Deccan Education Society's

Fergusson College (Autonomous) Pune

Learning Outcomes-Based Curriculum

For 3/4 years B.Sc. / B.Sc. (Honors) Programme

as per guidelines of

NEP-2020

NEP 1.0

for

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

With effect from

Academic Year

2025-2026

Program Outcomes (POs) for B. Sc.	
PO1	**Disciplinary Knowledge:** Demonstrate comprehensive knowledge of the disciplines that form a part of a graduate programme. Execute strong theoretical and practical understanding generated from the specific graduate programme in the area of work.
PO2	**Critical Thinking and Problem solving:** Exhibit the skills of analysis, inference, interpretation and problem solving by observing the situation closely and design the solutions.
PO3	**Social competence:** Display the understanding, behavioral skills needed for successful social adaptation, working in groups, exhibiting thoughts and ideas effectively in written and oral formats.
PO4	**Research-related skills and Scientific temper:** Develop the working knowledge and implementation skills about instrumentation and laboratory techniques to design and conduct independent experiments, interpret and establish hypothesis and create inquisitiveness towards research.
PO5	**Trans-disciplinary knowledge:** Integrate various disciplines to uplift the domains of cognitive abilities and transcend beyond discipline-specific approaches to address a common problem.
PO6	**Personal and professional competence:** Perform dependently as well as collaboratively to meet defined objectives and carry out work across interdisciplinary fields. Execute interpersonal relationships, self-motivation and adaptability skills and commit to professional ethics.
PO7	**Effective Citizenship and Ethics:** Demonstrate empathetic social concern and equity centered national development and ability to act with an informed awareness of moral and ethical issues and commit to professional ethics and responsibility.
PO8	**Environment and Sustainability:** Understand the impact of the scientific solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.
PO9	**Self-directed and Life-long learning:** Acquire the ability to engage in independent and life-long learning in the broadest context of socio-technological changes.

Deccan Education Society's
Fergusson College (Autonomous), Pune-4
Department of Electronic Science

Syllabi NEP 1.0 Implemented from Academic Year 2025-26
T.Y.B.Sc. Electronic Science Semester: V and VI

Program Specific Outcomes (PSOs)

PSO	Outcomes
PSO1	**Academic competence:** Apply the knowledge, facts, and rules of basic and applied sciences (Physics, Chemistry, Mathematics, and Statistics) to understand Electronic Science's elements. Identify basic elements and systems of the real analog world and modern digital world.
PSO2	**Personal and Professional Competence:** Demonstrate the ability to build and test basic blocks of modern digital systems and computers. Operate basic and advanced tools and Instruments. Discuss performance parameters for the selection of different sensors, actuators, and linear and digital ICs.
PSO3	**Research Competence:** Design and build electronic systems in various domains like computers, consumer products, medical instrumentation, transportation, agriculture, and defense. Formulate and provide creative, innovative, and effective solutions to real-world problems using hardware-software co-design tools for microcontroller / embedded systems and IoTs. Develop and utilize modern tools (like PSPICE, MATLAB, and Simulink) for mathematical modelling and simulation for future-ready systems.
PSO4	**Entrepreneurial and Social Competence:** Integrate skills of independent thinking, taking initiative, effective team-building, and leadership through real-life projects.

