NSRIT Estd. 2008
NADIMPALLI SATYANARAYANA RAJU INSTITUTE OF TECHNOLOGY
(AUTONOMOUS)
NAAC "A" GRADE
(Approved by AICTE, New Delhi | Affiliated to JNTUK, Kakinada | An ISO 9001, ISO 14001 & ISO 45001 Certified Institution)
Recognized under 2(f) of the UGC Act 1956 & Accredited by NAAC with 'A' Grade (3.10/4.00)
SONTYAM, Pendurthi - Anandapuram Highway, Visakhapatnam - 531173, Ph : 9885824167, 8099454546, www.nsrit.edu.in

**Department of Mechanical Engineering**

**Few specific feedback received reflecting the needs of stakeholders at Local-, Regional-, National, International level**

(The feedbacks are received through centralised online system using google form with timestamp and reflected in the Feedback Form by the Program Coordinator of Mechanical Engineering for documentation attested by the HoD). The received feedback (s) are further discussed in the internal pre-BoS meeting and escalated to the BoS for necessary approval.

| S. No | Few Feedback at | Feedback samples received | Integration into the curriculum | | Semester | POs/PSOs |
|---|---|---|---|---|---|---|
| | | | Course Code | Course Name | | |
| 1 | Local Level | Robotics | 20ME023 | Robotics & Automation | VII | 01, 04, 05, PSO2 |
| | | Python | 20CS403 | Python Programming | IV | 01 |
| | | Coding Courses | 20CS407 | Python Programming Lab | IV | 01 |
| | | Design Thinking | 20SHO02 | Design Thinking | VII | 01, 02, 04, 05, 10 |
| 2 | National Level | Thermal | 20ME603 | Heat Transfer | VI | 01, 02, 03, 04, PSO2 |
| | | | 20ME404 | Fluid Mechanics and Hydraulic Machines | IV | 02,03, PS01 |
| | | | 20ME013 | Power Plant Engineering | VII | 01, 02, PS01 |
| | | CAD | 20MES01 | NX CAD Essentials | III | 05, 10, PSO2 |
| | | | 20ME011 | CAD/CAM | VI | 01, 04 |
| | | | 20MES04 | Computer Aided Analysis | VI | 01, 04, 05 |
| | | Six Sigma | 20ME024 | Project Planning and Management | VII | 01, 04, 05, PSO2 |
| | | Summer Internship | | Summer Internship #12 | IV | 5, 8, 9, 10, PSO 1 |

**Commented [ds1]:** The program Mechanical Engineering received feedbacks and one sample among which is to include the deliverables related to Robotics, based on this feedback the course Robotics and Automation is introduced during the semester VII connecting few existing facilities. Other similar evidences are also attached in the trailing part of this document

**Commented [ds2]:** Though 'C' Programming is already there in the curriculum, stakeholders feel that Python Programming is very much essential for all. In that context, it is included in the curriculum and shown as proof. All other similar evidences are shown in trailing part of the proof.

**Formatted:** Font: Bold, Font color: Background 1

V. Ananda Babu
25/11/23

Head of the Department
Mechanical Engineering
N.S. Raju Institute of Technology (A)
Visakhapatnam-531173

| | | | | | | |
|---|---|---|---|---|---|---|
| | | Industry 4.0 | | Summer Internship #22 | VI | 5, 8, 9, 10, PSO 1 |
| 3 | International Level | CNC Algorithms | 20MES02 | Computer Numerical Control Programming | IV | 01, 02, 04, 05, 10 |

Note: Discussed and recommended to include in the curriculum during pre BOS meeting held on 03-09-2022.

**Head of the Department**

**PE** **20ME023 Robotics and Automation** **3 0 0 3**

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with POs | DoK |
|---|---|---|---|
| 20ME015.1 | Identify various robot configuration and components. | - | L1,L2, L3 |
| 20ME015.2 | Select appropriate actuators and sensors for a robot based on specific application | - | L1,L2, L3 |
| 20ME015.3 | Carry out kinematic and dynamic analysis for simple serial kinematic chains | - | L1,L2, L3 |
| 20ME015.4 | Perform trajectory planning for a manipulator by avoiding obstacles. | - | L1,L2, L3 |
| 20ME015.5 | Use knowledge of robotics for automation in manufacturing applications | - | L1,L2, L3 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge

**Unit I:** **11+1 Hours**

**INTRODUCTION:** Automation and Robotics, types of automation, assembly automation equipment, material handling systems, feed systems, Automated Guided Vehicles, Automated storage and retrieval systems, Flexible Manufacturing Systems, Computer Aided Process Planning Systems, Computer Aided manufacturing. CAD/CAM and Robotics – An over view of Robotics – present and future applications – classification by coordinate system and control system. COMPONENTS OF THE INDUSTRIAL ROBOTICS: Function line diagram representation of robot arms, common types of arms. Components, Architecture, number of degrees of freedom – Requirements and challenges of end effectors, determination of the end effectors, comparison of Electric, Hydraulic and Pneumatic types of locomotion devices.

**Unit II:** **11+1 Hours**

**MOTION ANALYSIS:** Homogeneous transformations as applicable to rotation and translation – problems. MANIPULATOR KINEMATICS: Specifications of matrices, D-H notation joint coordinates and world coordinates Forward and inverse kinematics – problems.

**Unit III:** **11+1 Hours**

Differential transformation and manipulators, Jacobians – problems Dynamics: Lagrange – Euler and Newton – Euler formulations – Problems.

