SEMESTER S7

MECHATRONICS

Course Code	OEEVT 721	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To provide knowledge about the integration of mechanical, electronics, control and computer engineering in the design of mechatronics systems.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	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. Actuators: Mechanical actuators, Electrical 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.	9
2	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. Measuring system for NC machines - direct and indirect measuring system.	9

	System modeling - Mathematical models and basic building blocks of general mechanical, electrical, fluid and thermal systems	
3	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. Case studies of Mechatronics systems: Automatic camera, bar code reader, pick and place robot, automatic car park barrier system, automobile engine management system.	**9**
4	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 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.	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain the sensors and actuators used in mechatronics	**K2**
CO2	Demonstrate the various components of a CNC machine	**K2**
CO3	Explain the principles of PLCs	**K2**
CO4	Explain the robotic sensors and vision system	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**											**2**
CO2	**3**		**2**	**2**	**2**							**2**
CO3	**3**	**3**	**2**	**2**	**2**							**2**
CO4	**3**		**2**	**2**	**2**	**2**						**2**

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering,	Bolton W.,	Person Education Limited, New Delhi,	2007
2	Mechatronics: Integrated Mechanical Electronic Systems,	Ramachandran K. P., G. K. Vijayaraghavan, M. S. Balasundaram,	Wiley India Pvt. Ltd., New Delhi,	2008
3	Introduction to Robotics: Analysis, Systems, Applications,.	Saeed B. Niku	Person Education, Inc., New Delhi	2006

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Introduction to Mechatronics and Measurement Systems,	David G. Aldatore, Michael B. Histand	McGraw-Hill Inc., USA.	2003
2	Industrial Robotics	Gordon M. Mair	Prentice Hall International, UK,	1998
3	Mechatronics,	HMT	Tata McGraw-Hill Publishing Company Ltd., New Delhi,.	2004
4	Smart Material Systems and MEMS: Design and Development Methodologies,	Vijay K. Varadan, K. J. Vinoy, S. Gopalakrishnan,	John Wiley & Sons Ltd., England,	2006.

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://onlinecourses.nptel.ac.in/noc21_me27/preview
2	https://nptel.ac.in/courses/112103174
3	https://archive.nptel.ac.in/courses/112/103/112103174/
4	https://nptel.ac.in/courses/112107298