GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

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

Course Title: ROBOTIC WORKSHOP PRACTICES

(Course Code: C4314101)

Diploma programme in which this course is offered	Semester in which offered
Automation and Robotics	Sem-1

1. RATIONALE:

Any student of diploma in Automation and Robotics engineering will be required to select and demonstrate various robotic components when the student reaches the industry. The whole course of this engineering is designed to train students to identify and demonstrate functional elements of robotics. Some of the other parts of this syllabus are basic concepts and components of robot technology

2. COMPETENCY

The course content should be taught and the curriculum should be implemented to develop different skills leading to the achievement of the following competency.

- Functional concepts of robot technology
- Demonstrate basic electrical, electronics, and robotic components of robot technology

3. COURSE OUTCOMES (COs)

The underpinning knowledge and the relevant skills associated with this competency are to be developed in the student to display the following COs:

a) Identify functional elements of robots.
b) Categorize different types of robots.
c) Simulate different electrical and electronic circuits.
d) Troubleshoot different electrical and electronic circuits.
e) Assemble mechanical components to build a robot.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA	ESE	CA	ESE	
0	0	4	2	0	0	25	25	50

(*): Out of 30 marks under the theory CA, 10 marks are for assessment of the micro-project to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessing the attainment of the cognitive domain UOs required for the attainment of the COs.

***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) that are the subcomponents of the COs. *These PrOs need to be attained to achieve the COs.*

Sr. No.	Practical Outcomes (PrOs)	Approx. Hrs. required
1	Categorize different types of Robots.	2
2	List industrial robots with their industrial application.	2
3	Discuss various functional elements of a robot.	2
4	Identify various sensors as functional elements of a robot.	2
5	Study different motors as functional elements of the robot.	4
6	Study basic control concepts for robotics.	2
7	Identify basic components of RF-based Dual-mode Robot.	2
8	Identify basic components of metal detection robot.	2
9	Study of robot with 2 DOF, 3 DOF, 4 DOF.	2
10	Identify the components for pick and place robot.	2
11	Demonstrate SPST and SPDT Switch.	2
12	Demonstrate DPST and DPDT Switch.	2
13	Demonstrate electromechanical relay.	2
14	Demonstrate proximity sensor.	2
15	Demonstrate IR sensor.	2
16	Perform wiring of AC supply with MCB and also DC supply.	2
17	Trace single phase AC circuit/ three phase AC circuit and DC circuit from the given wiring diagram.	2
18	Perform intensity control using a potentiometer on GPB.	2
19	Demonstrate motion sensor.	2
20	Demonstrate fan wiring diagram using capacitor.	2
21	Test the working of LED, LDR, photo diode and photo transistor.	2
22	Demonstrate working of DC, servo and stepper motor.	2

23	Operate pump using electromechanical relay.	2
24	Carryout wiring of DC supply/AC supply, Fuse, Relay, MCB/ AC Drive in control / AC motor starter, given controller in control panel as per given wiring diagram.	2
25	Prepare PCB layout manually on paper and using computer software.	2
26	Simulate half wave rectifier and measure output voltage waveform on CRO.	2
27	Simulate full wave rectifier and measure output voltage waveform on CRO.	2
28	Build +5v power supply circuit on simulation software.	2
29	Build positive and negative clipper circuit on simulation software.	2
30	Study the basic concept of welding.	2
31	Study the basic concept of drilling.	2
32	Demonstrate drilling skills to fabricate mechanical components of the robot.	2
33	Demonstrate basic components of Line follower robot.	2
34	Develop a robotic car using DPDT switch.	2
35	Demonstrate basic components of RF Controlled robots.	2
36	Build a simple robotic arm to pick and place.	2
37	Build simple up and down robotic arms.	2
	Total Hours	74

Note

*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**.** While designing exercises make sure that all COs are covered equally.*

Care must be taken in assigning and assessing study report. Teacher can assign group of students a drawing that is available from industry/catalog/manuals and ask them to answer simple questions related to interpretation of drawing. Teacher can also ask them to find material required from the problem of surface development and bill of material (part list).

*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.*

6. SUGGESTED LIST OF PROPOSED STUDENT ACTIVITIES

Students are required to prepare and submit a laboratory report on instruction/demonstration given by the instructor and workshop activities done by students as a part of term work.

They should also collect/record physical evidence for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare a chart of materials currently used for robotic components
b. Prepare a chart that displays the different types of robots
c. Prepare mini/micro project
d. Participate in a robotic competition for learning new trends and technology
e. Prepare a poster for safety guidelines

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

These 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
1	Axis Robotics Trainer
2	Axis Industrial Robotic Arm Trainer
3	Proximity trainer kit
4	Robot - Line Tracking Mouse Kit
5	Intelligent Robot Actuator Module
6	6-axis Robotics Trainer

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 the attainment of COs and competency.

