Bachelor of Technology Program in Mechatronics

I. Mechatronics

Mechatronics is an interdisciplinary discipline in engineering that integrates electronics, electrical engineering, mechanical engineering, computer science, robotics, control, telecommunications, and product design. To many it is synonymous with automation of electromechanical system engineering that finds wide applications in modern healthcare, automotive and advanced automated manufacturing engineering, in general. In this program, you are a thinker and a doer. You will find out how to make application-specific devices more safe and easier to use/handle. And of course: you design them! Think of an automated car wash, a robot-operated laser welding in automotive industries or surgery in healthcare, a wheelchair or robot arm replacement. The word 'Mechatronics' was originally coined by Tetsuro Mori of the Japanese company Yaskawa Electric Corporation, who held it as a company trade mark for years before making it license-free for anyone to use it in the world. In this course we will teach and expose you to the theory and practical knowledge that underpin Mechatronics so that at the end of the degree program you would become a specialist in automated system design techniques to **substitute** (at least to a great extent) requirements of physical hands-on-control and human intervention in situations where robotic products are essential and carry out automated product manufacturing engineering.

II. About the Program

This interdisciplinary program is offered by Department of Mechanical Engineering in the Ecole Centrale School of Engineering at Mahindra University in collaboration with the departments of Electronic and Electrical Engineering and Computer Science Engineering. The 4-year degree program provides students with broad engineering-related knowledge through basic courses in mechanics, electronics, computer programming, mathematics and physics. You will gain additional knowledge in management, design, Intelligent machines, health care and automated manufacturing. Students will have the option to specialize in the broad discipline of mechatronics in any one of the streams:

1. Advanced Manufacturing
2. Intelligent Machines
3. Health Care Systems

Total program credits: ~ 175

III. Expected Program Output

Characteristic attributes of the graduating students:

1. To be able to understand the basic engineering concepts with theoretical foundation in mathematical/physical modelling and software engineering.
2. To be able to understand and apply various concepts of mechanical design, electronics design and control.
3. To have the ability to apply engineering methods and tools to specify and develop mechanical components and systems in the context of mechatronics.
4. To have the ability to apply the engineering methods and tools and master the related skills in the process of developing mechatronic systems and products.
5. To have the ability to apply engineering methods and tools to, specify and develop analog and digital electronic circuits, specify and develop embedded hardware and software in a mechatronic context.

IV. Competencies

The competencies of a mechatronics engineer get developed around students working on the following topics of study:

- Theoretical foundation in mathematical/physical modelling
- Design and dynamic analysis of Mechatronics systems and products – practical and theoretical
- Automated technologies, design and development
- Methods and personal learning – Hands on experimental and simulation based learning.
- Specialization via electives and choice of one of the basket streams.

V. Themes

Year 1: Basic understanding of engineering and sciences

Year 2: Learn basics and working of mechanical, electronics and mechatronics systems.

Year 3: Hands on construction of Mechatronics system.

Year 4: Integration of Mechatronics concepts through Projects

VI. Tentative Courses

The courses proposed comprise of 5 broad categories – Basic Engineering and Sciences, Computer science, Mechanical Engineering, Electronics Engineering and Stream Specialization. Furthermore, trending electives will be offered in each of these domains wherein the students will be exposed to more specialized topics.

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Proposed Course Curriculum Outline – Semester Wise.

Semester I					
S. No.	**Course Name**	**Lecture**	**Tutorial**	**Practice**	**Credits**
1	Mathematics I (Calculus and ODEs)	4	1	0	5
2	Chemistry I	2	1	2	4
3	Introduction to Electrical and Electronics Engineering	2	1	2	4
4	Engineering Drawing	0	0	3	1.5
5	Mechanics	2	1	0	3
6	Earth and Environmental Sciences	2	0	0	2
7	Intro. to Entrepreneurship	0	0	3	1
8	Media Project	0	0	3	1.5
9	English	3	0	0	3
10	French I	0	2	0	0.5
Total credits					**25.5**