T. Y. B.Sc. Electronic Science NEP 1.0						
Semester	Paper	Paper Code	Title	Type	Credits	Exam Type
V	Major	ELS-301	Electronic Communication	Theory	2	CE+ESE
		ELS-302	Application Specific Design	Theory	2	CE+ESE
		ELS-303	Sensors and Actuators	Theory	2	CE+ESE
	Elective	ELS-304	Power Electronics	Theory	2	CE+ESE
		OR ELS-305	OR Nanotechnology	Theory	2	CE+ESE
		ELS-306	Microprocessors and Microcontrollers	Theory	2	CE+ESE
		OR ELS-307	OR Smart Systems	Theory	2	CE+ESE
	Major	ELS-311	Electronic Science Practical-5	Practical	2	CE+ESE
		ELS-312	Electronic Science Practical-6	Practical	2	CE+ESE
	VSC	ELS-331	Electronic Instruments	Theory	2	CE
		ELS-332	Electronic Science Practical-7 (Project)	Practical	2	CE
	Minor	ELS-321	Signal Conditioning Techniques	Theory	2	CE+ESE
	FP	ELS-345	Field Project	Theory / Practical	2	CE
VI	Major	ELS-351	Communication Systems	Theory	2	CE+ESE
		ELS-352	Designing with Verilog	Theory	2	CE+ESE
		ELS-353	Industrial Automation	Theory	2	CE+ESE
	Elective	ELS-354	Optoelectronics	Theory	2	CE+ESE
		OR ELS-355	OR Computer Hardware and Networks	Theory	2	CE+ESE
		ELS-356	Embedded Systems	Theory	2	CE+ESE
		OR ELS-357	OR Biomedical Instrumentation	Theory	2	CE+ESE
	Major	ELS-361	Electronic Science Practical-8	Practical	2	CE+ESE
		ELS-362	Electronic Science Practical-9	Practical	2	CE+ESE
	VSC	ELS-382	Electronic Science Practical-10 (Project)	Practical	2	CE
	Minor	ELS-371	Instrument Maintenance	Theory	2	CE+ESE
	OJT	ELS-395	**On Job Training**	Theory / Practical	4	CE
V CS	Minor	ELS-322	Wireless Communication	Theory	2	CE+ESE
VI CS	Minor	ELS-372	IoT Applications	Theory	2	CE+ESE

	ELS-301 - Electronic Communication **Major-Theory**	
	Number of Credits: 02 **No. of Hours:30**	
Course Outcomes (COs) **On completion of the course, the students will be able to:**		**Bloom's cognitive level**
CO1	Define various terminologies of electronic communication systems.	1
CO2	Describe various concepts, block diagrams, waveforms for various signals, and modulator-demodulator circuits of communication systems.	2
CO3	Apply various concepts of modulation and demodulation techniques to realize actual designing circuits.	3
CO4	Explain various radio transmitters and receivers along with characteristics and problems	4

ELS-301- Electronic Communication
(Major- Theory)

Unit No.	Title of Unit and Contents	No. of hours
1	**Principles of Electronic Communication** Communication systems – Significance and basic concepts and terminologies of communication, types/classification/modes of communication, Electronic communication system, Electromagnetic (EM) spectrum, concepts - bandwidth, gain, Block diagrams of Basic and Generalized communication system Introduction to Modulation and need/advantages of Modulation.	**6**
2	**Amplitude modulation (AM) and demodulation** AM concepts, modulation index, sidebands, frequency domain analysis, AM power, AM modulator circuit, concept of Bandwidth adjustment, double sideband (DSB) modulation, Balanced modulators, single sideband (SSB) modulation, SSB generation, Concept of vestigial sideband (VSB)	**8**

3	**Frequency modulation (FM) and demodulation** Concepts of frequency and phase modulations (FM and PM), modulation index, sidebands, FM Vs AM, modulator and demodulator circuits for FM	**8**
4	**Radio transmitters and receivers** Transmitter fundamentals, transmitter circuits- carrier generators, power amplifiers, concept and need of impedance matching, TRF and Superheterodyne receiver, concept of image frequency, noise and its basic types, receiver characteristics	**8**

Learning Resources- References

Sr. No.	References
1.	Electronic Communications- Dennis Roddy, John Coolen (4th edition), Pearson Publication
2.	Principles of Electronic Communication systems - Louis Frenzel (4th edition), McGraw Hill
3.	Electronic Communication systems -George Kennedy, Bernard Davis, TMC (2009)

	ELS-302 - Application Specific Design **Major Theory**	
	Number of Credits: 02 No. of Hours:30	
Course Outcomes (COs) **On completion of the course, the students will be able to:**		**Bloom's cognitive level**
CO1	Identify various types of amplifiers, their standard design procedure, and applications.	1
CO2	Explain various sensor and transducer interfacing circuits	2
CO3	Illustrate various types of application circuits designed using Opamp and linear ICs.	3
CO4	Analyze various active filters, signal generators, PLL applications, power supplies, etc.	4