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics

Unit-I **Fundamentals of Robotics and its classification**	1a. Understand the block diagram of ROBOT. 1b. Classify the different types of ROBOTS. 1c. Identify the functional elements of ROBOT. 1d. Explain the function of components used in ROBOT. 1e. Understand listed applications of ROBOT. 1f. Identify the components of the listed application of ROBOT.	**1.1 Definition and Block Diagram of ROBOT** **1.2 Classification of Robots:** • Based on location (fixed, mobile) • Based on Utilization (Industry, service) • Based on signal transmission medium (wired and wireless) **1.3 Functional Elements of ROBOT**: • Power Supplies • Sensors • Electric AC/DC motor • Servomotor • Driving mechanism • Manipulators • End Effectors • Locomotion device • Controllers **1.4 Applications of ROBOT:** • Line follower Robot • Gesture control Robot • Humanoid • Camera Drone

Unit– II **Application of Electrical and Electronic Components in Robotics**	**2a.** Perform wiring of different types of transformers, fuse, and choke in power supply. **2b.** Use different types of motor used in ROBOT. **2c.** Use different electronic components to perform various circuits. **2d.** Prepare PCB layout on paper and simulation software. **2e.** Build various circuits on simulation software using electrical and electronic components. **2f.** Build various circuits on PCB using electrical and electronic components.	**2.1 Concept of Electrical and Electronics** • AC/DC Power Supply **2.2 Electrical Component** • Transformer, fuse, choke • DC, Servomotor, Stepper motor **2.3 Electronic Component** • Resistor, capacitor, inductor • Diode, transistor • LED, LDR, Photodiode, Phototransistor • Relay and Switches **2.4 PCB, wiring, soldering de-soldering** • PCB layout in Simulation software • Types of electrical wiring (Batten, capping and casing, cleat, conduit) • Types of wiring joint ('T' joint, western union, married, straight, twisted and Britannia) • Soldering and de-soldering
Unit– III **Construction of ROBOT**	**3a.** Explain the concept of fitting, welding, and drilling to fabricate mechanical components. **3b.** Discuss various components in the robotic application. **3c.** Assemble various mechanical, electrical and electronic components to construct ROBOT. **3d.** Troubleshooting of a ROBOT	**3.1 Fabrication of mechanical components** • Fitting, Welding, Drilling • Mechanical Joints used in ROBOTICS (colinear, orthogonal, rotational, twisting, revolving) **3.2 Construction of ROBOT** • Mechanical Structure • Placement of electrical and electronic components and wiring • Testing and Troubleshooting

9. AFFECTIVE DOMAIN OUTCOMES

The following ***sample*** Affective Domain Outcomes (ADOs) are embedded in many of the above-mentioned COs. More could be added to fulfill the development of this course competency.

i. Practice & follow valid standards to assure quality work in the development of robotic mini projects
ii. Follow ethical practices as team leader and enable team members to do so at work.

iii. The student should be able to identify eco-friendly or recycled material prior to selection for robotic applications.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any) 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 microproject are group-based. However, in the fifth and sixth semesters, it should be preferably being ***individually*** undertaken to build up the skill and confidence in every student to become problem solver so that she/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based 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 total duration of the micro-project should be about **14 - *16 (fourteen to sixteen) student engagement hours*** during the course. The student 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:

Prepare robotic car using DPDT switch
Prepare pick and place robot using robotic components
Prepare RF controller robot
Prepare robot for metal detection application
Prepare robot for motion detection system
Prepare line follower robot
Prepare solar floor cleaner robot
Prepare solar tracker system using robotic components
Prepare stair climb robot
Prepare greenhouse managing robot for agriculture application

11. SUGGESTED LEARNING RESOURCES:

S. No.	Title of Book	Author	Publication with place, year and ISBN

1	Springer Handbook of Robotics	Bruno Siciliano , Oussama Khatib	Springer, ISBN: 9783319325521, 3319325523
2	Introduction to Robotics: Mechanics and Control (3rd Edition)	John Craig	Pearson ISBN:0201543613
3	Robotics and Automation Handbook	Thomas R. Kurfess	CRC Press ISBN4178978941 :

12. SOFTWARE/LEARNING WEBSITES

a. Multisim
b. Electronic Workbench
c. Proteus
d. https://www.labcenter.com/
e. https://nptel.ac.in

13. PO-COMPETENCY-CO MAPPING

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

Semester III	**Automobile Design & Drafting (4330206)**						
	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 ● Functional concepts of robot technology ● Demonstrate basic electrical, electronics and robotic components of robot technology	2	1	2	2	1	1	2
a) Identify functional elements of robots	2	-	1	1	1	1	2
b) Categorize different types of robots	2	-	1	1	1	1	2

c) Simulate different electrical and electronic circuits	3	1	2	1	1	1	3
d) Troubleshoot different electrical and electronic circuits	3	1	2	2	1	1	3
e) Assemble mechanical components to build a robot.	3	2	3	2	1	1	2

14. COURSE CURRICULUM DEVELOPMENT COMMITTEE

Member – Board of Studies (GTU), Electrical and Allied branches

Prof. S. Z. Shyara, IC Engineering, AVPTI, Rajkot

Prof. M. J. Vadhavaniya, IC Engineering, Government Polytechnic, Palanpur

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