Innovations by the Faculty in Teaching and Learning

The technology advancement opens an opportunity to adopt innovative pedagogy in teaching and learning methods. The department of Mechatronics engineering enabled various innovative teaching and learning techniques to enhance the students learning potentials. Such methods are collectively referred as **Participative Experiential and Problem solving (PEP) model**. This model helps students to improve the understanding and learning capabilities. Highlights of such innovative tools in PEP model are described here.

Table: Various innovations by faculty in the Teaching Learning Process

Sl. No	Type of TLP Innovation	PEP Model
1	Group discussion	**Participative Learning**
2	Industrial and educational visits	
3	Value Added Programs (VAP)	
4	Flipped classes	
5	Model Based Teaching and Learning	**Experiential Teaching-Learning methods**
6	Technical Paper writing	
7	Simulation Based Teaching	
8	Alive Quiz	**Problem Solving Methods**
9	Project Based Learning	
10	Ideathon and Hackathon	

Following are the innovative tools used by the Faculty in Teaching and Learning Process:

Participative Methods			
Sl. No	**Method Name**	**Description**	**Impacts**
1	**Group discussion**	**Objectives:** • To promote active learning • To Enhance Critical Thinking and Analytical Skills • To Improve Communication Skills **Process:** In this method, a topic is given to students to register their name for the discussion and the faculty will allow the students to talk on the topic. The moderation is done by a faculty and the activity is observed without deviating the given topics. Group discussion was conducted for 7th sem students on the topic "Applications of Real time system" under the course Real Time Systems during the academic year 2023-24 by Dr. Manjunatha K N. This enable the students to explore more on the specific topics and enhances the presentation skills.	• From this method, deeper understanding of the topic through peer explanation and debate, Enhanced verbal communication – expressing ideas clearly and confidently. • Teamwork & cooperation in achieving a common discussion goal.
2	**Industrial and educational visits**	**Objectives:** • Bridge Theory and Practice • Expose Students to Industrial Environment • Enhance Technical Competence and Professional skills **Process**:	• Students can correlate Real-world application of theoretical concepts learned in class. • Better understanding of industry processes,

		The Department of Mechatronics regularly organises industrial and educational visits to the students. One such example is visit to ABB during the academic year 2023-24. This is a part of the course Electric drives and Control, where the students are exposed to recent relays, contactors and switches used in high voltage and current applications. Students are taken to visit Tech Summit to experience the new innovations on cutting edge technologies.	tools, and workflows. Exposure to current technologies and industry practices.
3	**Value Added Programs (VAP)**	**Objectives:** • To Enhance the Technical and Employability Skills • To Bridge the Curriculum–Industry Gap • To Encourage Innovation and beyond curriculum learning **Process**: Value Added Programs (VAP) are designed to bridge the gap between university curriculum and industry requirements. The primary objective of conducting VAP is to enhance students' technical competencies beyond the prescribed syllabus and equip them with industry-relevant skills. These programs focus on practical knowledge, emerging technologies, and hands-on training that strengthen students' employability and professional readiness.	• Improved Employability and Placement Outcomes • Enhanced Practical Knowledge and Application Skills • Increased Industry Readiness

		The department of Mechatronics conducts VAP in every semester for all the students on cutting edge technologies like Embedded system Protocols, Robotics and Sensor fusion, Digital manufacturing and Advanced tools for Mechtronics	
4	**Flipped class**	**Objectives:** • To Promote Active Learning • Improve Student Engagement and Participation • Strengthen Self-Learning and Accountability **Process:** Flipped Classroom is an innovative pedagogical approach in which traditional lecture delivery is shifted outside the classroom through pre-recorded videos, reading materials, and digital resources, while classroom time is utilized for interactive discussions. In the flipped model, students study the theoretical concepts before coming to class through LMS platforms, video lectures, PPTs. During classroom sessions, faculty focus on clarifying doubts, conduct quizzes, moderating the group activities. Here the topic is assigned by the course instructor to set of students and finally activity is assessed through ALIVE quiz	• Improved Academic Performance • Greater Student Engagement • Development of Higher-Order Thinking Skills