ELS-302 - Application Specific Design
(Major- Theory)

Unit No.	**Title of Unit and Contents**	**No. of hours**
1	**Amplifier design** Use of standard design procedures and applications of – audio mixer, multi- channel amplifier, averaging amplifier, single supply operation, difference amplifier - 2 and 3 Opamp instrumentation amplifier, servo amplifier, Class-D Amplifier.	**4**
2	**Op amp Applications** Active filters – Types and Comparison, low pass, high pass, band pass and notch filters, with roll-off rate of 20, 40, 60 dB/decade, clipper-clamper, precision rectifier, peak detector, AC to DC converter, Voltage-to-frequency and Frequency-to-voltage converter, log-antilog amplifier.	**4**
3	**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 and strain gauge interfacing.	**10**

4	**Linear ICs With Mixed Signals** 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**

Learning Resources- References

Sr. No.	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 Bhaskaran, 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).

	ELS-303 - Sensors and Actuators **Major Theory**	
	Number of Credits: 02 **No. of Hours:30**	
Course Outcomes (COs) **On completion of the course, the students will be able to:**		**Bloom's cognitive level**
CO1	Define and list various sensors, actuators, power control devices, motors, and bus types used in digital transmission, signal conditioning, and wireless transmission.	1
CO2	Explain the operating principles, construction, and specifications of various sensors, Actuators, general sensor conditioning, transmission Standards. and wireless communication.	2
CO3	Classifications of sensors and actuators, Illustrating signal conditioning, transmission standards, and wireless communication.	3
CO4	Compares various valves, power devices, and pneumatic and hydraulic actuators, and explains the basic performance parameters of sensors, actuators, signal conditioning, and transmission.	4

ELS-303 - Sensors and Actuators
(Major- Theory)

Unit No.	Title of Unit and Contents	No. of hours
1	**Fundamentals of Sensors:** Need of sensors, Definition, Types of sensors, Classification, Operating principle, input-output parameters, Examples of devices, Specification and performance parameters, Accuracy, Resolution, Threshold, impedance, Sensitivity, Hysteresis, Linearity, Range, Reliability, Selectivity	**6**
2	**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 sensors	**12**

3	**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	**6**
4	**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. Pneumatic Transmission, Analog Transmission, Digital Transmission - Transmission Standards, Types of Serial buses, RS232, RS422, RS485, 4-20 current loop, Wireless transmission (in brief).	**6**

Learning Resources- References

Sr. No.	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,
3.	Edwin Wright, Deon Reynders, John Park, Newness, Elsevier (2004).
4.	Practical Telecommunications and Wireless Communications for Business and Industry Edwin Wright, Deon Reynders, Newness, Elsevier (2004).
5.	Sensors and Transducers, Dr. A.D. Shaligram, Chintan Publication (2013)
6.	Sensors and Transducers, D Patranabis, Prentice Hall Publication (2008)
7.	Sensors and Transducers, Principles and Applications, R.Y. Borse, Adhyan Publishers & Distributors, New Delhi (2012)

	ELS-304 - Power Electronics **Elective-Theory**	
	Number of Credits: **02 No. of Hours:30**	
Course Outcomes (COs) **On completion of the course, the students will be able to:**		**Bloom's cognitive level**
CO1	Identify various devices, and circuits in power electronics and outline their role in power electronic applications.	1
CO2	Discuss drive and protection circuits of power devices	2
CO3	Illustrate the role of power converters in industrial, commercial, and residential applications.	3
CO4	Classify various power converters, and general converter topologies and illustrate their use in power conversion and power transmission.	4

ELS -304 - Power Electronics
(Elective - Theory)

Unit No.	Title of Unit and Contents	No. of hours
1	**Introduction to Power Electronics** Definition and applications, Power semiconductor devices - characteristics, Power converters, single phase and three phase, magnetic circuits.	2
2	**Power Devices, Protection and Driving circuits** Power Diodes- Steady state and reverse recovery characteristics, types, diode with different loads, diode in series and parallel, free-wheeling 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 or gate driving circuits, Diac, Triac, GTO. Protections: Voltage and current protections, heat sinks, EMI shielding.	6

3	**Power Converters** Rectifiers: Performance parameters, half wave, Full wave center 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 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.	14
4	**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.	8

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

Learning Resources- References

Sr. No.	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).

