School of Electronics, Devi Ahilya University, Indore

M. Tech. Embedded Systems, Batch 2020 – 22 (Scheme)

Semester I — 28 Credits

Sr. No	Course Code	Course Name	Lecture (L) Hr	Tutorial (T) Hr	Practical (P) Hr	Credit
1	EL71105 (Core)	Embedded Microcontrollers	3	1	0	4
2	EL71106(Core)	Advanced Logic Design	3	1	0	4
3	EL71102	Linux Scripting and Networking	3	1	0	4
4	EL71103	System Programming	3	1	0	4
5	EL71202	Linux Lab	0	0	4	2
6	EL71203	System Programming Lab	0	0	4	2
7	EL71205	Embedded Microcontroller Lab	0	0	4	2
8	EL71206	Advanced Logic Design Lab	0	0	4	2
9	EL71301	Comprehensive Viva Voce (Virtual)	-	-	-	4

Semester II — 36 Credits

Sr. No	Course Code	Course Name	Lecture (L) Hr	Tutorial (T) Hr	Practical (P) Hr	Credit
1	EL72105 (Core)	VLSI Design Methodologies	3	1	0	4
2	EL72102 (Core)	Real Time Systems	3	1	0	4
3	EL72104	Advanced Embedded Microcontroller - ARM	3	1	0	4
4	Elective – I	(i) EL72101: Mobile System Programming (ii) EL72106: Digital Image Processing (iii) EL72111: Wireless Computer Networks & IoT Outside department- Please refer Appendix-I	3	1	0	4
5	Elective – II	Within department (i) EL72107:Digital Signal Processing Outside department-(Please refer Appendix-I)	3	1	0	4
6	EL72205	VLSI Lab	0	0	4	2
7	EL72202	Real Time Systems Lab	0	0	4	2
8	EL72204	Advanced Embedded Microcontroller Lab	0	0	4	2
9	Elective – I Lab	EL72201: Mobile System Programming/ EL72206: DIP Lab/ EL72207 : IoT Lab	0	0	4	2
10	Elective –II Lab	EL72207: Digital Signal Processing Lab	0	0	4	2
11	EL72401	Student Seminars	2	0	0	2
12	EL72301	Comprehensive Viva Voce (Virtual)	-	-	-	4

Semester III — 12 Credits

Sr. No	Course Code	Course Name	Lecture (L) Hr	Tutorial (T) Hr	Practical (P) Hr	Credit
1	EL73501	Major Project Phase I	-	-	-	12

Semester IV — 12 Credits

Sr. No	Course Code	Course Name	Lecture (L) Hr	Tutorial (T) Hr	Practical (P) Hr	Credit
1	EL74501	Major Project Phase II	-	-	-	12

Total Credits 88 Credits

Note: (i) A student is required to opt minimum 34 credits in semester I and minimum 30 credit in semester II.
(ii)The final Semester result of a candidate and award of M.Tech. degree shall be declared on completion of all theory, laboratory and project credits mentioned above.

SEMESTER – I

COURSE TITLE	COURSE CODE
System Programming	EL71103

Object Oriented Analysis: Review of object oriented concepts, potential benefits and drawbacks of object oriented. Compare object oriented paradigm with structural/procedural paradigm. What is class, how to Identify them, relationship among objects, relationship among classes.

Introduction to JAVA: Features of Java, How to write simple Java programs, Understanding CLASSPATH, Java keywords, Lexical issues, Comments, Reserved Keywords, Identifiers, Literals, Operators, Separators, Variables, Naming Conventions, Data Type- Numeric types, Integers, Floating point numbers, Casting characters, Boolean, Simple type, Arrays, Multiple dimensional arrays, Type conversion & casting, Operators, Control Statements, Selection Statements, Iteration Statements.

Introducing Class: Class fundamentals, Declaring objects, new and dot operator, this keyword, Introducing methods, Constructors, Garbage collection, Overloading methods and constructor, Nested and Inner class.

Inheritance: Extending classes, Access modifiers, Keywords- super, final, static, finalize method, Method overriding, Dynamic Method Dispatch, Abstract classes, The Object class and Class class.

