DEPARTMENT OF MECHATRONICS ENGINEERING

Innovation in Teaching and Learning

Innovative practices in the teaching-learning process include the use of Information and Communication Technology (ICT), effective delivery methods, and diversified assessment and evaluation techniques. These initiatives satisfy the following requirements:

Information and Communication Technology (ICT)

- **Interactive Classrooms**: Equipped with overhead projectors to facilitate effective teaching through presentations, animations, and simulations.
- **Domain-Specific Communication**: Faculty and students are provided with institutional email IDs in the domain kct.ac.in, with 30 GB of storage via Google Workspace.
- **Learning Management System**: Course materials, objective questions, assignments, and other resources are shared with students through MS Teams for seamless access.

Effective Delivery Methods

1. **Blended Learning and Flipped Classrooms**:
   Faculty integrate digital tools with traditional teaching methods, allowing students to engage with course content online prior to class. In-class sessions focus on discussions and active participation, deepening their understanding of complex topics.
2. **Simulations and Virtual Laboratories**:
   By incorporating simulations in labs, students can explore real-world scenarios in a digital environment. This approach bridges theoretical knowledge with practical application, enhancing conceptual clarity.
3. **Collaborative and Project-Based Learning**:
   Group projects addressing real-world challenges encourage teamwork, critical thinking, and problem-solving skills, enabling students to apply their knowledge effectively.
4. **Online Technical Quizzes**:
   Conducted through MS Teams to assess technical skills interactively.
5. **MOOCs and Online Certifications**:
   Students and faculty are encouraged to enrol in online courses via NPTEL, Coursera, edX, etc., with several participants achieving elite certifications.
6. **Pre-Prepared Course Materials**:
   Course content is uploaded to MS Teams before each semester begins, ensuring students are well-prepared.
7. **Purpose-Driven Teaching**:
   Faculty outline the objectives of each course at the semester's start and engage students through interactive discussions, fostering a deeper connection with the subject.
8. **Revised Bloom’s Taxonomy**:
   Teaching strategies are aligned with Bloom’s Taxonomy to ensure structured learning outcomes for every lecture.
9. **Formative Assessment**:
   Continuous assessments are conducted through in-class activities and thought-provoking questions to gauge understanding and progress.

Assessment and Evaluation

Beyond traditional exams, students are evaluated using diverse methods:

- **Activity-Based Assignments**
- **Minor Projects**
- **Group Presentations**
- **Poster, Chart, and Model Presentations**

Pedagogical advancements, including mini projects, presentations, and fieldwork, are summarized in the table below:

S.No	Regulation	Course (code/title)	Pedagogy employed	Impact on learning outcome
1.	2018	U18MCI4202: Sensor and Instrumentation	practical-based learning	Builds foundational knowledge of sensor technologies and enhances problem-solving skills
2.	2018	U18MCI6202: Robotics Engineering	Peer-to-Peer Learning, Simulation	Strengthens understanding of motion systems and automation, enabling design of robotic systems.
3.	2018	U18MCT4104: Theory of Machines	Peer-to-Peer Learning, Mini Project	Promotes hands-on learning by encouraging the creation of simple mechanism models.
4.	2018	U18MCI4201: Hydraulics and Pneumatics	Peer-to-Peer Learning, Simulations	Enhances skills in analyzing and designing fluid power systems for industrial applications.
5.	2018	U18MCT3103: Mechanics of Solids	Research Article Publication	Improves understanding of material testing and identification of material characteristics.
6.	2018	U18MCT3104: Fluid Mechanics and Thermal Sciences	Peer-to-Peer and Group Learning	Develops analytical and problem-solving skills related to fluid behavior and heat transfer.
7.	2018	U18MCE0004: Artificial Intelligence and Machine Learning	Mini Project	Cultivates the ability to design intelligent systems for addressing real-world problems.
8.	2018	U18MCT7002: Image Processing and	Project-Based Learning	Encourages application of image processing concepts through

		Computer Vision		practical projects.
9.	2018	U18MCT7001: Mobile Robotics	Simulation	Applies theoretical knowledge to solve real-time challenges in robotics and automation.
10.	2018	U18MCI6201: Computer-Aided Manufacturing	Project-Based Learning	Facilitates practical understanding of computer-aided techniques in manufacturing processes.
11.	2018	U18MCT0010: Automotive Electronics	Experimental Learning	Provides practical exposure to automotive electronics and embedded systems.
12.	2018	U18MBT7001: Engineering Economics	Peer-to-Peer and Group Learning	Develops collaborative skills and a deeper understanding of engineering economics.

