BIRLA INSTITUTE OF TECHNOLOGY & SCIENCE, PILANI
PILANI CAMPUS and K. K. BIRLA GOA CAMPUS
II SEMESTER 2015-2016
COURSE HANDOUT (PART II)

Date: 13/01/2016

In addition to Part I (General Handout for all courses appended to the timetable) this portion gives further specific details regarding the course.

Course No. : CS G523

Course Title : Software for Embedded Systems

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1.1 Objective:
Introduce the students to the issues and challenges in developing software for embedded systems. Educate them in formal modeling, design and development methodologies. Expose them to tools and techniques used for developing such software.

1.2 Scope:
The course will review basics of Embedded and Real-time systems and generic software processes. The primary focus will be on identifying specific issues related to embedded software development within the usual phases of software development cycle – requirements, design, implementation and testing. A number of illustrative examples will be used as ad-hoc case studies for different phases to bring out the issues and challenges in the process. Specific technologies, operating environments and development tools will be also used as part of the practical aspects of the course.

1.3 Course Description:
Embedded Systems; Software issues in Embedded Systems; Software Development Process; Requirements Analysis – Model driven systems design - UML – Architectural Design, Design Patterns, Detailed Design. Implementation, Run-time environments and Operating systems for embedded software. Testing – Methodologies, Test Cases.

2.1 Text Book:
  T1   Bruce Powel Douglass, "Real – Time UML: Advances in the UML for Real – Time Systems", 3rd Edition, 2004.
  T2   Cay Horstmann, "Object Oriented Design and Patterns", Wiley India, 2004

2.2 Reference books:
  R1. Frank Vahid and Toby Givargis, "Embedded System design", Wiley.
  R2. James Rumbaugh, Ivar Jacobson and Grady Booch, "The Unified Modeling Language Reference Manual", 2nd edition, Pearson Education, 2005.

R3. Luciano Lavagno, Grant Martin and Bran V Selic, "UML for Real: Design of Embedded Real-Time systems", Kluwer Academic Publishers, 2003.

R4. Big Java, Cay Horstmann, John Wiley & Sons, 3rd Edition, 2008.

R5. Jane W S Liu, "Real – Time Systems", Prentice Hall, 2000.

R6. Doug Lea, "Concurrent Programming in Java – Design Principles and Patterns" 3rd Edition, Addison - Wesley, 2006.

R7. Philip A Laplante, "Real – Time Systems Design and Analysis", 3rd Edition, John Wiley & Sons Inc., 2004.

R8. Gene Sally, "Pro Linux Embedded Systems"

R9. Bill O. Gallmeister, "POSIX.4: Programming for the Real World", O'Reilly.

R10. Jonathan Corbet, Alessandro Rubini, and Greg Kroah-Hartman, " Linux Device Drivers", 3rd Edition, http://lwn.net/Kernel/LDD3/

3.1 Lecture Modules & Learning Objectives

Module	Title	Learning Objectives
1	Introduction to Embedded Systems	Review of basics and understanding issues in Embedded Systems
2	Embedded System Modeling	Techniques for Modeling Embedded Systems
3	Software Design of a Product	Software Development Methodologies and phases
4	Java implementation	Implementation using Java language
5	Software Design for Real – Time / Embedded Systems	Understanding the Software design process by identifying and analyzing requirements for embedded systems software
6	Design, implementation and testing	Understanding high level architectural framework(s) and design patterns applicable for embedded software. Understanding detailed design issues, implementation issues, Testing methodology for embedded system. Learn Linux Device Driver programming.
7	Operating system and run time environments in Real – time / Embedded Systems	Embedded Linux with real – time extensions (POSIX – 4), usage of operating system environments,

3.2 Lecture Schedule

Mod #	Lect #	Topics	References
1	**1 – 2**	**Introduction to embedded system**	
	1	**Introduction to embedded and real – time system**	R1
	2	**Characteristics of software for embedded and real – time systems**	T1and R1
2	**3 – 5**	**Object Oriented modeling**	
	3 - 4	**Object oriented approach**	T2
	5	**Embedded systems and Object oriented approach**	T2
3	**6 – 20**	**Software design of a product**	

