# Subject Description Form

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| **Subject Code** | ME41004 |
| **Subject Title** | Mechatronics and Control |
| **Credit Value** | 3 |
| **Level** | 4 |
| **Pre-requisite/ Co-requisite/ Exclusion** | Pre-requisite: ME31003 System Dynamics |
| **Objectives** | To provide students the knowledge in designing mechatronic systems for product development which integrate mechanical, electrical and control systems engineering. |
| **Intended Learning Outcomes** | Upon completion of the subject, students will be able to:<br><br>a. Formulate and solve problems related to sensors, actuators, and signal conditioning in mechatronic systems, controller design and stability analysis, and performance specifications for mechatronic systems.<br>b. Design and analyze a given task or project in mechatronics system by applying knowledge acquired in the subject and information obtained through literature search.<br>c. Analyze and interpret data obtained from experiments to evaluate the performance and/or stability of mechatronic systems.<br>d. Present effectively in completing written reports of laboratory work and the given task. |
| **Subject Synopsis/ Indicative Syllabus** | ***Sensors and Actuators*** **-** Instrumentation and measurement principles; frequency response characteristics; sensors for motion and position measurement; force, pressure and acceleration sensors, *etc*; actuators such as direct current motors, stepper motors, piezoelectric actuators, *etc*.<br><br>***Signal Conditioning and Transmission*** **-** Concepts and principles; analogue electronics with operational amplifier; conversion between analog and digital signals, multiplexing; data acquisition principles, signal filtering.<br><br>***Digital Logic Controller and PLC*** **-** Logic; controller design in mechatronic system integration, combinational and sequential control, minimization of logic equations; ladder logic diagrams; introduction to microcontrollers and programmable logic controllers (PLC).<br><br>***Introduction to Feedback Control*** **–** Analysis of open-loop and closed-loop systems; transfer functions and block diagrams, time-domain specifications such as overshoot, settling time, steady-state error etc.<br><br>***Feedback Control Systems*** **–** Automatic controllers, basic P, PD, PI, PID controllers, Routh-Hurwitz stability criterion, controller design to satisfy the design specifications. |

**Laboratory Experiment**
There are two laboratory sessions.
Typical Experiments:
1. Displacement Measurement using Linear Variable Differential Transformer (LVDT)
2. Sequential control using programmable logic controller (PLC)
3. DC servomechanism
4. Water level control

**Teaching/Learning Methodology**

Lectures are used to deliver the fundamental knowledge in relation to sensors and actuators, signal conditionings, digital logic controllers, feedback control systems and stability analysis (Outcomes a and b).

Tutorials are used to illustrate the application of fundamental knowledge to practical situation (Outcomes a and b).

Assignments are used to help students in developing a firm understanding in the concepts taught (Outcomes a and b).

Experiments are used to relate the concepts to practical applications and students are exposed to hand-on experience, proper use of equipment and application of analytical skills on interpreting experimental results (Outcomes c and d).

The project is used to help students in enhancing their ability to apply the knowledge in relation to sensors and actuators in designing a real-life system (Outcomes a, b and d).

| Teaching/Learning Methodology | Outcomes | | | |
|---|---|---|---|---|
| | a | b | c | d |
| Lecture | √ | √ | | |
| Tutorial | √ | √ | | |
| Assignments | √ | √ | | |
| Experiment | | | √ | √ |
| Project | √ | √ | | √ |

**Assessment Methods in Alignment with Intended Learning Outcomes**

| Specific assessment methods/tasks | % weighting | Intended subject learning outcomes to be assessed (Please tick as appropriate) | | | |
|---|---|---|---|---|---|
| | | a | b | c | d |
| 1. Class Test | 15% | √ | √ | | |
| 2. Assignments | 10% | √ | √ | | |
| 3. Laboratory Report | 10% | √ | | √ | √ |
| 4. Project | 15% | √ | √ | | √ |
| 5. Examination | 50% | √ | √ | | |
| Total | 100% | | | | |

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| | Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:<br><br>Overall Assessment:<br>0.50 x End of Subject Examination + 0.50 x Continuous Assessment.<br><br>Tests, assignments, laboratory reports, and project are adopted in continuous assessment on students' timely feedback to and on-going understanding of the course. Students' overall understanding of the course and ability in applying the delivered knowledge are further assessed through a formal examination. | |
| **Student Study Effort Expected** | Class contact: | |
| | ▪ Lecture | 33 Hrs. |
| | ▪ Laboratory / Tutorial | 6 Hrs. |
| | Other student study effort: | |
| | ▪ Self-study | 36 Hrs. |
| | ▪ Homework assignment | 15 Hrs. |
| | ▪ Laboratory report | 6 Hrs. |
| | ▪ Project | 9 Hrs. |
| | Total student study effort | 105 Hrs. |
| **Reading List and References** | 1. Shetty, D. and Kolk, R. A., *Mechatronic System Design*, PWS Publishing Company, latest edition.<br>2. Alciatore, D. G. and Histand, M. B., *Introduction to Mechatronics and Measurement Systems*, McGraw Hill, latest edition.<br>3. Bolton, W., *Mechatronics: Electronic Control Systems in Mechanical Engineering*, Prentice Hall, latest edition.<br>4. Ogata, K., *Modern Control Engineering*, Prentice Hall, latest edition.<br>5. Gopal, M., *Control Systems Principles and Design*, Tata McGraw-Hill, latest edition.<br>6. Nise, N.S., *Control Systems Engineering*, John Wiley, latest edition. | |

*Revised March 2017*