# SAVITRIBAI PHULE PUNE UNIVERSITY

**(Formerly University of Pune)**

## S.Y. B. Sc. (Computer Science), Electronics

## Choice Based Credit System Syllabus

## To be implemented from

## Academic Year 2020–2021

## ( Under the faculty of Science and Technology )

# Savitribai Phule Pune University

## (Formerly University of Pune)

## SYLLABUS OF

## S. Y. B. Sc. (Computer Science), Electronics

### Choice Based Credit System

### To be implemented from A.Y. 2020-21

### Structure of S. Y. B. Sc.(Computer Science) Electronics

| Semester | Paper Code | Paper | Paper title | No. of Credit | Lectures/Week | Evaluation | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | CA | UE | Total |
| III | ELC-231 | I | Microcontroller Architecture & Programming | 2 | 3 (each lecture of 50 minutes) | 15 | 35 | 50 |
| | ELC-232 | II | Digital Communication and Networking | 2 | 3 (each lecture of 50 minutes) | 15 | 35 | 50 |
| | ELC-233 | III | Practical Course I | 2 | 1 pract / week (each practical of 04 hours & 20 minutes) | 15 | 35 | 50 |
| IV | ELC-241 | I | Embedded System Design | 2 | 3 (each lecture of 50 minutes) | 15 | 35 | 50 |
| | ELC-242 | II | Wireless Communication and Internet of Things | 2 | 3 (each lecture of 50 minutes) | 15 | 35 | 50 |
| | ELC-243 | III | Practical Course II | 2 | 1 pract / week (each practical of 04 hours & 20 minutes ) | 15 | 35 | 50 |

## S.Y.B.Sc.(Computer Science), Electronics- Semester III

## Paper-I: Microcontroller Architecture & Programming (ELC 231)

### Objectives:

1. To study the basics of 8051microcontroller
2. To study the Programming of8051microcontroller
3. To study the interfacing techniques of 8051microcontroller
4. To design different application circuits using 8051microcontroller

**Course Outcomes :** On completion of the course, student will be able

1. To write programs for 8051 microcontroller
2. To interface I/O peripherals to 8051 microcontroller
3. To design small microcontroller based projects

### COURSE CONTENTS

**UNIT- 1: Basics of Microcontroller & Intel 8051 architecture [08]**

Introduction to microcontrollers, difference in controller and processor.
Architecture of 8051, Internal block diagram, Internal RAM organization, SFRS, pin functions of 8051, I/O port structure & Operation, External Memory Interface.

**UNIT-2: Programming model of 8051 [10]**

Instruction classification, Instruction set, Addressing Modes: Immediate, register, direct, indirect and relative, assembler directives (ORG, END), features with examples, I/O Bit & Byte programming using assembly language for LED and seven segment display (SSD) interfacing.
Introduction to 8051 programming in C.

**UNIT- 3: Timer /Counter, Interrupts [10]**

Timer / counter: TMOD, TCON, SCON, SBUF, PCON Registers, Timer modes, programming for time delay using mode 1 and mode 2.
Interrupts: Introduction to interrupt, Interrupt types and their vector addresses, Interrupt enable register and interrupt priority register (IE, IP)

**UNIT- 4: Interfacing, Serial Communication [08]**

Programming of serial port without interrupt, Serial Communication: Synchronous and asynchronous serial communication, Use of timer to select baud rate for serial communication. Interfacing : ADC, DAC, LCD, stepper motor.

## Recommended books:

1. 8051 microcontroller and Embedded system using assembly and C : Mazidi and McKinley, Pearson publications
2. The 8051 microcontroller – Architecture, programming and applications: K.Uma Rao and Andhe Pallavi, Pearson publications.

## S.Y.B.Sc. Computer Science), Electronics, Semester III

## Paper-II, Digital Communication and Networking, ELC- 232

### Objectives:

1. To introduce to all aspects of data communication system
2. To introduce various digital modulation schemes
3. To identify the need of data coding and error detection/correction mechanism.
4. To study bandwidth utilization techniques : multiplexing and Spectrum spreading
5. To know data link layer protocol: Media Access Control
6. To study OSI and TCP/IP models of Networking.

