D. E. Society's

Fergusson College (Autonomous), Pune

Department of Electronic Science

Syllabus for

T. Y. B. Sc. (Electronic Science)

To be implemented from the June 2018

Introduction:

Fergusson College has become autonomous in June 2016. Choice Based Credit and Grading system (CBCGS) is followed for B.Sc. (Electronic Science) under autonomy. Third year B.Sc. syllabus is designed to maintain the right balance of theory and practice. Student taking admission to T. Y. B. Sc. (Electronic Science) need to complete total 48 credits (24 credits per semester) through 18 papers: twelve theory courses and six practical courses. The course work is divided into six theory papers, two practical papers and one project paper per semester.

In the theory courses adequate knowledge of core courses, discipline specific courses and skill based course will be acquired. There are 6 core courses: design with analog ICs, digital design with Verilog, Electronic communication, Modern communication systems, Microcontrollers and Embedded systems. There are 2 skill based courses - Embedded C and Modelling and simulation using MATLAB. In addition, students can select 4 out of 8 discipline specific electives from Sensors, Industrial automation, Optoelectronics, biomedical Instrumentation, Computer networking, Smart systems, Power Electronics and nanotechnology,

Each practical / project course is of 2 credits each. Each practical course includes minimum 10 practicals based on the theory courses learned in the semester. The aim of the course is to generate trained manpower with adequate theoretical and practical knowledge of the various facets of electronic circuits and systems. Due care is taken to inculcate conceptual understanding in basic phenomena, materials, devices, circuits and products and development of appropriate practical skills suitable for industrial needs.

Some of the **course objectives** are:

1. To explore Key Learning Areas (KLAs) of electronic science.
2. To equip student with necessary fundamental concepts and knowledge base.
3. To develop wide variety of practical skill related to electronic systems
4. To impart training on circuit design, analysis, building and testing.
5. To develop the ability to simulate various circuits and systems.
6. To prepare students for demonstrating the acquired knowledge.
7. To encourage student to develop skills for accepting challenges of upcoming technological advancements

Deccan Education Society's
FERGUSSON COLLEGE (AUTONOMOUS), PUNE 411004
Scheme of Course Structure (Faculty of Science)
2018-2019
T. Y. B. Sc. - Electronic Science

Sem.	Course Code	Title	Paper No.	Credits	Exam (I / E)	Marks (50 / 50)
V	ELS3501	Design with Analog ICs	I	3	I and E	50 + 50
	ELS3502	Electronic Communication System	II	3	I and E	50 + 50
	ELS3503	Microcontroller	III	3	I and E	50 + 50
	ELS3504	Embedded C	IV	3	I and E	50 + 50
	ELS3505	Sensors & Actuators	V (A)	3	I and E	50 + 50
		OR				50 + 50
	ELS3506	Optoelectronics	V (B)	3	I and E	50 + 50
	ELS3507	Computer Networks	VI (A)	3	I and E	50 + 50
		OR				50 + 50
	ELS3508	Smart Systems	VI(B)	3	I and E	50 + 50
	ELS3511	Electronic Science Practical - I	VII	2	I and E	50 + 50
	ELS3512	Electronic Science Practical - II	VIII	2	I and E	50 + 50
	ELS3513	Electronic Science Project - I	IX	2	I and E	50 + 50
VI	ELS3601	Digital Design with Verilog	I	3	I and E	50 + 50
	ELS3602	Modern Communication System	II	3	I and E	50 + 50
	ELS3603	Embedded Systems	III	3	I and E	50 + 50
	ELS3604	Modelling & Simulation using MATLAB	IV	3	I and E	50 + 50
	ELS3605	Industrial Automation	V(A)	3	I and E	50 + 50
		OR				50 + 50
	ELS3606	Biomedical Instrumentation	V(B)	3	I and E	50 + 50
	ELS3607	Power Electronics	VI(A)	3	I and E	50 + 50
		OR				50 + 50
	ELS3608	Nanotechnology	VI(B)	3	I and E	50 + 50
	ELS3611	Electronic Science Practical - III	VII	2	I and E	50 + 50
	ELS3612	Electronic Science Practical - IV	VIII	2	I and E	50 + 50
	ELS3613	Electronic Science Project - II	IX	2	I and E	50 + 50

T.Y.B.Sc. (Electronic Science) Semester V

ELS3501: Paper –I: Design with Analog ICs

(Credits 3)

Objectives:

1. To understand analog circuit design concepts.
2. To design analog electronic circuit for given specifications.
3. To learn the specifications and selection criterion for linear ICs.
4. To obtain information about different special purpose ICs and their applications.

1. **Amplifier design** **[10]**

   Use of standard design procedures and applications of – inverting amplifier, non-inverting amplifier, adder, audio mixer, multi-channel amplifier, averaging amplifier, voltage follower, voltage sources; single supply operation, difference amplifier, servo amplifier, Differential amplifier, instrumentation amplifier and bridge amplifiers – temperature, strain gauge interfacing.

