Deccan Education. Society's

Fergusson College (Autonomous), Pune

Department of Electronic Science

Syllabus

for

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

To be implemented from academic year 2021-22

Fergusson College (Autonomous), Pune

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

Under CBCS pattern (2019) ***effective from June 2021***

Sem.	Paper No.	Course code	Title	Credits	CE maximum Marks	ESE maximum Marks	Total maximum Marks
V	DSE-1A	ELS3501	Communication Electronics	2	50	50	100
	DSE-1B	ELS3502	Microprocessors & Microcontrollers	2	50	50	100
	DSE-2A	ELS3503	Circuit Design with Linear ICs	2	50	50	100
	DSE-2B	ELS3504	Sensors and Actuators	2	50	50	100
	DSE-3A	ELS3505	Power Electronics	2	50	50	100
	DSE-3B	ELS3506	Electronic design automation tools	2	50	50	100
	DSE-1	ELS3507	Electronics Practical-I	2	50	50	100
	DSE-2	ELS3508	Electronics Practical-II	2	50	50	100
	DSE-3	ELS3509	Electronics Practical-III / Project-I	2	50	50	100
	SEC-1*	ELS3511	PCB design and Fabrication	2	50	50	100
	SEC-2*	ELS3512	Robotics	2	50	50	100
			Total Credits	**22**			**1100**
VI	DSE-4A	ELS3601	Modern Communication Systems	2	50	50	100
	DSE-4B	ELS3602	Embedded Systems	2	50	50	100
	DSE-5A	ELS3603	Digital System Design	2	50	50	100
	DSE-5B	ELS3604	Industrial Automation	2	50	50	100
	DSE-6A	ELS3605	Optoelectronics	2	50	50	100
	DSE-6B	ELS3606	Semiconductor device technology	2	50	50	100
	DSE-4	ELS3607	Electronics Practical-IV	2	50	50	100
	DSE-5	ELS3608	Electronics Practical-V	2	50	50	100
	DSE-6	ELS3609	Electronics Practical-VI/Project-II	2	50	50	100
	SEC-3*	ELS3611	Computer Hardware / Networking	2	50	50	100
	SEC-4*	ELS3612	IoT and Applications	2	50	50	100
			Total Credits	**22**			**1100**

* ***For SEC courses - CE and ESE exam will be conducted by the department. It will not be conducted centrally***.

Note:

1. **DSE (Department Specific Elective**) – 12 Courses selected by the department. The list provided by UGC CBCS pattern for T.Y.B.Sc. is suggestive in nature and each department has a complete freedom to suggest their own papers under this category based on expertise, specialization, requirements, scope and need.
2. **SEC (Skill Enhancement courses)** – Minimum 4 for T.Y.B.Sc. These courses may be chosen from pool of courses designed to provide value-based and/or Skill-based knowledge and should contain both theory and lab/hands-on-training/field work. The main purpose of these courses is to provide students life-skills in hands on mode so as to increase their employability. The list provided by UGC is suggestive in nature and each department has freedom to suggest their own papers under this category based on expertise, specialization, requirements, scope and need.

T. Y. B.Sc. Semester V		
Title of the Course and Course Code	**Communication Electronics** **ELS3501**	**Number of Credits :2**
Course Outcomes (COs) **On completion of the course, the students will be able to:**		
CO1	Identify the importance of communication.	
CO2	Discuss various concepts and blocks of communication system.	
CO3	Apply the amplitude and frequency modulation and demodulation techniques to realize AM, FM circuits.	
CO4	Classify analog communication systems used in daily life w.r.t. their application areas	
CO5	Compare AM and FM w.r.t. definition, circuits, complexity, noise immunity, bandwidth requirement, quality etc.	
CO6	Design circuits for AM and FM with their respective demodulators.	

Unit. No.	Title of Unit and Contents	No. of Lectures
I	**Principles of Electronic communication** Communication systems – significance , basic concepts of electronic communication system, types/classification of communication systems , electromagnetic spectrum, concepts of - bandwidth, gain, attenuation, block diagram of generalised communication system , introduction to -modulation and multiplexing	6
II	**Amplitude modulation (AM) and demodulation** AM concepts, modulation index, sidebands, frequency domain, AM power, single sideband modulations, Classification of AM, AM modulators, AM demodulators, Balanced modulators and SSB circuits	10
III	**Frequency modulation (FM) and demodulation** Principles of Frequency and phase modulations, modulation index, sidebands, noise suppression effects, FM Vs AM, Frequency modulators, phase modulators, frequency demodulators	10
IV	**Radio transmitters and receivers** Transmitter fundamentals, transmitter circuits- carrier generators, power amplifiers, impedance matching- introduction, super heterodyne receiver, IF images, noise, receiver characteristics	10

References:

1. Principles of Electronic Communication System (4^{th} edition), Louis Frenzel, McGraw Hill Education (2016)

2. Electronic Communication systems (4th edition), George Kennedy, Bernard Davis, McGraw Hill companies (2009).

T. Y. B.Sc. Semester V		
Title of the Course and Course Code	**Microprocessors and Microcontrollers** **ELS3502**	**Number of Credits :2**
Course Outcomes (COs) **On completion of the course, the students will be able to:**		
CO1	Identify the role of Microprocessor.	
CO2	Discuss basics of Microcontroller and Architecture of 8051.	
CO3	Apply the knowledge to develop Assembly language program.	
CO4	Explain Addressing modes and instruction set.	
CO5	Review Timers, Counters, serial communication and interrupts, instruction set.	
CO6	Develop assembly language programs	

Unit. No.	Title of Unit and Contents	No. of Lectures
I	**Evolution of Microprocessor** Introduction to Microprocessors, Evolution of Microprocessor, architecture of 8085 microprocessor, architecture of 8086 microprocessor architecture of advanced processors, Introduction to Pentium and its higher generations, Introduction to advanced microprocessors and microcontrollers	**6**
II	**8051 Microcontroller** Architecture of 8051 microcontroller: block diagram, brief description of blocks, CPU registers, features of 8051, pin description, I/O ports, oscillator and clock, RESET operation, internal RAM, internal ROM, special function registers , CPU registers register A and register B, program status word, program counter, data pointer, stack and stack pointer, timers and timer registers, serial communication and port registers, interrupts and interrupt registers.	**12**
III	**Instruction Set & assembly language programming.** Different group of instructions: data transfer instructions, arithmetic instructions, logical instructions, Boolean instructions, program branching instructions: jump and call instructions, Addressing modes, Arithmetic, logical, data transfer, code conversion, Role of editor, assembler, and debugger,	**12**
IV	**Basic interfacing and case studies** Switches, LED, Keyboard and display interfacing and case studies	**06**