**Course Outcomes :** On completion of the course, student will be able

1. Define and explain terminologies of data communication
2. Understand the impact and limitations of various digital modulation techniques
3. To acknowledge the need of spread spectrum schemes.
4. Identify functions of data link layer and network layer while accessing communication link
5. To choose appropriate and advanced techniques to build the computer network

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### COURSE CONTENTS

**UNIT 1: Introduction to Electronic Communication (9)**

**Introduction to Communication:** Elements of Communication system, types of noise sources, Electromagnetic spectrum, signal and channel bandwidth,

**Types of communication:** simplex, half duplex, full duplex, baseband and broadband,

**Serial communication:** asynchronous and synchronous,

**Information Theory:** Information entropy, rate of information (data rate, baud rate), channel capacity, Nyquist theorem, Signal to noise ratio, Noise Figure, Shannon theorem,

**Error handling codes:** Necessity, Hamming code, CRC

**UNIT 2: Modulation and Demodulation (5)**

**Introduction to modulation and demodulation:** Concept and need of modulation and demodulation,

**Digital Modulation techniques:** Pulse Code Modulation (PCM), FSK, QPSK, QAM.

**UNIT 3: Multiplexing, Spectrum Spreading and Media Access Control (12)**

**Multiplexing techniques:** Frequency division multiplexing, wavelength division multiplexing, Time division multiplexing

**Spread Spectrum techniques:** Frequency hopping Spread Spectrum, Direct Sequence Spread Spectrum

**Media Access Control (MAC):**

Random Access Protocol: ALOHA, CSMA, CSMA/CD, CSMA/CA,
Controlled Access Protocols: Reservation, Polling, Token passing,
Channelization Protocols: FDMA, TDMA, CDMA.

**UNIT 4: Computer Networking (10)**

**Introduction to computer networks**

**Types of networks** : LAN, MAN, WAN, Wireless networks, Switching, Internet,

**Network topology :** point to point, Star, Ring, Bus, Mesh, Tree, Daisy Chain, Hybrid

**Network devices :** Repeater, Switch, Networking cables, Router, Bridge, Hub, Brouter, Gateway.

Wired LANs:-

**Ethernet:** Ethernet protocol, standard Ethernet, 100 MBPS Ethernet, Gigabit Ethernet, 10 Gigabit Ethernet,

**Computer network model:** OSI and TCP/IP.

## Recommended books:

1.Communication Electronics: Principles and Applications, Frenzel, Tata Mc Graw Hill publication, 5th edition.

2. Data Communication and Networking, Forouzan, Mc Graw Hill publication, 5th edition

3. Computer Networks, Tanenbaum, pHI publication, 5th edition

## S.Y.B.Sc.(Computer Science), Electronics, Semester III
## Paper III, Practical Course (ELC-233)

**Objectives:**

1. To get hands on training of Embedded C
2. To study experimentally interfacing of microcontroller
3. To design, build and test modulator and demodulators of digital communication
4. To build and test experimentally various techniques of wired communication
5. To develop practical skills of network setup

**Course Outcomes :** On completion of the course, student will be able

1. To design and build his/her own microcontroller based projects.
2. To acquire skills of Embedded C programming
3. To know multiplexing and modulation techniques useful in developing wireless application
4. Do build and test own network and do settings.

**Guidelines for Practical:**

- Practical batch size : 12
- Minimum no of Practical to be performed : 10
- At least five practical from each Group
- Electronics lab should have set up for embedded programming (Computers and microcontroller target and interfacing boards)

**COURSE CONTENTS**

### Group A: (Any 5)

1. Arithmetic, logical & code conversion problems using assembly/C programming
2. Interfacing of thumbwheel & seven segment display to 8051 microcontroller
3. Traffic light controller using 8051 microcontroller
4. Interfacing LCD to 8051Microcontroller
5. Waveform generation using DAC Interface to 8051Microcontroller

6. Event counter using opto-coupler, seven segment LED/LCD display interface to 8051Microcontroller
7. Speed Control of stepper motor using 8051 microcontroller