Experiential Learning Methods			
5	**Model Based Teaching and Learning**	**Objectives:** • Enhance Conceptual Clarity • Bridge Theory and Practical Application • Develop Problem-Solving Skills **Process:** Model Based Teaching is an effective pedagogical approach that uses physical models to enhance conceptual understanding. This method enables students to visualize abstract concepts and understand system behaviour through demonstrations and real-time analysis. Model based teaching was conducted for the topic links and mechanisms by Mr Naveen Kumar S N. Also discrete components of robot are given to students to build a robot model for line following specification using Arduino development kit. This approach makes the students to learn by making a model and experience the stages involved in program simulation, interfacing and validation.	• Better conceptual clarity through visual and physical representation of complex topics. • Enhanced memory retention due to visual and hands-on engagement. • Ability to visualize processes and relationships between components.
6	**Technical Paper writing**	**Objectives:** To Improve Technical Communication Skills • Develop Research and Analytical Skills • To Encourage Research Culture and Innovation	• Enhanced Research Orientation • Improved Communication and Presentation Skills

		Process: Technical Paper Writing is an effective academic practice that enhances students' research aptitude, analytical skills, and professional communication abilities. As part of the Teaching–Learning Process (TLP), students are encouraged present their findings in a structured technical format. Through technical paper writing activities, students learn the standard structure of research publications, including abstract, introduction, methodology, results, discussion, and conclusion. They gain exposure to referencing styles, plagiarism ethics, and the use of digital research databases. From Department of Mechatronics for a course like research methodology and IPR students successfully drafted technical paper and presented in an international conference.	• Increased Innovation and Creativity
7	**Simulation Based Teaching**	**Objectives:** • To Enhance Conceptual Understanding • To Strengthen Use of Modern Engineering Tools **Process:** Simulation Based Teaching is an advanced pedagogical approach that integrates simulation software and virtual laboratory tools to enhance conceptual clarity and practical understanding. In this method, students learn theoretical concepts	• Improved Conceptual Clarity and Academic Performance • Development of Analytical and Design Skills • Improved Student Engagement and Innovation

		through online compiler and simulated environments that replicate real-world systems and processes. In department of Mechatronics courses like python programming, HDL and Microcontrollers extensively used simulation based teaching methods	• Strengthened Digital and Technical Competency

Problem Solving Methods			
8	**Alive Quiz**	**Objectives:** • To Reinforce Conceptual Understanding • Make learning interactive and competitive • Encourage quick thinking and conceptual clarity. The department of Mechatronics conducts quizzes on Alive platform upon completion of the module and after the flipped classes. This quiz scores are considered for the consolidation of internal assessment marks. A sample of Alive quiz is enclosed for the course Electric Drives and Control. Conduction of quiz enables the student to prepare on module basis before the regular internal assessment.	Quick recall and reinforcement of key concepts. Better retention due to active retrieval practice. Enhanced focus on important points of the subject.
9	**Project Based Learning**	**Objectives:** • Strengthen Conceptual and Analytical Skills • Encourage "learning by doing" through hands-on projects. • Encourage systematic problem identification and solution development. **Process:** This method focuses on understanding of concepts through projects. Here teams are asked complete their software part during mini project and complete	• Application of theory to real-world problems and scenarios. • Deep understanding of subject matter through long-term, in-depth exploration. • Enhanced critical thinking by evaluating

		implementation with field trials. The department has mapped all projects to UN SDGS and made it mandate that all mini projects are continued as major projects to cater the expected project outcomes. This method enhanced the project outcomes in terms of good number of publications, IPS and conferences.	and refining project ideas.
10	**Ideathon and Hackathon**	**Objectives:** • To Enhance Problem-Solving Skills • Encourage Application-Oriented Learning **Process:** Ideathon and Hackathon are innovative, student-centric teaching practices designed to promote creativity. These events provide a platform for students to generate innovative ideas (Ideathon) and develop working prototypes or software/hardware solutions (Hackathon) within a limited time frame. An Ideathon focuses on idea generation, concept development, feasibility analysis, and presentation of innovative solutions to real-world problems. Students work individually or in teams to identify societal, industrial, or technological challenges and propose creative, sustainable solutions. A Hackathon, on the other hand, emphasizes rapid prototyping and implementation. Students collaborate intensively to design, code, simulate, or	• Enhanced Innovation Culture • Development of Practical and Technical Skills • Strengthened Teamwork and Leadership Skills

		build functional models addressing specific problem statements. This promotes teamwork, time management, leadership, and technical competency.	

1. **Collaborative learning tools with such as Alive:**

In Mechatronics Department, every course handling faculty using Alive platform to upload their study material and the same platform is used to conduct quizzes. Some Sample Course materials and quiz screen shots are shown here.

