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DEPARTMENT OF ELECTRONICS & INSTRUMENTATION ENGINEERING

Innovations by the Faculty in Teaching and Learning (8)

In contrast to conventional teaching practices, which primarily measures student success by the amount of knowledge transferred to students, innovative teaching methods delve into the nuanced understanding and retention of the material. It is not just about what is taught but how effectively students internalize and apply the knowledge imparted during lectures. Here are the different innovative methods followed by the faculty in teaching and learning process

S.No	Innovations by the Faculty in Teaching and Learning
1.	Problem Based Learning (PrBL)
2.	Project Based Learning(PBL)
3	Peer Group Learning
4	**Hands-on Programming and Debugging**
5	**Use of Simulation Tools**
6	**Case Studies and Research Projects**
7	**Industry Expert Interaction**
8	**Assessment through Prototyping**
9	**Experiential learning through Industry Academia collaboration**
10	Use of Mentimeter
11	Integrating online resources for remote lectures
12	Workshop conducted in the lab for students

1. Problem Based Learning (PrBL)

Course: U18EII7202 Advanced Control Systems

Course Faculty: Dr. P. S. Mayurappriyan

Course Overview:

• Course Overview • Introduction to Advanced Controls Systems	Course Outcome (CO1): Acquire knowledge of state space and state feedback in modern control systems, pole placement, design of state observers and output feedback	Active Learning Methodology: Course Expectation Exercise, You Tube Video Streaming

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Activity-Based Learning: Problem-Solving Activity

Introduction to Activity-Based Learning (ABL):

Activity-Based Learning (ABL) is an instructional approach that emphasizes hands-on, practical experiences over passive learning. It is designed to actively engage students by involving them in activities that require critical thinking, creativity, and collaboration. ABL is particularly effective in developing problem-solving skills, as it encourages students to apply knowledge and skills in real-life scenarios, making learning more meaningful and applicable.

Problem-Solving in ABL:

One of the key focuses of ABL is problem-solving. A problem-solving activity provides students with a specific challenge or task that requires them to think critically, analyze information, and come up with a viable solution. This type of activity simulates real-world situations where students must rely on both their prior knowledge and their capacity for innovation to solve problems. In the context of ABL, problem-solving activities are designed to be interactive, collaborative, and often interdisciplinary, helping students to make connections between different areas of knowledge.

Active Learning Strategy: Course Expectation Exercise:

- Name of the course (Advanced Control Systems) is written on the blackboard.
- Students are asked to individually write down three expectations they have for the course.
- Then students are put into small groups and to have informed them they must reach consensus regarding their group's top 3-5 expectations.
- Then the groups are allowed to report back to the whole class

You Tube Video Streaming

2. Introduction to State Space Systems

Module 1: State Space Analysis

Active Learning Strategy: Problem Based Learning (PrBL)

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CO1: Acquire knowledge of state space and state feedback in modern control systems, pole placement, design of state observers and output feedback controllers. (An)

Syllabus: State space analysis of continuous and discrete systems – solution of time invariant autonomous systems, forced system – state transition matrix – relationship between state equations and transfer function – properties of state transition matrix – computation of state transition matrix - controllability / observability criteria – controller / observer design by state feedback based on pole placement – design of state feedback control systems – full-order and reduced-order observer design.

Learning Objective:

1. Understand the concepts of state space analysis for continuous and discrete systems.

Problem Scenario:

In the bustling city of Coimbatore, the traffic police department is facing a significant challenge in optimizing traffic flow and reducing congestion at a complex intersection known as Lakshmi Mills Junction. Lakshmi Mills Junction connects multiple major highways and local roads, leading to a convergence of diverse traffic patterns and varying traffic volumes throughout the day.

The current traffic control system at Lakshmi Mills Junction relies on outdated signal timings and manual adjustments, resulting in frequent gridlocks and delays for commuters. To address this issue, the city authorities have decided to implement an advanced control system that leverages state-of-the-art technology to improve traffic management efficiency and enhance overall transportation infrastructure.

Your task as a control systems engineer is to design a state-of-the-art traffic control system for Central Junction using state space analysis, state feedback control, pole placement, and observer design techniques. The goal is to create an intelligent system that can dynamically adjust signal timings, lane allocations, and traffic flow patterns in real-time to minimize congestion, reduce travel times, and optimize traffic operations at the intersection.

By developing and implementing this advanced control system, you can revolutionize traffic management in Coimbatore, improve the daily commute experience for residents and visitors, and contribute to the city's efforts towards sustainable urban mobility.

Linked SDGs:

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I	2	STATE SPACE ANALYSIS: State space analysis of continuous and discrete systems – Introduction & Modeling of	CO1	Active Learning Methodology: Problem-Based Learning (PrBL)	5, 6, e-learning Resources
I	3	State Space Modeling - Tutorials	CO1	Active Learning Methodology: Problem-Based Learning (PrBL)	5, 6, e-learning Resources

Outcome: To develop a State Space model of any physical system

Assessment: Problem Solving Assignment

2. **Project Based Learning**

Course: U18EII5202 Embedded Microcontroller

Department of Electronics and Instrumentation Engineering of Kumaraguru College of Technology (KCT) has resolved to make the students' industry ready by conducting Project based learning in classrooms. The III-year EIE students at Kumaraguru College of Technology are assigned a Project-Based Activity as part of the **U18EII5202 Embedded Microcontroller** course. The activity aims to deepen their understanding of the operation, communication and applications of STM microcontrollers, among other concepts. To enrich the learning experience and make it more engaging, several innovative pedagogical methods has been integrated into the course.