## Group B: (Any 5)

1. Study of 3 or 4 Bit Pulse Code Modulation technique
2. Study of Frequency Shift Keying
3. Study of Time Division Multiplexing
4. Study of Frequency Division Multiplexing
5. Study of Code Division Multiple Access System
6. Study of Error detection and correction by using Hamming Code technique
7. Study of Computer network components : Cables, Connectors, Routers, Switches, Ethernet and related interfacing cards
8. To study Configuration of IP and MAC address and to study Local Area Network setup

# S.Y.B. Sc. (Computer Science), Electronics, Semester IV

## Paper I : Embedded System Design (ELC-241)

**Objectives:**

1. To understand the concept of Embedded systems.
2. To study the design flow and available tools for an Embedded system.
3. To understand the implementation of embedded system using firmware and hardware components.
4. To acquire programming skills for the development of Embedded system design.
5. To develop practical skills for designing embedded system Applications.

**Course Outcomes :** On completion of the course, student will be able

1. To understand the difference between general computing and the Embedded systems.
2. To know the fundamentals of embedded systems.
3. Understand the use of Single board Computer (Such as Raspberry Pi) for an embedded system application.
4. Familiar with the programming environment to develop embedded systems and their interfaces with peripheral devices.
5. To develop familiarity with tools used to develop in an embedded environment.

## COURSE CONTENTS

**Unit 1:Introduction to Embedded systems using single board computers (SBC) (08)**

Single boards computer block diagram, types, Comparison of SBC models, Specifications, I/O devices (Storage, display, keyboard and mouse), Network access devices

**Unit 2: Architecture of System on Chip (SOC) (08)**

Architecture of SoC, Basic version Broad Coprocessor, Pin Description of Raspberry Pi, Architectural features: CPU Overview, CPU Pipeline stages, CPU Cache Organization, Branch Prediction & Folding (Concept), GPU Overview

**Unit 3:Programming using Python (10)**

Overview of Rasberian OS (Operating System), Installation, different types of Operating Systems

Basic Python Programming (Script programming):Variable & data types, Flow Control structures, Conditional statements ( If…Then…else),
Functions: I/O function (GPIO, Digital),Time functions, Library functions
Basic Arithmetic Programs: Addition, Subtraction, Multiplication, Division

**Unit 4 : Interfacing of devices using Python Programming (10)**

Basic interfacing: LED, Switch, LCD
Internal Advanced: Bluetooth, Wifi, Ethernet,
External advanced: Camera, Serial Communication GSM, Ultrasonic Sensor, PIR, Finger Print reader.

## Recommended Books:

1. Rasberry Pi CookBook: Software & Hardware problems and Solutions By Simon Monk( O'Reilly Media Inc.)
2. Raspberry Pi Hardware Reference by Warren Gay ( Apress)
3. Rasberry Pi User Guide By Eben Upton, Greath Halfacree (John Wiley & Sons, Inc.)
4. Learning Python with Rasberry Pi, by Alex Bradbury, Ben Everard, John Wiley & Sons, Inc
5. Learn Raspberry Pi programming with Python By Wolfram Donat ( Apress)

# S.Y.B.Sc.(Computer Science), Electronics, Semester IV
# Paper II: Wireless Communication and Internet of Things (ELC242)

## Objectives:

1. To learn and understand applications of wireless communication system
2. To learn and understand cellular system
3. To learn and understand architecture of short range Wireless Technologies
4. To learn and understand basics of Internet of Things
5. To study applications of IoT

**Course Outcomes:** Students will be able to

1. Know working of wireless technologies such as Mobile communication, GSM, GPRS
2. Become familiar with 3G and 4G Cellular Network Technologies for Data Connections.
3. Understand working principles of short range communication application
4. Get introduce to upcoming technology of Internet of Things
5. Explore themselves and develop new IoT based applications

## COURSE CONTENTS

**Unit1: Wireless Communication: Cellular Telephony (12)**

**Overview of wireless communication**,

**Introduction of cellular telephony system:** Frequency reuse, handoff strategies, Co-channel and adjacent channel interference, block diagram of mobile handset

