School of Electronics, Devi Ahilya University, Indore

M. Tech. Embedded Systems, Batch 2021 – 23 (Scheme)

Semester I — 34 Credits

Sr. No	Course Code	Course Name	Lecture (L) Hr	Tutorial (T) Hr	Practical (P) Hr	Credit
Core Subjects						
1	EL71105	Embedded Microcontrollers	3	1	0	4
2	EL71106	Advanced Logic Design	3	1	0	4
3	EL71205	Embedded Microcontroller Lab	0	0	4	2
4	EL71206	Advanced Logic Design Lab	0	0	4	2
Electives: Discipline Centric						
5	EL71102	Linux Scripting and Networking	3	1	0	4
6	EL71103	System Programming	3	1	0	4
7	EL71202	Linux Lab	0	0	4	2
8	EL71203	System Programming Lab	0	0	4	2
Electives: Generic						
9	EL71104	Digital Signal Processing	3	1	0	4
10	EL71204	Digital Signal Processing Lab	0	0	4	2
Virtual						
11	EL71301	Comprehensive Viva Voce	-	-	-	4

Semester II — 30 Credits

Sr. No	Course Code	Course Name	Lecture (L) Hr	Tutorial (T) Hr	Practical (P) Hr	Credit
Core Subjects						
1	EL72105	VLSI Design Methodologies	3	1	0	4
2	EL72102	Real Time Systems	3	1	0	4
3	EL72205	VLSI Lab	0	0	4	2
4	EL72202	Real Time Systems Lab	0	0	4	2
Electives: Discipline Centric						
5	EL72104	Advanced Embedded Microcontroller - ARM	3	1	0	4
6	EL72204	Advanced Embedded Microcontroller Lab	0	0	4	2
Electives: Generic						
7	EL72101/ EL72106/ EL72111	Mobile System Programming/ Digital Image Processing/ Wireless Computer Networks & IoT	3	1	0	4
8	EL72201/ EL72206/ EL72211	Mobile System Programming Lab / Digital Image Processing Lab / Wireless Computer Networks & IoT Lab	0	0	4	2
9	EL72401	Student Seminars	2	0	0	2
Virtual						
10	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

Programme Outcomes

An embedded system is a programmed controlling and operating system with a dedicated function within a larger mechanical or electrical system, often with real-time computing constraints. It is embedded as part of a complete device often including hardware and mechanical parts. On completion of M.Tech Programme, the student will be able to

1. Understand the key technologies in Embedded Systems.
2. Apply acquired knowledge for development/debugging of programs implemented on microcontrollers and DSPs.
3. Analyze the various systems through testing, verification, validation and simulation techniques and tools in order to engineer reliable and safe Embedded Systems.
4. Evaluate the various technologies for performance and make use of the most efficient one for creating a novel solution of given problem.
5. Demonstrate use of team work, leadership skills, effective communication and decision making.
6. Recognize opportunities in Industry/Research.

SEMESTER – I

EL71105	Embedded Microcontrollers

Course Objectives

This course is structured to combine lectures, insightful demonstrations, case studies and tutorials for the students to gain an in-depth understanding of fundamental concepts on embedded systems. Upon completion of this subject, the students should be able to:

1. Understand the hardware and software components as well as their development cycles,
2. Understand the deployment of embedded processors and supporting devices in real-world applications
3. Interpret application specifications and make practical recommendations on resource selection for embedded systems.
4. Understand key concepts of embedded systems like IO, timers, interrupts, interaction with peripheral devices

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

EL71106	Advanced Logic Design

Course Objectives

To understand:

1. VHDL basics
2. Design of Combinational and Sequential Circuits
3. Modelling styles of VHDL and their advantages

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 3rd 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

EL71102	Linux Scripting and Networking

Course Objectives

1. Understand Linux Operating System
2. Use command substitution to capture program output in Linux Operating System
3. Use conditional statements to control the execution of shell scripts.
4. Able to do shell, Awk and perl Programming
5. Understand Embedded Linux System

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. Sumitabha Das., Unix Concepts and Applications., 4th Edition., Tata McGraw Hill
2. Behrouz A. Forouzan, Richard F. Gilberg : UNIX and Shell Programming- Cengage Learning – India Edition. 2009.

EL71103	System Programming

Course Objectives

1. Understand Object Oriented Principles.
2. Understand need and importance of JAVA Language
3. Understand and develop Core JAVA Programs.
4. Able to create packages, API and jar files.
5. Develop application using Swing, Applets, AWT and IO Package, database connectivity
6. Develop GUI Application using swing.
7. Develop minor project having GUI front end which fetches the data from backend.

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 Package : Buttons and Labels, Checkboxes and Radio Buttons, Choices, Lists, Text Fields, **Scanner Class. 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

EL71104	Digital Signal Processing

Course Objectives

1. To learn the theory and practice of Digital Signal Processing
2. To design and implement FIR and IIR digital filters
3. To study the architecture and features of DSP Processor
4. To learn practical applications of Digital Signal Processing

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 equalisation / 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 equalisation , Error control and coding.

References

1. Ashok Ambardar, Digital Signal Processing - A Modern Introduction
2. Proakis, Digital Signal Processing: Principles, Algorithms, And Applications

SEMESTER – II

EL72105	VLSI Design Methodologies

Course Objectives

1. Be able to use mathematical methods and circuit analysis models in analysis of CMOS digital electronics circuits, including logic components and their interconnect.
2. Be able to create models of moderately sized CMOS circuits that realize specified digital functions.
3. Be able to apply CMOS technology-specific layout rules in the placement and routing of transistors and interconnect, and to verify the functionality, timing, power, and parasitic effects.
4. Have an understanding of the characteristics of CMOS circuit construction.
5. Be able to complete a significant VLSI design project having a set of objectivecriteria and design constraints.
6. To provide experience designing integrated circuits using Computer Aided Design (CAD) Tools.

