Deccan Education Society's FERGUSSON COLLEGE (AUTONOMOUS), PUNE

Syllabus

for

M. Sc.(Electronic Science) Part II

(Semester-III and Semester-IV)

[Pattern 2019]

from Academic Year

2020-21

Program Structure of M.Sc. (Electronic Science) Part-II

Particulars	Paper	Paper code	Title of Paper	Type of Paper	No. of Credits
M.Sc. Semester-III	Paper- 1	ELS5301	Electronic Communication	CORE-1	4
	Paper - 2	ELS5302	Embedded System Design with ARM	CORE- 2	4
	Paper - 3	ELS5303	Data Communication and WSN	CORE- 3	4
	Paper -4	ELS5304	Internet of Things	Elective-1	4
		ELS5305	Operating System and Real Time Operating System	Elective-2 MOOCs	
		ELS5306	Machine Learning and Artificial Intelligence		
	Paper -5	ELS5307	Practical-V	PCORE-1	4
	Paper -6	ELS5308	Practical-VI	PCORE-1	4
M. Sc. Semester-IV	Paper -1	ELS5401	Electronic Science Project	PCORE-1	8*
***One Project credit is equivalent to minimum 5-6 hours (for 8 Credits 40 – 48 Hours per week)**					

MOOC courses	**Note : Students offering less than 12 theory papers i.e.(48 credits) in previous semester can opt for the following MOOCs courses**				
	Course- 1	ELS-01	IC Technology	MOOCs	4
	Course- 2	ELS-02	CMOS Analog VLSI Design	MOOCs	4
	Course-3	ELS-03	Introduction to Machine Learning	MOOCs	4
	Course- 4	ELS-04	Advances Linear Continuous Control System: Application with MATLAB Programming and Simulink	MOOCs	4
	Course- 5	ELS-05	Mechatronics and Manufacturing Automation	MOOCs	4

Guidelines for ELS5401: Electronic Science Project [8 credits]

Student need to select **project and internship** in industry/ R and D Institutes.

1. 25% weightage is given for Internship/ Entrepreneurial activities and 75% weightage for Project course work.
2. It is expected to spend 5-6 hours per credit i.e. for 8 Credits project course 40 – 48 Hours per week.
3. Therefore, a full-time intern is expected to spend 40 - 48 hours per week on Internship with Project work.
4. Weekly reporting of the progress of work should be done to the Faculty Mentor of the department.
5. **Internship [50 marks] + Project work [150 marks] = 200 marks**

Skill Component Courses – (for 1 Credit each)

1. **Mastering C language** – for scientific computations, file and database handling, real-world interfacing and graphics programming
2. **Introduction to HDL programming (VHDL/Verilog)**
3. **Matlab Programming and Simulink**: A Practical Introduction to Matlab Programming and Simulink.
4. **LabVIEW**: Introduction to LabVIEW.
5. **PLC/SCADA**: Introduction to PLC/SCADA with hands-on.
6. **Open source hardware platform** (like Arduino, Raspberry pi, Beagle Bone etc.)
7. Any other equivalent skill component course.

ELS5301: Electronic Communication [Credits – 4]

Course Outcomes

After learning this course student will be able to

CO1 Analyse basic concept of communication system, types of noise affecting communication system and noise parameters and Radio Wave propagation.

CO2 Integrate various Modulation and Demodulation Techniques and the various radio receivers with their parameters.

CO3 Design basic digital communication systems to solve a given communications problem.

