| Course code | Course Name | L-T-P-Credits | Year of Introduction |
|---|---|---|---|
| ME407 | MECHATRONICS | 3-0-0- 3 | 2016 |

**Prerequisite: Nil**

**Course Objectives:**

- To introduce the features of various sensors used in CNC machines and robots
- To study the fabrication and functioning of MEMS pressure and inertial sensors
- To enable development of hydraulic/pneumatic circuit and PLC programs for simple applications

**Syllabus**

Introduction to Mechatronics, sensors, Actuators, Micro Electro Mechanical Systems (MEMS), Mechatronics in Computer Numerical Control (CNC) machines, Mechatronics in Robotics-Electrical drives, Force and tactile sensors, Image processing techniques, Case studies of Mechatronics systems.

**Expected outcome:**

The students will be able to

i. Know the mechanical systems used in mechatronics
ii. Integrate mechanical, electronics, control and computer engineering in the design of mechatronics systems

**Text Books**:


1. Bolton W., Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, Person Education Limited, New Delhi, 2007
2. Ramachandran K. P., G. K. Vijayaraghavan, M. S. Balasundaram, Mechatronics: Integrated Mechanical Electronic Systems, Wiley India Pvt. Ltd., New Delhi, 2008.
3. Saeed B. Niku, Introduction to Robotics: Analysis, Systems, Applications, Person Education, Inc., New Delhi, 2006.


**References Books**:


1. David G. Aldatore, Michael B. Histand, Introduction to Mechatronics and Measurement Systems, McGraw-Hill Inc., USA, 2003.
2. Gordon M. Mair, Industrial Robotics, Prentice Hall International, UK, 1998.
3. HMT, Mechatronics, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2004.
4. Vijay K. Varadan, K. J. Vinoy, S. Gopalakrishnan, Smart Material Systems and MEMS: Design and Development Methodologies, John Wiley & Sons Ltd., England, 2006.


**Course Plan**

| Module | Contents | Hours | End Sem. Exam Marks |
|---|---|---|---|
| I | Introduction to Mechatronics: Structure of Mechatronics system. Sensors - Characteristics -Temperature, flow, pressure sensors. Displacement, position and proximity sensing by magnetic, optical, ultrasonic, inductive, capacitive and eddy current methods. Encoders: incremental and absolute, gray coded encoder. Resolvers and synchros. Piezoelectric sensors. Acoustic Emission sensors. Principle and types of vibration sensors. | 8 | 15% |

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|---|---|---|---|
| **II** | Actuators: Hydraulic and Pneumatic actuators - Directional control valves, pressure control valves, process control valves. Rotary actuators. Development of simple hydraulic and pneumatic circuits using standard Symbols. | 7 | 15% |
| **FIRST INTERNAL EXAM** | | | |
| **III** | Micro Electro Mechanical Systems (MEMS): Fabrication: Deposition, Lithography, Micromachining methods for MEMS, Deep Reactive Ion Etching (DRIE) and LIGA processes. Principle, fabrication and working of MEMS based pressure sensor, accelerometer and gyroscope. | 6 | 15% |
| **IV** | Mechatronics in Computer Numerical Control (CNC) machines: Design of modern CNC machines - Mechatronics elements - Machine structure: guide ways, drives. Bearings: anti-friction bearings, hydrostatic bearing and hydrodynamic bearing. Re-circulating ball screws, pre-loading methods. Re-circulating roller screws. Typical elements of open and closed loop control systems. Adaptive controllers for machine tools. Programmable Logic Controllers (PLC) –Basic structure, input/ output processing. Programming: Timers, Internal Relays, Counters and Shift registers. Development of simple ladder programs for specific purposes. | 8 | 15% |
| **SECOND INTERNAL EXAM** | | | |
| **V** | System modeling - Mathematical models and basic building blocks of general mechanical, electrical, fluid and thermal systems.<br>Mechatronics in Robotics-Electrical drives: DC, AC, brushless, servo and stepper motors. Harmonic drive. Force and tactile sensors. Range finders: ultrasonic and light based range finders | 6 | 20% |
| **VI** | Robotic vision system - Image acquisition: Vidicon, charge coupled device (CCD) and charge injection device (CID) cameras. Image processing techniques: histogram processing: sliding, stretching, equalization and thresholding.<br>Case studies of Mechatronics systems: Automatic camera, bar code reader, pick and place robot, automatic car park barrier system, automobile engine management system. | 7 | 20% |
| **END SEMESTER EXAM** | | | |

**Question Paper Pattern**

**Maximum marks: 100** **Time: 3 hrs**

The question paper should consist of three parts

**Part A**

There should be 2 questions each from module I and II. Each question carries 10 marks. Students will have to answer any three questions out of 4 (3X10 =30 marks)

**Part B**

There should be 2 questions each from module III and IV. Each question carries 10 marks. Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part C**

There should be 3 questions each from module V and VI. Each question carries 10 marks
Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

Note: Each question can have a maximum of four sub questions, if needed.