<u>Innovation in teaching learning process</u>

[1] Name of the Innovation activity: Hands-On Workshops and Labs

[2] Course code and course name: 1MEPC311, Mechatronics and Robotics

[3] Program and Class: Mechanical Engineering, T.Y.

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[5] Introduction:

Mechatronics is an interdisciplinary field that integrates mechanical engineering, electrical engineering, computer science, and control engineering. It is focused on the design and development of intelligent products that combine these different disciplines. A good example of a mechatronic system is an automatic washing machine. The washing machine uses a variety of sensors to determine the water level and temperature, and it uses motors to control the spin cycle.

Automatic washing machine

Robotics is a field of engineering that focuses on the design, construction, operation, and application of robots. Robots are machines that can sense their environment and take actions in response to that information. They can be used in a variety of applications, including manufacturing, healthcare, and logistics.

Industrial robot

[6] Motivation/Purpose of innovative technique

1. **Experiential Learning**:
   - **Motivation**: Experiential learning methodologies contribute to enhancing education quality.
   - **Purpose**:
     - Develop competencies.
     - Build creative and critical thinking skills.
     - Improve the quality of learning.
   - **Approach**:
     - Implementation, assessment, and reflections.
     - Synergize cognition, perception, behaviour, experience sharing, and evaluation.
     - Supported by knowledge accumulation.
2. **Integration of Theory and Practice**:
   - **Motivation**: Bridging the gap between theoretical knowledge and practical application.
   - **Purpose**:
     - Enhance hands-on experience.
     - Foster problem-solving skills.
     - Prepare students for real-world challenges.
   - **Approach**:
     - Develop training tools.
     - Integrate hands-on experience with project-based learning.
     - Collaborative knowledge sharing and interactive discussions.
3. **Student-Cantered Learning**:
   - **Motivation**: Empower students to take ownership of their learning.
   - **Purpose**:
     - Active student engagement.
     - Participation and investigation.
     - Encourage self-directed learning.
   - **Approach**:
     - Student-led projects.
     - Problem-solving activities.
     - Peer learning and knowledge exchange.

[7] Suitability of technique over course content

Mechatronics Techniques:

As you delve deeper into mechatronics, the techniques will focus on integrating different disciplines:

- **Mechanical Design:** Techniques like 3D modelling, computer-aided design (CAD), and machining will be used to design and build the physical structure of mechatronic systems.

- **Sensors & Actuators:** Techniques for selecting and interfacing with various sensors (pressure, temperature, etc.) and actuators (motors, solenoids) will be crucial for real-time data acquisition and system control.
- **Control Systems Engineering:** Techniques for designing feedback loops, implementing control algorithms (PID control, etc.), and ensuring system stability are key to creating intelligent and responsive mechatronic products.

Robotics Techniques:

In robotics, the focus shifts towards techniques specific to robot design and functionality:

- **Kinematics & Dynamics:** Techniques for analysing robot motion, including forward and inverse kinematics, will be used to understand robot movement and path planning.
- **Robot Perception:** Techniques for integrating sensors like cameras, LiDAR, and ultrasonic sensors for obstacle detection, object recognition, and environment mapping will be crucial for robots to interact with the world.
- **Machine Learning & Artificial Intelligence (AI):** As robots become more complex, techniques in machine learning and AI will be used for tasks like object manipulation, path optimization, and autonomous decision making.

Overall, a mechatronics and robotics program will equip you with a broad range of techniques, and you'll learn how to choose the most suitable ones for the specific challenge you're tackling.

[8] Procedure Followed

Hands-On Workshops and Labs:

- Provide access to robotics kits, sensors, and actuators.
- Conduct hands-on workshops where students assemble and program robots.
- Labs allow students to experiment, troubleshoot, and gain practical experience.