CO4 Understand Fibre Optic Techniques

Unit I	**Introduction to communication systems and Radio Wave propagation** Basics of Communication systems, Modulation and Bandwidth requirements, Need of modulation. Noise: External - Atmospheric, Extra-terrestrial, Industrial, Internal - thermal agitation, shot, transit time, Noise Calculations, noise figure, signal to noise ratio. **Propagation of waves:** Ground waves, sky-wave propagation, ionosphere, space waves, tropospheric scatter propagation.
Unit II	**Modulation and Demodulation Techniques** **Amplitude Modulation:** Frequency spectrum of the AM wave, representation of AM, Power relations in the AM wave. Generation of AM- Basic requirements, types of AM generation. **Single Sideband Techniques**: Suppression of carrier (DSBSC), Suppression of unwanted side bands (SSB) and Extensions of SSB. **Angle modulation:** Frequency and Phase modulation theory, pre-emphasis and de-emphasis, comparison of wideband and narrowband FM. Generation of FM-Direct methods, Indirect method. Radio Receivers: Tuned radio frequency receiver, superhetrodyne receiver, AM receivers, and FM receivers, demodulation of SSB.
Unit III	**Digital Transmission Techniques** Digital Transmission: Line Coding, Block Coding, PWM,PAM,PPM, Pulse Code Modulation (PCM), PCM generation and receiver, companding in PCM, Delta Modulation, Adaptive Delta Modulation, Analog Transmission: ASK, FSK, PSK, and QAM. Multiplexing TDM, FDM and WDM
Unit IV	**Introduction to Fiber Optic Techniques** Introduction to light, optical fiber, optical components, fiber connections and splices, fiber cabling and construction and optical networking.

Reference Books:

1. Behrouz A Forouzan, “Data Communications and Networking”, McGraw-Hill, 3rd Edition, 2004.
2. George Kennedy and Bernard Davis, Electronic Communication Systems, TMH.
3. Dennis Roddy and John Coolen, Electronic communications, Pearson.
4. Gary M. Miller, Modern electronic communication, 9th edition , PHI

ELS5302: Embedded System Design with ARM [Credits – 4]

Course Outcomes

After learning this course student will be able to

CO1 Analyse the features of embedded systems, architecture of ARM7, instruction set, development tools and its applications.

CO2 Explore the architectural features of LPC2148 microcontrollers along with the hardware and interfacing peripheral devices.

CO3 Design real time embedded system

CO4 Test the real-time operating system.

Unit I	**ARM Embedded System** RISC and ARM Design Philosophy, Embedded System Hardware and Software, ARM7 CPU Core, Processor Architecture (32-bit), ARM Programmer's Model, ARM Development Tools, Introduction to ARM families, ARM7TDMI Features, Pipelining, Exceptions, Interrupt Vector Table, ARM Instruction Set, Thumb Instruction, programming in assembly language. System Peripherals: Bus Structure, Memory Map, Register Programming
Unit II	**ARM7 Based Microcontroller LPC2148** Features, architecture (block diagram and its description), system control block (PLL and VPB divider), memory map, GPIO, pin connect block, timer, interfacing with LED, LCD, GLCD, and KEYPAD.GSM and GPS using UART, on-chip ADC using interrupt (VIC), EEPROM using I2C, SDCARD using SPI, on-chip DAC for waveform generation
Unit III	**Introduction to Operating Systems and RTOS** Operating system basics and types of operating systems, the BIOS and Boot Process: BIOS Actions, Operating System, Boot Process, Memory Management: segmentation and paging, Memories- virtual, cache etc. **Real time Systems Concepts:** Foreground / background systems, critical section of code, resources, shared resources, task, process and threads, multiprocessing and multitasking, task scheduling. IPC mechanism shared memory, context switches (or task switches), kernels schedulers, preemptive and non-preemptive kernels, reentrant functions, round-robin scheduling, priorities (task, static, dynamic), priority inversions, deadlock, semaphores, inter task communication, message mailboxes, message queues, interrupt, clock tick, real time system, issues in real time computing, structure of a real time system, hard real time system vs. Soft real time system, advantage and disadvantages of real-time kernels
Unit IV	**Real time operating system** **Kernel structure:** critical sections, task control blocks, task level context switch. **Task Management:** creating a task, task stacks, stack checking, deleting a task, suspending a task, resume a task. **Semaphore Management:** creating and deleting a semaphore, waiting on a semaphore, creating a Mutex, deleting Mutex, waiting on Mutex. Message Mailbox Management: crating a mailbox, deleting mailbox, waiting for a message at a mailbox porting an operating system like μC/OS II / RTLinux / Free RTOS or any other equivalent on an Embedded Platform

