[MME-3061]: [MECHATRONICS]

Programme: B. Tech **Year: 3rd** **Semester: V**

Course: Program Elective **Credits: 3.0** **Hours: 40**

Course Context and Overview (100 words):

This is an undergraduate electve course offered to 3rd year Mechanical Engineering students. The course will help the students in acquiring a mix of skills in mechanical, electronics and computing to be able to comprehend and design mechatronics systems. Theoretical knowledge on various sensors, actuators, digital electronics, signal conditioning devices and circuits which are used in mechatronic systems will be given. Study of methods for mathematically modeling and analyzing mechatronic systems and how to effectively interface them with controllers will also be done during this course.

Prerequisites Courses:

Basic Electronics, Electrical Technology.

Course outcomes (COs):

On completion of this course, students will be able to:

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CO1	Model and analyze mechatronic systems for an engineering application.	Unit 1,4,5,6,7
CO2	Identify sensors and actuators to monitor and control the behavior of process or product.	Unit 2, 3
CO3	Evaluate the performance of mechatronic systems.	Unit 2,6
CO4	Design a Mechatronic system for an engineering application.	Unit 4, 6

Text Books:

[1] William Bolton, "*Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering*", 4th edition, Pearson Education, 2008.

[2] Devdas Shetty & Richard Kolk "*Mechatronics System Design*", 3rd edition. PWS Publishing, 2009.
[3] David G Alciatore & Michael B Histand, "*Introduction to Mechatronics and Measurement systems*", 4th edition, Tata McGraw Hill, 2006.

Reference Books:

[1] J. Fraden, *AIP Handbook of Modern Sensors, Physics, Designs and Applications*. American Institute of Physics.
[2] A. D. Khazan, *Transducers and their Elements*. Prentice Hall.
[3] R.S. Muller and T.I. Kamins, *Device Electronics for Integrated Circuits.* John Wiley & Sons.
[4] S.M. Sze, *Physics of Semiconductor Devices*. Newest version.
[5] S.M. Sze, *Semiconductor Sensors*. John Wiley & Sons.
[6] L. Ristic, *Sensor Technology and Devices*. Artech House, Inc.
[7] R. Seippel, *Transducers, Sensors and Detectors*. Reston Publishing Company.
[8] RS. Muller and R. Howe, *Microsensors*. IEEE Press.
[9] A.S. Grove, *Physics and Technology of Semiconductor Devices*. John Wiley & Sons.

Video References:

[1] http://video_demos.colostate.edu/mechatronics
[2] http:// mechatronics.me.wisc.edu

Additional Resources:

NPTEL, MIT Video Lectures, Web Resources etc.

Course Module:

Units	Course Topics	Hours	Outcome
Unit 1	**Introduction**	**2**	Skill Development & Employability
	History of Mechatronics, scope and significance of mechatronic systems, elements of mechatronic systems, needs and benefits of mechatronics in Industry. Examples: Pick and place robot, Bar code, Engine Management system, Washing machine etc.		
Unit 2	**Mechatronic system components, circuits and response**	**8**	Skill Development & Employability

	Analysis of electric circuits and components, Amplitude Linearity, Bandwidth and Frequency Response, Phase linearity, Distortion of Signals, Response of a zero, first and second order system, system analogies.		
Unit 3	**Actuators**	**10**	Skill Development & Employability
	Electrical Actuators : Solenoids, relays, diodes, thyristors, triacs, BJT, FET, DC motor, Servo motor, BLDC Motor, AC Motor, stepper motors. Hydraulic & Pneumatic devices –Power supplies, valves, cylinder sequencing. Design of Hydraulic & Pneumatic circuits.		
Unit 4	**Digital Electronics**	**6**	Skill Development
	Number systems, BCD codes and arithmetic, Gray codes, self-complimenting codes, Error detection and correction principles. Boolean functions using Karnaugh map, Design of combinational circuits, Design of arithmetic circuits. Design of Code converters, Encoders and decoders.		
Unit 5	**Signal Conditioning**	**6**	Skill Development
	Operational amplifiers, Protection circuits and devices, comparator, filters, Multiplexer, Pulse width Modulation, Counters, decoders, Data acquisition, Analog to digital conversion, digital to analog conversion.		
Unit 6	**Closed-Loop controllers**	**5**	Skill Development & Employability
	Continuous and discrete control, Two-step mode control, Electronic P, I, D, PI and PID controllers, control system performance, tuning, adaptive control.		
Unit 7	**Case Study**	**2**	Skill Development & Employability
	Case studies of latest mechatronic systems.		

Evaluation Methods:

Item	Weightage
Mid term	30%

End term	50%
Teacher's assessment (Assignment/ Presentation/ Project/ Quiz)	20%

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