?v=TeBX6cKKHWY
- http://www.youtube.com/watch?v=QHF0sNHnttw&feature=related
- http://www.youtube.com/watch?v=Kv1zo9CAxt4&feature=relmfu
- http://www.piehtoolco.com
- http://sourcing.indiamart.com/engineering/articles/materials-used-hand-tools/
- https://www.youtube.com/watch?v=xtIR7q6AJm0
- https://www.youtube.com/watch?v=fu5JddScQ1Y
- https://www.youtube.com/watch?v=aU1P7-Cn72s

15. PO-COMPETENCY-CO MAPPING

Semester-I & II	Engineering Workshop Practice (Course Code: 4301901)						
	POs						
Competency & Course Outcomes	PO 1 Basic & Discipline specific knowledge	PO 2 Problem Analysis	PO 3 Design/ development of solutions	PO 4 Engineering Tools, Experimentation &Testing	PO 5 Engineering practices for society, sustainability & environment	PO 6 Project Management	PO 7 Lifelong learning

Competency	**1. Prepare simple jobs as per given specification using appropriate tools, instruments and equipment following safe working and good housekeeping practices.** **2. Identify and use of various electrical Tools, instruments and safety devices**						
Course Outcomes a) Use the preliminary safety measures while working in different shops of engineering workshop.	2	-	-	3	2	-	1
CO b) Select the appropriate tools/equipment required for specific job.	2	-	-	3	-	-	1
CO c) Perform various fitting and sheet metal operations to produce simple jobs.	-	-	-	2	1	-	1
d) Use various tools for performing plumbing operations.	-	-	-	1	1	-	1
CO e) Use tools and electrical measuring instruments	2	-	-	3	2	-	-
CO f) Select protective device for electrical protection	2	-	-	3	2	-	2
CO g) Follow safe practice to prevent accidents / hazard to personal and environment	-	-	-	3	3	-	2

*Legend: '**3**' for high, '**2**' for medium, **'1'** for low and **'-'** for no correlation of each CO with PO.*

16. COURSE CURRICULUM DEVELOPMENT

GTU Resource Persons

S. No.	Name and Designation	Institute	Contact No.	Email
1.	Hardik C Parmar Head of the Department (Mechanical Engineering)	Government Polytechnic, Himatnagar	98982 09252	hardikfly@gmail.com
2.	Vipulkumar V Bhuva Lecturer (Electrical Engineering)	Government Polytechnic, Jamnagar	94262 06905	Jvipul995@gmail.com
3.	Rameshbhai B Patel Lecturer (Mechanical Engineering)	Government Polytechnic, Himatnagar		arby7869@gmail.com

Annexure-1

SAMPLE SEFTY Undertaking:
(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 undertaking.
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 workshop and if you don't observe and obey the safety rules, you will not be allowed in the workshop.

Safety Undertaking

Date: .....

Name of Institute: .....

Name of Course with Code: Electrical and Mechanical Workshop Practice (1316401)

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 AND the safety of others in the work area.

I agree to:

1. Never work in the shop without my faculty 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 workshop.
4. Follow all instructions given by the faculty.
5. Immediately report any unsafe condition or activity to my faculty.
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 jewelry, secure loosed clothing, and wear safety shoes in the Workshop.
8. Clean all work areas and put equipment away before leaving the workshop.

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

Particulars:

Programme: ....

Batch No.: ..... Student Signature
Enrollment No.: .....

----------x----------