Reference Books:

1. Steve Furber ARM System On Chip Architecture, Pearson.
2. Andrew Sloss, Dominic Symes and Chris Wright, ARM System Developers Guide – Designing and Optimizing System Software, , ELSEVIER.
3. The insider,,s guide to the PHILIPLS ARM7 based Microcontrollers, An Engineer Introduction
4. LPC 214x User manual (UM10139) :- www.nxp.com
5. M. Naghibzadeh, Operating System Concepts and Techniques
6. Galvin, Operating Systems Concept, John Willey and Sons
7. Achyut Godbole, Operating Systems, TMH
8. Jean J. Labrosse , MicroC/OS-II The Real-Time Kernel, Elsevier

ELS 5303: Data Communication and WSN [Credits-4]

Course Outcomes

After learning the course student will be able to

CO1 Use of computer networking in various walks of life, describe the types of networks, network configurations and network topologies.
CO2 Analyse the responsibilities of data link layer.
CO3 List types of networking devices, backbone networks and Internet Protocol (IP)addressing.
CO4 Introduction to the concept of wireless sensor networks with applications.

Unit I	**Introduction:** Uses of Computer Networks: Business Applications, Home Applications, Mobile Users. Data communications, Network Criteria, point-to-point and multi point connection, physical topology Local Area Networks, Metropolitan Area Networks, Wide Area Networks, Wireless Networks, protocols and standards. Network Models: Layered tasks, Connection-Oriented and Connectionless Services, Service Primitives, The OSI Reference Model, The TCP/IP Reference Model, Comparison of the OSI and TCP/IP Reference Models, addressing. Physical Layer: Basis for Data Communication: Transmission of digital signals: Bit rate, bit length, baseband and broadband transmission, transmission impairment, data rate limits, performance, Guided Transmission Media Twisted Pair Coaxial Cable and Fiber Optics.
Unit II	**Data Link Layer:** Framing, Error Control, Flow Control, Error-Detection and correction: Introduction, Error detection using CRC. **Data Link Protocols:** Simplest Protocol, Stop-and-Wait Protocol, Stop-and-Wait ARQ, Go-Back-N ARQ, Selective Repeat ARQ, HDLC. Multiple Accesses. Random Access: ALOHA, Carrier Sense Multiple Access (CSMA) Protocols, CSMA with Collision Detection, CSMA with Collision Avoidance. **Controlled Access:** Reservation, Polling and Token Passing. **Channelization:** FDMA, TDMA, CDMA. Wired LAN: Ethernet, IEEE standards, Standard Ethernet. Changes in the standards, Fast Ethernet, Gigabit Ethernet.
Unit III	Connecting LANs, Backbone and Virtual LANs: Connecting devices, Back bone Networks, Virtual LANs. **Network Layer**: Need, Logical addressing, Ipv4 addresses, Ipv6 addresses, Ipv4 and Ipv6 datagrams, Transition from Ipv4 to Ipv6 **Network Layer**: Delivery, Forwarding, Types of Routing protocols, Unicast Routing Protocols, **The Transport Layer**: Process to process Delivery, User Datagram Protocol (UDP) and TCP. **Application layer:** Domain name space, Distribution of name space, Resolution.
Unit IV	**Overview Of Wireless Sensor Networks & Architectures** Introduction to wireless sensor networks, Challenges for Wireless Sensor Networks , Enabling Technologies For Wireless Sensor Networks, Advantage of Sensor Networks, Applications of Sensor Networks, Mobile Adhoc NETworks (MANETs), Sensor Node Hardware and Network Architecture: Single-node architecture, Hardware components & design constraints, Operating systems and execution environments, Optimization goals and figures of merit, Design principles for WSNs, Service interfaces of WSNs, Gateway concepts

Reference Books:

1. Behrouz A Forouzan, "Data Communications and Networking", McGraw-Hill, 3rdEdition, 2004.
2. Andrew S. Tanenbaum, "Computer Networks", Pearson Education/PHI, 4thEdition, 2003.
3. William Stallings, "Data and Computer Communication", Pearson Education Asia, 6thedition.
4. Kurose and Ross, "Computer Networking", Pearson Education, 2002.
5. Jerry Fitzgerald, Alan Dennis, Business Data Communications & Networking, John Wiley & Sons Inc, 2010
6. Holger Karl, Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", Wiley publication.