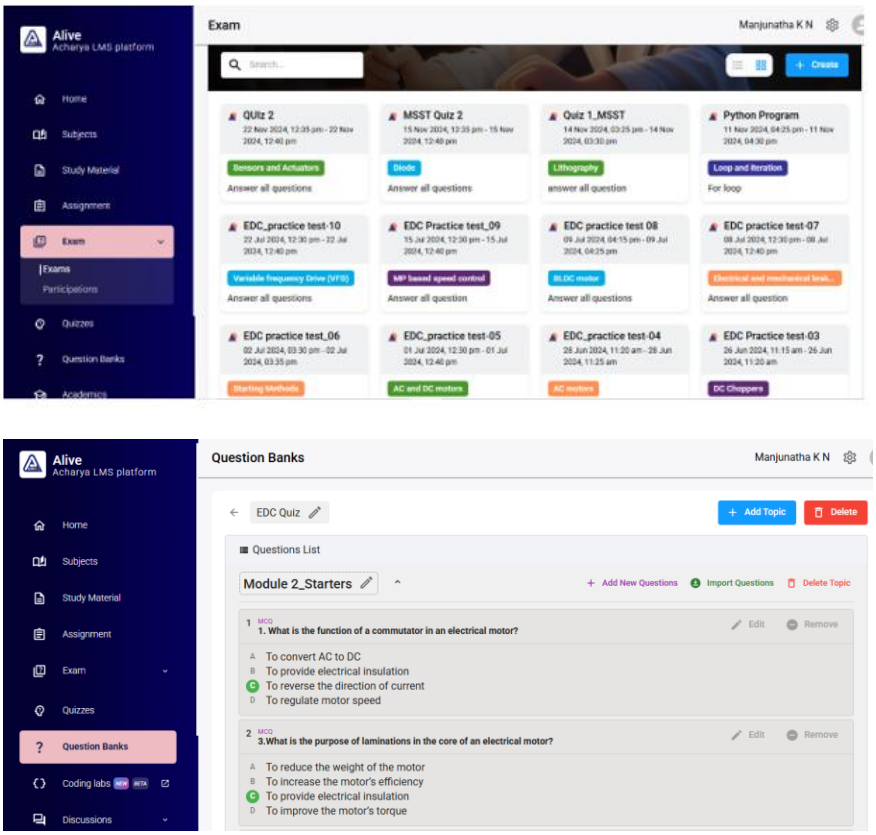

Fig: 2.1: Conducted quizzes on Alive platform to enhance the learning capabilities.

Impacts:

- Reinforces subject knowledge and key concepts through recall and application.
- Enhances critical thinking by requiring quick analysis and decision-making.

- Encourages active engagement with the learning material.

2. Information and Communication Technology (ICT) for enhanced learning

Topic: Speed control of DC motor

Use of **Virtual labs** for load test analysis on Separately excited DC motor through Simulation

- Concept of Self and separately excited DC motors are explained through simulation
- Students are asked to open the virtual labs and gothrough the electrical machines lab for various topics of DC machines and its charecterisation
- Taken topic of load test on DC motor, the platform provides pre and post simulation quiz to evaluate the concepts on DC motors.

- The virtual platform allows the students to select the components of circuit involved in DC motor and to make a connection. Once the connections are made design is simulated for the readings and graphs.
- Virtual lab also provides platform to solve quiz on the concept before and after the simulation, which enhance the knowledge on concept along with the practical understanding of the DC motor concepts.