References:

1. Advanced Microprocessors, Boris Bray, Tata McGraw Hill (2018)
2. 8051 Microcontroller Architecture, Programming and Applications: Kenneth Ayala, Thomson Delmar Learning (2005)
3. 8051 Microcontroller and Embedded System using Assembly and C: M. A. Mazidi, J.G. Mazidi, R.D. Mckinlay, Pearson Education India (2007)

T. Y. B.Sc. Semester V		
Title of the Course and Course Code	**Circuit Design with Linear ICs** **ELS3503**	**Number of Credits :2**
Course Outcomes (COs) **On completion of the course, the students will be able to:**		
CO1	Identify various types of amplifiers and discuss their standard design procedure and applications.	
CO2	Explain sensor and transducer interfacing circuits.	
CO3	Outline the specifications and selection criterion for linear ICs for various applications.	
CO4	Categorize various types of application circuits designed using opamp and linear ICs.	
CO5	Justify the selection and design criteria of linear ICs for different applications.	
CO6	Design active filters, signal generators, PLL applications, power supplies etc.	

Unit. No.	Title of Unit and Contents	No. of Lectures
I	**Amplifier design** Use of standard design procedures and applications of – audio mixer, multi-channel amplifier, averaging amplifier, single supply operation, difference amplifier (2/3 opamp instrumentation amplifier), servo amplifier, Class-D Amplifier.	6
II	**Sensor Interfacing** Hot wire anemometer, Temperature measurement using a thermocouple, T to V and T to F converters, Light sensitive switching, sensing analog light levels, Interfacing linear Hall effect transducers (LHETs), bridge amplifiers – temperature, strain gauge interfacing	8
III	**Opamp Applications** Active filters – Types and Comparison, low pass, high pass, band pass and notch filters, with -20, 40, 60 dB/decade, all pass filters, Clippers and clampers, precision rectifiers, peak detectors, AC to DC converters, Voltage-to-frequency and Frequency-to-voltage conversion, practical log, and antilog amplifiers.	10

IV	**Applications of linear ICs** IC comparator: LM311, Window comparator, ON-OFF control, PWM. Analog multiplier – Block diagram and applications Signal generators: Voltage controlled oscillator (IC566), function generator IC8038, XR2206. Phase locked loops (PLL): Block diagram, applications, IC565, CD4046.DC Power supply: Voltage reference LM385, Low dropout regulator (LDO), IC723, Single and dual power supply, fixed and variable power supply, tracking power supply, foldback current limiting.	12

References

1. R. A. Gayakwad, Op-Amps and Linear IC's, Pearson Education (2003).
2. Sergio Franco, Design with Operational Amplifiers and Analog Integrated Circuits, McGraw-Hill Education, (2015).
3. K.L. Kishore, OP-AMP and Linear Integrated Circuits, Pearson (2011).
4. S. Salivahanan and V.S. Kanchana Bhaaskaran, Linear Integrated Circuits, McGraw Hill Education (2015)
5. R. F. Coughlin and F. F. Driscoll, Operational amplifiers and Linear Integrated circuits, Pearson Education (2001).
6. George Clayton and Steve Winder, Operational Amplifiers, Newnes (2003).
7. Albert Malvino and David Bates, Electronic Principles, Eighth Edition (2016).
8. https://nptel.ac.in/courses/108/108/108108114/

T. Y. B.Sc. Semester V		
Title of the Course and Course Code	**Sensors and Actuators** **ELS3504**	**Number of Credits :2**
Course Outcomes (COs) **On completion of the course, the students will be able to:**		
CO1	Define basic performance parameters of sensors and identify their applications.	
CO2	Explain operating principles, construction and specifications of various sensors and actuators.	
CO3	Classify various types of sensors and actuators.	
CO4	Differentiate between pneumatic and electronic signal conditioning and outline their application areas.	
CO5	Select appropriate sensors and actuators for a given application.	
CO6	Propose the signal transmission method for a particular application.	

Unit. No.	Title of Unit and Contents	No. of Lectures
I	**Fundamentals of Sensors** 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	6
II	**Typical Sensors** Principle, Construction, Working, specifications of commercially available sensors and applications – temperature, displacement, Force, Torque, Pressure, position/ Motion, level, flow, Humidity, pH sensors, load cells, smoke and chemical sensor, sound, and light.	12
II	**Actuators** Actuators-principle, construction and specifications, Pressure controller, flow control actuators (Valves), Power control devices, magnetic control device - Relay, Solenoid, Electromechanical: servo, DC motor, AC motor, Stepper motor, piezo	6
IV	**Signal conditioning and transmission** General Sensor Conditioning, Conditioning for Offset and Span, Linearization in Analog Circuits, Conditioning Considerations for - Direct Reading Sensors, Capacitive Sensors, Magnetic Sensors, Resistance Temperature Devices, Thermocouple, LVDTs, Semiconductor Devices etc. Pneumatic Transmission, Analog Transmission, Digital Transmission - Transmission Standards, Types of Serial buses, RS232, RS422, RS485, 4-20 current loop, HART, Modbus, Fieldbus and Profibus, Wireless transmission (in brief)	12

References

1. Fundamentals of industrial instrumentation and process control, William C. Dunn, McGraw Hill Publication (2005)
2. Practical Industrial Data Networks Design, Installation and Troubleshooting, Steve Mackay, Edwin Wright, Deon Reynders, John Park, Newness, Elsevier (2004).
3. Practical Telecommunications and Wireless Communications for Business and Industry Edwin Wright, Deon Reynders, Newness, Elsevier (2004).
4. Sensors and Transducers, Dr. A.D. Shaligram, Chintan Publication (2013)
5. Sensors and Transducers, D Patranabis, Prentice Hall Publication (2008)
6. Sensors and Transducers, Principles and Applications, R.Y. Borse, Adhyan Publishers & Distributers, New Delhi (2012)

T. Y. B.Sc. Semester V		
Title of the Course and Course Code	**Power Electronics** **ELS3505**	**Number of Credits :2**
Course Outcomes (COs) **On completion of the course, the students will be able to:**		
CO1	Identify various devices, circuits, and outline their role in power electronic applications.	
CO2	Discuss drive and protection circuits of power devices.	
CO3	Illustrate the role of power converters in industrial, commercial, and residential applications.	
CO4	Classify various power converters, general converter topologies and illustrate their use in power conversion and power transmission.	
CO5	Determine the basic parameters of various power converters and compare them.	
CO6	Design base/ gate drive circuits and protection circuits of power devices	