2. **Comparators and controls**

   Comparator, Schmitt trigger, IC Voltage comparators, Design of for UTP and LTP, zero-crossing detector with hysteresis, voltage level detectors, on-off control, precision comparator, window detector, propagation delay measurement **[06]**

3. **Applications of Op-amps and linear ICs** **[24]**

   Design of - DC voltmeter, high resistance voltmeter, V to I converter, LED tester, 4 to 20 mA current source, I to V converter, photodiode/ solar cell parameter measurement, current amplifier, phase shifter, T to V and T to F converter circuits, V to f and f to V converters, clippers and clampers, Precision rectifiers, peak detectors, AC to DC converters, Sample and hold circuits

   Design of Active filters- low pass, high pass, band pass and notch filters with -20, 40, 60 dB/decade, Voltage multipliers, Data converter ICs, Power supply design – single/ dual – fixed and variable

4. **Design of signal generators** **[08]**

   Design of - Multi-vibrators, triangular wave generators, saw tooth wave generators, quadrature oscillator, precision triangle/square wave generators, sine wave generators

References:

1. Operational amplifiers and linear integrated circuits, Robert F. Coughlin, Frederick F. Driscoll, Prentice Hall of India (2014)
2. Design with operational amplifiers and analog integrated circuits, Sergio Franco, Tata McGraw Hill (2009)
3. Operational amplifiers and linear integrated circuits, *Ramakant* A. *Gayakwad*, Pearson (2015)
4. Operational amplifiers and linear integrated circuits, David Bell, Oxford University Press, (2016).

T.Y.B.Sc. (Electronic Science) Semester V

ELS3502: Paper –II: Electronic Communication Systems

(Credits 3)

Objectives:

1. To understand the principles of communication
2. To study the amplitude modulation and demodulation techniques.
3. To learn frequency modulation and demodulation techniques
4. To know the radio transmitters and receivers.

1. **Principles of Electronic communication** **[04]**
   Communication systems – significance , types, modulation and multiplexing, electromagnetic spectrum, bandwidth, gain, attenuation

2. **Amplitude modulation and demodulation** **[14]**
   AM concepts, modulation index, sidebands, frequency domain, AM power, single sideband modulations, Classification of AM, AM modulators, AM demodulators, Balanced modulators and SSB circuits

3. **Frequency modulation and demodulation** **[12]**
   Principles of Frequency and phase modulations, modulation index, sidebands, noise suppression effects, FM Vs AM, Frequency modulators, phase modulators, frequency demodulators

4. **Radio transmitters and receivers** **[18]**
   Transmitter fundamentals, carrier generators, power amplifiers, impedance matching network, transmitter circuits, super heterodyne receiver, IF images, noise, receiver circuits.

References:

1. Principles of Electronic Communication System (4^{th} edition), Louis Frenzel, McGraw Hill Education (2016)
2. Electronic Communication systems (4^{th} edition), George Kennedy, Bernard Davis, McGraw Hill companies (2009).

T.Y.B.Sc. (Electronic Science) Sem. III

ELS 3503: Paper-III: Microcontrollers

(Credits 3)

Objectives:

1. Describe the architecture of 8 bit microcontrollers.
2. Understand various addressing modes and instruction set of microcontroller
3. Learn the program development tools and develop programming skills
4. Interface various memory and I/O devices

1. **Introduction to microcontrollers** **[04]**
   CPU, RAM and ROM, Buses: Address, Data, Control, I/O devices, Programs, microprocessor Vs microcontrollers.

2. **Microcontroller Architecture** **[12]**
   8-bit Microcontroller Hardware (like Intel 8X51/52 or PIC or AVR), pin description, I/O structure, memory organization: general purpose RAM, Bit addressable RAM and Register bank, Special function registers – Flags and PSW, A, B registers, Stack & Stack Pointer, Data Pointer, port registers, timer registers, serial port registers, interrupt registers, power control register, Oscillator & Clock, Program Counter, Internal Memory, Internal RAM/ROM, Reset operation

3. **Instruction Set** **[12]**
   Addressing Modes: register addressing, direct addressing, indirect addressing, immediate addressing, relative addressing, absolute addressing, long addressing, index addressing, Different Groups of Instructions-Data Transfer Instructions, Logical Operation, Arithmetic Operations, Boolean instructions, program branching instructions - Jump and Call Instructions

4. **Programming and Development tools** **[08]**
   Algorithms, Flow Charts, Program Designing, Editors, Assemblers, Assembler directives, Compilers, Linkers, Cross-Compilers, Simulators, Debugger, Emulators

5. **Simple Program** **[12]**
   Simple programs - Arithmetic, Logical, Code Conversion, Block Data Transfer & Timer Programming

References:

3. The 8051 microcontroller, Scott MacKenzie, Prentice Hall Inc. (1995)
4. The 8051 Microcontroller, Architecture, Programming and Application [Second Edition], Kenneth J. Ayala, Penram International, (1999).
5. The 8051 Microcontroller And Embedded Systems, Using Assembly and C Pearson Education , M.A. Mazidi, J. G. Mazidi, R.D. Mckinlay, Second Edition (2009)
6. The 8051 Microcontroller And Embedded Systems, Using Assembly and C, Kenneth J. Ayala, Dhanjay V. Gadre Cengage Learning
7. Microcontrollers [Theory and Applications], Deshmukh Ajay V,TMH (2010)

T.Y.B.Sc. (Electronic Science) Semester V

ELS3504: Paper –IV: Embedded C

(Credits 3)

Objectives:

1. To understand fundamentals of C language.
2. To develop algorithm/flowcharts for problem solving and writing programs.
3. To learn to use C programs for embedded system
4. To study optimization of programs for embedded applications

1. **C for embedded systems** **[10]**
   What is an embedded system, Benefits of C in embedded systems, problem specifications - product requirements, hardware engineering, software planning, software architecture, flow charts, state diagrams, pseudo code, resource management, overview of embedded system resources – CPU, memory, timers, interrupts, IO ports, data converters, First embedded program, In-line assembly language, device knowledge #pragma, libraries.

2. **Data types and variables** **[10]**
   Identifiers, data types, function data, character data, integer data, bit data, real numbers, complex data types – pointers, array, enumerated types, structures, unions, data type modifiers- constant, volatile, signed, unsigned, short, long, near and far. Storage class modifiers – extern, static, register, auto etc.