Packages and Interfaces: Defining a package, Access Protection in packages, importing packages, Access protection, Defining an Interface, Implementing Interfaces, Applying interfaces, Variables in interfaces, Achieving multiple inheritances through interfaces.

String Handling: String Class, String constructors, Special string operations, Character extracting, String comparison, Searching strings, Modifying a string, Strings buffer, Different string methods.

Exception Handling: Fundamentals, Exception types, try and catch, Multiple catch clauses, nested try statements, Throw, throws and finally, Exception subclasses, Creating own exception classes.

Multithreading: Thread basics, Creating and running a thread, The thread life cycle, Thread priorities, Advanced threading, Asynchronization, Messaging, Inter thread communications, Priorities and Scheduling, Daemon threads.

Introduction to Applets, AWT. Swing Package : Buttons and Labels, Checkboxes and Radio Buttons, Lists and Combo Boxes Simple menu, Submenu IO Package : Buffered Input Stream, Buffered Output Stream, Buffered Reader, Buffered Writer. JDBC and ODBC connectivity

REFERENCES

1. Herbert Schildt , "Java : The Complete Reference", 7th Edition, Tata McGraw – Hill Education
2. Gready Booch , "Object-Oriented Analysis and Design with Applications", 3rd Edition
3. David Flanagan, "Java in a Nutshell", 3rd Edition, O'Reilly Media

COURSE TITLE	COURSE CODE
Embedded Microcontrollers	EL71105

Computer Architectures: RISC/CISC and Harvard/Princeton Architectures. Introduction: The 8051. Microcontroller, Criteria for choosing a microcontroller, 8051 Family members & block diagram. The 8051 Assembly Language Programming: 8051 internal registers,

Structure of Assembly Language, Program Counter & ROM Space, Data types & Directives, PSW, Register Banks & Stack. JMP, LOOP & CALL Instructions: Looping, Conditional & unconditional jump, LCALL, ACALL, PUSH, POP instructions & Subroutines. Time Delay Generation & Calculation. I/O Port Programming: Pin description, I/O Ports, Bit addressability & Read-modify-write feature.

Addressing Modes: Addressing modes, Indexed addressing & Look up tables, SFR registers and their addresses. Arithmetic & Logical Instructions: Addition, subtraction, BCD numbers and DA A instruction, multiplication and division, signed number and overflow problem in arithmetic operations. Logic & Compare Instructions, Rotate & Swap Instructions, BCD & ASCII conversion programs. Single Bit Instructions: Single bit instructions, Registers & bit addressability, Bit addressable RAM, Reading input pins Vs. Port Latch. 8051Timer /Counter Programming: Timer Registers, TMOD Register, Timer mode 1, mode 2, mode 3 programming. Counter Programming.

8051 Serial Communication: Basics of serial communication, Asynchronous serial communication & data framing, RS 232 standards, MAX 232. Baud rate selection & T1 register, SBUF, SCON Registers, and Serial port Programming to transmit & receive data serially.

8051 Interrupts Programming: 8051 interrupts, IVT for 8051, IE register, TCON register and Timer Interrupts, External H/W Interrupts Programming. Serial Port Interrupts Programming, Interrupt Priority upon reset and IP register.

Real World Interfacing: LED, Switches, LCD, ADC, DAC, Sensors, Stepper Motor, Keyboard, and Memory.

REFERENCES

1. 8051 Microcontroller and Embedded Systems : M.A. Mazidi & J. G. Mazidi. Pearson Education
2. Microcontrollers: Architecture, Programming & System Design: Rajkamal Pearson Education
3. 8051 Microcontrollers Arch., Programming & Applications: K. J. Ayala Penram International

COURSE TITLE	COURSE CODE
Advanced Logic Design	EL71106

Unit I

Boolean Algebra, Minimization of Boolean functions, Karnaugh Map and Applications, Two variable K-map, Three variable K-map, Four variable K-map, Five variable K-map, Don't care combinations.