Unit. No.	Title of Unit and Contents	No. of Lectures
I	**Introduction to Power Electronics** Definition, Applications, Power semiconductor devices - control characteristics, Power converters, single phase and three phase, magnetic circuits.	4
II	**Power Devices, Protection and Driving circuits** **Power Diodes:** Steady state and 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, SCR characteristics, two transistor models, turn-on and, turn-off methods, dv/dt and di/dt protection, gate protection circuits, base/gate driving circuits. **Protections:** Voltage and current protections, heat sinks, EMI shielding.	8
III	**Power Converters** **Rectifiers:** Performance parameters, half wave, Full wave centre tapped and bridge rectifier with resistive and inductive loads, AC and DC Filters. **Controlled rectifiers:** Principle, Semi, Full and Dual Converters, Power factor improvement. **AC voltage controllers:** On-off and Phase angle control, bidirectional control, Cycloconverters. **DC to DC Converters:** Step-up, Step-down converters, types of choppers/converters, DC regulators - types, Buck, and Boost regulators. **Inverters:** Performance parameters, principle, Half Bridge and	14

	full Bridge inverter, Voltage control methods, Inverter filters, introduction to current source inverters. **Static Switches:** AC and DC Switches, Solid state relays and Microelectronic relays.	
IV	**Applications** **Power Supplies (AC/DC):** Switch mode power supply (DC) using flyback, forward, half bridge and full bridge converters, Uninterrupted power supply (UPS). **Power Electronics in clean energy:** Solar and Wind Renewable Energy Systems, fuel cell energy systems, electric cars, hybrid cars. **Applications:** Induction and dielectric heating and switch mode welding, Electronic ballast, Battery charging, wireless power transfer (WPT) system.	10

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

References:

1. Power electronics: Circuits, Devices and Applications, Muhammad H. Rashid, (2014, Pearson).
2. Power Electronics, M. D. Singh and K.B. Khanchandani, TMH Education (2008)
3. Power Electronics, Drives, and Advanced Applications, Vinod Kumar, Ranjan Kumar Behera Dheeraj Joshi, and Ramesh Bansal, CRC Press (2020).
4. Power Electronics, Ned Mohan, Undeland, Robbins, Third Edition, John Wiley & Sons (2006).

T. Y. B.Sc. Semester V		
Title of the Course and Course Code	**Electronic design automation tools** **ELS3506**	**Number of Credits :2**
Course Outcomes (COs) **On completion of the course, the students will be able to:**		
CO1	Identify the various freeware and commercial software used for Electronic Design Automation.	
CO2	Compare the various EDA tools used for circuit simulation and design.	
CO3	Apply the knowledge of basic sciences and fundamental concepts in solving problems related to electronics.	
CO4	Analyse the basic analog and digital electronic circuits using SPICE.	
CO5	Select and apply appropriate techniques and IT tools for the design and analysis of the systems.	
CO6	Design electronic circuits for given application and simulate it.	

Unit. No.	**Title of unit and Contents**	**No. of Lectures**
I	**Introduction to SPICE** [Any one circuit simulation package with schematic entry like	**08**

	LTSPICE, PSpice, Multisim, Proteus, Circuit Lab or any other equivalent] Introduction to SPICE software. Recognize various schematic symbols /model parameters of resistor, capacitor, inductor, energy sources (VCVS, CCVS, Sinusoidal source, pulse, etc.), transformer, DIODE, BJT, FET, MOSFET, etc., units & values. Use SPICE Schematic Editor to draw and analyse (DC, AC, Transient) simple analog and digital electronic circuits.	
II	**Assignments / Exercises** Schematic entry of circuits using standard package, Analysis – Transient, AC, DC. Some of the following. **Analog circuits:** Potential divider network, RC integrating and differentiating circuits, Rectification, Zener Diode Voltage Regulator, Peak Detector, Diode Limiters, Low pass Filters, High pass Filters, Bandpass Filters, Band-Reject Filters, BJT Characteristics, Biasing of BJT Circuits, Frequency Response of Transistor Amplifiers, Feedback Amplifiers, Opamp Oscillators, Astable Multivibrator etc. **Digital circuits:** Truth table verification of basic and universal gates, Half adder /full adder circuits using gates, 4 bit adder/BCD adder, Encoder/Multiplexers, Flipflops/Counters etc.	**10**
III	**Introduction to MATLAB** [Any one numerical computational package Matlab, Octave, FreeMat, Scilab] Fundamentals, basic operations on array, matrix, complex numbers etc., Script and function files, plotting commands, control statements, Writing simple programs for handling arrays and plotting of mathematical functions, plotting of analog, discrete and noise signals, analysing the simple electronic circuits/network using node and mesh equations.	**08**
IV	**Assignments / Exercises (**Some of the following) 1. Solve / plot the mathematical equations containing complex numbers, array, matrix multiplication and quadratic equations etc. 2. Obtain different types of plots (2D/3D, surface plot, polar plot) 3. Plot the diode/transistor characteristics. 4. Solve node, mesh, and loop equations of simple electrical/network circuits. 5. Find the poles and zeros hence plot the transfer functions/polynomials. 6. Plot a full wave rectified waveform using Fourier series. 7. Plot the sine, cosine, triangle, and exponential waveform. 8. Plot sampled sine, cosine, triangle, and exponential waveform. 9. Verify the sampling theorem. 10. Simulation for time division multiplexing (TDM) and plot the characteristics curve. 11. To Generate & to detect analog Modulation schemes like AM, FM and Pulse Modulation techniques like PAM, PWM and PPM. 12. To Generate & to detect Modulation schemes like PCM, DM	**10**

	and Digital Modulation schemes like ASK, FSK, BPSK, and QPSK.	

