SYLLABUS :-

Status of the subject: Core (for M. Tech. in Embedded Controls and Software) to be offered in the Autumn Semester.Pre-requisites of the subject: NoneOverview, Objectives and Content: Overview: Ubiquitous applications of embedded computing are catalyzing a significant paradigm shift in the development of complex software. Most complex component based engineering systems, ranging from home appliances to automobiles, are controlled by software running on multiple processors embedded within various components of the system. The science behind the systematic and provably correct development of embedded software is a subject of considerable recent interest, yet little expertise in this area is documented in literature. It is therefore an important objective to develop curriculum addressing this requirement and to train students in understanding the nuances behind the design and verification of embedded software.Objectives: â¢To develop an understanding of embedded software development vis-Ã -vis the traditional software engineering practices.â¢To study embedded system architectures, operating system principles, models and design constraints for component based designs.â¢ To learn techniques for validation of embedded computing systems, and rigorous software engineering techniques for developing zero defect embedded software. â¢To apply the results in real world situations. Content: 1.Overview: Architecture and Environments of Embedded Systems; Layers of Embedded Software including Interface and Communication, Operating Systems, Monitoring Diagnostics and Control, Data Management, etc. 2.Specification, Modeling and Refinement of Embedded Controls Software (ECS): Specification: Methods, Schemes, Properties, Correctness and Completeness. Modeling: Discrete, Continuous, Hybrid; Modelling Interaction. Structured and Behavioural Modelling with UML 2.0, Simulink/Stateflow. Design-Refinement-Validation Flow.3.Design and Implementation of ECS: Layered Design, Implementation on Processor-ASIC-ASIP Platforms; Structured design methods, Architectural patterns for real-time software, Component-based design, Model-driven development. Satisfaction / Optimization of various criteria including Functional, Timing, Power, Performance, Safety; Automated Synthesis / Application Mapping Techniques.4.Validation and Testing: Off-line Techniques using Formal Verification (Model Checking, Theorem Proving, etc) and Simulation based Validation (Assertions, Test Suites, Regression); Component Testing, Black-box, white-box, and gray-box techniques, Performance testing, Automated testing techniques and tools, Hardware-in-loop Testing; Software-in-loop testing, On-line Techniques including Monitors, Diagnosis, Self-Checking, Reconfiguration Units, etc; 5.Notions of Software Engineering Techniques for ECS Product Life Cycle including Design, Testing, Configuration Management, Maintenance, Reliability, Quality, etc.Name of the faculty member(s) of the department who have the necessary expertise and will be willing to teach the subject currently: Prof. Rajib Mall Prof. P P ChakrabartiProf. Pallab DasguptaWill the subject require appointment of adjunct faculty? If yes, the number of such

adjunct faculty: Not necessary, but participation and contributions from experts as adjunct faculty will definitely enrich the course. Do the content of the subject have an overlap with any other subject offered in the Institute? If yes, give details: No. Suggested reading/text books/reference books; i)Schauffele and Zurawka,â Automotive Software Engineering,â SAE International Press, 2005.ii)L. Lavagno, G. Martin, and B. Selic,â UML for Real,â Kluwer Academic Publishers, 2003.iii)Lee, Leung and Son, Handbook of Real-Time and Embedded Systems, CRC Press, ISBN: 1-58488-678-1iv)Huth and Ryan, Logic in Computer Science â Modeling and Reasoning about Systems, Cambridge University Press, ISBN: 0-521-67089-6v)Pablo Tabuda, Verification and Control of Hybrid Systems: A Symbolic Approach, Springer, ISBN: 978-1-4419-0223-8 Name of the departments/centers/schools/programs whose students are expected to take up the course: i)Students of M.Tech in Embedded Controls and Softwareii)Students of other departments Electrical Engineering and Computer Science and Engineering may also take up this course as a breadth subject depending on capacity limitations.