Unit II

VHDL, History, Capabilities, Hardware Abstraction, Overview of VHDL: Basic Terminology, Entity Declaration, Architecture Body, Structural modeling, Behavior Modeling, Data Flow modeling, Mixed Style of Modeling, Configuration Declaration, Package Declaration, Package Body, Model Analysis, Simulation

Unit III

Combinational logic circuits: Arithmetic Circuits – Half adders, Full adders, Half Subtractor, Full Subtractor, Code Converters: Binary to Gray code converters, Gray-to-binary Converter, BCD-to-excess-3 Code Converter, Excess-3 - to – BCD Code Converter, Parity Generator and Parity Checker, BCD Adder, Magnitude Comparators, Encoders, Decoders: Different type of decoders, BCD-to-seven-segment decoder, Implementation of functions using decoder, Multiplexer, Implementation of functions using decoder, Demultiplexer, Analysis of combinational circuit, Realization of combinational circuit from verbal description

Unit IV

Sequential circuits : Latches & Flip-flops, RS, JK, D and T flip-flops, and Synthesis of inputs, Race around problem, Master Slave flip flops, Edge Triggering and Level Triggering, Interconversion of flip-flops, Analysis of Sequential circuit on the basis of state equation, state table and state diagram.
Registers: Introduction of Registers, Shift Registers, Types of Shift Registers: SISO, SIPO, PISO, PIPO,

Bidirectional Shift Registers, Ring Counter, Johnson Counter
Counters: Asynchronous (Ripple) Counters, Asynchronous Decade Counter, Asynchronous Binary Counters

Unit V

Basic Language Elements: Identifiers, Data Objects, Data Types, Operators. Modeling Style: Behavioral Modeling: Process Statement, Variable Assignment Statement, Signal Assignment Statement, Wait Statement, If Statement, Case Statement, Loop Statement, Exit Statement, Next Statement, Assertion Statement, Data Flow Modeling: Concurrent Signal Assignment Statement, Concurrent versus Sequential Signal Assignment, Conditional Signal Assignment Statement, Selected Signal Assignment Statement, Block Statement, Concurrent Assertion Statement, Structural Modeling, Packages and Libraries: Package Declaration, Package body, Design Libraries

Unit VI

Introduction of Synchronous Sequential Machines, Realization of Flow table from verbal description for designing of sequential circuit, Realization of synchronous sequential circuit using different flip flops, Sequence Detector, Designing of sequence detector using different flip flops., Mealy and Moore model Machines, Inter-conversion between Mealy and Moore machine. Model Simulation: Simulation on FPGAdv, Test Bench Generation. VHDL code for mealy and Moore FSM.

References

1. Digital Design III rd edition: M. Morris Mano.
2. Z. Kohavi (TMH), "Switching & Finite Automata Theory".
3. A VHDL Primer: J.Bhaskar, III Edition, Pearson Education Asia
4. VHDL: Douglas Perry, III Edition, Tata McGraw Hill

COURSE TITLE	COURSE CODE
Digital Signal Processing	EL71104

Signal Processing Review: Signals, Systems and Applications, Amplification, distortion, and noise, Linear, time-invariant systems, impulse response and convolution sum, linear constant-coefficient difference equation, Fourier transform and frequency response

The Generic DSP System Introduction: ADCs and DACs / Signal Conditioning, Anti-alias and Reconstructions Filters Distortion, Quantization Error and Noise, The Nyquist Sampling Rate, z-domain representation and transforms Frequency Domain Analysis :Periodic, aperiodic and random signals, The DFT, DTFT and FFT, Signal analysis and synthesis based on DFT, Modern spectral analysis, Time/Frequency Representation

Digital Filtering :FIR and IIR Digital Filters, Digital Filter Design Parameters and methods, All-pass, low-pass, band-pass, comb filters etc.., Poles and zeroes and the Z- domain. DSP Software/Hardware: The Generic DSP Processor Architecture, Application Specific Integrated Circuits, DSP Design and Analysis Software, Application specific – MATLAB programming. Filter Design: Fundamental structures of digital filters, Internal representation of LTI systems, Digital filter design – I, Digital filter design – II.

