



GUJARAT TECHNOLOGICAL UNIVERSITY

Master of Engineering

Subject Code: 3725410

Semester – II

Subject Name: System Design with Embedded Linux

Type of course: Core – IV

Prerequisite: Basic knowledge of C, Operating System

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 C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	Characteristics of Embedded Linux based systems: Open Source, Vendor Independence, Varied Hardware Support, Low Cost, Standards Compliance, Embedded Linux Versus Desktop Linux, Embedded Linux Distributions	5
2	Architecture of Embedded Linux Kernel: Hardware Abstraction Layer (HAL), Memory Manager, Scheduler, File System, IO Subsystem, Networking Subsystems, Linux Start-Up Sequence: Boot Loader Phase, Kernel Start-Up, User Space Initialization, GNU Cross-Platform Toolchain: Building Toolchain, Building Toolchain for MIPS	10
3	Board Support Package: Inserting BSP in Kernel Build Procedure, The Boot Loader Interface, Memory Map, Interrupt Management, Timers, UART, Power Management	7
4	Embedded Storage: Flash Map, Memory Technology Device, MTD Architecture, MTD Driver for NOR Flash, Flash-Mapping Drivers, MTD Block and Character Devices, Embedded File Systems, Optimizing Storage Space	10
5	Embedded Drivers: Linux Serial Driver, Ethernet Driver, I2C Subsystem on Linux, USB Gadgets, Kernel Modules	8



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6	Porting Applications: Architectural Comparison, Application Porting Roadmap, Programming with Pthreads, Operating System Porting Layer (OSPL), Kernel API Driver	5
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Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	30	20	20	10	10

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

- 1) P. Raghavan, Amol Lad and Sriram Neelakandan, Auerbach Publications, "Embedded Linux System Design And Development", ISBN: 10: 0-8493-4058-6
- 2) Karim Yaghmour, "Building Embedded Linux Systems", O'Reilly Publications, 2nd Edition, ISBN 780596529680
- 3) Christopher Hallinam, "Embedded Linux Primer", 2nd Edition, Prentice Hall Publication, ISBN 0137017839
- 4) Daniel W Lewis, "Fundamentals of Embedded Software: Where C and Assembly meet", 1st Edition, Prentice hall, ISBN 0130615897

Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	Students will understand the architecture of an Embedded Linux system.	20
CO-2	Students will acquire the knowledge and skill for utilizing open source technologies to build an Embedded Linux system.	30
CO-3	Students will understand the board support package and embedded storage options.	20
CO-4	Students will achieve the ability to develop char device drivers	30



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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).

Major Equipment:

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

List of Open Source Software/learning website:

QEMU - a generic and open source machine emulator

Xenomai - a real-time development framework

<http://free-electrons.com/>