Table 1 Pedagogical advancements

The "Sensors and Instrumentation" course featured a practical-based learning module where students engaged in hands-on activities to select appropriate sensors and design driver circuits for simple applications as shown in Figure 1.

Activity Highlights:

1. **Sensor Selection**: Students explored different sensor types and learned criteria for choosing the right sensor for various applications.
2. Circuit Design: Participants developed driver circuits to integrate with their selected sensors, enhancing their understanding of electronic components and schematics.
3. Model Construction: Using their sensors and circuits, students built and tested models to demonstrate real-world functionality.
4. Optimization: Students refined their models through testing, applying problem-solving skills to achieve optimal performance.

Figure 1 Students engaged in hands-on activities

For the Professional Elective course, "Artificial Intelligence and Machine Learning," an experiential learning session was conducted using color balls and elastic bands to demonstrate the K-Means clustering algorithm as shown in Figure 2.

This hands-on activity significantly enhanced students understanding through active participation.

Activity Details:

1. **Setup:** Students received colored balls as data points and elastic bands for cluster boundaries. 2.
2. **Initialization:** Three students placed their balls centrally as initial cluster centers.
3. **Assignment:** Students connected their balls to the nearest center, showing clustering assignment.
4. **Update:** Central students adjusted positions based on the average location of connected balls until stabilization.

Figure 2. Experiential learning session

In the Mobile Robotics course, a project-based active learning method was employed to engage students effectively as shown in Figure 3.

This approach allowed participants to explore robotics using simple DIY platforms, significantly enhancing their creativity and technical skills.

Key Aspects of the Course:

- **DIY Robotic Kits:** Students constructed robots using DIY kits, gaining a practical understanding of robotic components and assembly through project-based learning.

- **Hardware Integration:** Hands-on sessions enabled students to connect motors, sensors, and other hardware to their robotic frameworks, reinforcing the active learning methodology with tangible applications.
- **Controller Programming**: Participants programmed controllers to operate their robots, integrating software with hardware and applying real-world problem-solving skills.
- **Practical Experimentation:** The course promoted iterative testing and refinement of robotic designs, emphasizing experiential learning and the practical application of theoretical knowledge.

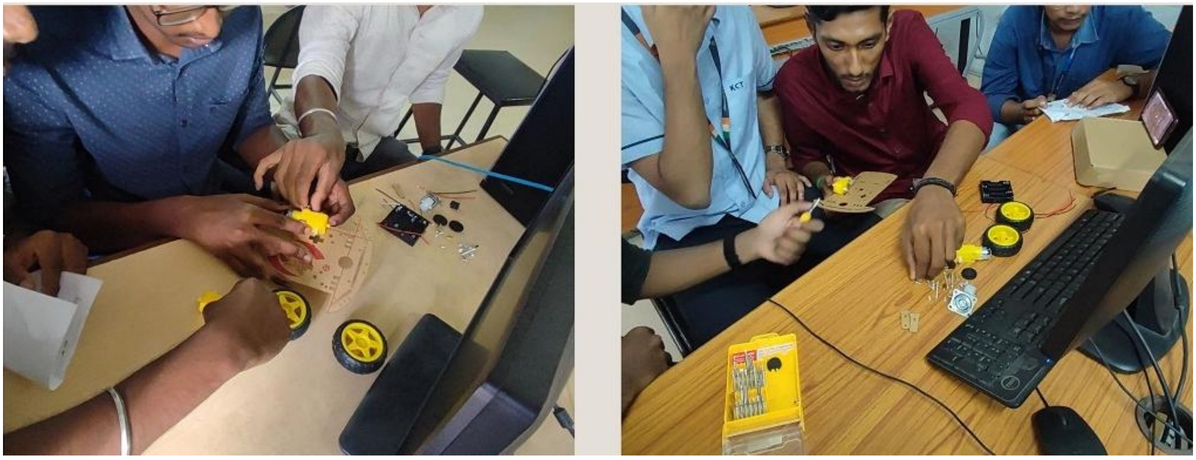

Figure 3 project-based active learning for Mobile Robotics course