



SRI VENKATESWARA UNIVERSITY

**4-Year UG Honours in B.Sc. (Artificial Intelligence) as Major in consonance
with Curriculum framework w.e.f. AY 2026-27**

COURSE STRUCTURE (for Semester IV)

Year	Semester	Course	Title of the Course	No. of Hrs /Week	No. of Credits
II	IV	8	Data Science with R	3	3
			Data Science with R Lab	2	1
		9	Foundation of ML & Supervised Learning	3	3
			Foundation of ML & Supervised Learning lab	2	1
		10	Robotics Principles & Embedded systems	3	3
			Robotics Principles & Embedded systems Lab	2	1



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II Year Syllabus for 4-Year UG Honours in B.Sc. (Artificial Intelligence) as Major in consonance with the Curriculum framework w.e.f. AY 2026-27

II Year IV Semester

Sl. No.	Category	Course No.	Course Name	No. of Hours		Total No. of Hours	No. of Credits		Total No. of Credits
				Theory	Practical		Theory	Practical	
1	Major-Core	8	Data Science with R	3	2	5	3	1	4
2	Major-Core	9	Foundation of ML & Supervised Learning	3	2	5	3	1	4
3	Major-Core	10	Robotics Principles & Embedded systems	3	2	5	3	1	4
4	Minor	2		3	2	5	3	1	4
5	MDC	3		2	0	2	2	0	2
6	SEC	4	SEC: Design Thinking/Problem solving/ others	2	0	2	2	0	2
				16	8	24	16	4	20

SRI VENKATESWARA UNIVERSITY::TIRUPATI
B.Sc. Artificial Intelligence Honours
II year IV Semester
COURSE 10: ROBOTICS PRINCIPLES AND EMBEDDED SYSTEMS

Theory

Credits: 3

3 hrs/week

Course Objectives

1. To introduce fundamental concepts of robotics including robot classification, kinematics, and mechanisms.
2. To explain the roles and types of actuators, drives, and sensors, including piezoelectric technologies.
3. To develop an understanding of robot control systems, feedback mechanisms, and intelligent control methods.
4. To expose students to embedded systems, focusing on microcontrollers and interfacing with hardware components.
5. To provide practical experience in Arduino programming and hardware interfacing for robotics applications.

Course Outcomes

Upon successful completion of this course, students will be able to:

1. Classify different types of robots and explain their kinematic principles and degrees of freedom.
2. Describe actuators, drives, and sensor technologies used in robotics, including piezoelectric actuators and sensors.
3. Design and analyze control systems for robotic joints with feedback and intelligent control strategies.
4. Understand embedded systems concepts and program microcontroller-based systems (Arduino) for robotic applications.
5. Develop and implement practical robotics solutions using Arduino hardware and software tools.

Unit 1: Introduction to Robotics

Classification of Robots, Components and Characteristics of Robots, Applications of Robotics, Degrees of Freedom: Definition, importance, calculation, examples
Fundamentals of Kinematics and Position Analysis, Robots as Mechanisms, Matrix Representation and Transformation Matrices, Forward and Inverse Kinematics

Unit 2: Actuators and Drives

Actuating Systems: Features, selection criteria, Actuators: Types- electric, hydraulic, pneumatic, Drives: Types and characteristics-electric, hydraulic, pneumatic, stepper, servo; comparison and usage, Piezoelectric actuators: Principle, applications in microrobotics, advantages (precision, quick response, energy harvesting) , Use of Reduction Gears, Actuating Devices and Control

Unit 3: Grippers and Sensors

Grippers: Types (mechanical, magnetic, vacuum, adhesive), applications, Criteria for gripper selection, Sensor characteristics, Description of Vision, Force, Proximity, Tilt Sensors, Piezoelectric sensors (Working principle, parts, & applications), types (force, vibration, pressure), applications of robotics, Principles and practical applications of key sensor types

Unit 4: Robot Controls

Point-to-Point and Continuous Path Control, Intelligent Robot Control Methods, Control Systems for Robot Joints, Control Actions, Feedback Devices: Concepts and significance, Integration of sensors in feedback and control loops (e.g., vibration damping, tactile feedback,

health monitoring), Closed-loop vs. Open-loop Control Systems

Unit 5: Embedded Systems

Embedded Systems: Definition, characteristics, and significance in robotics, Microcontrollers and Microprocessors, Arduino microcontroller architecture and applications, Interfacing sensors, actuators, drives, and grippers with embedded systems, Embedded programming essentials (C/C++, input/output, analog/digital signals), Embedded communication protocols (serial, I2C basics), Integration of sensor data in embedded applications.

