# GUJARAT TECHNOLOGICAL UNIVERSITY

**Bachelor of Engineering**
**Subject Code: 3172010**
**Semester – VII**
**Subject Name: Automated Manufacturing**

**Type of course:** Engineering Science (Professional Core)

**Prerequisite:** Zeal to learn the course

**Rationale:** This subject is useful to understand the different types of automation and production system used in industries. Understand the different components of Computer Aided Manufacturing (CAM) basic concept of Computer Numerical Control (CNC), Numerical machine (NC) and Direct numerical machine (DNC). Techniques in robot manipulator Kinematics, enough to evaluate, chose, and incorporate robots in engineering systems. Familiarize with applications of Group Technology, Flexible manufacturing techniques.

**Teaching and Examination Scheme:**

| Teaching Scheme | | | Credits | Examination Marks | | | | Total Marks |
|---|---|---|---|---|---|---|---|---|
| L | T | P | C | Theory Marks | | Practical Marks | | |
| | | | | ESE (E) | PA (M) | ESE (V) | PA (I) | |
| 3 | 0 | 2 | 4 | 70 | 30 | 30 | 20 | 150 |

**Content:**

| Sr. No. | Content | Total Hrs |
|---|---|---|
| 1 | **INTRODUCTION** <br> Automation and types, production systems, automation in production system, automation principles and strategies, production facilities, introduction to NC, CNC and DNC machines tools, Explanation of execution system, Basic configuration of machine, Accuracy, Precision, Resolution, CNC MCU, Advantage, Capabilities and Limitations, Intelligent Manufacturing, Recent Trends | 05 |
| 2 | **MOTION CONTROL AND MACHINE ELEMENTS:** <br> Recirculating Ball screws, Linear Motion Guide ways, Hardened and ground guide ways, Tool Clamping systems, Servo motors and their applications, Feedback systems, Tachos, Encoders, Linear Glass Scales. Automatic Tool Changer (ATC), Automatic Pallet Changer (APC). | 05 |
| 3 | **BASIC PART PROGRAMMING IN CNC LATHE AND MILLING** <br> Axes identification, coordinate system, movements and interpolation with other axis, Application of rotary axis, Manual programming for CNC turning and Milling, Programming formats, Tool offsets, Type of compensations and cutting parameters, Introduction to G codes and M codes for CNC Turning and Milling, single and multipass canned cycle in turning and milling, sub programing. | 10 |
| 4 | **FUNDAMENTALS OF ROBOTICS:** <br> Introduction, Fundamentals of robot technology - anatomy, work volume, drives system, types of end effector, robot sensor. Robot and its peripherals; Basic control systems. | 05 |

| | | | |
|---|---|---|---|
| 5 | **KINEMATICS OF ROBOTIC MANUPULATORS:** Introduction to manipulator kinematics; homogeneous transformations and robot kinematics; Matrix Representation point, vector, frame and rigid body; Representation of Transformations of pure translation and rotation; Denavit-Hartenberg (D-H) representation for the concept of forward and inverse kinematics. | 08 | |
| 6 | **FLEXIBILITY IN MANUFACTURING:** Definition & concept, flexible automation & productivity, components of FMS, Different types of FMS, Technology required for FMS system | 04 | |
| 7 | **GROUP TECHNOLOGY:** Part family, Part classification and coding, production flow analysis – OPITZ classification system, cellular manufacturing, quantitative analysis in cellular manufacturing. Rank Order Clustering Technique (ROC), Holier Method –I,II, | 05 | |

**Suggested Specification table with Marks (Theory):**

| Distribution of Theory Marks | | | | | |
|---|---|---|---|---|---|
| R Level | U Level | A Level | N Level | E Level | C Level |
| **25** | **20** | **20** | **15** | **10** | **10** |

**Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)**

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

**Reference Books:**

1. Automation Production systems and Computer Integrated Manufacturing, 2nd Edition, Groover M.P.Prentice Hall of India
2. CNC Fundamentals and Programming, P. M. Agrawal &V. J. Patel, Charotar Publishing House Pvt. Ltd.
3. Mohsen Shahinpoo, A Robot Engineering Textbook Harper & Row Publishers
4. Saeed B. Niku Introduction to Robotics: Analysis, Systems, Applications PHI publishers
5. S. R. Deb Robotics Technology & Flexible Automation Tata McGraw Hill
6. R.K. Mittal, I.J. Nagrath Robotics and Control Tata McGraw-Hill

**Course Outcomes:**

After successful completion of the course the students shall be able to:

| Sr. No. | CO statement | Marks % weightage |
|---|---|---|
| CO-1 | Understand the different types of automation, production system and NC, CNC machine used in industries. | 15% |
| CO-2 | Create programs manually for the CNC Lathe and CNC Mill using G and M codes. | 30% |

*w.e.f. AY 2018-19*

| CO-3 | develop skills to evaluate, choose, and incorporate robots in engineering systems. | 20% |
|------|-----------------------------------------------------------------------------------|-----|
| CO-4 | Get familiarize with the concepts and techniques in robot manipulator Kinematics. | 20% |
| CO-5 | Get acquainted with the applications of Group Technology and Flexible manufacturing techniques to solve manufacturing and other industry related problems. | 15% |

**List of Experiments:**

1. Introduction to Computer Aided Manufacturing Systems.

2. Operation with Single Turning Cycle (G90) and facing Cycle (G94) for simple turning, facing and step turning.

3. Circular interpolation by G02 and G03 on STAR MILL with incremental and absolute programming.

4. Cutter Radius compensation and use of Mirroring command on STAR MILL

5. Drilling, Grooving and Threading cycles on Turning Center.

6. Multiple Turning stock removal, Multiple Facing stock removal and pattern repeating cycles on Turning Centers.

7. Programing for pick and place the object using ARISTSIM simulation software.

8. Programming for snake configuration using RCS – 6.

9. Programming for Arc welding circular path and pipe joint using ARISTSIM simulation software.

10. Programming for Golfer Configuration using RCS – 6.

11. Programming for Part Handling (Pick and Place) using ARISTOXT 6 Axis Robot.

**Major Equipment:**

1. XL TURN (CNC Lathe Machine)

2. STAR MILL (CNC Milling Machine)

3. Cut viewer turn and cut viewer Mill Offline software.

4. ARISTOXT 6 Axis Robot.

5. ARISTSIM simulation software.

6. RCS – 6 Kit

**List of Open Source Software/learning website:** The website of NPTEL may be utilized for additional learning.