SYLLABUS :-

Status of the subject: Core for the M.Tech. Programme on Embedded Controls and Software to be offered in the Autumn Semester.Pre-requisites of the subject: NoneOverview, Objectives and Content: Overview The course will start from the fundamentals of mathematical modeling of dynamical systems in various forms like differential equations and other transform domains. Examples of systems from different domains such as electrical, electronic, mechanical, thermal, aerospace, etc. will be taken to illustrate the basic modeling concepts. It would then introduce the fundamentals of closed loop control and the techniques for the design on various types of controllers. The main flavor this course would bring would be in terms of controller implementation, real-time control aspects and practical applications of control, which are normally not found in regular courses on control systems. About 60 percent. of the course will be devoted to these topics. Objectives:After the completion of the course, the students should be able to â¢Develop mathematical models of physical systems using differential equations and other transform techniquesâ¢Analyse the performance of control loops and design controllers for achieving a given control objectiveâ¢Implement control algorithms in embedded platforms and compare the performance with the theoretical predictionâ¢Apply the results in some real world situations. Content: Part 1: Introduction: Mathematical modeling of physical systems: Review of differential equation, transfer function and state variable representations; Examples of modeling different types of systems. (8-10 hrs.)Part 2: Control System Design: Closed loop control: Analysis of simple control loops; Stability; Time and Frequency domain specifications of control system performance. Simple approaches for controller design; Discretization. Practical realization of a control loop; (10-12 hrs.)Part 3: Controller Implementation: Architecture of embedded controllers and description of various components; Design and implementation of control loops : Choice of embedded computing platforms, i/o and communication . (8-10 hrs.)Part 4: Real-time Issues: Real-time issues in controller implementation: Scheduling algorithms and their performance analysis; Constraints of the operating systems; Real-time operating systems; Validation techniques for control systems. Performance assessment of control algorithms on the target implementation architecture for the given application. (8-10 hrs.)Part 5: Applications: Case studies from automotive, aerospace, process control and other application domains. (4-6 hrs.)Name of the faculty member(s) of the department who have the necessary expertise and will be willing to teach the subject currently: Prof. Amit PatraProf. Siddhartha MukhopadhyayDr. Aurobindo RoutrayDr. A. K. DebWill the subject require appointment of adjunct faculty? If yes, the number of such adjunct faculty: It would be desirable to have some adjunct faculty from the industry to bring application expertise, at least at the initial stages of introduction of the course. Do the content of the subject have an overlap with any other subject offered in the Institute? If yes, give

details: Yes, there is some (about 20 percent) overlap with the undergraduate course on Control Systems Engineering (EE31001). This is necessary since this is going to be the core course in an inter-disciplinary programme, and all the students joining the programme need to have the fundamental knowledge on control system. However, keeping in mind the post-graduate level of the course, this material will be taught at an advanced and compact level, with the students being asked to fill-in the details by self-study.Suggested reading/text books/reference books:i)Computer Controlled Systems : Karl Johan Astrom, Bjorn Wittenmark, Prentice-Hall India Private Ltd. 1994.ii)Digital Control of Dynamic Systems (3rd Edition) : Gene F. Franklin, J. David Powell and Michael Workman, Addison Wesley Longmen, Inc. iii)Handbook of Networked and Embedded Control Systems, Dimitrios Hristu-Varsakelis, William S. Levineiv)Digital Control System Analysis and Design, (3rd edition) : Charles L. Phillips and H. Troy Nagle, Prentice Hall. v)Implementation of Digital Controllers : A Survey, H. Hanselmann , Automatica, Volume 23, Issue 1, January 1987, Pages 7-32 vi)Embedded Microcomputer Systems : Real-time interfacing, J. W. Valavano, Thompson Asia, Pte Ltd.vii)Computers as components : Principles of Embedded Computing Systems Design, Wayne Wolf, Academic PressName of the departments/centers/schools/programs whose students are expected to take up the course: i)As Core: M.Tech. students of Embedded Controls and Softwareii)As Elective: The M.Tech., Senior B.Tech (Hons), and Dual Degree students of the department of Electrical Engineering, Electronics and Electrical Communications Engineering, Mechanical Engineering, Aerospace Engineering and Computer Science and Engineering.