Introduction to CMOS VLSI Design: Historical Perspective, Overview of VLSI Design Methodologies

Fabrication of MOSFETs: CMOS logic, fabrication and layout, Design methodology and tools, Fabrication Process Flow – Basic steps, CMOS n-well process, Layout Design rules

MOS Transistors, MOS Inverters: MOS Transistor theory, Layout Design Rules, Circuit characterization and performance estimation, Circuit Simulation, 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, Combinational and sequential circuit design

Semiconductor Memories: DRAM, SRAM, Flash Memory, Non Volatile Memory, Memory system design

References

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

EL72102	Real Time Systems

Course Objectives

1. Real-time scheduling and schedulability analysis
2. Formal specification and verification of timing constraints and properties
3. Design methods for real-time systems
4. Development and implementation of new techniques to advance the state-of-the-art real-time systems research

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.

EL72104	Advanced Embedded Microcontroller - ARM

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

EL72106	Digital Image Processing

Course Objectives

1. To study the image fundamentals and mathematical transforms necessary for image processing.
2. To study the image enhancement techniques
3. To study image restoration procedures.
4. To study the image compression procedures.

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.

EL72101	Mobile System Programming

Course Objectives

1. Build your own Android apps
2. Explain the differences between Android and other mobile development environments Understand Android applications work, their life cycle, manifest, Intents, and using external resources
3. Design and develop useful Android applications with compelling user interfaces by using, extending, and creating your own layouts and Views and using Menus.
4. Take advantage of Android's APIs for data storage, retrieval, user preferences, files, databases, and content providers
5. Tap into location-based services, geocoder, compass sensors, and create rich map-based applications

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

EL72111	Wireless Computer Networks & Internet of Things

Course Objectives

1. Understand the principles behind the Modern Network approaches such as IoT
2. Study of IoT Architecture and Protocols
3. Programming using Python
4. Creation of various algorithms for IoT
5. Design the IoT System using various interfaces like text, speech, web interfaces

COMPUTER NETWORKING FUNDAMENTALS

OSI Model, Protocols on various OSI layers. Compare TCP/IP and OSI Model, IP Addressing and its classes, Sub-netting, Networking equipment's – Router, Switches, Overview and working principle of Wireless

Networking equipment's – Access Points, Hubs etc., Sockets Programming in Java for Server Client Computing.

IOT FUNDAMENTALS

IOT Introduction, IoT Components, Architecture of IoT, IoT Hardware Platforms, System on Chip, Introduction of IOT Protocols, details of MQTT protocol, sensors and actuators, cloud, softwares and user interface for IoT

PROGRAMMING USING PYTHON

Introduction to Python, Compiled Vs. Interpreted language, basic data types, comments, Operators, conditional statement and loop, function and module creation, import statements

Classes and Objects, __init__, __del__ methods, built in class attributes, Inheritance, Polymorphism, Abstraction and Encapsulation.

GUI Programming, Qpython introduction for Android device.

RASPBERRY PI SETUP AND PROGRAMMING

Raspbian OS configuration on RPi, headless setup, ssh configuration, configuration of static IP, wlan connectivity configuration, PIR Sensor interfacing, SQLite database programming, SenseHat Programming,

IOT SYSTEM DEVELOPMENT

Telegram interfacing using BotFather for controlling RPi, Amazon Alexa for controlling RPi, Blynk Interfacing, Grove Sesnsor Interfacing, Node Red programming, Data logging on Things Speak,

References

1. Rajkamal, "Internet of Things : Architecture and Design Principles", Mcgraw-Hill Education, 2017
2. Honbo Zhou, "The internet of things in the cloud: a middleware perspective", CRC press, 2012.
3. Behrouz A. Forouzan, "DATA COMMUNICATIONS AND NETWORKING", Mcgraw-Hill Education, 2017

Appendix- I

Choice Based Courses

NOTICE

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 since (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-6728	Legal Aspects of Information Security	4(3,1,0)
CS–5718	Network Security	5(3,1,2)
CS–6723	Mobile & Wireless Systems	4(3,1,0)
CS-6727	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 Electronics:

(i) Programme: M.Tech. in Embedded Systems

Courses Offered:

Course Code	Subjects	Credit(L T P)
MTES 21	VLSI Design	4 (4-0-0)
MTES 22	System / FPGA Architecture	4 (4-0-0)
MTES 23	Real Time Operating Systems & Linux	4 (4-0-0)
MTES 24	Embedded System Programming-.NET framework	4 (4-0-0)
MTES 25	ARM & its Interfacing	4 (4-0-0)

(ii) Programme: M.Tech. in Spatial Information Technology

Courses Offered:

Course Code	Subjects	Credit(L T P)
MTSIT 21	Global Positioning Network	4 (4-0-0)
MTSIT 22	Digital Image Processing	4 (4-0-0)
MTSIT 23	Remote Sensing	4 (4-0-0)

MTSIT 24	VB& .NET Programming (Framework)	4 (4-0-0)
MTSIT 25	J2ME	4 (4-0-0)

(iii) Programme: M.Tech. in Mobile Computing Technology

Courses Offered:

Course Code	Subjects	Credit(L T P)
MTMCT 21	Mobile Computing	4 (4-0-0)
MTMCT 22	Mobile Database	4 (4-0-0)
MTMCT 23	Wireless Networks	4 (4-0-0)
MTMCT 24	Mobile System Programming II –J2ME & Python	4 (4-0-0)
MTMCT 25	ARM & its Interfacing	4 (4-0-0)

3. 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)

4. 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

5. 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

6. 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.