### ROBOTICS & ARTIFICIAL INTELLIGENCE -EL 1
### Semester II (Production Engineering)   SUB CODE: MEPR205-A
### Teaching Scheme (Credits and Hours)

| Teaching Scheme | | | | Total Credit | Evaluation Scheme | | | | | | Total Marks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| L | T | P | Total | | THEORY | | IE | CIA | PR. / VIVO | | |
| | | | | | Hrs | Marks | Marks | Marks | Marks | | |
| Hrs | Hrs | Hrs | Hrs | | | | | | | | |
| 3 | 0 | 2 | 5 | 4 | 3 | 70 | 30 | 20 | 30 | | 150 |

**LEARNING OBJECTIVES:**
The objective of this course is

- To learn various concepts related to manipulator kinematics, robotic cell design, robot programming.

**LESSON PLANNING**

| SR.NO | CHAPTER NO | DATE/WEEK | %WEIGTAGE |
|---|---|---|---|
| 1 | 1,2 | 1$^{st}$ 2$^{nd}$ 3$^{rd}$ | 20 |
| 2 | 3 | 4$^{th}$ 5$^{th}$ 6$^{th}$ | 20 |
| 3 | 4,5,6 | 7$^{th}$ 8$^{th}$ 9$^{th}$ | 20 |
| 4 | 7,8 | 10$^{th}$ 11$^{th}$ 12$^{th}$ | 20 |
| 5 | 9 | 13$^{th}$ 14$^{th}$ 15$^{th}$ | 20 |

**Total hours (Theory):  45, Total hours (Practical): 30,  Total hours: 75**

**DETAILED SYLLABUS**

| Chap. No. | Topic |
|---|---|
| 1 | **Introduction**<br>Automation and Robotics, Robot anatomy, robot configuration, motions joint notation work volume, robot drive system, control system and dynamic performance, precision of movement. |
| 2 | **Control system and components**<br>Basic concept and modals controllers control system analysis, robot activation and feedback components. Positions sensors, velocity sensors, actuators sensors, power transmission system. |
| 3 | **Motion analysis and control:**<br>Manipulator kinematics, position representation forward transformation, homogeneous transformation, manipulator path control, robot dynamics, configuration of robot controller. |
| 4 | **End effectors:**<br>Grippers-types, operation, mechanism, force analysis, tools as end effectors consideration in gripper selection and design. |
| 5 | **Sensor:**<br>Desirable features, tactile, proximity and range sensors, uses sensors in robotics |
| 6 | **Machine vision:**<br>Functions, Sensing and Digitizing-imaging, Devices, Lighting techniques, Analog to digital single conversion, Image storage, Image processing and Analysis-image data reduction, Segmentation feature extraction. Object recognition, training the vision system, Robotics application. |

| 7 | **Robot cell design and application**:<br>Robot work cell design and control, Safety in Robotics, Robot cell layouts, Multiple Robots and machine interference, Robots cycle time analysis, Industrial application of robots. |
|---|---|
| 8 | **Robot programming:**<br>Methods of Robot Programming, Characteristics of task level languages lead through programming methods, Motion interpolation, Artificial intelligence, Basics, Goals of artificial intelligence, AI techniques, Problem representation in AI, Problem reduction and solution techniques, Application of AI and ES in Robots. |
| 9 | **Artificial intelligence and expert systems**<br>Concepts and definition of AI, AI Problems, The Underlying assumption, What is an AI technique?, AI characteristics, AI versus Natural Intelligence, Applications of AI, Etc.<br>**Problems, Problem Spaces, and Search:**<br> Defining the Problem as State Space Search, Production Systems, Problem Characteristics, Production Systems Characteristics, Issues in the Design of Search Programs, Advantages and Disadvantages of DFS & BFS Techniques.<br>**Heuristic Search Techniques:** What is heuristic?, Heuristic Function, Importance of Heuristic Function, Examples, Search Techniques: Generate – and – Test, Hill Climbing, Best-First Search, Problem reduction, Constraint – Satisfaction, Means- Ends Analysis. .<br>**Structured Representation Approaches:**<br>Semantic Networks, Frames, Conceptual Dependency, Scripts, etc.<br>**Expert system & neural network:**<br>Fuggy Logic, Application of AI in manufacturing**,** Use of software in AI |