References:

1. S. Haykin and B. V. Veen, Signal and Systems, John Wiley & Sons (2004).
2. V. Oppenheim, A. S. Wilsky and S. H. Nawab, Signals and Systems, Pearson Education (2007).
3. Digital Signal Processing, S. Salivahan, A. Vallavraj and C. Gnanpriya, McGraw Hill, TMH, 3rd edition, (2007).
4. Signals and Systems Using MATLAB, Luis F. Chaparro, Academic Press is an imprint of Elsevier.
5. D. Sundararajan, Practical approach to signals and systems, John Wiley & Sons (2008).
6. Won Young Yang, Signals and Systems with MATLAB, Springer (2009).
7. https://onlinecourses.nptel.ac.in/noc21_ee28/preview

Websites:

1. https://www.scilab.org/ (For scilab setup)
2. https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwjWn6GRt_jvAhVVWX0KHdtgAVAQFjAAegQIBhAD&url=https%3A%2F%2Fwww.scilab.org%2Fsites%2Fdefault%2Ffiles%2FScilab_beginners_0.pdf&usg=AOvVaw0MXbUnBTsAUAqSXQJ5gEL_
3. https://www.scilab.org/tutorials
4. https://spoken-tutorial.org/tutorial-search/?search_foss=Scilab&search_language=English
5. https://mars.uta.edu/mae3183/simulation/introscilab_baudin.pdf

LTSPICE Tutorials

1. https://www.analog.com/en/design-center/design-tools-and-calculators/ltspice-simulator.html#
2. https://www.analog.com/en/education/education-library/tutorials.html
3. https://www.analog.com/en/search.html?q=*&Filters=resource_type_l2_fac_s:f8eadfaf64cf48afb4ad8b54198f6f2a_ff0fe204950d410a86fcfbe07d0464d8|resource_type_fac_s:f8eadfaf64cf48afb4ad8b54198f6f2a

T. Y. B.Sc. Semester V		
Title of the Course and Course Code	**Electronics Practical-I** **ELS3507**	**Number of Credits :2**
Course Outcomes (COs) **On completion of the course, the students will be able to:**		
CO1	List and define the objectives of a given experiment.	
CO2	Interpret the results obtained and validate them.	
CO3	Carry out experiments and tabulate the results.	
CO4	Compare the results of an experiment with the desired output.	
CO5	Select the appropriate electronic components/ sensors and test / measuring equipment.	

CO6	Design electronic circuit and construct it.

Experiments: Communication Electronics (Any 3/4)

1. AM generation and envelop detector.
2. AM transmitter
3. SSB Modulator
4. Frequency Modulator using VCO
5. Frequency Demodulator
6. FM Transmitter
7. AM Receiver

Experiments: Design with Linear ICs (Any 3/4)

1. Current Transmitter - 4 to 20mA / light level sensing.
2. V to f / f to V converter
3. Precision rectifier/ Peak detector
4. Second order Active filters – HP/ LP/ BP/ BR
5. Function generator
6. Comparator Applications: Level control / Window detector/ Power-supply monitor/On-Off control
7. Foldback current limiting.
8. Class D amplifier.
9. PLL characteristics / PLL application

Experiments: Sensors and Actuators (Any 3/4)

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. Displacement Measurement/ Displacement measurement using LVDT.
7. Motor – DC/AC/Stepper/Sensor
8. Solenoid/ Piezo Sensor

Experiments: Power Electronics (Any 3/4)

1. Buck/ Boost regulator
2. DC Chopper / Two Quadrant Chopper
3. Single phase Bridge Inverter
4. Single phase Semi-/Full-/-Dual Converter
5. Single phase AC Regulator
6. Light intensity regulator / Fan Regulator
7. AC/DC Static Switches
8. Study of DC Drive

T. Y. B.Sc. Semester V		
Title of the Course and Course Code	**Electronics Practical-II ELS3508**	**Number of Credits :2**
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Identify the experimental skills to be achieved	
CO2	Discuss the logic for implementing the software program	
CO3	Demonstrate the software program strategy using algorithm / flowchart.	
CO4	Analyse the software program for different input parameters	
CO5	Determine the outcome of a software program	
CO6	Modify the software program for different input conditions.	

Microprocessors & Microcontrollers (Any 4)

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

Assignments / Exercises based on SPICE (Any 4)

Schematic entry of circuits using standard package, Analysis –Transient, AC, DC. Some of the following.

1. **Analog circuits:** passive and active circuits (minimum 10)
2. **Digital circuits:** combinational and sequential circuits (minimum 5)

Assignments / Exercises based on MATLAB/Scilab (minimum 4)

1. Solve / plot the mathematical equations containing complex numbers, array, matrix multiplication and quadratic equations etc.
2. Obtain different types of plots (2D/3D, surface plot, polar plot)
3. Plot the diode/transistor characteristics.
4. Solve node, mesh, and loop equations of simple electrical/network circuits.
5. Find the poles and zeros hence plot the transfer functions/polynomials.
6. Plot a full wave rectified waveform using Fourier series.
7. Plot the sine, cosine, triangle, and exponential waveform.
8. Plot sampled sine, cosine, triangle, and exponential waveform.
9. Verify the sampling theorem.
10. Simulation for time division multiplexing (TDM) and plot the characteristics curve.
11. To Generate & to detect analog Modulation schemes like AM, FM and Pulse Modulation techniques like PAM, PWM and PPM.

12. To Generate & to detect Modulation schemes like PCM, DM and Digital Modulation schemes like ASK, FSK, BPSK, and QPSK.

T. Y. B.Sc. Semester V		
Title of the Course and Course Code	**Electronics Practical -III / Project-I ELS3509**	**Number of Credits :2**
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Define the aim and objectives of a project.	
CO2	Predict the appropriate hardware/ software platforms required for the execution of the project.	
CO3	Carry out the literature survey related to the topics of the selected project.	
CO4	Compare the actual outcome with expected outcome after testing of the developed project.	
CO5	Test the developed system in different phases.	
CO6	Design and develop a system required to fulfil the objectives of the project.	

For Practical course- Remaining (Minimum 10) experiments based on Practical Course I and II. Or

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 (Concurrent examination) as well as end-semester examination are as follows:

For CE:

1. Project Selection, Reference work, first presentation (10)
2. System development, designing, testing (15)
3. Report writing, Demonstration and presentation (15)
4. Overall Performance (10)

For ESE:

1. Self-Expression, and Communication Skill (10)
2. Demonstration and Presentation (30)
3. Viva voce. (10)

T. Y. B.Sc. Semester V		
Title of the Course and Course Code	**PCB design and Fabrication ELS3511**	**Number of Credits :2**
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Identify dimensions of electronic and mechanical components for PCB layouts.	
CO2	Outline the PCB artwork and layout preparation steps.	
CO3	Examine and produce PCB layout for analog and digital circuits using software.	
CO4	Identify different transfer techniques for PCBs.	
CO5	Compare the performance of traditional tools Vs CAD tools for making PCBs.	
CO6	Formulate a strategy for preparing double sided or multiplayer PCBs.	