3. **C Functions, control structures, Decision and looping structures** **[18]**
   Combining statements in a block, functions, control structures, main, initialization functions, control statements, decision structures, looping structures, control expression, break and continue, operations and expressions

4. **Optimizing and testing Embedded C programs** **[10]**
   Editing, compiling, linking, locating, building, debugging and downloading C programs, Creating and writing libraries, optimization based on instruction set, hand optimization, debugging embedded C, mixed C and assembly, working with emulators and simulators, packaging embedded software, Obtain software specifications for Case studies for applications based on 8bit embedded systems.

References:

1. C programming for embedded systems, Kirk Zurell, R&D books, CMP media Inc. (2000)
2. Programming Embedded Systems in C and C++, Michel Barr, O'Reilly (2001)

T.Y.B.Sc. (Electronic Science) Semester V

ELS3505: Paper –V (A): Sensors & Actuator

(Credits 3)

Objectives:

1. To study basic performance parameters of sensors.
2. To understand various types of sensors along with their working principles and specifications
3. To learn the principle, construction and working of various actuators.
4. To study signal conditioning circuits and signal transmission

1. Basics of Sensors **[04]**

Need of sensors , Definition, Types of sensors, Classification, Principle, input-output parameters, Examples of devices, Specification and performance parameters, Accuracy, Resolution, Threshold, impedance, Sensitivity, Hysteresis, Linearity, Range, Reliability, Selectivity

2. Typical Sensors **[24]**

Principle, Construction, Working, specifications of commercially available sensors and applications – Displacement, position/ Motion, Force, Torque, temperature, Pressure, level, flow, Humidity, pH sensors, load cells, smoke and chemical sensor, sound and light.

3. Actuators **[08]**

Actuators-principle, construction and specifications,
Pressure controller, flow control actuators(Valves), Power control devices, magnetic control device - Relay, Solenoid, , motors- servo, stepper Electromechanical:, DC motor, AC motor, Stepper motor, piezo, Electro thermal: Heaters

4. Signal conditioning circuits **[06]**

Conditioning, pneumatic signal conditioning, visual display conditioning, electrical signal conditioning and A-D conversion

5. Signal transmission **[06]**

Pneumatic transmission, analog transmission, digital transmission, D-A conversion and telemetry

References:

1. Fundamentals of industrial instrumentation and process control, William C. Dunn, Mc Gaw Hill Publication (2005)
2. Sensors and Transducers, D Patranabis, Prentice Hall Publication (2008)
3. Sensors and Transducers, Dr. A. D. Shaligram, Chintan Publication (2013)
4. Sensors and Transducers, Principles and Applications, R.Y. Borse, Adhyan Publishers & Distributers, New Delhi (2012)

T.Y.B.Sc. (Electronic Science) Semester V

Paper- III: ELS 3506: Optoelectronics

(Credits 3)

Objectives:

1. To understand Different type of Light Sources
2. To learn Light Emitting Diodes and Lasers Diodes
3. To study Photo-detectors
4. To learn Optical Fibre

1. Introduction to Optics, Optoelectronics and fiber Optic Sensors [08]

Introduction Nature of Light, Basic Interaction of light with Solid Materials, Modulation of light: Birefringence or Double Refraction, Electro optic effects, Magneto-optic effect, Acousto-optic devices.

2. Light Sources I: Light Emitting Diodes and Laser Diodes [12]

Light Emitting Diodes: Luminescence, photoluminescence, Electroluminescence, Injection- luminescence and the light emitting diode, LED materials, LED Structural design and efficiency, Special class of LEDs, LED performance and Spectral Response.

LASER: Basic Working process of Laser Devices, Stimulated Emission and Lasing Action, Spectral Response of Laser.

3. Photodetectors [12]

Introduction, Responsivity and Quantum Efficiency of photodetector, material selection for photodetector, photoconductive photodetector, Junction photodetector, special class of Photodetectors, Optocoupler.

4. Optical Fiber [12]

Introduction, Design of Optical Fiber, Mode of Optical Fiber, Signal Distortion in optical Fiber, signal loss in Optical Fiber, Fiber production and packaging, Optical Fiber Integration, path loss calibration

5. Optoelectronic applications [04]

IR, PIR, Li-Fi, Display technologies

References:

1. Optoelectronics and Optical fiber Sensors, Asit Baran Maity, PHI (2013)
2. Optoelectronics – An Introduction, J. Wilson & J.F.B. Hawkes, PHI (1996).

T.Y.B.Sc. (Electronic Science) Semester V

Paper –VI(A) ELS3507: Computer Networks

(Credits 3)

Objectives:

1. To get familiar with computer networking concepts.
2. To understand the network topology.
3. To learn about the networking standards and protocols
4. To know different characteristics of transmission media for networks.

1. Basic concepts **[16]**

Models of network computing – centralized, distributed, collaborative, client server, peer-to-peer
Physical Topologies – bus, ring, star, mesh, FDDI, Access methods
Categories of networks – LAN, MAN,WAN, PAN, BAN, internet
Network services

2. Networking standards **[12]**

Standards and models, OSI reference model, IEEE reference models, TCP/IP reference models

3. Transmission media **[12]**

Transmission frequency, transmission media characteristics, cable media – coaxial cable, twisted pair, fiber-optic cable. Wireless media – IR, Laser, Radio, microwave and spread spectrum

4. Internetworking devices **[08]**

Network adapter, addressing, modems, repeaters, Hub, Bridges, Routers and gateways.