Online references: (NPTEL/ MOOC)

1. Link:1: http://nptel.ac.in/courses/106105081.
2. Link:2: http://nptel.ac.in/courses/106105082.
3. Link:3: https://nptel.ac.in/courses/106/105/106105160/
4. Link: 4: https://www.netacad.com/courses/networking

ELS 5304 Internet of Things [Credits – 4]

Course Outcomes

After learning this course student will be able to
CO1 Categorize IoT system including basic design strategy , process modelling and building small low cost embedded IoT system
CO2 Explore fundamentals of security and implement secure infrastructure for IoT
CO3 Analyse real world application scenarios of IoT with different case studies.
CO4 Use Python Programming in IoT development.

Unit I	**Introduction to Internet of Things** Definition and characteristics of IoT, Internet of Things: Vision, Emerging Trends, Economic Significance, Technical Building Blocks, Physical design of IoT, Things in IoT, IoT Communication APIs, IoT enabling technologies, Wireless Sensor Networks, IoT levels and deployment templates, IoT Issues and Challenges, Applications
Unit II	**IoT Physical Devices and Endpoints** Basic building blocks of an IoT device, horizontal and verticals of IoT applications, four pillars of IoT, M2M: The internet of devices, RFID: The internet of objects, WSN: The internet of transducer, SCADA: Choosing platform for IoT development, Choosing IoT hardware processor (Arduino, Raspberry Pi etc.), IoT and M2M, SDN and NFV for IoT
Unit III	**IoT Systems – Logical Design using Python** Introduction to Python, Installing Python, Python Data Types and data structures, control flow, Functions, Modules, Packages, Object oriented programming, Classes, File handling, Date/Time operations, Python Packages of interest for IoT, GUI programming for IoT, Python programming for interfacing of different processors.
Unit IV	**IoT Protocols, Security and Web/ Cloud of Things** IoT protocols, Protocol Standardization for IoT, Issues with IoT Standardization, Unified Data Standards, Protocols- IEEE 802.15.4, BACNet Protocol, Modbus IoT Security: Vulnerabilities of IoT, Security Requirements, Challenges for Secure IoT, Threat Modeling, Key elements of IoT Security Web of Things versus Internet of Things, Two Pillars of the Web, Architecture Standardization for WoT, Cloud Standards – Cloud Providers and Systems, Mobile Cloud Computing, The Cloud of Things Architecture, Data Handling and Analytics Big Data Analytics, Fog Computing, Case Study: Agriculture, Healthcare, Activity Monitoring, Automation etc.

Reference Books:

1. Reema Thareja, "Python Programming Using Problem Solving Approach", Oxford University Press, ISBN 13: 978-0-19-948017-6
2. R. Nageswara Rao, "Core Python Programming", Dreamtech Press; Second edition ISBN- 10: 938605230X, ISBN-13: 978-9386052308 ASIN: B07BFSR3LL
3. Arshdeep Bahga, Vijay Madisetti, ―Internet of Things – A hands-on approach‖, Universities 8. Press, ISBN: 0: 0996025510, 13: 978-0996025515
4. Honbo Zhou, ―The Internet of Things in the Cloud: A Middleware Perspective‖, CRC Press, 2012. ISBN : 9781439892992
5. Dieter Uckelmann, Mark Harrison, Florian Michahelles, ―Architecting the Internet of Things‖, Springer, 2011. ISBN: 978-3-642-19156-5
6. Lyla B. Das, ―Embedded Systems: An Integrated Approach‖ Pearson , ISBN: 9332511675, 9789332511675.
7. Olivier Hersent, Omar Elloumi and David Boswarthick, ―The Internet of Things: Applications to the Smart Grid and Building Automation, Wiley, 2012, 9781119958345