Recommended Textbooks & References

1. "Robotics: Mechanics and Control" by Guruprasad K. Eastern Economy Edition
2. "Modern Robotics: Mechanics, Planning, and Control" by Kevin M. Lynch and Frank C. Park, Cambridge University Press.
3. "Introduction to Autonomous Mobile Robots" by Roland Siegwart et al. (Free e Resource)
4. "Arduino Programming in 24 Hours" by Richard Blum, Sams Teach Yourself
5. "Springer Handbook of Robotics" edited by Bruno Siciliano and Oussama Khatib.

Unit 1: Introduction to Robotics

Activity: Analyze and classify various types of robots; calculate degrees of freedom for given robot models.

Outcome: Students will understand robot types, components, and the significance of degrees of freedom.

Evaluation Method: Written assignments and quizzes on robot classification and kinematics concepts.

Unit 2: Actuators and Drives

Activity: Investigate characteristics of electric, hydraulic, pneumatic actuators and drives; study piezoelectric actuator demonstrations.

Outcome: Ability to compare different actuators and drives and understand piezoelectric actuator applications.

Evaluation Method: Lab demonstration reports and presentation on actuators.

Unit 3: Grippers and Sensors

Activity: Examine different types of grippers; conduct hands-on experience with piezoelectric, proximity, force, and vision sensors.

Outcome: Understand gripper types, sensor characteristics, and apply piezoelectric sensing principles.

Evaluation Method: Practical sensor interfacing reports and sensor data analysis.

Unit 4: Robot Controls

Activity: Implement point-to-point and continuous path control algorithms; integrate sensor feedback for closed-loop control.

Outcome: Develop understanding of control methods and feedback systems in robotics.

Evaluation Method: Lab assignments implementing control algorithms on robotic joints; tests on control theory.

Unit 5: Embedded Systems

Activity: Program Arduino microcontrollers to interface sensors, actuators, and drives; develop embedded control applications.

Outcome: Ability to design embedded systems and program Arduino for real-world robotics applications.

Evaluation Method: Project work based on Arduino robotics applications, demonstration and code review.

SEMESTER-IV

COURSE 10: ROBOTICS PRINCIPLES AND EMBEDDED SYSTEMS

Practical

Credits: 1

2 hrs/week

Note: This lab has to be completed using Arduino Micro controller and Arduino programming.

1. Introduction to Arduino and Basic Programming - Setting up Arduino IDE - Blinking an LED — basic digital output
2. Reading Digital Inputs - Interfacing and reading button presses/switches
3. Interfacing Analog Sensors - Reading values from a potentiometer or light-dependent resistor (LDR)
4. Ultrasonic Distance Sensor Interfacing - Measuring distance using HC-SR04 sensor and displaying data
5. Servo Motor Control - Controlling servo motor angles for robotic joint simulation
6. DC Motor and Motor Driver Interfacing - Running a DC motor with L298N motor driver
7. Stepper Motor Control - Basic control of stepper motors for precise movements
8. Line Following Robot Implementation - Using IR sensors to detect and follow a line on the ground
9. Obstacle Avoidance Robot - Using ultrasonic sensors and motor control to avoid obstacles
10. Force/Tactile Sensor Interfacing (including Piezo sensors) - Reading piezoelectric sensor signals as force or vibration inputs
11. Temperature Sensor Interfacing - Using sensors like LM35 or DHT11 for environmental sensing
12. Bluetooth Module (HC-05) Controlled Robot - Controlling robot movement wirelessly using smartphone commands
13. Servo-Driven Robotic Gripper - Building and controlling a simple gripper mechanism
14. PWM Motor Speed Control - Controlling motor speed using Pulse Width Modulation techniques

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MODEL QUESTION PAPER

Time: 3 Hours

Max. Marks: 75

PART-A

Answer any **FIVE** of the following. Each Question Carries 3 marks.

(5X3=15)

1. Short answer question from unit-I
2. Short answer question from unit-I
3. Short answer question from unit-II
4. Short answer question from unit-II
5. Short answer question from unit-III
6. Short answer question from unit-III
7. Short answer question from unit-IV
8. Short answer question from unit-IV
9. Short answer question from unit-V
10. Short answer question from unit-V

PART-B

Answer **FIVE** of the following. Each Question Carries 12 marks.

(5X12=60)

11. a) Essay question from Unit-I
OR
b) Essay question from Unit-I
12. a) Essay question from Unit-II
OR
b) Essay question from Unit-II
13. a) Essay question from Unit-III
OR
b) Essay question from Unit-III
14. a) Essay question from Unit-IV
OR
b) Essay question from Unit-IV
15. a) Essay question from Unit-V
OR
b) Essay question from Unit-V