5. Protocols **[06]**

Physical layer, Data link layer and TCP/IP

References:

1. Networking essential, Glenn Berg, New Riders [2014]
2. Data Communication and Networking, Behrouz Forouzan, Mc Graw Hill education (2007)
3. Computer Networking and the Internet, Andrew Tannenbaum, Pearson education (2011)

T.Y.B.Sc. (Electronic Science) Semester V

Paper –VI(B) ELS3508: Smart Systems

(Credits 3)

Objectives:

1. To know basic theory and functions of smart systems
2. To understand the important components and modules of smart systems
3. To understand design and implementation methods of smarter systems
4. To learn about the case studies of smart systems in various domains

1. Characteristics and Applications **[06]**

Characteristics- development and challenges, Applications – environment, automotive sector, IOT, healthcare

2. Elements of smart systems **[10]**

Sensors, Transmitting system, command and control unit, decision making, Actuators, Energy harvesting systems.

3. Integration technologies **[20]**

Design and implementation methods of smarter systems, Signal processing and communication between smart systems, modelling and simulation of smart systems, synthesis and evaluation of solutions and comparison, Concept of Neural network, Neuron, and training, applications, Virtual instrumentation, data acquisition, LAB view

4. Case studies **[12]**

Smart building, smart cars, smart homes, smart farming, smart cities, intelligent transport system, Self driving cars, M2M enabled Robots, Wellness armbands, applications from sectors - Environment, automotive sector, IOT, healthcare

References:

1. Smart systems integration and simulation, Nicola Bombieri etc., Springer International (2016)
2. Micro and smart systems, G. K. Ananthasuresh etc. Wiley (2012)

T. Y. B. Sc. (Electronic Science) Semester V

ELS3511: Electronic Science Practical - I

(Credits 2)

GROUP A: Design with Analog ICs

1. Audio Mixer
2. Instrumentation Amp
3. Bridge amp – temp/strain gauge
4. 4 to 20mA current source
5. Solar cell parameter measurement
6. Precision reckfor
7. Active filter
8. Function generator
9. Window detector

Group B: Electronic Communication System

1. AM & detection
2. FM/PM
3. Power Amp
4. Impedance matching network
5. Mixer
6. Super heterodyne receiver
7. AM/FM low power transmitter

Group C: Sensors (Elective-I)

1. Temperature (2 sensor) measurements system
2. Light Sensors (2) measurements system
3. Load cell/ Gas sensor system
4. Proximity/ optical sensor system
5. Level sensors
6. Motor – DC/AC/Stepper/Sensor
7. Solenoid/ Prezo Sensor

Group D: Opto Electronics (Elective-II)

1. LED/ Laser diode characterisation
2. Photo diode/ detection cell
3. Optical fiber characterisation
4. OFC TX
5. OFC RX
6. Voice/Signal (OFC) communication system

Note: Minimum 3 experiments from each group including one elective (Minimum 10 experiments for a course)

T. Y. B. Sc. (Electronic Science) Semester V

ELS3512: Electronic Science Practical - II

(Credits 2)

Group A: Microcontrollers

1. ALP – Basic exercise
2. Arithmetic / logical
3. Loop structure
4. Code conversion
5. Subroutines Assemble
6. Timer programming

Group B: Embedded C

1. Simple Programme
2. Decision making/ function
3. Loop structure
4. Switch care statement
5. Intro to C & assembly
6. Simple Programme
7. Software debugging write Hardware
8. I/O, timer programs (serial/parallel)

Group C: Computer networking (Elective-I)

1. Study of Network components
2. Preparing / setting up a LAN
3. Preparing setting up wireless network
4. Troubleshooting network
5. Preventive maintenance
6. Handling network admin function
7. Case studies

Group D: Smart system (Elective-II)

1. Smart sensor
2. Energy harvesting system
3. Virtual instrumentation
4. Virtual instrumentation – LABVIEW
5. Case studies

Note: Minimum 3 experiments from each group including one elective (Minimum 10 experiments for a course)

T. Y.B. Sc. (Electronic Science) Semester V

ELS3513: Electronic Science Project - I

(Credits 2)

For the project course, student can select a project related to any domain relevant to Electronic Science. The student should report about a progress of a project to the guide at least once in the week. Log book of the continuous progress of the work should be maintained by candidate. A one copy of project report should be submitted to the department and another copy can be kept by the student. The assessment of the project work is a continuous process. The guidelines of the assessment of the project for in-semester examination as well as end-semester examination are as follows:

Concurrent Evaluation (CE):

Sr. No.	**Performance Criteria**	**Max. Marks**	**Average Rating**				
			Excel-lent	Very Good	Good	Fair	Poor
1.	Project Selection, Reference work, first presentation	10	10	8	6	4	2
2.	System development, designing, testing	10	10	8	6	4	2
3.	Report writing, Demonstration and final presentation	20	20	16	12	8	4
4.	Overall Performance	10	10	8	6	4	2
	TOTAL	50	50	40	30	20	10

End semester examination (ESE):

Sr. No.	**Performance Criteria**	**Max. %**	**Rating (%)**				
			Excel-lent	Very Good	Good	Fair	Poor
1.	Selection of Project	10	10	8	6	4	2
2.	Planning and Implementation	20	20	16	12	8	4
3.	Project outcome	20	20	16	12	8	4
4.	Regularity of Work	10	10	8	6	4	2
5.	Report Writing Skills	10	10	8	6	4	2
6.	Self Expression, Communication Skill and Presentation	10	10	8	6	4	2
7.	Viva-Voce	20	20	16	12	8	4
	TOTAL	100	100	80	60	40	20

Guidelines for Projects:

1. The name and subject of the project type must be well defined.
2. Planning of the work must be specified.
3. Theoretical, reference work must be provided.
4. Pilot experimentations / Preparations must be specified.
5. Typical design aspects, theoretical aspects, aim and objectives of the work must be specified in detail.
6. The actual work done must be reported along with experimentation procedures.
7. There must be observations, interpretations, conclusions, results of the project work.
8. Algorithm, program strategy, module wise description of parts etc be provided in case of projects related with development of computer software.
9. Applications, usefulness, student's contribution in it must be clearly specified.
10. Further extension work may be suggested for better outcome of the project.
11. It is recommended to present the projects in competitions / project exhibitions organized by various authorities.

