GUJARAT TECHNOLOGICAL UNIVERSITY

ELECTRONICS & COMMUNICATION (EMBEDDED SYSTEM) (54)
EMBEDDED AND LINUX PROGRAMMING
SUBJECT CODE: 2725405
SEMESTER: II

Type of course: Cross-platform development, Kernel programming, Device Driver development

Prerequisite: Basic knowledge of C, Linux kernel

Rationale: As Linux is used in a number of embedded applications, embedded engineer must learn basic methods and techniques required to build embedded systems based on the Linux kernel. Embedded developer must have knowledge of developing device driver.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks		Practical Marks				
				ESE (E)	PA (M)	ESE (V)		PA (I)		
						ESE	OEP	PA	RP	
3	2#	2	5	70	30	20	10	10	10	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	**Embedded C Programming** Basic concepts of C programming, Program structure, Tokens, Data Types, Expressions, Flow of Control, Pointers & Arrays, Strings, Structures, Functions, Preprocessor directives	8	20
2	**Programming and Run-time Environment** Basic Compilation Techniques, Compiling, Assembling, Linking, Debugging & Profiling	6	15
3	**Embedded Linux Environment** Host and target, Host/target Development setups, Host/target Debug setups, Embedded Linux Architecture, Boot-configuration	6	15
4	**Linux Hardware support and Development tool** Architecture – Buses & interfaces – I/O – GNU cross-platform development toolchain – C Library	6	15
5	**Linux kernel** Getting kernel – Kernel configuration – Kernel compilation – Kernel installation	6	15
6	**Root filesystem & bootloader** File hierarchy standard – Filesystem type – initramfs – botloaders – uboot	5	10
7	**Device driver** Fundamentals of Device Driver, Basic of Character device driver and Block device driver, Linux Kernel Module, Writing Device Driver	5	10

Reference Books:

1. Karim Yaghmour**, "**Building Embedded Linux Systems", O'Reilly Publications, 2nd Edition, ISBN 780596529680
2. Christopher Hallinam, "Embedded Linux Primer"**,** 2nd Edition, Prentice Hall Publication, ISBN 0137017839
3. Daniel W Lewis , "Fundamentals of Embedded Software: Where C and Assembly meet", 1st Edition, Prentice hall, ISBN 0130615897

Course Outcome:

1. Application development with Embedded C
2. Familiarity with architecture of an Embedded Linux system.
3. Knowledge open source technologies to build an Embedded Linux system.
4. Ability to develop char device drivers

List of Experiments:

1. Introduction to the basic Linux environment and commands
2. Study of compiling 'C' codes with GCC
3. Study of debugging of 'C' codes with GDB
4. Study of Make utility to compile codes
5. Study of Code profiling techniques with 'gprof'
6. Learning basic of shell scripting
7. Cross-compilation of 'C' code for ARM based development board
8. Compiling u-boot boot loader for ARM based development board
9. Cross-compiling Linux 2.6 Kernel and porting on board
10. Making utilities using Busybox
11. Inserting a Linux Kernel Module(LKM)

Design based Problems (DP)/Open Ended Problem:

1. Select one development Embedded Linux board, learn hardware details of that board to configure and build appropriate GNU cross-toolchain on host machine (host machine in this case will be your desktop or laptop) Use uClibc library with buildroot tool.
2. Develop a GNU cross-toolchain using Diet libc
3. Build embedded Linux system with Yocto project for Raspberry Pi/Beagle Board.
4. Generally we keep our kernel in removable storage. Make NFS mounted root filesystem setup to boot embedded linux.
5. QEMU is a generic and open source machine emulator. Install QEMU on your host and ty to emulate Wheezy rsapbian os for raspberry pi.
6. Xenomai is a real-time development framework cooperating with the Linux kernel, in order to provide a pervasive, interface-agnostic, hard real-time support to user-space applications, seamlessly integrated into the GNU/Linux environment. Add support of Xenomai to your embedded Linux setup.
7. Write a Linux kernel module to read data from usb.

Major Equipments:

Any of ARM based development board like Devkit8000, Beagleboard, Raspberry Pi etc. having OS support.

List of Software:

Linux

Learning website:

http://free-electrons.com/

Review Presentation (RP): The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers, integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website