

Course No	Course Name	L-T-P-C	Semester	Remark
ME201M	Introduction to Robotics	(2-0-2-6)	3 <sup>rd</sup> Sem	Project work will start from 4 <sup>th</sup> Semester. Interested Faculty members from other Dept. will be encouraged to participate in this program.
ME202M	Mechatronics	(2-0-2-6)	4 <sup>th</sup> Sem	
ME301M	Robotic Vision and Control	(2-0-2-6)	5 <sup>th</sup> Sem	
ME302M	Fundamentals of Artificial Intelligence	(2-0-2-6)	6 <sup>th</sup> Sem	
ME401M	Project	(0-0-6-6)		

### **Syllabi for the minor course in Robotics and Artificial Intelligence**

#### **ME201M: Introduction to Robotics (2-0-2-6)**

Introduction – Types and classification of robots, science of robots, technology of robots; Elements of Robots – Homogeneous transformation, joints and links, link transformation matrices, actuators and transmission and sensors; Kinematics of serial robots – Direct and inverse kinematics of serial robots, inverse kinematics of a general 6R robot; Kinematics of parallel robots – Loop-closure constraint equations, Direct and inverse kinematics of parallel robots, mobility of parallel manipulators; Velocity and Static analysis of manipulators – Linear and angular velocity of links, serial and parallel manipulator Jacobian, singularities in serial and parallel manipulators, statics of serial and parallel manipulators; Dynamics of serial and parallel robots – Lagrangian formulation, equations of motion, inverse dynamics and simulation of equations of motion. Trajectory planning. Lab shall comprise of experiments and numerical simulation of kinematics and dynamics of robots, and trajectory planning.

References/Textbooks:

- 1) Fu. K.S., Gonzalez R.C. and Lee C.S.G., *Robotics: Control, Sensing, Vision and Intelligence*, Tata McGraw Hill, 2008.
- 2) Ghosal A. *Robotics: Fundamental Concepts and Analysis*, Oxford University Press, 2006.
- 3) Craig J.J., *Introduction to Robotics – Mechanics and Control*, Pearson Prentice Hall, 2005.
- 4) Saha. S.K., *Introduction to Robotics*, McGraw Hill Education (India) Private Limited, 2014.
- 5) Spong M.W., Hutchinson S. and Vidyasagar M., *Robot Modeling and Control*, John Wiley Sons & Inc., 2005.

#### **ME202M: Mechatronics (2-0-2-6)**

Introduction to Mechatronics – Mechatronics Design with examples; Electric circuits and components; Semiconductor Electronics, Analog and Digital Electronics; Sensors – Position and Speed Measurement, Stress and Strain Measurement, Temperature Measurement, Vibration and Acceleration Measurement, Pressure and Flow measurement; Actuators – Electromagnetic Principles, Solenoids and Relays, Electric motors, Hydraulics, Pneumatics; Microprocessor architecture, programming and interfacing; Data acquisition systems. Robot Programming Languages.

Lab shall comprise of several case studies, both numerical and experimental.

References/Textbooks:

- 1) Wilamowski B.M. and Irwin J.D., *The Industrial Electronics Handbook – Control and*

*Mechatronics*, 2<sup>nd</sup> Ed, CRC Press, Taylor and Francis Group LLC, 2011.

2) Bolton W., *Mechatronics: Electronic Control Systems in Mechanical and Electric Engineering*, Pearson Education Limited, 2008.

3) Alciatore D.G. and Hstand M.B., *Introduction to Mechatronics and Measurement Systems*, Mcgraw Hill, New York, 2012.

4) Godfrey O., *Mechatronics: Principles and Applications*, Elsevier, 2005.

5) Bishop R.H., *The Mechatronics Handbook*, CRC Press LLC, 2002.

### **ME301M: Robotic Vision and Control (2-0-2-6)**

Robotic Vision, Control System Analysis – Basics of Feedback Control, Stability analysis, Frequency Domain Analysis; Control System Design – State space representation, Internal Model Control, PID control; Control of Robot Manipulators – Computed Torque Control, Robust Control, Adaptive Control, Advanced Control, Neural Network Control, Force Control, Soft Computing Techniques; Robot Locomotion – Legged Robots and Wheeled Robots, Mobile Robot Kinematics, Perception and Mobile Robot Localization, Planning and Navigation.

Lab shall comprise of several case studies, both numerical and experimental.

References/Textbooks:

1) Horn B.K.P., *Robot Vision*, MIT Press, 1986.

2) Peter C., *Robotics, Vision and Control: Fundamental Algorithms in MATLAB*, Springer Tracts in Advanced Robotics, 2011.

3) Lewis F.L., Dawson D.M. and Abdallah C.T., *Robot Manipulator Control: Theory and Practice*, Marcel Dekker Inc., NY, USA, 2004.

4) Siegwart R. and Nourbakhsh I.R., *Introduction to Autonomous Mobile Robots*, MIT Press, Cambridge, MA, USA, 2004. Godfrey O., *Mechatronics: Principles and Applications*, Elsevier, 2005.

5) Murray R.M., Li Z. and Sastry S.S., *A Mathematical Introduction to Robotic Manipulation*, CRC Press, 1994.

6) Correll N., *Introduction to Autonomous Robots*, v1.7, Magellan Scientific, 2016. ISBN-13: 978-0692700877.

### **ME302M: Fundamentals of Artificial Intelligence (2-0-2-6)**

AI: History, Trends and Future – Introduction to AI, History and Background, Impact on foundations of Engineering, Future Directions; Problem Solving by Search - Production Systems, Uninformed vs. Informed Search Strategies, Heuristic Functions, CSP, Introduction to Game Theory, Minimax, Alpha-Beta Pruning; Knowledge Representation and Reasoning - Propositional Logic, Language of First-Order Logic, Resolution and Reasoning, Answer Extraction, Procedural Control of Reasoning; Planning - Planning Problem, Planning with State Space Search, Planning Graphs, Other approaches in planning & analysis; Decision Making - Sequential Decision Problems (SDP), Optimality in SDP, Algorithms for optimal Policies (Value Iteration, Policy Iteration).

Laboratory: Introduce Common Lisp. Review the fundamentals of symbolic programming - consider such issues in AI programming such as pattern matching, search, problem solving, and reasoning. Components: Learning LISP; AI Experiments; and a Term Project.

### **ME401M: Project**

The project work will start from 4<sup>th</sup> semester. Focus will be to develop products related to robotics and Artificial Intelligence which may be useful for social, educational, medical, agricultural or industrial applications. Faculty members from other departments will be encouraged to be co-supervisor in these minor projects.