T.Y.B.Sc. (Electronic Science) Semester VI

Paper –I: ELS3601 Digital design with verilog

(Credits 3)

Objectives:

1. To utilize k-maps in the design of combinational circuits.
2. To understand the design principles of sequential circuits using state machine notations.
3. To study Verilog Hardware Description Language (HDL)
4. To get introduced to Programmable Logic devices (PLDs)

1. Design of Combinational Circuits [12]

Combinational circuits, Analysis procedure and examples, Design procedures and examples, Binary adder and subtractor, carry propagation, carry look ahead generator, BCD adder, Magnitude comparator, priority encoder design, code converter design, Design of logic function generator using multiplexer,

2. Design of Sequential Circuits with State Machine Concepts [12]

State Machine Concepts - Characteristic table, Characteristic equations, state equations, state table, transition table, state diagram, excitation table, analysis of sequential circuit, Mealy and Moore state models of finite state machine, Design of counters using state machine concepts : synchronous counters, up-down counters, mod counters, random sequence generators/counters.

3. Verilog Hardware Description Language (HDL) [20]

Introduction: Need for standard hardware description language in circuit simulation, comparison of traditional programming languages with HDL, Hierarchical modeling concepts-Top-down design methodology, Bottom-up design methodology, 4 levels of abstraction in Verilog- Behavioral level, Dataflow level, Gate level and Switch level, concept of Verilog module, ports, instance, Standard Verilog module, system primitives and user defined primitives (UDPs), Concept of design block and stimulus block.

Basic constructs and conventions in Verilog :

Lexical conventions or Tokens – whitespace, comments, operators, numbers, strings, keywards, identifiers. Data types – values and strength levels, net type, register type, vector type, integer, real and time register type, array type, memory type, parameter type and string type. System tasks - concept, 4 main system tasks- $display, $monitor, $stop, $finish. Compiler directives – concept, 4 main compiler directives - ‘define, ‘include, ‘ifdef, ‘timescale. Modules & ports.

Gate level Modeling- Gate types, Gate delays. Data flow modeling- Continuous Assignments, Delays expression, operators & operands. Behavioral Modeling- Structured Procedures, Procedural Assignments, Timing Controls, Conditional statements, Multiway Branching, Loops. Examples of Verilog Design- Multiplexer, Demultiplexer, Encoder, Decoder, Half Adder, Full Adder, Flip Flops, Counters, and Shift register.

4. Programmable Logic Design **[04]**

Introduction to Programmable Logic devices(PLDs), ROM as PLD, Programmable Array Logic(PAL), Programmable Logic Array (PLA), Complex Programmable Logic Devices (CPLDs), Field Programmable Gate Array(FPGA)

References:

1. Digital Design: with an introduction to Verilog HDL, 5/e, **M. Morris Mano**, Michel D. Ciletti, Pearson Education (2013)
2. Verilog HDL - A guide to digital design & synthesis By **Samir Palnitkar**, Pearson Second Edition (2011)
3. Fundamentals of digital logic with verilog design, Stephan Brown and Zvonko Vranesic, Mc Graw Hill (2014)

T.Y.B.Sc. (Electronic Science) Semester VI

Paper- II: ELS3602: Modern Communication Systems

(Credits 3)

Objectives:

1. To study the antenna fundamentals and radio propagation
2. To learn the digital communication techniques.
3. To understand the digital data transmission methods
4. To know different wired and wireless telecommunication systems

1. **Antenna and wave propagation** **[12]**

Antenna fundamentals, Parameters, Elementary doublet (Hertzian dipole),
Basic Antenna types- Resonant antenna, Radiation patterns and length considerations, Non-resonant antenna.
Directional high frequency antennas- folded dipole, Marconi Antennas, rhombic antenna
VHF, UHF & Microwave antenna- Yagi, Parabolic reflectors, horn antenna
Propagation of Waves**:** Ground (Surface waves), space waves, sky wave

2. **Digital Communication techniques** **[12]**

Types- Analog-analog, Analog-digital, Digital-analog, Digital-digital, Pulse modulation, Pulse code modulation, Differential Pulse Code Modulation, Delta modulation, Adaptive delta modulation, Companding, TDM, FDM, Block diagram of Digital Communication System.

3. **Digital data transmission** **[08]**

Characteristics of data transmission system, digital codes- RZ, NRZ, AMI, Manchester, Differential Manchester, error detection and correction techniques
Concept of modem, modem classification and interfacing

4. **Telecommunication systems** **[16]**

Telephone system, FAX, Internet telephony,
Cellular telephone system- 2G, 3G, 4G, 5G cellular systems, -characteristics and applications, Base station and small cell,
Wireless LAN, PANs, Bluetooth, Zigbee, IR, RF and near field communication

References:

1. Principles of Electronic Communication System (4^{th} edition), Louis Frenzel, McGraw Hill Education (2016)
2. Electronic Communication systems (4^{th} edition), George Kennedy, Bernard Davis, McGraw Hill companies (2009)

T.Y.B.Sc. (Electronic Science) Semester VI

ELS3603: Paper- II: Embedded system

(Credits 3)

Objectives:

1. To understand the Embedded system design issues.
2. To learn Hardware and software components in Embedded System.
3. To understand the Embedded OS environment.
4. To learn embedded software development and testing process.