	6 – 12	**Object oriented modeling and design with UML**	T1, R2 and R3
	13 – 16	**UML, UML diagrams, use cases and scenarios – Identification, Details and Diagrams**	T1, R2 and R3
	17 – 20	**Analysis – Object Discovery & Identification, Objects Associations & Attributes, Classes and Relationships, State and Behavior, State charts and Scenarios**	T1, R2 and R3
4	**21 - 23**	**Java implementation**	
	21	**Java programming introduction.**	R4
	22 – 23	**Implementation of UML diagrams using Java**	R4
5	**24 – 26**	**Software design for Real – time / Embedded systems**	
	24 - 26	**ROPES Model for Embedded Software design**	T1 and R3
6	**27 – 35**	**Design, Implementation and testing of Software for Embedded system**	
	27	**Overview of Design & Architecture, Physical Architecture**	T1 and R3
	28 – 29	**UML Mapping - Revisit of software engineering to make it suit for Real – time / Embedded system**	R3
	30 – 35	**Design patterns, Architectural Frameworks, Concurrency design and issues in Real – time / Embedded system**	R3 and R4
7	**36 - 40**	**Operating systems and Run-time Environments in Embedded system**	
	36 – 38	**Real – time / Embedded OS Design issues – Embedded Linux A case study**	R8
	39 – 40	**Posix-4- Real-time extensions, UML profile for schedulability and time - RT UML**	R9

4.1 Evaluation Scheme:

Components	Weightage	Date & Time	Remarks
Test I	30%	-	Closed Book
Assignment 1	10%	Using System-on-Chip (SOC) platform (Embedded device like Raspberry Pi, Arduino, MSP430 based device etc.. Confirm the suitability of device you plan to use.)	Open Book
Project	15%	Based on SOC chosen	Open Book
Presentation	5%	Defending the project design	Open Book
Comprehensive Examination	40%	11/5 FN	Closed Book

4.2 Projects:
- Project will include the following components:
  (a) Problem Identification, Specification, and Use Cases.
  (b) Requirements Analysis, State-charting.
  (c) Modular Design/Detailed Design
  (d) Prototype Implementation

- Students should present their work as presentation seminars and should attend others presentations.
- Projects will be evaluated individually through presentation / demonstration.
- Projects are to be completed in time with no postponements.

4.3 Malpractice Regulations:
1. Any student or team of students found involved in mal practices in working out projects will be awarded negative marks equal to the weightage of that project and will be blacklisted.
2. Any student or team of students found repeatedly – more than once across all courses – involved in mal-practices will be reported to the Disciplinary Committee for further action. This will be in addition to the sanction mentioned above.
3. A mal-practice - in this context - will include but not be limited to:
   - Submitting some other student's / team's solution(s) as one's own;
   - Copying some other student's / team's data or code or other forms of a solution;
   - Seeing some other student's / team's data or code or other forms of a solution;
   - Permitting some other student / team to see or to copy or to submit one's own solution;
   - OR other equivalent forms of plagiarism wherein the student or team does not work out the solution and/or uses some other solution or part thereof (such as downloading it from the web).
4. The degree of mal-practice (the size of the solution involved or the number of students involved) will not be considered as mitigating evidence. Failure on the part of instructor(s) to detect mal-practice at or before the time of evaluation may not prevent sanctions later on.

5. **Chamber Consultation Hour**: To be announced in the class.

6. **Notice**: Notice concerning this course will be displayed on
   In Pilani: intrabits website for the course
   In Goa: LMS

7. **Makeup Policy**:
   - Permission of the Instructor is required to take a make-up
   - Make-up applications must be given to the Instructor personally.
   - A make-up test shall be granted only in genuine cases wherein the Instructor's judgment - the student would be physically unable to appear for the test.
   - In case of an unanticipated illness preventing a student from appearing for a test, the student must present a Medical Certificate from BITS medical centre.
   - Requests for make-up for the comprehensive examination – under any circumstances – can only be made to Instruction Division.

Instructor-in-Charge
CS G523