**LIST OF PRACTICALS**

| Sr. No. | Practical Content |
|---|---|
| 1 | KINEMATIC ANALYSIS OF VARIUS ROBOTIC CONFIGUTRATION |
| 2 | KINEMATIC ANALYSIS  OF MANIPULATOR USING D-H MATRIX |
| 3 | DYNAMIC ANALYSIS OF MANIPULATOR |
| 4 | FORCE ANALYSIS OF END EFFECTOR FOR A GIVEN APPLICATION |
| 5 | MACHINE VISION ANALYSIS IN MANUFACTURING |
| 6 | PROGRAMMING OF A ROBOT FOR PICK & PLACE APPLICATION USING TEACH METHOD |
| 7 | VALIDATION OF CUTTING PARAMETER OPTIMIZATION OF SURFACE FINISH IN TURNING USING ANN |
| 8 | HEURISTIC SEARCH USING HILL CLIMBING FOR A GIVEN APPLICATION |
| 9 | USE OF FUZZY LOGIC IN PRACTICAL APPLICATION LIKE WASHING MACHINE |
| 10 | TO GET AQUIANTED WITH USE OF AI SOFTWARE FOR VARIOUS APPLICATIONS IN MANUFACTURING |

**INSTRUCTIONAL METHOD AND PEDAGOGY** (Continuous Internal Assessment (CIA) Scheme)

- At the start of course, the course delivery pattern, prerequisite of the subject will be discussed
- Lecture may be conducted with the aid of multi-media projector, black board, OHP etc. & equal weightage should be given to all units while conducting teaching & examination.
- Attendance is compulsory in lectures and Tutorial.
- Viva Voce will be conducted at the end of the semester of 30 Marks.
- One internal exam of 30 marks is conducted as a part of Mid semester evaluation.

**STUDENTS LEARNING OUTCOMES:**

At the end of the course

- The students will gain an idea related to robot anatomy, motion analysis and implementation related to hazardous applications.
- Gain an overview of AI

**Reference Books:**

1. Introduction to Robotics Analysis, Systems, Applications by Saeed B Niku PHI.
2. A Robot Engg text book by Moshen Shahinpoor, Harper and Row Publishers,NY.
3. Fundamentals of Robotics – Analysis and Control, Robert J Schilling, PHI.
4. Robotic technology, Principles and practice – Werner G Holz book – Van Nostrand Reinhold Co NY.
5. Robotic Engineering – An Integrated Approach by Richard D Klaffer, Thomas A Chmielewski, Michael Negin – PHI.
6. Robot Dynamics and Control – Mark W Spong, M Vidyasagar – Wiley India.
7. Intro to Robotics, Mechanics and Control by John J Craig, Pearson Education.
8. Modelling and Control of Vehicular and robotic systems by Sisil Kumararawadu – Narosa Publishing house.
9. Industrial Robots by Ganesh S Hegde – Laxmi Publications.
10. Fu K.S., Gonzalez R.C. and Lee C.S.G., "Robotics Control, Sensing, Vision and Intelligence", Mc Graw Hill, 1987.
11. Richard D, Klafter, Thomas, A, Chmielewski, Michael Negin, "Robotics Engineering – An Integrated Approach", Prentice-Hall of India Pvt. Ltd., 1984.
12. Deb S.R." Robotics Technology and Flexible Automation", Tata McGraw -Hill, 1994.
13. Groover Mikell, P., Mitchell Weis, Roger, N. Nagel, Nicholas G. Odrey," Industrial Robotics Technology, Programming and Applications", McGraw -Hill, Int. 1986.
14. Timothy Jordanides et al,"Expert Systems and Robotics ", Springer –Verlag, New York, May 1991.
15. Artificial Intelligence, Elaine Rich, Kevin Knight, Second Edition, Tata McGraw-Hill.
16. Decision Support Systems and Intelligent Systems, Efraim Turban and Jay E. Aronson, Sixth Edition 2002, Pearson Education Asia.
17. Principles of Artificial Intelligence by NILSON.