1. **Introduction** **[06]**

Introduction to embedded system, embedded system architecture, classifications of embedded systems, challenges and design issues in embedded systems, fundamentals of embedded processor and microcontrollers, CISC vs. RISC, fundamentals of Von-Neuman / Harvard architectures, types of microcontrollers, selection of microcontroller

2. **Architecture of PIC and AVR microcontrollers** **[20]**

PIC: Overview of PIC 18 family, WREG register, GPRAM and EEPROM in PIC, File register, default access bank, status register, RISC architecture of PIC, Oscillator, timers, ports, program counter, Interrupt logic controller

AVR: Overview of AVR family architecture, register file, ALU, memory access, IO ports, Memory, EEPROM, SRAM, timer, interrupt, UART, Watchdown timer, power down modes

3. **Understanding Embedded Systems** **[12]**

I/O Interface, Real world Interfacing, Introduction to Advanced Architectures, Processor and memory Organization, Memory types (RAM, ROM, EPROM, EEPROM, FLASH), memory maps and addresses, Processor and memory selection, Some I/O interfacing: LEDs and LCD,DC Motor and Stepper Motor, Switches and Relays, HEX Keypad, ADC, Temperature Sensor, , Seven segment display, Dot matrix display

4. **Devices and Communication Buses for Devices Network:** **[06]**

I/O types and examples, Serial Communication Devices, Parallel Device Ports, Wireless Devices, Timer and Counting Devices, Watchdog Timer, Real Time Clock, Networked Embedded Systems, Serial/parallel bus communication Protocols, Internet Embedded Systems- Network Protocols, Wireless and Mobile System Protocols

5. **Case studies** **[04]**

References:

1. Embedded Systems – Architecture, Programming and Design" 2nd edition, Raj Kamal, McGraw Hill
2. PIC microcontroller and Embedded systems, Mazidi, Mckinlay, Causey, Pearson Education (2009)
3. Programming and customizing the AVR microcontroller, Dhananjay Gadre, Mc Graw Hill (2001)

T.Y.B.Sc. (Electronic Science) Semester VI

Paper- IV: ELS3604: Modelling and simulation using MATLAB

(Credits 3)

Objectives:

1. To learn features of MATLAB programming tool.
2. To correlate theory and real-world applications in the field of science and technology
3. To develop and solve own problems and solve similar problems in the field of electrical systems
4. To understand and use of MATLAB simulink tool

1. Modelling and Simulation **[06]**

Need, types, steps of modelling, Equivalent circuits and mathematical models of circuit elements, simulation concept and illustrative examples.

2. Basics of MATLAB **[20]**

Working in command window, input, output, file types, saving and loading, built in functions, script files, function files, matrix and array operations, command line functions, inline, functional evaluation, strings, built in function, Array-1D, 2D & mathematical operations with array, 2D & 3D plots. Script files, function files, file handling. Programming: -Conditional statement, Switch-case statement, loops, nested loops, break &continue statement, polynomial operations.

3. MATLAB Applications **[08]**

Root finding, Data analysis, Statistical functions, Polynomials, Curve fitting, Interpolation, Integration and differentiation, Ordinary differential equations, Circuit analysis i.e. Filters, Bode Plot, Pole Zero Plots.

4. Simulations using SIMULINK **[14]**

Introduction, Block diagram, Functions, Creating and working with simulink models, Simulink classes i.e. Virtual subsystems, Non virtual subsystems, Bus selector, creator, blocks, configuration parameters, data types conversion blocks, input and output blocks, MUX/DMUX blocks, integrator block operators, switch block, saturation block, application block sets, Defining and Managing signals (waveforms), waveform parameters, Running a simulation, analyzing the results, Simulink examples (i.e. Ohms law, Kirchhoff's law, Network theorems, Filter, Resonant Circuits and Rectifiers.)

References:

1. Getting Started with MATLAB , Rudra Pratap, 7th Ed. Oxford University Press, N.Delhi
2. MATLAB : An introduction with applications, Amos Gilat , Wiley India (2008)
3. MATLAB Programming For Engineers, Stephen J. Chapman , Thomas Learning (2008)
4. MATLAB Programming, Y Kirani Singh and B. B. Chaudhari, PHI, (2007)
5. Introduction to Simulink with Engineering Applications, Steven T Karris, 2nd edition, Orchard Publication, (2008)
6. Matlab and Simulink for Engineers, A.K.,Tyagi, Oxford University Press, New Delhi (2012)

T.Y.B.Sc. (Electronic Science) Semester VI

Paper- V: ELS3605: Industrial automation

(Credits 3)

Objectives:

1. To study the applications of industrial automation.
2. To understand the structure of automation.
3. To learn about PLC and Scada system
4. To know the robotic systems and applications.

1. **Fundamentals of Process automation** **[12]**
   Process control system: Continuous control, discrete state control, composite discrete/continuous control, Process Characteristics: Process equation, Process load, Process lag, self regulation Control system parameters: Error, Variable range, control parameter range, control lag, dead time, cycling, sensors and actuators in automation

2. **Controller modes** **[12]**
   Discontinous controller modes: Two position mode, Multiposition mode, floating control mode Continuous controller modes: Proportional control, Integral control, Derivative control and composite modes Proportional-Integral, Proportional derivative, Proportional-integral – derivative (PID).

