GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2022 (COGC-2021)
Semester - VIII
Course Title: **Automation in Fabrication Technology**
(Course Code : 4385505)

Diploma programmer in which this course is offered	Semester in which offered
Fabrication Technology	Eight

1. RATIONALE

Modern manufacturing industries are implementing automation in their manufacturing process. This course develops capability in students to demonstrate and use of different hardware component for automation. Student can prepare part program and run on CNC simulator. Student can get hands on practical skill to make different turning & machining jobs. Student get describe anatomy of industrial robot. He/she get knowledge about the application of robotics in modern manufacturing industries. To Increases productivity and to reduce manufacturing time with the concept of Group technology may apply in the industries. In the era of industries 4.0, most of the industries are developing flexible manufacturing cell to improve quality and productivity of manufacturing. Students can connect themselves with latest automation and robotics technology after studying the subjects.

2. COMPETENCY

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

- **Use knowledge of Automation in manufacturing industry.**
- **Prepare part program for CNC lathe and milling.**

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 achievement of the following COs:

i. Describe automation in production system.
ii. Describe different hardware used in Automation.
iii. Prepare part Program for CNC lathe/ CNC milling machine.
iv. Describe robotics in modern manufacturing industries.
v. Describe concept of cellular manufacturing and Flexible manufacturing system.

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	
4	0	2	5	30*	70	25	25	150

(*): 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) are the sub-components of the COs. *These PrOs need to be attained to achieve COs.*

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	To study about automation in Production system.	1	2
2	Calculate a digital code for ADC from given data.	2	2
3	Calculate an analog signal value for DAC from given Data.	2	2
4	To study different hardware used in CNC machine.	2,3	2
5	To study different G codes & M codes for CNC machines.	3	2
6	Prepare part program for given job in absolute and incremental mode	3	2
7	Prepare a part program for facing operation on CNC lathe machine.	3	2
8	Prepare a part program for straight turning with concave radius operation on CNC lathe machine.	3	2
9	Prepare a part program for taper turning operation on CNC lathe machine.	3	2
10	Prepare a part program for convex radius operation on CNC lathe machine.	3	2
11	To study about Robot anatomy and prepare specification of welding Robot for given application.	4	2
12	Identify the part families from the given list of the objects.	5	2
13	Prepare a Group Technology layout based on production flow analysis for given data (Rank order clustering)	5	2
14	To study about FMS and prepare specification of automatic welding cell.	5	2
Total Hours			**28**

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. *Boiler suit, safety shoes and necessary tools & instruments are compulsory while attending laboratory and has to be brought by students (Annexure-1).*

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 %
For PrOs no: 1,2,3,4,5,6,11,12,13,14		
1	Knowledge of experiment	30
2	Quality of report	30
3	Participation	20
4	Originality	10
5	Punctuality	10
Total		**100**

Sr. No.	Sample Performance Indicators for the PrOs	Weightage in %
For PrOs no: 7,8,9,10		
1	Knowledge of experiment	20
2	Performance	30
3	Procedure followed	30
4	Quality of report	10
5	Punctuality	10
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

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

Sr. No.	Equipment Name with Broad Specifications	PrO. No.
1.	CNC Trainer Lathe Machine	4,5,7,8,9,10
1.	Simulator for turning and machining center	4,5,6,7,8,9,10
1.	Industrial Robot	11
2.	Computer with necessary software's	1,12,13,14
3.	Multimedia Projector	1,12,13,14
4.	Multimedia Printer	All

7. AFFECTIVE DOMAIN OUTCOMES

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

a) Follow safety practices in laboratory.
b) Practice good housekeeping.
c) Work as a leader/a team member.
d) Maintain tools/equipment
e) 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. 'Organisation Level' in 2nd year.
iii. 'Characterization Level' in 3rd year & 4th 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)	Topics and Sub-topics
Unit-I **Introduction To Automation**	1a. Describe application of automation in modern manufacturing industry 1b. Describe automation is production system 1c. Describe reasons of automation 1d. Describe benefits and drawbacks of automation	1.1 History of Automation 1.2 Functional areas (Application) of automation 1.3 Automation in production systems 1.4 Reasons for automation 1.5 Benefits and drawback of Automation 1.6 Automation principles & strategies 1.7 Basic elements of an automated system 1.8 Advance automation functions 1.9 Levels of automation
Unit– II **Hardware Components For Automation And Process Control**	2a. Describe different sensors used in industrial automation 2b. Describe different actuators used in industrial automation 2c. Calculate digital code for ADC 2d. Calculate analog signal for	2.1 Sensors 2.2 Actuators 2.3 Analog-to-digital converter 2.4 Digital-to-analog converter 2.5 Input/output devices for discrete data 2.6 PLC (Programmable Logic Controller)