DSP Audio/Baseband Processing: Over-/under-sampling; Sigma delta ADC/ DACs, Sample rate; decimation & interpolation, Quantization noise shaping Adaptive DSP Algorithms: Least squares (LS) and Least mean squares (LMS), Channel equalization / Inverse system identification, Echo Control for feedback suppression, Acoustic echo control /noise control DSP Baseband Communications : Information theory, AM/FM/PM modulation; ASK/PSK/FSK Signaling, Pulse shaping / Matched Filtering /Root Raised Cosine , Data equalization , Error control and coding.

REFERENCES

1. Ashok Ambardar, Digital Signal Processing
2. John G. Proakis & Dimitris G. Manolakis, Digital Signal Processing: Principles, Algorithms, and Applications, Third Edition, Pearson Publication

COURSE TITLE	COURSE CODE
Linux Scripting and Networking	EL71102

General Overview of the System: Introduction, Linux and Unix System structure, Features of Unix and Linux System, user perspective, O/S services assumption about Hardware. The Kernel and buffer cache architecture of Unix O/S, System concepts, Kernel data Structure, Kernel functions, System administration, Buffer headers, Structure of the buffer pool, Scenarios for retrieval of the buffer, Reading and writing disk block, Advantage and disadvantage of buffer cache.

Internal Representation of Files: INODES, Structure of File System and Directories, Super block, Inode assignment to a new file, Allocation of disk blocks, File System and Types, Tuning and repairing File Systems.

System Calls for the System: Open read write file and record close, File creation, Operation of special files change directory and change root, change owner and change mode, STAT and FSTAT, PIPES Mounting and unmounting files system, Link Unlink.

Structures of Processes and process control: Process states and transitions layout of system memory, Process attribute, the context of a process, manipulation of process address space, Sleep process creation/termination. The user Id of a process, changing the size of a process. The SHELL, System Security.

Interprocess Communication and multiprocessor system: Process tracing system V IPO network communication sockets problem of multiprocessors systems, solution with master and hare process, and solution with semaphores.

Introduction to shell scripts: shell Bourne shell, C shell, Unix commands, permissions, editors, filters sed, grep family, shell variables, scripts, metacharacters and environment, if and case statements, for while and until loops. Shell programming.

Awk and perl Programming: Awk pattern scanning and processing language, BEGIN and END patterns, Awk arithmetic and variables, Awk built in variable names and operators, arrays, strings, functions, perl; the chop() function, variable and operators, $_ and $. , Lists, arrays, regular expression and substitution, file handling, subroutines, formatted printing.

Introduction to Embedded Linux System: Embedded Linux system and structure, storage and kernel based options on embedded system, File structure and develop embedded based environment, Mobile based Linux Operating System.

Case Study: Installation of Linux, Customization of Linux, Installation of SAMBA, APACHE TOMCAT, Send MAIL, Postfix, Implementation of DNS, LDAP services, Firewall, Proxy server

References:

1. M.J. Bach "Design of UNIX O.S. ", Prentice Hall of India.
2. Y.Kanetkar "Unix shell programming", BPB Pub.
3. B.W. Kernighan & R. Pike, "The UNIX Programming Environment", Prentice Hall of India, 1995.
4. Vikas/Thomson "Jack Dent Tony Gaddis "Guide to UNIX using LINUX" Pub. House Pvt. Ltd.
5. Christopher Hallinan, "Embedded Linux Primer: A Practical, Real-World Approach" Pub. Prentice Hall
6. Karim Yaghmour, Jon Masters, Gilad Ben-Yossef, and Philippe Gerum, "Building Embedded Linux Systems" Pub. O'REILLY

SEMESTER – II

COURSE TITLE	COURSE CODE
Real Time Systems	EL72102

Introduction
Modeling Timing constraints
Scheduling Real-Time Tasks: Types of Schedulers, table-driven, Cyclic, EDF, RMA
Handling Resource sharing among real-time tasks
Scheduling Real-Time Tasks in Multiprocessor and Distributed systems
Commercial Real-time operating systems: General concepts, Unix and
Windows as RTOS
Survey of commercial RTOS

References:

1. Jane W. Liu, "Real-Time Systems," Pearson Education, 2001.
2. Krishna and Shin, "Real-Time Systems," Tata McGraw Hill. 1999.
3. Alan C. Shaw, Real-Time Systems and Software, Wiley,2001.
4. Philip Laplante, Real-Time Systems Design and Analysis,2nd Edition, Prentice Hall of India.