[9] Evaluation process followed

1. Defining Evaluation Criteria:

- **Project Goals:** Clearly defined project goals are essential. What was the project aiming to achieve? This could be functionality, efficiency, cost, or a combination of factors.
- **Technical Specifications:** Break down the project's functionalities into measurable criteria. For a robot arm, this might be accuracy, speed, or range of motion. For a self-driving car, it could be path following, obstacle detection accuracy, or reaction time.
- **Documentation & Design:** Evaluate the quality of the project documentation, including design choices, code clarity, and schematics. Did the chosen techniques effectively solve the problem?

2. Performance Testing:

- **Functionality Testing:** This is the core – assess if the project achieves its intended functionalities. Can the robot perform the desired tasks? Does the mechatronic system operate as planned?
- **Quantitative Testing:** Use measurable data to evaluate performance against technical specifications. Measure speed, accuracy, efficiency, or other relevant metrics.
- **Comparative Analysis (Optional):** If applicable, compare the project's performance to existing solutions or benchmarks. This helps assess its relative effectiveness.

3. Safety and Reliability:

- **Safety Features:** Evaluate the project's safety features and adherence to safety protocols. Does it operate safely and mitigate potential hazards?
- **Reliability Testing:** Assess the project's consistency and robustness. Can it function reliably under varying conditions or repeated use?

4. Innovation and Creativity:

- **Novelty of Approach:** Did the project use innovative techniques or solutions? Did it address the challenge in a unique way?
- **Potential Applications:** Evaluate the broader potential applications of the project's design or technology. Can it be adapted for other uses?

5. Communication and Presentation:

- **Project Report:** Assess the quality of the project report, including clarity, organization, and technical explanation. Can others understand the project and its results?
- **Demonstration (Optional):** If applicable, evaluate the effectiveness of the project demonstration. Did it clearly showcase the project's capabilities?

Evaluation Tools:

- Rubrics with specific criteria and scoring scales can be used for objective evaluation.
- Presentations and reports allow for communication of the project's achievements.
- Data acquisition systems can be used to capture performance metrics during testing.

Remember: The weighting of each evaluation criteria will depend on the specific project and its goals. It's important to tailor the evaluation process to ensure a well-rounded assessment of the project's success.

[10] Outcome:

Skills Development:

- **Practical Application of Knowledge:** These sessions allow you to apply the theoretical knowledge from lectures to real-world scenarios. You'll gain hands-on experience with:
  - Building and assembling robots or mechatronic systems.
  - Programming robots to perform specific tasks.
  - Using sensors and actuators to interact with the environment.
  - Troubleshooting and debugging hardware and software issues.

- **Developing Technical Expertise:** You'll gain proficiency in specific techniques like:
    - Soldering electronic components.
    - Operating different types of tools (e.g., 3D printers, CNC machines).
    - Calibrating sensors and actuators.
    - Data acquisition and analysis.

Problem-Solving and Design Thinking:

- **Project-Based Learning:** Many workshops involve hands-on projects where you'll:
    - Define project goals and design a solution.
    - Select appropriate components (hardware and software).
    - Integrate different engineering disciplines.
    - Prototype, test, and iterate on your design.
- **Collaboration and Teamwork:** Workshops often involve working in teams:
    - Develop communication and teamwork skills.
    - Learn from each other's approaches and problem-solving techniques.
    - Share ideas and work collaboratively towards a common goal.

Creativity and Innovation:

- **Experimentation and Open-Ended Exploration:** Workshops often encourage creative exploration:
    - Experiment with different design approaches and techniques.
    - Find innovative solutions to challenges faced during the project.
    - Think outside the box and apply your knowledge in new ways.

Outcomes Tailored to Specific Areas:

- **Mechatronics Workshops:** These might focus on building and controlling intelligent systems such as:
    - Automated machines
    - Self-balancing robots
    - Line following robots with object detection
- **Robotics Workshops:** These might involve building and programming robots for specific tasks:
    - Maze solving robots
    - Object manipulation robots
    - Autonomous robots with obstacle avoidance

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