	T.R. İZMİR KÂTİP ÇELEBİ UNIVERSITY FACULTY OF ENGINEERING AND ARCHITECTURE MECHANICAL ENGINEERING DEPARTMENT	**Form No:** FRM-1 **First Pub Date:** 15.11.2016 **Revision Date:** 15.02.2017

DESIGN PROJECT PROPOSAL FORM

Academic Year	**2022 -2023**	**Semester**	Fall ☐ Spring ▣
Project Type	**Research** ☐ ME 411 Thermal & Fluid Design ☐ ME 413 Mechanical Design × ME 415 Robotics & Control Design	**Application** ☐ ME 412 Thermal & Fluid Design ☐ ME 414 Mechanical Design × ME 416 Robotics & Control Design	
Advisor	Asst.Prof.Dr.Çağlar UYULAN		

Project Title	Model-Based Verification and Validation of Distributed Controller Architectures (Microcontroller Application: Automated Guided Vehicle)
Purpose and Scope	This research project is devoted to strategies for automated model-based verification and validation (V&V) of distributed control systems. Such systems are fundamentally Cyber-Physical, as they involve the use of networked micro-controllers to control the behaviour of physical systems and can be found in many application areas, including aerospace, medicine and automotive. This effort is driven by the profound benefits of model-based development for the design of single-controller embedded software, and by the great challenges that currently confront designers of distributed controller architectures, especially in modern ground vehicles. **Executable modelling of real-time architectures.** A mathematically well-grounded modelling notation for distributed real-time architectures (for example Automated Guided Vehicle (AGV) model) is being developed for use in defining models of interacting controllers. **Defining inter-model consistency.** A framework is being built for determining when a system model developed by systems and software engineers is sufficiently similar to an idealized controller model. **Algorithmic consistency checking.** Strategies for automatically computing whether the system and idealized models are consistent in all possible contexts will be developed, using research in model checking as a basis. **Scenario-based consistency checking.** Techniques for establishing consistency of system and idealized models in specific, user-defined scenarios are being developed, again using model checking as an enabling technology. **Tool development.** A modelling environment for distributed systems, and tools for consistency checking, is being built around the environment will be built on top of MATLAB / Simulink / Stateflow. V&V of distributed controller systems. The mathematics being developed is aimed at providing a basis for reasoning about system behaviour before the systems are constructed. Its impact lies in both the formalization of basic notions such as architecture and model consistency that are still being understood within the controls community and the algorithmic analyses made possible by these formalizations. These tools are built for simulating and validating distributed control architectures without having to build costly prototypes. The enhanced efficiency in engineering design

	processes that are enabled is intended to promote the faster development of more sophisticated distributed control systems, leading to safer and better-performing ground vehicles and other such systems.
Work Packages	• Software Architecture and Distributed Control Specifications • Augmenting the control framework with real-time (embedded microcontroller, integrating MATLAB models) • Modelling communication primitives • Model-Checking Solutions to Consistency • Scenario-Based Consistency Checking
# of Team Members	
This section to be filled by the Commission	The Project Proposal ☐ is approved. ☐ should be revised considering the following suggestions:

The projects are aimed to prepare students to attain the following program educational objectives:
(a) an ability to apply knowledge of mathematics, science, and engineering
(b) an ability to design and conduct experiments, as well as to analyze and interpret data
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
(d) an ability to function on multidisciplinary teams
(e) an ability to identify, formulate, and solve engineering problems
(f) an understanding of professional and ethical responsibility
(g) an ability to communicate effectively
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
(i) a recognition of the need for, and an ability to engage in life-long learning
(j) a knowledge of contemporary issues
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Therefore, the final report of the project should contain the following:

i. Definition of the design problem and its limitations
ii. Theoretical information about the topic, standards and patents
iii. Different design options and selection criteria
iv. Optimal solution with appropriate selection criteria
v. Cost accounting, feasibility, compliance with regulations and standards, environmental impacts, and compliance with ethical rules
vi. Engineering drawing and presentation methods for presenting