3. **Programmable logic controllers and SCADA** **[12]**
   PLC system, How to choose PLC, IO devices, IO processing, ladder/ structural and functional block programming, SCADA systems fundamentals and overview and Applications

4. **Robotics** **[12]**
   Advantages and applications of robots, basic structure of robots, classification and structure of robotic system, point-to-point, continuous path, manipulator, wrist motion and gripper, drives and controls, Trajectory generation and motion control
   Applications – handling, loading and unloading, manufacturing cell, welding, spray painting, assembly, machining, NC and CNC machines, CAD/CAM system

References:

1. Process control Instrumentation Technology, C.D. Johnson, John Willy and Sons, Inc., 3rd Edition (2015).
2. Programmable logic controllers, W. Boltan, Newnes publication (2009)
3. Robotics for engineers, Yoram Koren, McGraw Hill Book Company (2012)

T.Y.B.Sc. (Electronic Science) Semester VI

ELS3606: Paper V(B) : Biomedical instrumentation

(Credits 3)

Objectives:

1. To make the students conversant with bio-potentials and their significance
2. To impart knowledge of medical instrumentation and its use

1. **Bio-potentials** **[14]**
   Electrical activity of excitable cells -Central nervous system functional organization of peripheral nervous system -ENG, EMG, ECG, EEG

2. **Biopotential electrodes** **[06]**
   Body surface recording electrodes -Internal electrodes -Electrode arrays, microelectrodes -Electrodes for electric stimulation of tissue -Ion selective electrodes Practical hints in the use of electrodes

3. **Recording systems** **[08]**
   Basic recording system. General considerations for bioelectric recorder amplifier. Sources of external noise in low level recording circuits. amplifiers used with recording systems. Writing systems.

4. **Instrumentation for clinical laboratory** **[14]**
   Blood: Introduction, Tests: Blood cell counter (conducting method) Chemical tests: Colorimeter (filter-photometer), flame photometer, spectrophotometer. Automation of chemical tests.

5. **Electrical safety** **[10]**
   Physiological effects of electric current. Electric power distribution system. Macro-shock and micro-shock hazards. Prevention of accidents and grounding of equipment. Double insulation, protection by low voltage, ground fault circuit interrupter. Isolation of patient connected parts. Isolated power distribution system.

References:

1. Medical instrumentation: Application and design by J. G. Webster John Wiley and sons (2003)
2. Handbook of Biomedical Instrumentation by R. S. Khandpur Tata McGraw Hill (2007)
3. Bioinstrumentation by J. G. Webster John Wiley and sons (2004)

T.Y.B.Sc. (Electronic Science) Semester VI

ELS3607: Paper VI(A): Power Electronics

(Credits 3)

Objectives:

1. To get introduce to basics of power electronics and familiar with Power Electronic Devices, circuits and applications
2. To learn about power devices and protections of devices
3. To study various types of power circuits
4. To study applications of power electronics

1. **Introduction to Power Electronics** **[06]**

   Definition of power electronics, Applications of power electronics, classification of power semiconductor devices, control characteristics of devices, characteristics of power devices as a switch, types of Power circuits, Concept of single phase and three phase using phasors, basics of magnetic circuits

2. **Power Devices, Protection and Driving circuits** **[12]**

   Power Diodes: Reverse recovery characteristics, types, diode with different loads, diode in series and parallel, freewheeling diode

   Power transistors: Power BJT, power MOSFET, IGBT- Steady state and Switching Characteristic, Driving circuits

   Thyristors: Types of Thyristors, SCR characteristics, Two transistor static and transient model, turn-on and, turn-off methods, dv/dt and di/dt protection, gate protection circuits, gate driving circuits using BJT, UJT and PUT

   Voltage and current protections, thermal management of heat sinks for power devices. EMI standards, sources and shielding methods

3. **Power Circuits** **[18]**

   Rectifiers: Performance parameters, Half wave, Full wave centre tapped and bridge rectifier with resistive and inductive loads, DC Filters: concept of C, L and LC filters

   Controlled rectifiers: Principle, Semi, Full and Dual Converters

   AC voltage controllers: on-off control, Phase angle control, bidirectional control with Resistive load, Cycloconverter

   DC to DC converters: Step-up, Step-down, concepts of choppers/converters, various quadrants converters, Buck and Boost regulators

   Inverters: Performance parameters, principle, Half Bridge and full Bridge inverter, Voltage control methods, Inverter filters, introduction to current source inverter

   Static Switches: AC and DC Switches, Solid state relays and Microelectronic relays

4. **Applications** **[12]**

   Power Supplies (AC/DC): Switch mode power supply (DC) using flyback, forward, half bridge and full bridge converters, Uninterrupted power supply (UPS) .

   Motor drives: DC motor drives using rectifiers and Choppers, Introduction to AC motors and drives.

Other Applications: High frequency florescent lighting, Induction heating and electric welding

Note: Scope of the syllabus is limited to **single phase circuit** unless otherwise specified.