COURSE TITLE	COURSE CODE
Advanced Embedded Microcontrollers - ARM	EL72104

Course Objectives

1. To provide in-depth knowledge about ARM Architecture and its instruction set.
2. To explain the systems development using ARM target boards.
3. To design the system applications using Embedded C programming
4. Describe the architectural features and instructions of 32 bit ARM Cortex M3 microcontroller.
5. Understand various Sensors, Actuators & Interfacing Modules

UNIT I

ARM Design Philosophy & RISC Architecture: The RISC Design Philosophy, The RISC Design Philosophy, ARM Programmer's Model: Data Types, Processor Modes, ARM7TDMI Registers, ARM7TDMI Vector Table, The Pipeline, ARM Processor Family, ARM Cortex-A and Cortex-R, ARM Cortex-M

UNIT II

ARM 7 vs ARM Cortex M Introduction, Architecture, Register Organization, AMBA Architecture. Big Endian vs. Little Endian, Global Variables and RAM Storage, Familiarization of Keil uVision 5 IDE and Legacy software for ARM Cortex M4

UNIT III

General Structure of ARM assembly module, Assembler directives- AREA, ENTRY, END, SPACE, DCD, DCB, DCW, DCI, DCQ, EQU, EXPORT, ALIGN, CODE16, CODE32, DATA. Simple ALP programs on Arithmetic & logical operations, Factorial, string operation, sorting, searching, and Scan

Assembly Language Programming: Fundamentals of ARM instructions, Barrel shifter, Classification and explanation of instructions with examples-Data processing, Branch, Load-store, Data processing instructions, Load – Store instruction, Software interrupt instructions, Program status register instructions, Loading constants, Conditional Execution

Introduction to the THUMB instruction set: Introduction, THUMB register usage, ARM – THUMB interworking, the branch instructions, Data processing instructions, Stack instructions, Software interrupt instructions.

UNIT IV

STM32 GPIO Management overview, Overview of Output devices interfacing with STM32.

Introduction mbed online compiler. mbed Programming and Interfacing of LEDs, Switch (Digital sensor), Pushbutton, Toggle button, buzzer, LCD, with STM32. Write embedded C program to generate an Interrupt process using STM32.

UNIT V

Interfacing and Programming DC Motor, Stepper Motor, Servo Motor with STM32

Serial Communication Parallel Communication, UART Initialization, UART communication in polling Mode & in Interrupt Mode

Timer Basics, Timer Vs Counter, General Purpose Timer, SysTick Timer. ADC & DAC Basics, Initialization, DAC Peripherals & Modules. PWM and its overview

Text Books:

1. Steve Furber, 'ARM system on chip architecture', Addision Wesley, 2010.
2. A. N. Sloss, Dominic Symes, C. Wright, J. Rayfield 'ARM System Developer's Guide Designing and Optimizing System Software', Elsevier 2007.
3. William Hohl, 'ARM Assembly Language' Fundamentals and Techniques, 2014.

Reference Websites:

1. https://www.arm.com
2. https://os.mbed.com

COURSE TITLE	COURSE CODE
Mobile System Programming	EL72101

Basics of Operating System : Component of Computer System, Booting Process, kernel & Evolution of Operating Systems. Real Time Operating Systems, its types-soft real time operating systems, its features and examples, hard real time operating systems its features and examples. Operating Structure: System Call, OS Services, System Program, System Structure, Virtual Machine, and System Design & Implementation. Process Management: Process Concept, Process Scheduling, Process Co-operation, Inter-Process Communication. Memory Management: Paging and Segmentation

Introduction to Android: Background and positioning of the Android platform, including comparisons to other popular platforms such as BlackBerry, iPhone, and Windows Mobile, high-level architecture of Android applications and the operating system environment. Introducing Android, Stacking up Android, Booting Android development, An Android application, Summary

Development environment.: The Android SDK, Fitting the pieces together, Building an Android application in Eclipse, Building an Android application in Eclipse, The Android Emulator, Debugging

