

6	Robot Sensors and Actuators: Introduction to Sensors, Sensor Characteristics, Different types of sensors like LVDT, Tactile sensor, Proximity and range sensors, Touch sensor, Optical Encoders, Remote center Compliance (RCC) and Sniff sensors. Hydraulic, Pneumatic and Electric Actuators, Integration of IoT in robotics for sensor data acquisition and control.	4
7	Fundamentals of Fuzzy Logic Classical sets-Fuzzy sets-Fuzzy relations-Fuzzification – Defuzzification- Fuzzy rules, fuzzy set and systems, Real-world applications in robotics and smart manufacturing systems.	5
8	Architecture of Neural Networks Biological neural networks, Artificial Neural Network (ANN), Basic learning rules: Mc-culloch-Pitts neuron, Architecture, algorithm, applications, Single layer, Multi-layer feed forward network, Back propagation algorithm.	4

Practical content

The term work shall be based on experimental and analytical work on the topics mentioned above and will be defended by the candidates.

Text Books

- 1 John J. Craig, 'Introduction to Robotics: Mechanics and Control', 3rd edition Pearson, 2013.
- 2 R. K. Mittal, I. J. Nagrath, 'Robotics and Control', Tata McGraw-Hill Education, 2004

Reference Books

- 1 Robert J. Schilling, 'Fundamentals of Robotics – Analysis & Control', PHI, 2009.
- 2 Mikell P. Groover, Mitchell Weiss, 'Industrial Robotics (Technology, Programming and Applications)', 2nd Edition, McGraw-Hill Education, 2012
- 3 Mohsen Shahinpoor, 'A Robot Engineering Textbook', Longman Higher Education, 1987.
- 4 Elaine Rich, Kevin Knight, 'Artificial Intelligence', 2nd, Tata McGraw-Hill, 1990.
- 5 Laxmidhar Behera, Indrani Kar, 'Intelligent Systems and Control: Principles and Applications' McGraw- Hill Higher Education, 2010.
- 6 Nils J. Nilsson, 'Principles of Artificial Intelligence (Symbolic Computation/Artificial Intelligence)', 1st Edition, Springer, 1982.

MOOCs Links:

- 1 https://onlinecourses.nptel.ac.in/noc21_me32/preview
- 2 https://onlinecourses-archive.nptel.ac.in/noc18_cs19
- 3 <https://www.coursera.org/learn/ai-for-everyone>
- 4 <http://www.roboanalyzer.com/>

Mapping of CO with PO and PSO:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO 0	PSO 1	PSO 2	PSO 1	PSO 2	PSO 3
CO1	3	2	2	1	1	3	3	3	1	0	1	1	2	1	2
CO2	2	3	3	2	3	2	2	2	2	1	2	2	3	3	3
CO3	3	2	3	3	2	1	1	1	1	0	1	2	2	2	2
CO4	2	3	2	3	2	2	2	2	2	1	2	2	3	2	3
CO5	3	3	3	2	3	2	2	2	3	2	3	2	3	3	3