Unit. No.	Title of Unit and Contents	No. of lectures
I	**Basics of PCBs** Need, Classification, Electronics components (discrete, ICs, SMDs) – symbols, dimensions, packages, Connectors and cables.	**4**
II	**Circuit layout and artwork** Layout planning and design - Drawings and diagrams, General PCB design considerations, Mechanical design considerations, Electrical considerations, Components placement rules, Layout design Artwork generation and automation - Manual artwork, guidelines for artwork preparations, film master preparations, CAD / CAM tools, design automation	**14**
III	**Preparing PCBs** Laminates and types; Image transfer techniques - Cleaning, screen printing, pattern transfer techniques, photo printing; Etching techniques - etching solutions and etching techniques; Mechanical operations - cutting methods, punching, drilling, assembly, soldering	**14**
IV	**PCB technology trends**: Multilayer and flexible PCBs	**4**

Skills

1. Identification of symbols, physical dimensions, packages of electronic components and devices.
2. Use of different circuit assembly techniques- tag board, general purpose board, Bread board and PCB.
3. Prepare circuit layout (e.g. use of graph paper)
4. Generate Artwork – manual process
5. Use open source software for preparing PCB layouts
6. Prepare at least 5/6 PCB layouts

7. Transfer layout on laminates - pattern transfer or photo printing
8. Use etching techniques
9. Drilling and mounting techniques
10. Testing and troubleshooting.

References:

1. Printed Circuit boards: Design and Technology, Bosshart, McGraw Hill education (1983)
2. Printed Circuit Boards: Design, fabrication, assembly and Testing, R. S. Khandpur, McGraw Hill education

T. Y. B.Sc. Semester V		
Title of the Course and Course Code	**Robotics ELS3512**	**Number of Credits :2**
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Identify the importance of robotics in various domains.	
CO2	Explain the localization, mapping and routing for robots.	
CO3	Show the design of simple robot with reference to mechanical, electrical and electronic sections.	
CO4	Identify different interfacing and control sections of robots	
CO5	Determine the type of Robot required in different sectors.	
CO6	Design a prototype robot along with programming tools.	

Unit. No.	**Title of Unit and Contents**	**No. of Lectures**
I	Introduction to robotics, Past, present and future of robotics, Robots applications – Manufacturing Industry, underwater, aerial (drone), medical etc.	**4**
II	Robot mechanism, Kinematics (forward and inverse), mechanical systems-gears, wheels, belts,	**6**
III	Interfacing and control – Actuators (electrical) - DC motors, BLDCs, Servos, PWM, control and Feedback systems Sensors integration (Light, temp, ultrasonic, perception) Microcontrollers/ computer systems, localization, mapping, path/trajectory planning.	**20**
IV	Prototype robot programming and implementation	**6**

Skills:

1. Know the different application domains for robots
2. Identify different robots used in these domains
3. Prepare specifications of robots for these applications
4. Select a domain for robotics applications

5. Know the mechanical, electrical, electronics and computer parts of robots with their specs.
6. Prepare the part list for designing a simple robot
7. Select appropriate parts of these robots with specs
8. Integrate the sensor and actuator systems
9. Assemble/ program the system
10. Demonstrate the working of robot.

References:

1. Robert J Schilling, Fundamentals of Robotics, Prentice Hall India, 200
2. John J Craig, Introduction to Robotics, Prentice Hall International, 2005.
3. Introduction to robotics, Swayam course, Prof. T. Ashokan, IIT, Madras.

T. Y. B.Sc. Semester VI		
Title of the Course and Course Code	**Modern Communication Systems ELS3601**	**Number of Credits :2**
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Identify the importance of antenna and characteristics.	
CO2	Explain construction of VHF, UHF and microwave antenna.	
CO3	Apply the communication systems principles for digital and data communication.	
CO4	Classify various antenna used in day today life.	
CO5	Compare unipolar and bipolar line codes used in data communication.	
CO6	Propose the role of telecommunication system (wired and wireless) in real world applications.	

Unit. No.	**Title of unit and Contents**	**No. of Lectures**
I	Antenna and wave propagation: 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	**12**
II	Digital Communication techniques 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.	**8**
III	Digital data transmission Characteristics of data transmission system, digital codes-Unipolar, bipolar, RZ, NRZ, AMI,	**8**

	Manchester, Differential Manchester, error detection and correction techniques Concept of modem, modem classification and interfacing	
IV	Telecommunication systems- Telephone system, PBX, IP phones, Cellular telephone system- 2G, 3G, 4G, 5G cellular systems, - characteristics and applications	**8**

References:

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

T. Y. B.Sc. Semester VI		
Title of the Course and Course Code	**Embedded Systems ELS3602**	**Number of Credits :2**
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Describe the basics of Microcontroller.	
CO2	Discuss the concept and types of embedded systems.	
CO3	Apply knowledge to Interface with AVR Microcontroller.	
CO4	Analyse case studies.	
CO5	Test knowledge to Interface with AVR Microcontroller.	
CO6	Create Embedded C programs.	

Unit. No.	**Title of Unit and Contents**	**No. of Lectures**
I	**Introduction** Introduction to Embedded system, embedded system architecture , classification of Embedded systems, challenges and design issues in embedded systems, fundamentals of embedded processors and microcontrollers, CISC Vs RISC architecture, fundamentals of Von – Neuman /Harvard architecture, types of microcontrollers, selection of Microcontrollers, Introduction to ARM architecture	**6**
II	**Architecture of AVR Microcontroller** Overview of AVR family, features, simplified view of AVR microcontroller, general purpose registers in AVR, AVR data memory, status register, program counter, program ROM space, RISC architecture, EEPROM, Flash ROM, Timer, interrupt, UART, watchdog timer	**10**

III	**AVR programming in C** Concept of IDE, Data types, time delays in C, arithmetic operations, logical operations, data serialization, memory allocation, programming timers 0,1 IVand 2, serial port programming, interrupt programming. Concept of Real time scheduling algorithm, deadlock, semaphore and IDE	**8**
IV	**Interfacing and application** LED blinking, seven segment display interfacing, LCD interfacing, Keyboard interfacing, sensor interfacing, stepper motor interfacing, PWM programming and DC motor speed control, SPI protocol, I2C protocol, RTC interfacing IR / RFID, zigbee. Case studies of embedded systems	**12**

References:

1. Embedded system: Architecture, programming and design 2nd edition Rajkamal.
2. The AVR Microcontroller and Embedded Systems using Assembly and C M. A. Mazidi, Sarmat Naimi, Sepehr Naimi,Pearson, 10th impression 2019.