User interfaces.: Activity Life Cycle, Creating the Activity, An Overview of User Interfaces
3.4 Using XML Layouts, Selection Widgets, Date and Time Tabs, Hardware & Software Keyboards, Using Menus, Using Fonts, The WebView and the WebKit Browser, Dialog Boxes: AlertDialog & Toast, Using resources

Intents and Services: Working with Intent classes, Listening in with broadcast receivers, Building a Service, Performing Inter-Process Communication
Storing and retrieving data: Using preferences, Using the filesystem, Persisting data to a database, Working with ContentProvider classes

Networking and web services: An overview of networking, Checking the network status, Communicating with a server socket, Working with HTTP POST, Working with HTTP GET

Notifications and alarms: Introducing Toast, Introducing notifications, Alarms

Multimedia: Introduction to multimedia and OpenCORE, Playing audio, Playing video, Capturing media

Location Services: Simulating your location within the emulator, Using LocationManager and LocationProvider, Working with maps, Converting places and addresses with Geocoder

REFERENCES

1. Operating System Concepts – Silberschtz Galvin Gagne
2. Hello, Android by Ed Burnette

COURSE TITLE	COURSE CODE
Digital Image Processing	EL72106

FUNDAMENTALS OF IMAGE PROCESSING: Introduction - Steps in image processing systems - Image acquisition -Sampling and Quantization - Pixel relationships - Color fundamentals and models, File formats, Image operations – Arithmetic and Morphological.

IMAGE ENHANCEMENT: Spatial Domain: Gray level Transformations - Histogram processing - Spatial filtering smoothing and sharpening. Frequency Domain: Filtering in frequency domain - DFT, FFT, DCT - Smoothing and sharpening filters – Homomorphic Filtering.

IMAGE SEGMENTATION AND FEATURE ANALYSIS Detection of Discontinuities - Edge operators - Edge linking and Boundary Detection - Thresholding - Region based segmentation - Morphological Watersheds - Motion Segmentation.

OBJECT RECOGNITION: Introduction – Pattern and Pattern Class – Selection Measurement Parameters – Approaches – Types of Classification – Bayes, Template matching, Non parametric density estimation, Neural Network approach – Applications.

VIDEO PROCESSING: Real time image and Video processing – parallelism – Algorithm simplification strategy – Hardware platforms – DSP, FPGA, GPU, General purpose processors.

REFERENCES

1. Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing", 3rd Edition, Pearson Eduction, 2009.
2. Nasser Kehtarnavaz, Mark Noel Gamadia, "Real-time image and video processing: from research to reality", Morgan Claypool publishers, 2006.
3. S. Jayarman, S. Esakkirajan, T. Veerakumar, "Digital Image Processing", Tata McGraw Hill, 2010.
4. Anil K. Jain, "Fundamentals of Digital Image Processing", Pearson Education, 2003.
5. Milan Sonka, Vaclav Hlavac and Roger Boyle, "Image Processing, Analysis and Machine Vision", 2nd Edition, Thomson, 2007.

COURSE TITLE	COURSE CODE
Wireless Computer Networks & Internet of Things	EL72111

COMPUTER NETWORKING FUNDAMENTALS

OSI Model, Data transfer referred with OSI Model, IP Addressing, Point to Point Data transfer, Point to Multi Point Data transfer & Network Topologies, Sub-netting, Network Topologies referred with Web, Introduction to Web Servers, and Introduction to Cloud Computing.

Overview and working principle of Wired Networking equipment's – Router, Switches, Overview and working principle of Wireless Networking equipment's – Access Points, Hubs etc. Linux Network configuration Concepts: Networking configurations in Linux Accessing Hardware & Device Files interactions.

DATA TRANSFER PROTOCOLS

Data transfer between nodes using TCP, UDP and HTTP protocols; DHCP. Programming examples for data transfer through sockets in C++ and Java on Windows and Linux.