Unit	Unit Outcomes (UOs)	Topics and Sub-topics
	DAC 2e. Describe PLC	
Unit-III **Numerical Control**	3a. Compare NC and conventional machine 3b. Describe NC/CNC/ DNC machines 3c. Prepare manual part program for CNC lathe 3d. Prepare manual part program for CNC milling machine 3e. Describe adaptive control system 3f. Describe machining center	3.1 Fundamental of NC technology 3.2 Difference between conventional & NC machine tools 3.3 Main components / elements of NC machine 3.4 The NC procedure 3.5 Classification of NC machines 3.6 Data input and storage media 3.7 Tape code 3.8 NC words 3.9 Tape format 3.10 Data processing techniques 3.11 Manual part programming 3.12 Computer aided programming 3.13 The programming languages 3.14 Tape reader 3.15 Tooling for NC machines 3.16 Advantages, disadvantages and applications of NC machines 3.17 Computer numerical control-CNC 3.18 Part programming for CNC lathe and CNC milling machine 3.19 Distributed/Direct numerical control-DNC 3.20 Adaptive control machining system 3.21 Machining center
Unit- IV **Industrial Robotics**	4a. Describe anatomy of robot. 4b. Describe different robot control systems 4c. Describe industrial robot application 4d. Describe robot programming	4.1 Robot anatomy & related attribute 4.2 Robot control systems 4.3 End effectors 4.4 Sensors in robotics 4.5 Industrial robot applications 4.6 Introduction of Robot programming
Unit- V **Cellular manufacturing & Flexible Manufacturing System**	5a. Identify part families 5b. Describe cellular manufacturing 5c. Describe FMS 5d. Describe automated welding cell	5.1 Cellular manufacturing 5.1.1 Part families 5.1.2 Part classification and coding 5.1.3 Production flow analysis 5.1.4 Cellular manufacturing 5.1.5 Application of Group Technologies 5.2 Flexible Manufacturing System

Unit	Unit Outcomes (UOs)	Topics and Sub-topics
		5.2.1 Introduction 5.2.2 Sub systems of FMS 5.2.3 Scope of FMS 5.2.4 Types of FMS 5.2.5 Benefits of FMS 5.2.6 Major Elements of FMS 5.2.7 Optimization of FMS 5.2.8 Typical FMS layout

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Introduction To Automation	8	3	11	-	14
II	Hardware Components For Automation And Process Control	6	-	4	7	11
III	Numerical Control	14	3	14	-	17
IV	Industrial Robotics	14	3	11	-	14
V	Cellular manufacturing & Flexible Manufacturing System	14	3	11	-	14
	TOTAL	**56**	**12**	**51**	**07**	**70**

Legends: *R=Remember, U=Understand, A=Apply and above (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.*

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** 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 solutions of different assignments given by subject faculty.
b) Download videos showing correct practices for different automation system and its application.
c) Visit at local manufacturing industry and prepare the report on it.
d) Fill up the lab manual.

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***.

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-projects are group-based (group of 3 to 5). However, **in the fifth and eighth semesters**, 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 duration of the micro project 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) **Chart making:** Student have to prepare a chart on automation, Industrial robots and its configuration, FMS etc. with its theories and working principle, application etc. given by the subject teacher.
b) **Video Preparation:** Student has to prepare his/her video on automation, Industrial robots and its configuration, FMS etc. given by the subject teacher.
c) **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.
d) **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.
e) **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.

13. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication with place, year and ISBN
1	Automation, Production systems, and Computer Integrated Manufacturing	Mikell P. Groover	PHI Learning Pvt. Ltd.
2	Welding Technology	O. P. Khanna	Dhanpat Rai Publication
3	CAD/CAM/CIM	P. Radhakrishanan S. Subramaniyam V. Raju	New Age Publications
4	C.N.C. Programming	Pabla B.S. Adithan M.	New Age International, New Delhi,2014(reprint)
5	Computer Numerical Control	Hans B. Kief T. Frederick waters	
6	Production technology vol-2	O. P. Khanna	Dhanpat Rai Publication
7	Computer Aided Manufacturing	Rao P N Tiwari N K Kundra T	Tata McGraw Hill 2014
8	Robotics and Industrial Automation	R.K.Rajput	S.Chand and Company