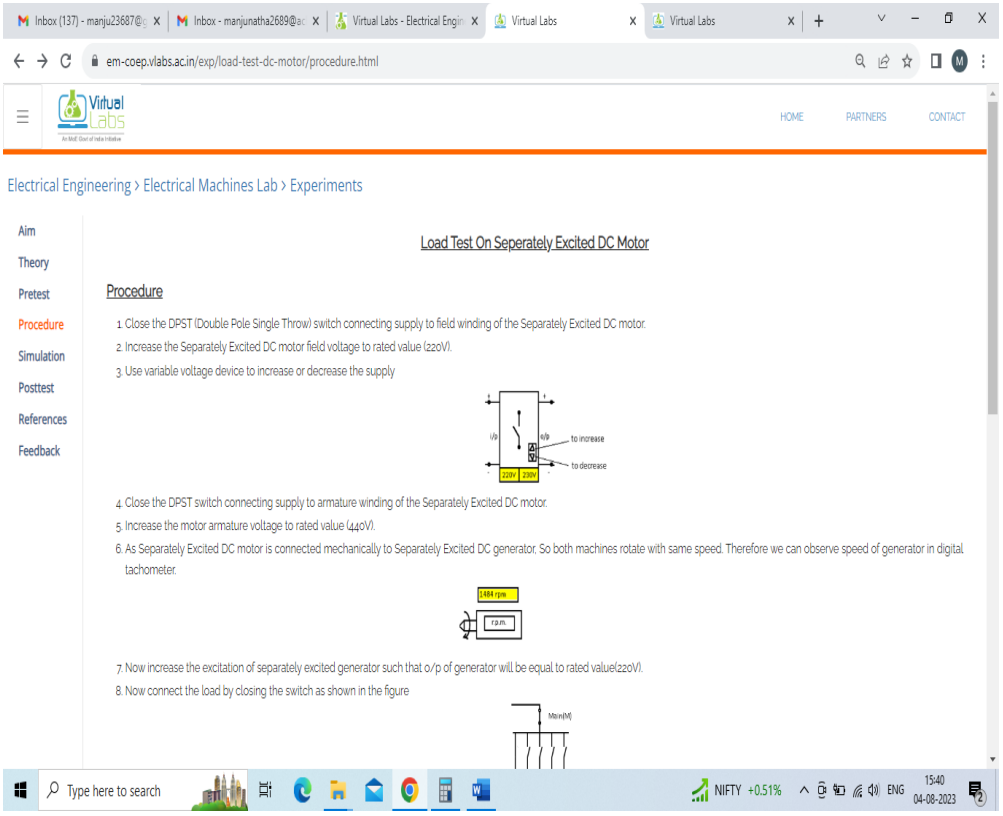

Fig: 2.2: Use of Virtual lab for the topic DC motor under Electric Drives and Control.

Impacts

- Deepens understanding of theoretical concepts by providing interactive, visual simulations.
- Bridges the gap between theory and practice without the need for physical lab infrastructure.
- Students can understand the concept very well with the help of virtual simulation of actual circuit.
- It will enable the students to analyse the design and working of the concepts used

3. Physical Model based Learning

From the model based activity, where the students project teams are used Rpi and the supported hardware. Two teams are identified to present on this activity based on their ongoing project.

From this activity, students are able to understand interaction of hardware with software. Here we have taken an example of ongoing projects whose system design is with Rpi and communicating hardware.

Fig: 2.3: Students are involved in robot model building activity with Arduino Kit.

Impacts:

- Strengthens conceptual understanding by visualizing and experiencing abstract theories in tangible form.
- Enhances problem-solving and analytical thinking through real-time observation and experimentation.

4. Project Based Learning

Project-Based Learning (PBL) is a student-centered and outcome-driven pedagogical approach that enhances experiential learning by engaging students in solving real-world problems through structured projects. This method promotes deeper conceptual understanding, critical thinking, and analytical skills while encouraging creativity and innovation.

Fig: 2.4: Students are engaged in explaining the project models, showing microcontrollers-based automation system.

. **Impacts:**

- Promotes deep understanding of subject concepts through real-world application.
- Enhances critical thinking, problem-solving, and decision-making abilities.

5. eLearning through MOOC courses

The adoption of MOOCs in academic institutions enhances traditional classroom teaching and promotes self-directed, flexible, and technology-enabled learning.

Under this innovative approach, students are encouraged to enroll in relevant MOOC courses aligned with their curriculum and professional interests. These courses are delivered through digital platforms and include video lectures, interactive quizzes, assignments, discussion forums, and certification assessments. Faculty members guide students in selecting appropriate courses and integrate MOOC learning outcomes with regular classroom instruction.

Fig: 2.5: Student completed their MOOC courses through Coursera certification.

Impacts:

- Expands knowledge beyond classroom boundaries by accessing global expertise.
- Promotes self-directed learning and critical thinking through diverse course materials.

6. Subject Centric seminars and exhibitions

For the Course Flipped class is identified as a part of ICT activity and the students are communicated in advance with the topics and assigned particular schedule to discuss or present with their class peers.