WIRELESS LOCAL AREA NETWORKS

(i) Wi-Fi Organizations and Standards: Regulatory Bodies, IEEE, Wi-Fi Alliance, WLAN Connectivity, WLAN QoS & Power-Save, IEEE 802.11 Standards,802.11- 2007,802.11a/b/g, 802.11e/h/I,802.11n

(ii) Wi-Fi Hardware & Software: Access Points, WLAN Routers, WLAN Bridges,WLAN Repeaters, WLAN Controllers/Switches, Direct-connect Aps, Distributed connect Aps, PoE Infrastructure, Midspan, Endpoint, Client hardware and software, Antenna types and uses Wi-Fi Security concepts, Wi-Fi Applications

WIRELESS SECURE NETWORKS (WSN) & WIRELESS PERSONAL NETWORKS (WPN)
Wireless Personal Area Networks, Bluetooth, Bluetooth Standards, BlueTooth Protocol Architecture, UWB, IEEE 802.15 standards, ZigBee, Sub1GHz, Sensor Networks, Interfacing problems and co-existence strategies in Sensor Networks, Routing protocols in Wireless Sensor Networks.

IOT PLATFORM OVERVIEW
Overview of IoT supported Hardware platforms such as: Raspberry pi, ARM Cortex Processors, Arduino and Intel Galileo boards.

Network Fundamentals:

IoT ARCHITECTURE:
History of IoT, M2M – Machine to Machine, Web of Things, IoT protocols

(i) Applications: Remote Monitoring & Sensing, Remote Controlling, Performance Analysis
(ii) The Architecture: The Layering concepts, IoT Communication Pattern, IoT protocol Architecture, The 6LoWPAN
(iii) Security aspects in IoT

IoT APPLICATION DEVELOPMENT:
Application Protocols- MQTT, REST/HTTP, CoAP, MySQL. Sensors and sensor Node and interfacing using any Embedded target boards. (Raspberry Pi / Intel Galileo/ARM Cortex/ Arduino)

COURSE TITLE	COURSE CODE
VLSI Design Methodologies	EL72105

Introduction to CMOS VLSI Design: Hstorical Perspective, Overview of VLSI Design Methodologies
Fabrication of MOSFETs: Fabrication Process Flow – Basic steps, CMOS n-well process, Layout Design rules
MOS Transistors, MOS Inverters: Static Characteristics, Switching Characteristics and inter connect effect, Combinational MOS, Logic Circuits and Sequential MOS Logic Circuits,
Dynamic Logic Circuits: Basic Principles of Pass Transistors, Voltage Bootstrapping, Dynamic CMOS circuit Techniques
Semiconductor Memories: DRAM, SRAM, Flash Memory, Non Volatile Memory.

REFERENCES

1. Principles of CMOS VLSI Design: Weste and Eshraghian, Pearson Education
2. CMOS Digital Integrated Circuits: Kang & Leblebici, TMH
3. Modern VLSI Design: W.Wolf, Pearson Education
4. CMOS Logic Circuit Design: J.P. Uyemura, Kluwer Academics Publisher

COURSE TITLE	COURSE CODE
Soft Skill: Seminar	EL72401

COURSE TITLE	COURSE CODE
Major Project Phase I	EL73501
Major Project Phase II	EL74501

M.Tech projects should be socially relevant and research oriented ones. Each student is expected to do an individual project. The project work is carried out in two phases – Phase I in III semester and Phase II in IV semester. Phase II of the project work shall be in continuation of Phase I only. At the completion of a project the student will submit a project report, which will be evaluated (end semester assessment) by duly appointed examiner(s). This evaluation will be based on the project report and a viva voce examination on the project.

Appendix A

Choice Based Courses

The M.Tech. students admitted in one School of Studies can opt **a** course of minimum 4 credits from M.Tech. programmes being run at other School (s) of Studies. The courses being run in different School (s) of Studies during second semester (2013-14) at M.Tech. level are listed below:

1. School of Computer Science and IT:

(i) Programme: M.Tech. in Computer Science

Courses Offered:

Course Code	Subjects	Credit(L T P)
CS-6418	Advanced Database Management Systems	5(3,1,2)
CS-6516	Advanced Operating Systems	5(3,1,2)
CS-6517	Advanced Compiler Design	5(3,1,2)
CS-6518	Cloud Computing	5(3,1,2)

