

**GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT**

**COURSE CURRICULUM**  
**COURSE TITLE : AUTOMATION IN FABRICATION TECHNOLOGY**  
**( COURSE CODE : 3385503 )**

<b>Diploma Programme in which this course is offered</b>	<b>Semester in which offered</b>
Fabrication Technology	8 <sup>th</sup> Semester

**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 and thermal cutting jobs. Student can demonstrate automated welding design and learn different welding softwares. Student can demonstrate and use welding robots for various welding processes in fabrication industries.

**2. LIST OF 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 and skill of Automation in fabrication industry**
- **Prepare part program for CNC turning, machining and thermal cutting center.**

**3. COURSE OUTCOMES (CO's)**

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

1. Describe NC, CNC and DNC machines.
2. Prepare CNC part program for turning, machining and thermal cutting center.
3. Describe computer aided welding.
4. Describe industrial welding robot.
5. Describe flexible automated welding cell.

**4. TEACHING AND EXAMINATION SCHEME**

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	PA	ESE	PA	150
4	-	2	6	70	30	20	30	

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

**5. DETAILED COURSE CONTENTS**

<b>Unit</b>	<b>Major Learning Outcomes</b>	<b>Topics and Sub-topics</b>
<b>Unit – I Introduction To Automation</b>	1 a. Describe functional areas, advantages and limitations of automation in fabrication industries	<b>INTRODUCTION TO AUTOMATION</b> 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
<b>Unit– II Hardware Components For Automation And Process Control</b>	2 a. Describe different hardware component of automated system	<b>HARDWARE COMPONENTS FOR AUTOMATION AND PROCESS CONTROL</b> 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)
<b>Unit– III Numerical Control</b>	3 a. Describe NC/CNC/DNC machines  3 b. Prepare NC part program for turning centre, machining centre and thermal cutting centre	<b>NUMERICAL CONTROL</b> 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 Distributed/Direct numerical control-DNC 3.19 Adaptive control machining system 3.20 Machining center

Unit	Major Learning Outcomes	Topics and Sub-topics
<b>Unit- IV</b> <b>Computer Aided Welding Design</b>	4 a. Describe concept of computer aided welding design	<b>COMPUTER AIDED WELDING DESIGN</b> 4.1 Introduction and welding analysis 4.2 Engineering design v/s welding design 4.3 Perspective in welding design 4.4 Computer aided welding analysis 4.5 Computer aided welding design 4.6 Use of interactive computer graphics
<b>Unit-V</b> <b>Computer Systems For Welding Engineering</b>	5 a. Describe different software used for welding engineers	<b>COMPUTER SYSTEMS FOR WELDING ENGINEERING</b> 5.1 Introduction 5.2 Computer system 5.3 Software for welding engineers MAGDATA, PREHEAT, WELDCOST, WELDSPEC, WELDVOL, DISTORTCAL, CUTBEST, WELDBEST, SUPERWELDBEST, FERRITEPREDICTOR, WELD SELECTOR, TURBO- IX , WELD ASSIST, WELD CRACK EXPERT, PROCEDURE-WRITE etc.
<b>Unit-VI</b> <b>Industrial Robotics</b>	6 a. Describe anatomy, hardware and software of industrial robots	<b>INDUSTRIAL ROBOTICS</b> 6.1 Robot anatomy & related attribute 6.2 Robot control systems 6.3 End effectors 6.4 Sensors in robotics 6.5 Industrial robot applications 6.6 Introduction of Robot programming
<b>Unit-VII</b> <b>Welding Robots</b>	7 a. Describe construction and working of welding robots in fabrication industries	<b>WELDING ROBOTS</b> 7.1 Introduction of Welding robots 7.2 Robotic welding system 7.3 Types of welding robots 7.4 Robot selection mechanics 7.5 Integrated the welding system 7.6 Joint tracking system
<b>Unit-VIII</b> <b>Welding Automation</b>	8 a. Describe concept of welding automation in fabrication industries	<b>WELDING AUTOMATION</b> 8.1 Introduction of welding automation 8.2 Concept of welding automation 8.3 Welding operation, structure analysis 8.4 Classification of welding automation 8.5 Machine welding 8.6 Automatic welding 8.7 Flexible automated welding

**6. SUGGESTED SPECIFICATION TABLE WITH HOURS & MARKS (THEORY )**

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total
1	Introduction To Automation	6	0	7	0	7
2	Hardware Components For Automation And Process Control	6	0	0	7	7
3	Numerical Control	12	7	0	14	21
4	Computer Aided Welding Design	6	0	7	0	7
5	Computer Systems For Welding Engineering	6	7	0	0	7
6	Industrial Robotics	8	0	7	0	7
7	Welding Robots	6	0	7	0	7
8	Welding Automation	6	7	0	0	7
	<b>Total</b>	<b>56</b>	<b>21</b>	<b>28</b>	<b>21</b>	<b>70</b>

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

**NOTE :-**

Suggested specification table shall be treated as only general guidance for students and teachers. The actual distribution of marks in the question paper may vary from above table.