References:

1. Power electronics: Circuits, Devices and Applications , M.H. Rashid, third Edition Pearson Education, (2004)
2. Power Electronics , Ned Mohan, Undeland, Robbins, Third Edition, John Wiley & Sons (2006)
3. Power electronics Laboratory : theory , Practice & Organization, O.P. Arora, Narosa Publishing, house (2007)
4. Power Electronics, P.C. Sen, Tata Mc Graw Hill, (1998)

T.Y.B.Sc. (Electronic Science) Semester VI

ELS3608: Paper VI(B) : Nano technology

(Credits 3)

Objectives:

1. To understand the basics of Nano-technology
2. To learn the principles of nano-materials
3. To study the application areas of nano-technology**.**

1. **Fundamentals** **[16]**
   Introduction to nano-science and nanotechnology - Definition, nanometre scale, nano-material; Nanoscience in nature – natural nonmaterial; Material properties at nanoscale- surface properties, electrical properties, optical properties, magnetic properties and mechanical properties

2. **Overview of nano materials** **[16]**
   Bio mimetic nano materials, self assembled nano materials, nano structured metals and alloys, polymers, semiconductors, ceramics and glassy materials, carbon based material, composites and nano coatings

3. **Applications** **[16]**
   Medicine and healthcare – diagnosis, imaging, therapy, regenerative medicine; Environment – pollution prevention, environment sensing, food packaging and monitoring; Energy –solar energy, Hydrogen fuel cell, rechargeable batteries, energy savings; ICT – ICs, data storage, photonics, display, wearable sensing textiles

References:

1. Nanotechnologies: Principles, Applications, Implications and Hands-on Activities – Lusa Fillpponi and Duncan Sutherland, European commission (2013)
2. Nanotechnology – Linda Williams and Wade Adams, McGraw Hill (2006)
3. Nanotechnology –Richard Booker and Earl Boysen, Wiley Publishing Inc. (2005)
4. Essential of Nanotechnology, Jeremy Ransden, Ventus publishing Aps (2009)

T. Y. B. Sc. (Electronic Science) Semester VI

ELS3611: Electronic Science Practical - III

(Credits 2)

Group A: Modern Communication

1. Antenna Characterisation
2. Antenna design tools
3. Pulse modular – PAM/PWM/PFM
4. Pulse code mod
5. TDM/ FDP
6. Error detection/connecting system
7. Wireless TX/RX (RF, Zigbee, IR, Bluetooth)

Group B: Power Electronics

1. Controller rectifier
2. Fan regulator/ light regulator
3. Buck regulator
4. SMPS
5. UPS
6. Static switches
7. DC motor control
8. Induction healing

Group C: Industrial Automation

1. On – controller application system
2. PID control system
3. PLC Programme – Ladder programme
4. Elevator cart
5. Bottle filling
6. Sorting system
7. Pick & place robot
8. CAD software – Auto/ E-Cad

Note: Minimum 3 experiments from each group (Minimum 10 experiments for a course)

T. Y. B. Sc. (Electronic Science) Semester VI

ELS3612: Electronic Science Practical - IV

(Credits 2)

Group A: Verilog

1. Combination circuit design – I
2. Combination circuit design – I
3. Sequential circuit design – I
4. Sequential circuit design – II
5. FSM design – I
6. FSM design – II
7. 8 – bit serial / parallel Part design
8. 8 – bit Time design
9. FPGA/ CPLD implementation

Group B: Embedded System

1. LED/LED bank information
2. Key switches / Keyboard information
3. LCD interface
4. 7 – frequency display
5. DAC inter Application
6. ADC inter application
7. Stepper motor
8. Embedded system case study – I
9. Embedded system case study – II
10. Serial communication

Group C: Modelling & Simulation

1. MATLAB simple exercise
2. 2D plot
3. Curve fitting & interpolation
4. Integration / differential
5. Solving differential equations
6. 3D Plots
7. Devise /process modelling
8. Simulink Application – I
9. Simulink Application – II
10. Image processing application

Note: Minimum 3 experiments from each group (Minimum 10 experiments for a course)

T. Y. B. Sc. (Electronic Science) Semester VI

ELS3613: Electronic Science Project - II

(Credits 2)

For the project course, student can select a project related to any domain relevant to Electronic Science. The student should report about a progress of a project to the guide at least once in the week. Log book of the continuous progress of the work should be maintained by candidate. A one copy of project report should be submitted to the department and another copy can be kept by the student. The assessment of the project work is a continuous process. The guidelines of the assessment of the project for in-semester examination as well as end-semester examination are as follows:

Concurrent Evaluation (CE):

Sr. No.	**Performance Criteria**	**Max. Marks**	**Average Rating**				
			Excel-lent	Very Good	Good	Fair	Poor
1.	Project Selection, Reference work, first presentation	10	10	8	6	4	2
2.	System development, designing, testing	10	10	8	6	4	2
3.	Report writing, Demonstration and final presentation	20	20	16	12	8	4
4.	Overall Performance	10	10	8	6	4	2
	TOTAL	50	50	40	30	20	10

End semester examination (ESE):

Sr. No.	**Performance Criteria**	**Max. %**	**Rating (%)**				
			Excel-lent	Very Good	Good	Fair	Poor
1.	Selection of Project	10	10	8	6	4	2
2.	Planning and Implementation	20	20	16	12	8	4
3.	Project outcome	20	20	16	12	8	4
4.	Regularity of Work	10	10	8	6	4	2
5.	Report Writing Skills	10	10	8	6	4	2
6.	Self Expression, Communication Skill and Presentation	10	10	8	6	4	2
7.	Viva-Voce	20	20	16	12	8	4
	TOTAL	100	100	80	60	40	20

Guidelines for Projects:

1. The name and subject of the project type must be well defined.
2. Planning of the work must be specified.
3. Theoretical, reference work must be provided.
4. Pilot experimentations / Preparations must be specified.
5. Typical design aspects, theoretical aspects, aim and objectives of the work must be specified in detail.
6. The actual work done must be reported along with experimentation procedures.
7. There must be observations, interpretations, conclusions, results of the project work.
8. Algorithm, program strategy, module wise description of parts etc be provided in case of projects related with development of computer software.
9. Applications, usefulness, student's contribution in it must be clearly specified.
10. Further extension work may be suggested for better outcome of the project.
11. It is recommended to present the projects in competitions / project exhibitions organized by various authorities.