(ii) Programme: M.Tech. in Network Management and Information Security:

Courses Offered:

Course Code	Subjects	Credit(L T P)
CS-6628	Legal Aspects of Information Security	4(3,1,0)
CS–5618	Network Security	5(3,1,2)
CS–6623	Mobile & Wireless Systems	4(3,1,0)
CS-6627	Web Technology & Java Security	6(3,1,4)

(iii) Programme: M.Tech. in Information Architecture and Software Engineering

Courses Offered:

Course Code	Subjects	Credit(L T P)
CS-6313	Software Testing & Quality Assurance	5(3,1,2)
CS-6316	Software Reuse & Customization	5(3,1,2)
CS-4409	Enterprise Resource Planning	5(3,1,2)
CS-6418	Advanced Database Management Systems	5(3,1,2)

2. School of Future Studies and Planning:

(i) Programme: M.Tech. in Future Studies and Planning

Courses Offered:

Course Code	Subjects	Credit(L T P)
FS-721	Technology Forecasting & Assessment	4 (3-1-0)
FS-722	Data Mining for Analytics	4 (3-0-2)
FS-723	Industrial Engineering and Systems	4 (3-1-0)
FS-724	System Dynamics	4 (2-1-2)
FS-725	Innovation Management	4 (3-0-2)
FS-726	Market Research	4 (2-1-2)
FS-727	Policy Design and Analysis	4 (3-0-2)
FS-728	Multivariate Analysis	4 (3-0-2)

(ii) Programme: M.Tech. in Systems Management

Courses Offered:

Course Code	Subjects	Credit(L T P)
SM-721	Mathematical Modelling	4 (3-1-0)
SM-722	System Simulation	4 (2-1-2)

SM-723	Enterprise Resource Planning	4 (3-1-0)
SM-724	Project Management	4 (2-1-2)
SM-725	Data Mining and Data Warehousing	4 (2-1-2)
SM-726	e-Business & e-Governance	4 (3-0-2)
SM-727	Software Quality Management	4 (3-0-2)
SM-728	Artificial Intelligence & Neural Networks	4 (2-1-2)

3. School of Energy and Environmental Studies:

Programme: M.Tech. in Energy Management

Courses Offered:

Course Code	Subjects	Credit(L T P)
EN-703	Heat Transfer And Process Integration	3
EN-704	Engineering Thermodynamics : Quality & Quantity Aspects	3
EN-705	Water and Waste Water: Pollution and Control Technologies	3
EN-710	Environmental Auditing and Environmental Impact Assessment	3
EN-711	Energy Modeling and Project Management	3
EN-717	Computer Applications: Energy Software	3
EN-718	Bio and Fossil Fuels Technology	3
EN-803	Biomass/Biogas laboratory	3
EN-804	Solar Thermal and Photo - Voltaic Laboratory	3

4. School of Instrumentation:

Programme: M.Tech. in Instrumentation

Courses Offered:

Course Code	Subjects	Credit(L T P)
IS-702	Computer Networks	3
IS-704	Computer Controlled and SCADA Systems	4
IS-706	VLSI Design	4
IS-708	Embedded based system design -II (ARM Micro-Controller)	4
IS-710	Bio-Medical Instrumentation	4
IS-712	Digital Control Systems	4
IS-716	Digital Signal Processing	3
IS-718	Instrument Technology Lab-II	8

5. School of Physics:

Programme: M.Tech. in Laser Science and Applications

Courses Offered:

Course Code	Subjects	Credit(L T P)
PHY 902	High Voltage Engineering for LASER	4
PHY 904	LASER Systems	4
PHY 906	LASER Application II	4
PHY 908	Optical Communications	4
PHY 910	Free Electron Lasers	3

Note:

1. The opted course will be named as choice based course and it will be equivalent to an elective course of that programme.
2. Credits earned through choice based course from other department will be counted in calculating CGPA for the award of the degree in which admission is taken.
3. Time table of opted courses will be announced later.
4. Teaching and examination of choice based course will be conducted by the school of studies where this course is being offered.
5. Each course will have 10 additional seats for the students of other departments.