# Department of Automation and Robotics

## Course Design Review

## Action Taken Report of the University on the Feedback of Stakeholders

## Programme Outcomes (PO's)

**The graduates will have,**

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| **PO 1: Engineering knowledge** | Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems. |
| **PO 2: Problem analysis** | Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences. |
| **PO 3: Design/Development of Solutions** | Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations. |
| **PO 4: Conduct investigations of complex problems** | Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions. |
| **PO 5: Modern tool usage** | Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations. |
| **PO 6: The engineer and society** | Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice. |
| **PO 7: Environment and sustainability** | Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development. |
| **PO 8: Ethics** | Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice. |
| **PO 9: Individual and team work** | Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. |
| **PO 10: Communication** | Communicate effectively on complex engineering activities with the engineering community and with t h e society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions. |
| **PO 11: Project management and finance** | Demonstrate knowledge and understanding of t h e engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments. |
| **PO 12: Life-long learning** | Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change. |
| **PSO 13: Foundations of robotics** | Identify the needs, analyze, design and develop simple robotic systems and programs for diverse applications. |
| **PSO 14: Integration and applications of automation and robotics** | Identify the needs, design, select and integrate appropriate automation and robotic subsystems for diverse applications. |

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1. **Action Taken Report Approved in Board of Studies dated** 01-04-2017 **and implemented with effect from** June 2017

| **Observations/ Recommendations based on feedback** | **POs impacted** |
|---|---|
| **Employer Feedback:**<br>• Programming Skills especially of Non-IT Students needs improvement.<br>• Emphasis on Problem Solving & alternate solutions required.<br><br>**Teachers Feedback (Pre-BoS MoM):**<br>Microcontrollers 16EARC207<br>• Students need to learn about Flash and EEPROM memory.<br>• Exposure on industrial applications of Microcontrollers is required.<br>Product Realization 16EARP208<br>• A course on Engineering Design was introduced at IV semester, which stopped at development of conceptual designs. It was found that students needed to be proficient in prototype development to make them undergo the entire cycle of product realization.<br>Manufacturing & Metrology lab<br>• Experiments related to measurement need to be added. | PO1,PO2, PO3,PO5, PO9, PO10,PO11,PO 12 |

| **Actions taken** | **Course Revised (R)/ Added (A)** | **BoS approved Date** |
|---|---|---|
| 1. Concepts related to data storage using flash and EEPROM memories and industrial applications of microcontrollers were introduced - 10 hours.<br>2. A course on Engineering Design was introduced at IV semester, with the emphasis on prototype development and entire cycle of product realization process.<br>3. Manufacturing & Metrology lab is introduced to include demonstrations, experiments, structured enquiry and open-ended experiments. | Microcontrollers 16ARC207 (R)<br>Product Realization 16EARP208 (R)<br>Manufacturing & Metrology lab 16EARP205(R) | 01-04-2017 |

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2. **Action Taken Report Approved in Board of Studies dated 31-3-2018 and implemented with effect from June-2018.**

| Observations/ Recommendations based on feedback | POs impacted |
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| **Employers Feedback:**<br>• Programming Skills especially of Non-IT Students needs improvement.<br>• Logical Thinking needs improvement & more practice.<br>• Practical Applications of Concepts / more hands on required as students are more theoretical.<br><br>**Teachers Feedback (Pre-BoS MoM):**<br>OOP and Python Practice - 16EARP305<br>• More focus needs to be given for solving real world problems.<br>DBMS Practice 16EARP306<br>• Required proficiency in designing of database to address the requirements of the course offered from V semester onwards.<br>Power Electronics, Motors & Drives 16EARE301<br>• Identified scope of addition of robotics and industrial drives concepts.<br>• Reorganize flow of topics.<br>Hydraulics and Pneumatics Lab 16EARP302<br>• Scope for Simulation and analysis of fluid power circuit using MATLAB has been identified.<br>Algorithm Analysis & Program Design 17EARC203<br>• Required proficiency in programming to address the requirements of course offered from III semester onwards.<br>Microcontrollers 17EARC207<br>• Students need to learn the latest technology subject like Machine learning.<br>• The subject can be much appreciated by robotics students if subject is taught with Robot operating system<br>Control Systems 17EARC209<br>• Content related to basics of controllers was missing in control systems (code 16EARC209) | **PO1, PO2, PO5** |