3. **Peer Group Learning:** Students can collaborate in small groups to work on real-world projects, encouraging mutual learning, sharing of ideas, and development of critical thinking skills. Peer discussions can also help in reinforcing theoretical knowledge and addressing any challenges faced during the project work**.**

4. **Hands-on Programming and Debugging:** Students can write, compile, and debug embedded C code for STM microcontrollers. This will help them understand microcontroller

operation, memory management, and peripheral interfacing.

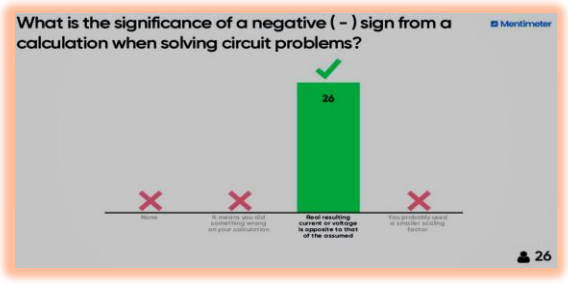
5. **Simulation Tools:** Using simulation tools like Proteus or STM32CubeMX, students can simulate embedded systems before hardware implementation, helping them troubleshoot issues early in the design process.
6. **Case Studies and Research Projects:** Analyzing industry case studies of embedded system applications, like in automotive, healthcare, or robotics, and researching emerging technologies like AI/ML integration in embedded systems, can spark innovative thinking among students
7. **Industry Expert Interaction:** Inviting industry experts to discuss current trends, challenges, and best practices in embedded systems development will bridge the gap between theory and practical applications.
8. **Assessment through Prototyping:** Encourage students to develop and present prototypes as part of the final assessment, which could be based on a problem-solving project or real-world application of embedded microcontrollers. These activities will not only enhance their technical understanding of STM microcontrollers but also develop critical thinking, problem-solving, and industry-ready skills.

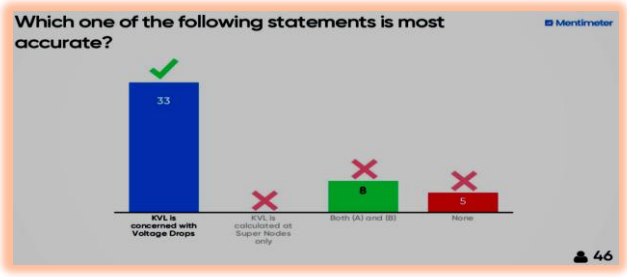
9. **Experiential learning through Industry Academia collaboration**

An industry professional deliver lecture for a specific module using advanced software tools. A module of the course MEMS AND SENSOR DESIGN is been handled by Dr.K.Sripadraja, Product Manager, Intellisense software private limited. The students will design the sensors in the syllabus and simulate them using Intellisuite software. This enhances the practical insights of students, bridging the gap between theory and application. This also promotes Industry Academia collaboration. This exposure to industry trends and case studies makes the learning process dynamic.

10. **Use of Mentimeter**

Mentimeter is an interactive presentation tool that enhances engagement during lectures. We do a quick checking and consolidation of students' learning through Mentimeter. It assess the understanding during or after the lecture. Students love to participate in the quiz with a lot of enthusiasm as the privacy is protected. It also encourages students to ask questions reducing





hesitation.

11. **Integrating online resources for remote lectures**

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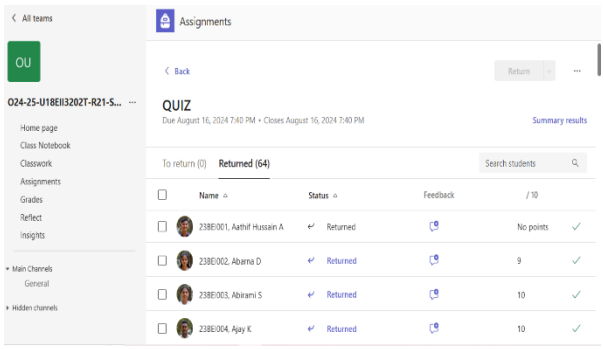
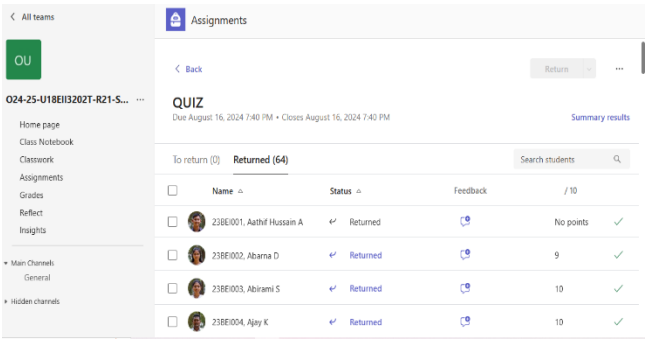
MS Teams channel is created for each subject to deliver an effective teaching through presentations and videos. Microsoft outlook IDS are provided for all faculty and students in a common domain kct.ac.in with adequate storage capacity. Objective questions, Course Materials, assignments and other data are shared through MS Teams, MS Streams, one drive to the students.





12. **Workshop conducted in the lab for students**

The Department of Electronics and Instrumentation organized a workshop on Embedded AI from August 1st to 3rd, 2023. Led by experts from DigiTod Electronics, the event focused on the integration of Artificial Intelligence into embedded microcontrollers, with a special emphasis on STM32. The workshop spanned three days and included both practical training and informative lectures. Attendees were provided with an understanding of the peripheral components of the Nucleo F411-RE board, a comprehensive overview of microcontrollers and machine learning, and the process of integrating embedded systems with machine

learning modules. The practical engagement involved utilizing sensors to gain hands-on experience with the STM32 board, employing Cube IDE and NanoEdge software for implementation.