**Overview of Cellular Telephony generations:** 1G to 5G,3G (W-CDMA, UMTS), 4G(LTE)

**GSM:** architecture, frame structure, mobility management,

**GPRS :** architecture, application

**Unit 2 : Short Range Wireless Technologies and Location Tracking (12)**

**Short range Technologies :**

*Bluetooth:* Bluetooth architecture, Bluetooth protocol stack, Bluetooth frame structure
*Zigbee:* Architecture, topologies, applications, Z wave: Protocol architecture, applications
*RFID:* working of RFID system, types of RFID tags, RFID frequencies, applications

**Location Tracking:** GPS system**:** components of GPS system (space segment, control segment, user segment), GPS receiver, Applications

**Unit 3: IoT Architecture (08)**

**Introduction to IOT** : Evolution of IOT, M2M and/or IOT, Seven layer architecture of IoT, Role of cloud in IoT, cloud topologies, Cloud access, Protocols in IoT, Cross connectivity across IoT system components:

- Device to Gateway-short range Wireless: cellphone as gateway, dedicated wireless Access points
- Gateway to cloud: Long range connectivity, (wired, cellular, Satellite, WAN)
- Direct Device to Cloud connectivity ,

**Networking technologies:** Low power local area networking (LPLAN), Low power wide area networking (LPWAN) technologies, comparison of LoRa, sigfox NB-IoT, Cat –M.

**Unit 4: IoT Applications (04)**

**Application domains**,

**Challenges in IoT :** Power consumption, Physical security, durability, Secure Connectivity, Secure Data Storage, Data volume, Scalability

**Case studies:**

Case Study 1: Smart Irrigation system for Agricultural field
Case Study 2:Home Automation
Case Study 3: Smart Cities

## Recommended books:

1. Wireless Communications Principles and Practice, Rappaport, Pearson publication
2. Mobile Communications, Jochen Schiller, Pearson publication
3. Internet of Things : Principles and Paradigms, Rajkumar Buyya and Dastjerdi, MK publishers
4. Internet of Things, Mayur Ramgir, Pearson publication

## S.Y.B.Sc.(Computer Science), Electronics, Semester IV
## Paper III, Practical Course (ELC-243)

### Objectives:

1. To use basic concepts for building various applications of embedded electronics.
2. To build experimental setup and test the circuits.
3. To develop skills of analyzing test results of given experiments.
4. Developing Trained Personals for educating and training for upcoming graduates in wireless communication.
5. Implement basic IoT applications on embedded platform

**Course Outcomes :** On completion of the course, students will be able

1. To design and develop own smart applications using Rasberry-Pi
2. To write Python program for simple applications
3. To build own IoT based system

### Guidelines :

- Practical batch size : 12
- Minimum no of Practical to be performed : 10
- Eight compulsory experiments: At least four practical from each Group
- One activity equivalent to 2 experiments by the student.
  a. Continuation of F. Y. activity.
  b. Electronics project Based on the Theory Courses learnt
  c. Documentation type experiments
  d. Presentation/Seminar on Electronics /advanced topic/research topics.

**Prerequisite:** Rasberry Pi boards, Arduino / LoRa boards

### COURSE CONTENTS

**Group A (any 4)**

1. Programming of Raspberry Pi to control LEDs attached to the GPIO pins
2. Programming of Raspberry Pi to get feedback from a switch connected to the GPIO pins

3. Programming of Raspberry Pi to detect temperature using temperature sensor

4. Programming of Raspberry Pi to detect light intensity using photocell sensor
5. Programming of Raspberry Pi for Motion detection
6. Programming of Raspberry Pi for image detection

**Group B (any 4)**

1. Study of GSM system (Message transmission & Reception).
2. To study working of SIM card in GSM handset
3. Study of GPRS system
4. Study of Zig-bee for one application
5. Study of RFID system
6. Introduction to Python programming.
7. To study Arduino based LED switching using mobile
8. Temperature and humidity sensing using Arduino
9. LoRa Interfacing.