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| • State space was introduced as a foundation for mechatronics system design (18EARC304), which was taught in 5th semester.<br><br>Microcontrollers Lab 17EARP207<br>• Students need exposure to PCB design and fabrication.<br><br>**Students Feedback:**<br>Microcontrollers Lab 17EARP207<br>• Needs hands on experience of PCB fabrication. | |

| **Actions taken** | **Course Revised(R) / Added (A)** | **BoS approved Date** |
|---|---|---|
| 1. Strategy of the content delivery was altered with addition of structured queries.<br>2. DBMS Practice (16EARP306) is introduced to include demonstrations, experiments, structured enquiry and open-ended experiments to solve real world problems. The focus is given on database design and normalization.<br>3. Theory of stepper motors for robotics and industrial drives has been included – 20 Hours<br>4. Simulation and analysis of fluid power circuits using MATLAB has been added – 6 Hours.<br>5. Exercise on Hydraulic accumulator, Sequential control of drives, and control of hydraulic circuits using logic gates is added – 6 Hours.<br>6. Few concepts like dynamic programming and trees were added to address real world problems.<br>7. New topics related to High end processors and Micro-Python that is programming microcontrollers using python were introduced - 10 hours. | OOP and Python Practice 16EARP305(R)<br>DBMS Practice 16EARP306(A)<br>Power Electronics, Motors & Drives 16EARE301(R)<br>Hydraulics and Pneumatics Lab – 16EARP302(R)<br>Algorithm Analysis & Program Design 17EARC203 (R)<br>Microcontrollers 17EARC207(R)<br>Control Systems | **31-3-2018** |

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| 8. Introduced the content related to controllers<br>• Introduction of chapter on PID controller design<br>• Topics namely, types of Controllers; Mathematical modeling of PID, ON-OFF controller, Effect of Proportional, Derivative and Integral elements on system behavior, Design of controller for simple applications are introduced.<br>9. Introduced a topic on state space and General State-Space Representation<br>10. New content for design and fabrication of PIC, Atmega328 development board and PIC programmer were introduced - 4 hours. | 17EARC209 (R)<br>Microcontrollers Lab<br>17EARP207(R) | |

3. **Action Taken Report Approved in Board of Studies dated** 13-04-2019 **and implemented with effect from** June 2019

| **Observations/ Recommendations based on feedback** | **POs impacted** |
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| **Employers Feedback:**<br>• Programming Skills especially of Non-IT Students needs improvement.<br>• Logical Thinking needs improvement & more practice.<br>• Practical Applications of Concepts / more hands on required- students are more theoretical<br>• Fundamentals/Basics must be improved.<br>• Projects Quality & Depth to be improved.<br>• Emphasis on Problem Solving & alternate solutions needed.<br>• Practical Applications of Concepts / more hands on required- students are more theoretical.<br>• With respect to Projects - Implementing change in requirements -- is an important skill.<br>• Students need to do more interesting projects.<br><br>**Teachers Feedback (Pre-BoS ,MoM):**<br>Machine Learning and ROS 16EARE403<br>• Students need to learn the latest technology subject like Machine learning.<br>• The subject can be much appreciated by robotics students if subject is taught with Robot operating system<br><br>Measurement System 16EARE401<br>• Sensors and Signal conditioning chapter and Data acquisition systems chapter was newly added. | PO1, PO2, PO3, PO4, PO5, PO10, PO11, PO12, PO13,PO14 |

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Measurement System 17EARC304

- Scope of subject based on measurement has been identified as one of the important aspects in the field of control systems for automation and robotics applications.

Mechatronics and Measurement Lab 17EARP303

- Need for Introduction of exercises on Electronic Measurements and Sensors is proposed.
- Need for introducing exercises in line with the curricular changes required to emphasize on model based design, sensors and measurements for simulation and hardware based experiments.