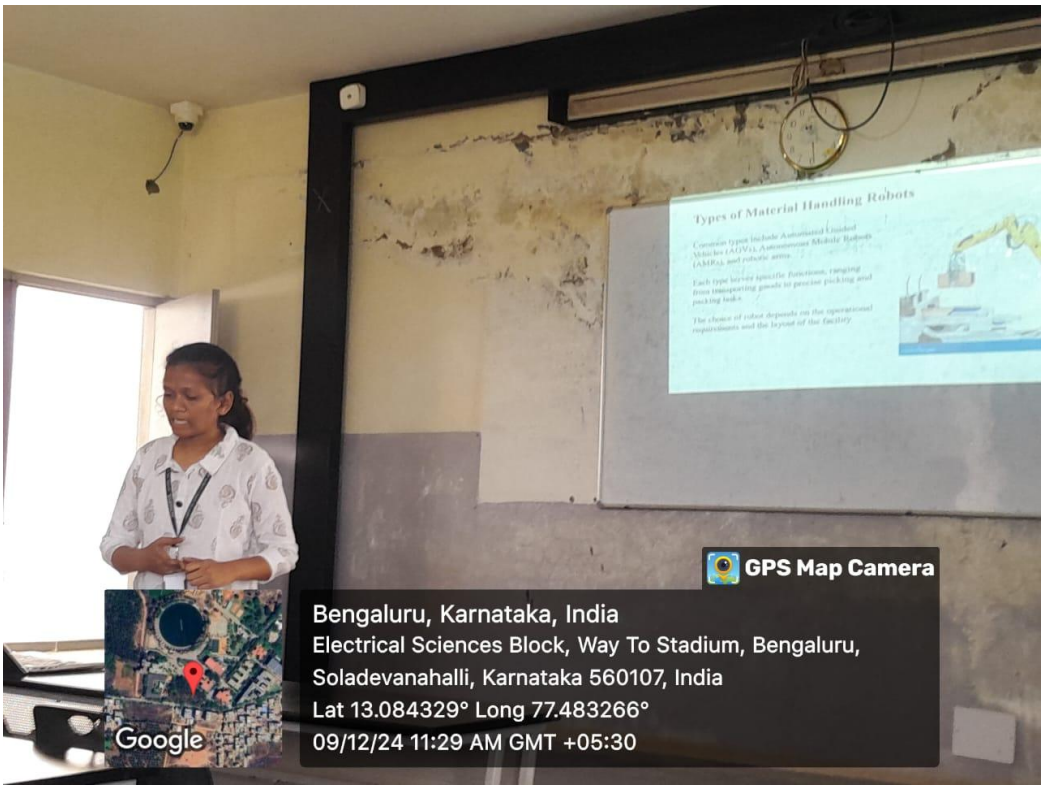

Fig: 2.6: Students actively taking part in model exhibition and one of the team explain the working of Multipurpose Drone.

Impacts:

- Enhances in-depth understanding of subject-specific concepts through research and presentation.

- Promotes critical thinking and analytical skills by exploring recent trends, innovations, and case studies.

7. Industrial/ Educational trips

Under this innovative approach, the institution organizes regular industrial and educational trips aligned with the academic curriculum and program outcomes. Students are taken to manufacturing units, research centers, laboratories, power plants, automation facilities, and reputed educational institutions. These visits are carefully planned and coordinated by faculty members to ensure meaningful learning experiences.

During industrial visits, students interact with industry professionals and technical experts, gaining insights into production processes, quality control, safety standards, maintenance practices, and management systems. Educational trips to universities, research institutes, museums, and science centers enhance students' understanding of advanced concepts, innovation trends, and interdisciplinary applications.

Fig: 2.7: Students Visited Indian Institute of Horticulture Research (IIHR), Bengaluru as a part of their educational trip.

Impacts:

- Bridges the gap between classroom theories and real-world practices.
- Provides first hand exposure to industry operations, workflows, and technologies.

8. Open Day Visit to IISc

The Open Day Visit to the Indian Institute of Science (IISc), Bengaluru, is an important innovative initiative under the Teaching–Learning Process (TLP) aimed at providing

students with exposure to advanced research, innovation, and academic excellence. IISc is one of India's premier research institutions, and its Open Day offers a unique opportunity for students to interact with scientists, researchers, and academicians while exploring cutting-edge laboratories and research facilities.

Fig: 2.8: Students Visited IISc, Bengaluru on Open Day.

Impacts:

- Bridges the gap between classroom theories and real-world practices.
- Provides first hand exposure to industry operations, workflows, and technologies.