**7. SUGGESTED LIST OF EXERCISE/PRACTICAL**

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 mainly 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 overall 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*

<b>S. No.</b>	<b>Unit No.</b>	<b>Exercise /Practical</b> (Outcomes in psychomotor domain)	<b>Approx. Hrs. Required</b>
1	III	Prepare Part program for a given job in Absolute & Incremental Mode machine.	2
2	III	Prepare Part program for Turning centre for a given job on simulator.	2
3	III	Prepare a given job on CNC trainer lathe.	2
4	III	Prepare Part program for Machining centre for a given job on simulator.	2
5	III	Prepare part program for cutting centre for a given job on simulator.	2
6	IV	Calculate the induced stress by using lug design software.	2
7	IV	1. Calculate load carried by the lug when lug dimension is known by using software 2. Calculate dimensions of lug when load carried by it is known by using software	2
8	V	Prepare PWHT cycle as per ASME Sec VIII Div-1, UCS-56 by using software.	2
9	V	Calculate the weld cost of manual SMAW & GTAW process by using software.	2
10	V	Calculate the weld cost of automatic SAW & GMAW process by using software.	2
11	V	Calculate the heat-time by using software.	2
12	V	Prepare engineering unit conversation sheet by using software	2
13	VI,VII	Prepare specification of welding Robot for given application.	2
14	VIII	Prepare specification of automatic welding cell	2
<b>Total Hrs.</b>			<b>28</b>

## 8. SUGGESTED LIST OF PROPOSED STUDENT ACTIVITIES

Following is the list of proposed student activities:

- 8.1 Prepare sketchbook of drawing of various topics of syllabus
- 8.2 Prepare a question bank.
- 8.3 10 min PPT presentation on the given topic from the syllabus and beyond the syllabus
- 8.4 Report writing on various topics from syllabus and beyond syllabus
- 8.5 Fill up lab manual.

## 9. SPECIAL INSTRUCTIONAL STRATEGIES (if any)

- i. Arrange industrial visit.
- ii. Arrange expert lecture.
- iii. Show video films/animation films/photographs of different automated manufacturing process and discuss their features.

## 10. SUGGESTED LEARNING RESOURCES

### A. List of Books

S. No.	Title of Books	Author	Publication
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. Subramaniam V. Raju	New Age Publications
4	N. C. Programming	Pabla	
5	Computer Numerical Control	Hans B. Kief T. Frederick waters	
6	Production technology vol-2	O. P. Khanna	Dhanpat Rai Publication

### B. List of Major Equipment/ Instrument

1. CNC Trainer lathe / CNC Turning Centre
2. CNC Machining Centre
3. Welding Robot
4. Automated Welding System ( GTAW / GMAW / FCAW / SAW )
5. CNC machine simulator
6. Computers

### C. List of Software/Learning Websites

1. Welding Engineering Softwares like MAGDATA, PREHEAT, WELDCOST, WELDSPEC, WELDVOL, DISTORTCAL, CUTBEST, WELDBEST, SUPERWELDBEST, FERRITEPREDICTOR, WELD SELECTOR, TURBO-IX, WELD ASSIST, WELD CRACK EXPERT, PROCEDURE-WRITE

## 11. COURSE CURRICULUM DEVELOPMENT COMMITTEE

### Faculty Members from Polytechnics

- **Prof. P. B. Pathak**, I/C HOD, Deptt. of Fabrication Technology, Sir B.P.I., Bhavnagar
- **Prof. B. K. Gandhi**, Sr. Lecturer, Deptt. of Fabrication Technology, Sir B.P.I., Bhavnagar
- **Prof. S. Y. Merchant**, Sr. Lecturer, Deptt. of Fabrication Technology, Sir B.P.I., Bhavnagar

### Co-coordinator and Faculty Members from NITTTR Bhopal