T. Y. B.Sc. Semester VI		
Title of the Course and Course Code	**Digital system design** **ELS3603**	**Number of Credits :2**
Course Outcomes (COs) **On completion of the course, the students will be able to:**		
CO1	Identify the designing of various combinational and sequential circuits and describe programmable Logic devices (PLDs), at introductory level	
CO2	Illustrate the given consumer application in digital terms of combinational and sequential circuit problem and associate the concepts behind the Verilog HDL	
CO3	Apply abstractions in Verilog to simulate various combinational and sequential design problems	
CO4	Identify different simulation problems of combinational and sequential applications at various levels of abstraction	
CO5	Compare array and vector data types and their effective usage & Classify the modelling concepts in Verilog	
CO6	Design combinational and sequential circuits with various considerations of operation	

Unit No.	Title of Unit and Contents	No. of Lectures
I	**Verilog Hardware Description Language (HDL)** **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	**20**

	and Switch level, concept of Verilog module, IIports, instance, Standard Verilog module, system primitives and user dIIIefined primitives (UDPs), Concept of design block and stimulus block. **BasIVic 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 systems tasks- $display, $monitor, $stop, $finish. Compiler directives – concept, 4 main compiler directives - ‘define, ‘include, ‘ifdef, ‘timescale. Modules & ports. Gate level Modelling- Gate types, Gate delays. Data flow modelling- Continuous Assignments, Delays expression, operators & operands. Behavioral modeling- Structured Procedures, Procedural Assignments, Timing Controls, Conditional statements, Multiway Branching, Loops.	
II	**Designing of combinational circuits using Verilog** Multiplexer, Demultiplexer, Encoder, Decoder, Half Adder, Full Adder etc. in various levels of abstraction	**7**
III	**Designing of sequential circuits using Verilog** Various types of Flip Flops, Counters, and Shift register etc in various levels of abstraction,	**7**
IV	**Introduction to Programmable Logic Design (PLDs)** 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)	**2**

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, Samir Palnitkar, Pearson Second Edition (2011)
3. Fundamentals of digital logic with verilog design, Stephan Brown and Zvonko Vranesic, McGraw Hill (2014).

T. Y. B.Sc. Semester VI		
Title of the Course and Course Code	**Industrial Automation ELS3604**	**Number of Credits :2**
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Identify the basic elements of process control system for automation.	
CO2	Discuss various operational modes of process controllers and compare their performance.	
CO3	Examine the continuous and dis-continuous controllers for given applications.	
CO4	Explain and outline basic PLC hardware components and describe SCADA system.	
CO5	Recommend appropriate sensors and actuators for a given automation system.	
CO6	Develop PLC programs for a given automation System.	

Unit No.	Title of Unit and Contents	No. of Lectures
I	**Fundamentals of Process automation** 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.	**6**
II	**Controller modes** Discontinuous 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). Batch process	**12**
III	**Programmable logic controllers and PLC Programming** Historical background, programmable controller and features, principle of operation, architecture, memory, Input/output module with reference to sink or source, output module-relay, transistor, triac, power supply, selection of PLC, Examples of applications AC mains interfaces, PLC wiring, device wiring, 24V DC input interfaces, sourcing devices, sinking devices, output interface configurations and wiring. Programming methods- ladder diagrams, function blocks, statement list, programming a PLC, programming terminals, ladder relay instructions, ladder relay programming (digital gates, Boolean expression, flip flop), Interlocking and trip concept, Timers, counters, and shift registers, arithmetic functions	**14**

IV	**Supervisory control and data acquisition (SCADA)** Introduction to SCADA, Fundamental Principles of Modern SCADA Systems, Advantages and Disadvantages, SCADA Hardware and Software, Interfacing PLC to SCADA.	**4**

References

1. Process control Instrumentation Technology, C.D. Johnson, John Willy and Sons, Inc., 3rd Edition (2015).
2. Programmable Logic Controllers Programming Methods and Applications, John R. Hackworth and Fredrick D. Hackworth, Jr., Pearson Education, 2004.
3. Programmable Logic Controllers, W. Bolton,4th Edition, 2006
4. Frank D. Petruzella, "Programmable Logic Controllers", Third Edition, Tata McGraw Hill Education Private Limited, 2010.
5. Learning Programmable Logic Controllers with Applications, PK Srivstava, BPB Publications.
6. Practical SCADA for Industry David Bailey BEng, Bailey and Associates, Perth, Australia (2003)

T. Y. B.Sc. Semester VI		
Title of the Course and Course Code	**Optoelectronics** **ELS3605**	**Number of Credits :2**
Course Outcomes (COs) **On completion of the course, the students will be able to:**		
CO1	Describe the phenomena such as polarization, diffraction, interference, and coherence related to wave nature of light.	
CO2	Distinguish between various types of luminescence by method of excitation.	
CO3	Outline the selection criterion of display devices, optical sources, and photodetectors for various applications.	
CO4	Categorize various types of optical sources, photodetectors, and display devices.	
CO5	Review various measurement techniques used for characterization of optical fiber.	
CO6	Prepare a report on commercially available displays, optical - sources, detectors, fibers, cables and connectors.	

Unit. No	**Title of Unit and Contents**	**No. of Lectures**
I	**Overview of Optics** Wave nature of light - Polarization, superposition principle, interference, diffraction, optical components, light sources- black body radiation, line sources, Modulation of light - Linear, circular, and elliptical polarization, birefringence, electro-optic effects, Kerr modulator, magneto-optic effect, acousto-optic effect.	**6**

II	**Display Devices and Lasers** Light Emitting Diodes: Luminescence, photoluminescence, Electroluminescence, Injection- luminescence and the light emitting diode, LED - materials, construction, response time, efficiency, and spectral response, plasma displays, display brightness, liquid crystal displays, Numeric displays. Lasers: Interaction of radiation and matter, Einstein coefficients, Condition for amplification, laser cavity, threshold for laser oscillation, line shape function. Examples of common lasers. The semiconductor injection laser diode.	**12**
III	**Photodetectors** Thermal detectors – thermoelectric, bolometer, pneumatic, pyroelectric. Photon devices – photoemissive devices, vacuum photodiodes, photomultiplier tube, photoconductive detectors, PN detector, PIN detector, avalanche photodiode, detector arrays, solar cell.	**6**
IV	**Fundamentals of Optical Fibers** Total internal reflection, planer optical waveguide, optical fiber waveguide - step index multimode fiber, intermodal dispersion, graded index fibers, Single-mode fibers, fiber materials and types, dispersion in Single-mode fibers, losses in fibers, fiber - material, manufacturing, cables, and connectors Measurement of fiber characteristics – fiber attenuation and dispersion measurements, numerical aperture measurement, cut-off wavelengths of single mode fiber, refractive index profile measurement, optical time domain reflectometer (OTDR).	**12**

References:

1. J. Wilson and J. F. B. Hawkes, Optoelectronics: An Introduction, Prentice Hall India (1996).
2. S. O. Kasap, Optoelectronics and Photonics: Principles and Practices, Pearson Education (2009).
3. Vladimir Protopopov, Practical Opto-Electronics - An Illustrated Guide for the Laboratory, (z-lib.org).
4. John M. Senior, Optical Fiber Communications Principles and Practice, Third Edition, Pearson Education Limited (2009).
5. R. P. Khare, Fiber optics and optoelectronics oxford University Press.
6. Govind P. Agrawal, Fiber-Optic Communications Systems, Third Edition, John Wiley & Sons, (2002).
7. Ghatak A.K. and Thyagarajan K., "Introduction to fiber optics," Cambridge Univ. Press. (1998).