14. SOFTWARE/LEARNING WEBSITES

- https://youtu.be/zno8BYcdQzk?si=okfGf_y-y_Z6v_HR
- https://youtu.be/IS3Kv-54THE?si=-5evlX-xEbaP2EpY
- https://youtu.be/fVprvuxEAIs?si=PFHr9U8bpxCT1Uj2
- https://youtu.be/LDu7kTGRqbk?si=K5jV6ZI3wU32DdEq
- https://youtu.be/eXulkex-vlc?si=cWIGub5NpJs8_-2M
- https://youtu.be/DdY-UQhUpYU?si=zTIjrbE4FzrESFEI
- https://youtu.be/bMn_TPtX7xQ?si=KEUL6-7slPYXpHxN
- https://youtu.be/IL2dsjy63g0?si=pBo5sXs24431o2Fv
- https://youtu.be/C_zPZoLclJY?si=H09ih8bzaYDmpOw6
- https://youtu.be/B6hzMp40zgM?si=KK1bG0szf34qkj9_
- https://youtu.be/ImtSsDLgAaI?si=QDkco1bhOHnCoUOK
- https://youtu.be/S3vETSQLtSI?si=OjJ7rF_70Yci-pR8
- https://youtu.be/ViY0G55NvTs?si=SmUfygWndcfJf_xx
- https://youtu.be/R0Ch7Q-tgH0?si=WhZUqWKXmEXIZwcy
- https://youtu.be/23WVNU7OCnE?si=Fc4GouucGjXUzpsH
- https://youtu.be/xrwz9IxpMJg?si=KZqYfDbKrUKqqRdZ
- https://youtu.be/j8vYClEnyk0?si=67voFBLvie7H1KpQ
- https://youtu.be/o0NLi-wJS1I?si=B1xje3whd3qcoyUi
- https://youtu.be/6rsvc4D4iCc?si=_eDi7PyVSYTPhGxH
- https://youtu.be/5boZ_0OlxaI?si=0GBc1bAnC9EWgklT
- https://youtu.be/LfHD3l_DbsE?si=CMbGELFtIgqk0PZK
- https://youtu.be/YoslM2Sxihs?si=IjJb7ZsoqCZ576HN

- https://youtu.be/tiarT1YS-lM?si=QhcX49hbzTZVIsNp
- https://youtu.be/49RET0N-ITY?si=1kQgy-9EH8XfDE1R
- https://youtu.be/eFU7tSld7Yc?si=GIoXt--6Phs0dV6w
- https://youtu.be/8yErkF3TUI8?si=yFe5dapwJygk-l6s
- https://youtu.be/toTYb7Sirm0?si=4NqP5oo9JPpzTesO
- https://youtu.be/voN_297SXD8?si=jbpw-hLm8gaBjbH0

15. PO-COMPETENCY-CO MAPPING

Semester VIII	Automation in fabrication technology (Course Code: 4385504)						
	POs						
Competency & Course Outcomes	**PO 1 Basic & Discipline specific knowledge**	**PO 2 Problem Analysis**	**PO 3 Design/ develop-ment of solutions**	**PO 4 Engineering Tools, Experimen-tation & Testing**	**PO 5 Engineering practices for society, sustainability & environment**	**PO 6 Project Manage-ment**	**PO 7 Life-long learning**
Competency	**Use knowledge of Automation in manufacturing industry. Prepare part program for CNC lathe and milling.**						
CO1) Describe automation in production system.	3	-	-	-	1	-	2
CO2) Describe different hardware used in Automation.	3	1	-	-	-	-	2
CO3) Prepare part Program for CNC lathe/ CNC milling machine.	3	1	-	-	-	-	2
CO4) Describe use of robotics in modern manufacturing industries.	3	-	-	-	-	-	2
CO5) Describe concept of cellular manufacturing and Flexible manufacturing system.	3	1	-	-	1	-	2

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

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

Sr. No.	Name and Designation	Institute	Contact No.	Email
1.	Mr. Samirbhai Y. Merchant *I/C H.O.D Fabrication Technology Department*	Sir Bhavsinhji Polytechnic Institute Bhavnagar	9428408314	symerchant72@gmail.com
2.	Mr. Kapilkumar B. Pipavat *Lecturer in Fabrication Technology*	Sir Bhavsinhji Polytechnic Institute Bhavnagar	9427343525	kbpipavat.bpti@gmail.com
3.	Mr. Rohankumar B. Zapadiya Lecturer in Fabrication Technology	Sir Bhavsinhji Polytechnic Institute Bhavnagar	9033219351	rohan.zapadiya@gmail.com
4.	Mr. Parthiv T. Trivedi *Lecturer in Fabrication Technology*	Sir Bhavsinhji Polytechnic Institute Bhavnagar	9924185501	trivediparthivbpti@gmail.com

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.

::

Safety Contract

Date: ______________

Name of Institute: ____

Name of Course with Code: Automation In Fabrication Technology (4385504)

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.
8. Cut or Tie back long hair, remove jewellery, secure loosed clothing, and wear boiler suit & safety shoes in the laboratory.
9. Clean all work areas and put equipment away before leaving the laboratory.

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

Particulars:

Programme: _______________________ Student Signature

Batch No.: ______________________ __________________________

Enrolment No.: ___________________