ELS5307: Electronic Science Practical Course – V

[Credit-4]

Any 12 Practical (+)

Title of Experiment

I. Electronic Communication

1. Design of AM transmitter
2. Design of FM transmitter
3. Delta modulation and demodulation
4. Design PCM encoder and decoder system
5. Design of ASK / FSK transmitter and receiver
6. Time division Multiplexing/FDM
7. Varactor diode characteristics and its application in FM
8. Phase Shift Keying (BPSK/QPSK)
9. BPSK Modulation and Demodulation

II. Data Communication and WSN

1. Study of line Coding
2. Study line coding and Decoding
3. Different physical equipment for networking.
4. Different internetworking devices in a computer network.
5. Basic Networking Commands.
6. Extracting MAC address using Python.
7. Mobile Ad hoc Network (MANET).

III. Programmable Logic Controllers and Applications

1. PLC Program to Control Traffic Lights
2. PLC Program to Count and Pack Parts from Conveyor
3. PLC Program to Maintain Level of a Tank
4. Relay programming (all logic gates, Boolean equation like multiplexer, demultiplexer, encoder, decoder, latch etc.)
5. Conveyor belt control

Note: Any other equivalent practical

ELS5308: Electronic Science Practical Course – VI

[Credit-4]

Any 12 Practical

Title of Experiment

I. Embedded System Design with ARM

1. Basic Assembly level Programmes
2. Interfacing Alphanumeric LCD to 16/32 bit microcontroller
3. Interfacing LPC2148 to LCD/GLCD
4. Interfacing key board to 16/32 bit microcontroller
5. Programming ADC of 16/32 bit microcontroller
6. Programming DAC of 16/32 bit microcontroller
7. Interfacing external interrupt.
8. Programming RTC / EEPROM / I2C of 16/32 bit microcontroller
9. Programming UART of 16/32 bit microcontroller
10. Interfacing SD card to LPC2148
11. Interfacing EEPROM to LPC2148 using I2C protocol
12. Multi-tasking/Semaphores/Mutex/Message/Queues using uC/OS-II

II. Internet of Things

1. Python programs using list, tuples, dictionaries, sets etc.
2. Python programming using functions, modules, packages, Object oriented programming and file handling in Python.

   Experiments using Arduino/Raspberry Pi or equivalent board:
3. Python programming for hardware interfacing (Arduino, Raspberry-Pi boards etc.).
   Interface LED/Buzzer and write a program to turn ON/OFF LED/Buzzer.
4. Interface Push button/Digital Sensor (IR/LDR)
5. Interface DHT 11 with Arduino/Raspberry Pi and write a program to display Temperature and Humidity on display device
6. Interface motor using relay with Arduino/Raspberry Pi and write a program to turn on motor when push button is pressed or at a sensor detection.
7. Interface Bluetooth with Arduino/Raspberry Pi and write a program to send sensor data to smartphone using Bluetooth.
8. Interface Bluetooth with Arduino/Raspberry Pi and write a program to turn LED ON/OFF when "1" or"0" is received from smart phone using Bluetooth.
9. Upload Temperature/ Humidity data on Thing speak etc. cloud. Retrieve temperature /humidity data from Thing speak or any cloud.
10. Installation of MySQL on Raspberry Pi and perform basic SQL queries.
11. Program Arduino/Raspberry Pi to publish temperature data to MQTT broker.
    Program Arduino/Raspberry Pi to subscribe to MQTT broker for temperature data and print it.
12. Program Arduino/Raspberry Pi to create TCP server on it and respond with temperature/humidity (any sensor data) data to TCP client when requested.
    Program Arduino/Raspberry Pi to create UDP server on it and respond with temperature/humidity (any sensor data) data to UDP client when requested.
13. IoT based Web Controlled Home Automation using Protocols.

Note: Any other equivalent practical