T. Y. B.Sc. Semester VI		
Title of the Course and Course Code	**Semiconductor Device Technology ELS3606**	**Number of Credits :2**
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Outline the basic fabrication steps used in semiconductor process technology	
CO2	Discuss various crystal growth methods and defects in semiconductor materials.	
CO3	Illustrate oxidation and impurity doping in semiconductors.	
CO4	Distinguish various lithographic, etching and metallization techniques used in device fabrication.	
CO5	Compare the various technologies techniques used for device and IC fabrication and specify the challenges for integration.	
CO6	Build an idea on process integration – NMOS, CMOS and Bipolar process.	

Unit. No.	Title of Unit and Contents	No. of Lectures
I	**Introduction to Semiconductor Technology** Semiconductor Materials, Semiconductor Devices, Semiconductor Process Technology, Basic Fabrication Steps **Crystal Growth:** Silicon Crystal Growth from the Melt, Czochralski (CZ) technique, Silicon Float-Zone Process, GaAs crystal growth, techniques, material characterization, epitaxial-growth techniques, structures, and defects in epitaxial layers **Film Deposition Techniques:** Dielectric Deposition, Polysilicon Deposition, Metallization	**8**
II	**Oxidation, Diffusion, and Ion Implantation** **Oxidation:** Thermal Oxidation, Chemical Vapor Deposition (CVD) of Dielectrics and Polysilicon Metallization, Kinetics of Growth, Thin Oxide Growth, Oxide Quality, Oxide Thickness Characterization **Impurity Doping:** Basic Diffusion Process, Diffusion Equation, Diffusion Profile, Extrinsic Diffusion, Lateral Diffusion, Doping through Ion Implantation, and its comparison with diffusion.	**8**
III	**Lithography and Etching and Metallization** **Lithography:** Optical Lithography, Next-Generation Lithographic Methods, and their comparison, **Etching:** Wet Chemical Etching, Dry Etching, Etch Mechanism, Plasma Diagnostics, Reactive Plasma Etching techniques and equipment and Applications. **Metallization:** Physical Vapor Deposition (PVD) and CVD technique for Aluminium and Copper Metallization.	**10**
IV	**Process Integration and IC Manufacturing** Passive components, Bipolar Technology, MOS/MES-FET Technology, MEMS Technology, Challenges for Nanoelectronics	**10**

	Packaging: Testing, Wafer thinning and Die Separation, Die Attachment, Wire Bonding techniques, Packaging types - TO, DIP, Pin Grid Arrays (PGAs), Leadless Chip Carriers (LCQ), Packages for Surface Mounting, Flip Chip and Tape Automated Bonding Processes – Flip Chip Technology Ball Grid Array (BGA), The Tape Automated Bonding (TAB) Process, Chip Scale Packages, **Yield:** Uniform and Nonuniform Defect Densities	

References

1. Gary S.May and S.M.Sze, Fundamentals of Semiconductor Fabrication, John Wiley & Sons (2004)
2. S.M. Sze and M.K. Lee, Semiconductor Devices Physics and Technology, Physics and Technology, John Wiley & Sons, (2012).
3. Richard C. Jaeger, Introduction to Microelectronic Fabrication, Second Edition, Prentke-Hall (2002).
4. Andrea Chen Randy Hsiao-Yu Lo, Semiconductor Packaging: Materials Interaction and Reliability, CRC Press (2012).
5. MITopencourseware, Course No. 6.774, Physics of Microfabrication, https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-774-physics-ofmicrofabrication-front-end-processing-fall-2004/

T. Y. B.Sc. Semester VI		
Title of the Course and Course Code	**Electronics Practical-IV** **ELS3607**	**Number of Credits :2**
Course Outcomes (COs) **On completion of the course, the students will be able to:**		
CO1	Define the objectives of a given experiment.	
CO2	Summarise the observations taken during the experimentation and tabulate the results.	
CO3	Demonstrate the use of automation systems.	
CO4	Compare the results of conducted experiments with the expected outcomes.	
CO5	Select the appropriate components, I/O devices and measuring equipment for given experiment.	
CO6	Develop a PLC programs for different applications and implement it on a given PLC.	

Experiments: Modern Communication Systems (Any 3/4)

1. Sampling Theorem
2. BPSK Modulation and Demodulation
3. QPSK Modulation and Demodulation
4. Pulse Code Modulation and Demodulation
5. Delta Modulation and Demodulation

6. Time division multiplexing
7. Various line codes (Data Formats)
8. Various line code with decoding

Experiments: Industrial Automation (Any 3/4)

1. ON – OFF controller
2. Two Position controller
3. P/ PI/ PID control
4. PLC Ladder Programming – Basic logic gates
5. PLC Ladder Programming – Timers, counters, and shift registers
6. ON – OFF controller using PLC
7. PLC Applications: Elevator cart / Bottle filling / Sorting system /Water level controller

Experiments: Optoelectronics (Any 3/4)

1. Characteristics of LEDs
2. Characteristics of Photodetectors.
3. Diffraction experiments using a laser.
4. Study of propagation loss in optical fibers
5. Study of bending loss in fibers
6. Setting up of fiber optic voice link
7. Measurement of Numerical Aperture
8. Fiber in sensor application
9. Design of fiber optic Transmitter
10. Design of fiber optic Receiver

T. Y. B.Sc. Semester VI		
Title of the Course and Course Code	**Electronics Practical-V** **ELS3608**	**Number of Credits :2**
Course Outcomes (COs) **On completion of the course, the students will be able to:**		
CO1	Identify the experimental skills	
CO2	Discuss the logic for implementation of a software program	
CO3	Demonstrate the program strategy using algorithm / flowchart.	
CO4	Analyse the program for different input parameters	
CO5	Determine the outcomes of a software program	
CO6	Modify the software program for different input conditions.	