Machine Learning & ROS 17EARC305

- Required proficiency in addressing real world problems with improved learning ability for automation and robotics solutions.

Object Oriented Programming & Database Management Systems 17EARC301

- More emphasis on programming and database is required.

Mechatronics System Design 17EARC303

- Need for revising of chapters in line with the curricular changes required to emphasize on modeling, Electric Drives, Model based design of Systems and Identification and Case studies has to be taken up.
- Emphasis required on modeling and System Identification.

Object Oriented Programming & Database Management Systems Lab 17EARP301

- More emphasis on programming and database was suggested.

AI for Autonomous Robots 17EARE301

- Required proficiency in addressing real world problems with improved learning ability to design and implement intelligent solutions for automation and robotics problems.

Digital System Design and FPGA Programming 17EARE304

- Need for introduction of a course on Reconfigurable architectures, and FPGA Programming was proposed, in order to introduce concepts of Parallel computing and power-efficient architectures. This is in line with the requirements of recent trends in computing employed in Automation and Robotics applications.
- Need for introducing power-efficient architectures based on FPGA was proposed.

Hydraulics and Pneumatics 17EARC308

- Suggestions on the alteration of the existing syllabus were received indicating emphasis on core design aspects.

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Industrial Robotics Lab 17EARP306

- Use of RoboAnalyzer tool for building industrial robots in Industrial Robotics Lab was proposed.
- Scope of implementing Robotics toolbox in Industrial Robotics Lab was identified.

Analog and Digital Electronics 18EARC201

- Refining the flow of topics was suggested.
- Inclusion of a topic on integrated circuits was required.

Data Structures, Algorithm Design and Analysis 18EARC203.

- Required proficiency in programming to address the requirements of course offered from III semester onwards.

Object Oriented Programming & Database Management Systems 18EARC209

- Focus on implementation as it was crucial to crack the initial placement round.
- Required proficiency in programming to address the requirements of course offered from V semester onwards (internal discussion).

Object Oriented Programming & Database Management Systems Lab 18EARP209

- Focus on implementation was emphasized in order to help students crack the initial placement round.
- Required proficiency in programming to address the requirements of course offered from V semester onwards
- Reduce the number of programming languages

Microcontrollers Programming and Interfacing 18EARC208

- Students have to get exposure on advanced microcontrollers.

Control Systems 18EARC207

- Case studies of control systems play an important role in understanding the control systems concepts.

Microcontrollers Programming and Interfacing Lab 18EARP208

- Students needs to get hands on experience on IOT systems

**Students Feedback:**

- Reduction in the number of programming languages needed.

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| Actions taken | Course Revised (R)/ Added (A) | BoS approved Date |
|---|---|---|
| 1. New subject was introduced to understand machine learning with respect to the robot operating system has introduced.<br>2. Addition of Sensors and Signal conditioning chapter and Data acquisition systems chapter of 10 Hours to the existing syllabus.<br>3. The Measurement System as a course has been introduced for the academic year 2019-20 which is of 40 Hours syllabus.<br>4. Characterization of Sensor modules and study of sensor fusion techniques -6 hrs, System Identification of DC motor -6hrs<br>5. Developing of Data acquisition model in an embedded system(3hrs)<br>6. Topics related to the Robotic operating system were added.<br>7. The course was added to support the previously offered OOP & Python Practice (16EARP305) and DBMS Practice (16EARP306).<br>8. The new course included Java programming, Python programming and MySQL database.<br>9. Topics related Modeling of Processes, Model based Design of Systems & Identification and Case studies were added.<br>10. OOP & Python Practice (16EARP305) and DBMS Practice (16EARP306) were combined with demonstrations, experiments, structured enquiry and open-ended experiments on Java programming, Python programming and MySQL database.<br>11. Industry relevant context was introduced.<br>12. Topics related to Robotic architectures, artificial intelligence were added in the course AI for autonomous systems (17EARE301).<br>13. Digital System Design and FPGA Programming 17EARE304 | Machine Learning and ROS 16EARE403(A)<br>Measurement System 16EARE401(R)<br>Machine Learning & ROS (A)<br>17EARC305 Object Oriented Programming & Database Management Systems 17EARC301(A)<br>Object Oriented Programming & Database Management Systems Lab 17EARP301(A)<br>AI for Autonomous Robots 17EARE301(R)<br>Digital System Design and FPGA Programming 17EARE304(A)<br>Hydraulics and Pneumatics 17EARC308(R)<br>Industrial Robotics Lab (17EARP306)(R)<br>Analog and Digital | 13-04-2019 |