Semester II					
S. No.	**Course Name**	**Lecture**	**Tutorial**	**Practice**	**Credits**
1	Mathematics II (Linear algebra& Complex Analysis)	4	1	0	4
2	Physics I	2	1	2	4
3	Thermodynamics	2	1	0	3
4	Intro to Mechatronics +EM conversion	3	0	0	3
5	Computer Aided Engineering Drawing	1	0	3	2.5
6	Introduction to computer sciences	2	1	2	4
7	Workshop Practice	0	0	2	1
8	Entrepreneurship practice	0	0	2	1
9	Professional Ethics	0	1	0	1
10	French II	0	2	0	0.5
Total credits					**24**

Semester III					
S. No.	**Course Name**	**Lecture**	**Tutorial**	**Practice**	**Credits**
1	Mathematics III	3	1	0	4
2	Physics II	3	1	2	5
3	Data Structures and Algorithms	2	2	2	5
4	Introduction to Material sciences	2	0	2	3
5	Signals and Systems (Fractal)	2	2	0	2
6	Lean Start-up	0	0	3	1
7	Economics	3	0	0	1.5
8	French language III	0	2	0	0.5
Total credits					22

Semester IV					
S. No.	**Course Name**	**Lecture**	**Tutorial**	**Practice**	**Credits**
1	Digital Signal Processing	1	1	0	2
2	Fluid Mechanics	3	1	0	4
3	Solid Mechanics	2	1	0	3
4	Digital Electronics	2	1	2	4
5	Theory of Mechanisms (K & D)	3	0	2	4
6	Design Thinking	1	0	2	2
7	Capstone project*	0	0	2	1
8	Financial Accounting	3	0	0	1.5
9	French language IV	0	2	0	0.5
Total credits					22

*A capstone project is a multi-faceted mini-project that serves as a culminating academic and intellectual experience for students

Semester V					
S. No.	**Course Name**	**Lecture**	**Tutorial**	**Practice**	**Credits**
1	Power Electronics and Control Systems	3	1	0	4
	Manufacturing & Automated processes	2	0	2	3
2	Measurement & instrumentation	2	0	2	3
3	Design of Machine Elements	3	1	0	4
4	Robotics I	3	0	0	3
5	Stream Course I	3	0	0	3
6	HSS and Management Elective I	2	0	0	2
7	Capstone project	0	0	2	1
8	French language V (optional)	0	2	0	0
Total credits					23

Semester VI					
S. No.	**Course Name**	**Lecture**	**Tutorial**	**Practice**	**Credits**
1	Human Computer Interaction	3	0	0	3
2	Machine learning	3	0	0	3
3	Embedded Systems	2	0	0	2
4	Robotics II	3	0	1	3.5
5	Stream Course II	3	0	0	3
6	Open Elective I	3	0	0	3
7	HSS and Management Elective II	2	0	0	2
8	Mechatronics Semester project	0	0	6	3
9	Intro to Professional development & employment skills	2	0	0	2
10	French language VI (Optional)	0	2	0	0
Total credits					24.5

Semester VII					
S. No.	**Course Name**	**Lecture**	**Tutorial**	**Practice**	**Credits**
1	Mechatronics System Design	1	0	2	2
2	Industrial Engineering and Operations Research	3	1	0	4
3	Open Elective III	3	0	0	3
4	Stream Course III	3	0	0	3
5	HSS and Management Elective III	2	0	0	2
6	Final Year Project I	0	0	6	3
7	French language VII (Optional)	0	2	0	0
Total credits					17

Semester VIII					
S. No.	**Course Name**	**Lecture**	**Tutorial**	**Practice**	**Credits**
1	Stream Course IV	3	0	0	3
2	Open Elective III	3	0	0	3
3	Final Year Project II	0	5	8	9
4	French VIII (Optional)	0	2	0	0
Total credits					15

VII. Stream Courses

Mechatronics students can specialize in any one of the following streams:

1. **Advanced Manufacturing**
   Subjects:
   a. Micro and Nano fabrication (NanoTech)
   b. Flexible manufacturing
   c. Computer Integrated Manufacturing
   d. Industry 4.0

2. **Intelligent Systems/Machines**
   Subjects:
   a. Cyber Physical System
   b. Digital Interfacing
   c. Real time operating systems
   d. Intelligent Dynamic mechatronics system

3. **Health Care Systems**
   Subjects:
   a. Bio medical Engineering
   b. Bio-Medical Instrumentation
   c. Assistive and Rehabilitation Robotics
   d. Surgical Robotics