Experiments: Embedded Systems (Any 5)

1. LED/LED bank information

2. Key switches / Keyboard information
3. LCD interface
4. 7 – Segment 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

Experiments: Verilog (Any 5)

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.
7. 8– bit serial / parallel port design
8. Timer design

T. Y. B.Sc. Semester VI		
Title of the Course and Course Code	**Electronics Practical -VI/ Project-II ELS3609**	**Number of Credits :2**
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Define the aim and objectives of a project.	
CO2	Predict the appropriate hardware/ software platforms required for the execution of the project.	
CO3	Carry out the literature survey related to the topics of the selected project.	
CO4	Compare the actual outcome with expected outcome after testing of the developed project.	
CO5	Test the developed system in different phases.	
CO6	Design and develop a system required to fulfil the objectives of the project.	

For Practical course- Remaining (Minimum 10) experiments based on Practical Course I and II. Or

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 (Concurrent examination) as well as end-semester examination are as follows:

For CE:

1. Project Selection, Reference work, first presentation (10)
2. System development, designing, testing (15)
3. Report writing, Demonstration and presentation (15)
4. Overall Performance (10)

For ESE:

1. Self-Expression, and Communication Skill (10)
2. Demonstration and Presentation (30)
3. Viva voce. (10)

T. Y. B.Sc. Semester VI		
Title of the Course and Course Code	**Computer Hardware and Networking ELS3611**	**Number of Credits :2**
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Identify various parts of computer hardware and networks	
CO2	Discuss the architecture of computer motherboard and IO devices	
CO3	Demonstrate the steps of assembling a PC.	
CO4	Analyse the characteristics and topologies of computer networks	
CO5	Review and conduct survey various organizations to obtain networking requirements.	
CO6	Propose a preventive maintenance schedule for computer hardware and network setup.	

Unit. No.	**Title of Unit and Contents**	**No. of Lectures**
I	**An Overview of System and Components:** CPU Cabinet: Power supply, SMPS, Motherboard, CPU, Cables and connectors, Main and auxiliary memory, Front and rear panel study. CPU: Microprocessor as CPU, General block diagram of CPU, CPU bus system, Packing, Cooling, Sockets and slots, **Input and Output Devices:** wired /wireless Keyboard, Mouse, Joystick, Scanner, Digitizers, Light pen, Touch screen, Barcode Scanner Camcorder. Output devices: Monitor (CRT, LCD/ LED Panel,) Printer: Dot Matrix, Inkjet, LASER, Thermal, Plotter, Barcode Printers, Sound devices (Speaker, Headphone, Bluetooth, dongle) **Storage devices:** Types and characteristics, Classification,	15

	Semiconductor, Magnetic, Optical ROM and its types. RAM and its types: SDRAM, EDORAM, DDR Series, Flash RAM. Memory modules, SIMM and DIMMs. Secondary Memory: Hard Disc Drive, Floppy Disc, CDROM, CD R/W, DVD, Pen Drive, flash memories: Mini/micro SD Card. Formatting and Utility Tools for drivers.	
II	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, Standards and models, OSI reference model, IEEE reference models, TCP/IP reference models, Network adapter, addressing, modems, repeaters, Hub, Bridges, Routers and gateways.	15
III	**Preventive maintenance and troubleshooting** Motherboard, I/O devices, storage devices and power supply Network devices, Cables and other faults Cyber security and network threats/attacks	6

Skills:

1. Identification of Computer Hardware parts including peripherals
2. Obtaining technical specifications of PC/Lap top
3. Understand external I/O specifications
4. Installations of PC and other hardware
5. Learn Preventive maintenance procedures.
6. Obtain the networking requirements of organization.
7. Select the network type and hardware requirements.
8. Network cabling and server
9. Network installation
10. Preventive maintenance.

References

1. Upgrading and Repairing of PCs, Scott Muller, Que (2014)
2. IBM PC and Clones: Hardware, troubleshooting and maintenance, B. Govindarajalu, Tata McGraw Hill (2008)
3. Computer Motherboard Testing and Fault finding, S. K. Gupta
4. A+ guide to PC hardware maintenance and repair, Michael Graves, Thompson (2015)
5. Computer Hardware: Barry Blundell, Thompson (2008)
6. www.howstuffworks.com

T. Y. B.Sc. Semester VI		
Title of the Course and Course Code	**IoT and Applications ELS3612**	**Number of Credits :2**
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Define and identify the basic functional blocks of IoT	
CO2	Discuss the elements of IoT implementation technology	
CO3	Demonstrate the implementation of simple IoT system using Ardiono/ Rasbery Pi	
CO4	Identify the integration steps of IoT using python programming	
CO5	Review and classify the data handling and analytics related to IoT with reference to cloud computing.	
CO6	Write a report by comparing the applicability of IoT in Healthcare and Connected vehicles.	

Unit. No.	Title of Unit and Contents	No. of Lectures
I	**Basics of IoT** Introduction to IoT, Sensing, Actuation, Basics of Networking, communication protocols	**6**
II	**Implementation technology** Connectivity technology, Sensor networks, UAV networks, ,machine to machine communication, Introduction to Ardino / Rasbery PI, Integration of sensors and actuators, Python programming, Software defined networking (SDN)	**18**
III	**Advanced topics –** Cloud computing, data handling and analytics, sensor cloud, fog computing	**6**
IV	**Case studies** – Smart cities, connected vehicles, Smart grid, Industrial IoT, Agriculture, Healthcare, Activity Monitoring	**6**

References

1. S. Misra, A. Mukherjee, and A. Roy, 2020. Introduction to IoT. Cambridge University Press.
2. S. Misra, C. Roy, and A. Mukherjee, 2020. Introduction to Industrial Internet of Things and Industry 4.0. CRC Press.
3. https://onlinecourses.nptel.ac.in/noc21_cs17/preview
4. Swayam / NPTEL on line course Introduction to internet of things, By Prof. Sudip Misra, IIT Kharagpur

Importance

Internet of Things (IoT) is presently a hot technology worldwide. Government, academia, and industry are involved in different aspects of research, implementation, and business with IoT. IoT cuts across different application domain verticals ranging from civilian to defence sectors. These domains include agriculture, space, healthcare, manufacturing, construction, water, and mining, which are presently transitioning their legacy infrastructure to support IoT. Today it is possible to

envision pervasive connectivity, storage, and computation, which, in turn, gives rise to building different IoT solutions. IoT-based applications such as innovative shopping system, infrastructure management in both urban and rural areas, remote health monitoring and emergency notification systems, and transportation systems, are gradually relying on IoT based systems. Therefore, it is very important to learn the fundamentals of this emerging technology.