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| Unit I:15 hours :Review of Logic Design Fundamentals, State machine Charts & Micro programming<br>Unit II:15 hours: Designing with FPGA, Modeling and Design with HDL<br>Unit III:10hrs : Testing and Verification, Case studies<br>14. Theory credits were reduced from 4-0-0 to 3-0-0, with more focus on Hydraulic Control Systems<br>15. Introduced topic related to Robo Analyzer tool - 9 hours, Introduced Robotics Toolbox by Peter Corke – 3 hours Include a topic on integrated circuits – 4 Hours<br>16. Programming with focus on concepts like inheritance, polymorphism and abstraction related to C++ were added.<br>17. Course was shifted to IV semester as courses from V semester onwards required proficiency in programming.<br>18. Theory credits were reduced from 4-0-0 to 3-0-0, with more focus on implementation as part of Lab<br>19. Number of programming languages reduced with focus solely on classical OOP and database<br>20. Content was rearranged<br>21. The lab was shifted to IV semester as courses from V semester onwards required proficiency in programming<br>22. The lab credits were increased from 0-0-1 to 0-0-2, with more focus on implementation as part of Lab. This required introduction of new demonstrations, experiments, and structured enquiry.<br>23. Number of programming languages reduced with focus solely on Visual Studio C++ and MySQL database, and deletion of Python programming content<br>24. New advanced microcontroller STMicroelectronics microcontroller was introduced that can be programmed using python. | Electronics<br>18EARC201(R)<br>Data Structures, Algorithm Design and Analysis<br>18EARC203(R)<br>Object Oriented Programming & Database Management Systems<br>18EARC209(R)<br>Object Oriented Programming & Database Management Systems Lab<br>18EARP209(R)<br>Microcontrollers Programming and Interfacing<br>18EARC208(R)<br>Control Systems<br>18EARC207(R)<br>Microcontrollers Programming and Interfacing Lab 18EARP208(R) | |

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| 25. Case studies were introduced in unit-3, in Chapter No. 8: Case Studies. Plants for Pressure Control, Electromechanical Plants, Modeling and design of Inverted Pendulum, Modeling and design of Aircraft.<br><br>26. Lab experiments related to design and development of IOT systems and program development using of STM family of microcontrollers were introduced - 6 hours | | |

**4. Action Taken Report Approved in Board of Studies dated** 03-06-2020 **and implemented with effect from** July 2020

| **Observations/ Recommendations based on feedback** | **POs impacted** |
|---|---|
| **Employer Feedback:**<br>• Programming Skills especially of Non-IT Students needs improvement.<br>• Logical Thinking needs improvement & more practice.<br>• Practical Applications of Concepts / more hands on required- students are more theoretical<br>• Projects Quality & Depth to be improved.<br>• Emphasis on Problem Solving & alternate solutions needed.<br>• Practical Applications of Concepts / more hands on required- students are more theoretical.<br>• With respect to Projects - Implementing change in requirements is an important skill.<br>• Students need to do more interesting projects<br><br>**Teacher's Feedback:**<br>Project 1 18EARW401<br>• Decision taken in the Pre-BOS meeting to add one more project activity in VII semester for improving complex problem solving skills for students opting for internship program in VIII semester. | PO1,PO2, PO3,PO4<br>PO5, PO9,<br>PO10,PO11,PO12,<br>PO13, PO14 |

| **Actions taken** | **Course Revised (R)/ Added (A)** | **BoS approved Date** |
|---|---|---|
| 1. New Project course was introduced in which the student has to select suitable complex problem and build solution for the same. | Project 1<br>18EARW401(A) | 03-06-2020 |

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