**Unit IV:** **1** **1+1 Hours**

General considerations in path description and generation. Trajectory planning and avoidance of obstacles, path planning, Skew motion, joint integrated motion –straight line motion – Robot programming, languages and software packages-description of paths with a robot programming language.

**Unit V:** **11+1 Hours**

**ROBOT ACTUATORS AND FEED BACK COMPONENTS:** Actuators: Pneumatic, Hydraulic actuators, electric & stepper motors. Feedback components: position sensors – potentiometers, resolvers, encoders – Velocity sensors.

**ROBOT APPLICATIONS IN MANUFACTURING:** Material Transfer - Material handling, loading and unloading- Processing - spot and continuous arc welding & spray painting - Assembly and Inspection.

**Text Books**

1. Industrial Robotics / Groover M P /Pearson Edu.
2. Robotics and Control / Mittal R K & Nagrath I J / TMH.

**Reference Books**

1. Robotics / Fu K S/ McGraw Hill.
2. Robotic Engineering / Richard D. Klafter, Prentice Hall
3. Robot Analysis and Control / H. Asada and J.J.E. Slotine / BSP Books Pvt.Ltd.
4. Introduction to Robotics / John J Craig / Pearson Edu.

**Web References**

**Internal Assessment Pattern**

| Cognitive Level | InternalAssessment#1(%) | InternalAssessment#2(%) |
|---|---|---|
| L1 | 20 | 20 |
| L2 | 40 | 40 |
| L3 | 40 | 40 |
| Total (%) | 100 | 100 |

**Sample Short and Long Answer Questions of Various Cognitive Levels**

**L1: Remember**

**L2: Understand**

**L3: Apply**

Head of the Department
Mechanical Engineering
N.S. Raju Institute of Technology (A)
Visakhapatnam-531173

CONTROL COPY ATTESTED

Chairman
Board of Studies(ME)

## SC 20MES02 Computer Numerical Control Programming

1 0 2 2

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with POs | | | | | DoK |
|---|---|---|---|---|---|---|---|
| | | PO1 | PO2 | PO4 | P05 | PO10 | |
| 20MESO1.1 | Delineate the operation sequence and route sheet for given mechanical parts. | 3 | 1 | 1 | 1 | 1 | L1 |
| 20MES01.2 | Exemplify the selection criteria for CNC machines by describing principle, operation, procedural steps for different tooling. | 3 | 1 | 2 | 1 | 1 | L2 |
| 20MES01.3 | Load the part program with interface software application for automatic part programming. | 3 | 2 | 2 | 2 | 3 | L3 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create DoK: Depth of Knowledge

### Unit I: Fundamentals of process planning — 09 Hours

Process planning, Structure of process plan, Factors influencing process plan, Sequence of operation of process plan, CAM, NC,CNC and DNC, Selection criteria for CNC machines, Adoptive Control, Classifications of CNC Machine, Modes of operation of CNC, Working of: Machine Structure, Sideways, Spindle drive, Axis drive, Recirculation ball screw Feedback devices (transducers, encoders), Automatic tool changer (ATC), Automatic pallet changer (APC), CNC axis and motion nomenclature, CNC tooling – tool pre setting, qualified tool, tool holders and inserts

### Unit II: G and M Codes — 09 Hours

Axes Identification in CNC turning and Machining centres, Machine zero, home position, work piece zero, program zero, CNC part programming: Programming format and Structure of part program, ISO G and M codes for turning and milling-meaning and applications of important codes.

### Unit III: CNC Part Programming — 12 Hours

Compensations: Tool length compensation, Pitch error compensation, Tool radius compensation, Simple part programming for turning using ISO format having straight turning, taper turning (linear interpolation) and convex/concave turning (circular interpolation), Simple part programming for milling using ISO format, Importance, types, applications and format for: Canned cycles, Macro, Do loops, Subroutine, Mirror image, CNC turning and milling part programming using canned cycles, Do loops and Subroutine, CAD CAM integration: Concept Steps involved in CAD/CAM integration, CAM software.

### Experiments List

1. What is the operation sequence for given drawing
2. How to prepare route sheet for given drawing
3. Demonstrate CAM, NC, CNC and DNC and differentiate them.
4. Choose the selection criteria for CNC machines
5. Show working principle of CNC system with sketches.
6. Identify different modes of operations of CNC machine.
7. Explain different tooling used in CNC systems.
8. Develop part programs for given component on turning and milling machine.
9. Make use of various positions of machine and parts.
10. Utilize the program using canned cycles, Do loops and Subroutine

### Internal Assessment Pattern

| Cognitive Level | Internal Assessment #1 (%) | Internal Assessment #2 (%) |
|---|---|---|
| L1 | 20 | 20 |
| L2 | 40 | 40 |
| L3 | 40 | 40 |
| Total (%) | 100 | 100 |

## Sample Questions of Various Cognitive Levels

### L1: Remember

1. What is the operation sequence for given mechanical component
2. How to prepare route sheet for given mechanical component
3. Choose the selection criteria for CNC machines for given mechanical component.
4. Show working principle of CNC system with sketches.

### L2: Understand

1. Demonstrate CAM, NC, CNC and DNC and differentiate them.
2. Explain different tooling used in CNC systems.

### L3: Apply

1. Identify different modes of operations of CNC machine.
2. Develop part programs for given component on turning and milling machine.
3. Make use of various positions of machine and parts.
4. Utilize the program using canned cycles, Do loops and Subroutine

CONTROL COPY ATTESTED

Head of the Department
Mechanical Engineering
N S. Raju Institute of Technology (A)
Visakhapatnam-531173

Chairman
Board of Studies (ME)