	ELS-305 - Nanotechnology **ElectiveTheory**	
	Number of Credits: 02 **No. of Hours:30**	
Course Outcomes (COs) **On completion of the course, the students will be able to:**		**Bloom's cognitive level**
CO1	Identify various nanomaterials, and outline their role in nanoscience and nanotechnology.	1
CO2	Discuss the various nanostructures and materials associated with nanotechnology	2
CO3	Illustrate the role of nanotechnology in the sectors of medicine, health care, and environment	3
CO4	Classify various applications of nanotechnology in specifically energy and integrated circuit technology.	4

ELS-305 - Nanotechnology
(Elective - Theory)

Unit No.	Title of Unit and Contents	No. of hours
1	**Introduction to nano-science and nanotechnology**: Definition, nanometer scale, nano-material. Nanoscience in nature: natural nonmaterial. Material properties at nanoscale: surface properties, electrical properties, optical properties, magnetic properties and mechanical properties.	10
2	**Overview of nano materials** 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	10
3	**Applications** 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	10

Learning Resources- References

Sr. No.	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)

	ELS-306 - Microprocessors and Microcontrollers **Elective-Theory**	
	Number of Credits: 02 **No. of Hours:30**	
Course Outcomes (COs) **On completion of the course, the students will be able to:**		**Bloom's cognitive level**
CO1	Understand the evolution, architecture, and interfacing of microprocessors and microcontrollers	1
CO2	Explain the features, functionalities, and addressing modes of microprocessors, microcontrollers, and their peripherals.	2
CO3	Analyze the operation, instruction sets, and interfacing techniques of microprocessors and microcontrollers.	3
CO4	Design and implement systems using microprocessors, microcontrollers, and peripheral interfacing techniques.	4

ELS-306 - Microprocessors and Microcontrollers
(Elective- Theory)

Unit No.	Title of Unit and Contents	No. of hours
1	**Evolution of Microprocessors and Microcontrollers** 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	**04**
2	**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, stack and stack pointer, timers and timer registers, serial communication and port registers, interrupts and interrupt registers.	**06**
3	**Instruction Set & assembly language programming.** Different groups 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.	**10**

4	**Basic interfacing and case studies** Switches, LED, LCD, seven-segment display, Keyboard interfacing, and case studies.	**10**

Learning Resources- References

Sr. No.	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,

	ELS-307 - Smart Systems **Elective-Theory**	
	Number of Credits: 02 **No. of Hours:30**	
Course Outcomes (COs) **On completion of the course, the students will be able to:**		**Bloom's cognitive level**
CO1	Explain the characteristics, challenges, and applications of smart systems in various sectors.	1
CO2	Describe the components of smart systems, including sensors, actuators, and energy harvesting systems, and their roles.	2
CO3	Design and simulate smart systems using integration technologies like signal processing, neural networks, and virtual instrumentation.	3
CO4	Analyze and evaluate case studies of smart systems in domains like smart cities, healthcare, and IoT.	4

ELS-307 - Smart Systems
(Elective - Theory)

Unit No.	Title of Unit and Contents	No. of hours
1	**Characteristics and Applications** Characteristics- development and challenges, Applications – environment, automotive sector, IOT, healthcare	**04**
2	**Elements of smart systems** Sensors, transmitting system, command and control unit, decision making, Actuators, Energy harvesting systems.	**10**
3	**Integration technologies** 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	**10**
4	**Case studies** 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.	**06**

Learning Resources- References

Sr. No.	References
1.	Smart systems integration and simulation, Nicola Bombieri, etc., Springer International (2016)
2.	Micro and smart systems, G. K Anantha Suresh, etc. Wiley (2012)

	ELS-311 - Electronic Science **Practical-5 Major-Practical**	
	Number of Credits: 02 **No. of. Hours: 30**	
Course Outcomes (COs) **On completion of the course, the students will be able to:**		**Bloom's cognitive level**
CO1	List and define the objectives of a given experiment.	1
CO2	Interpret the results obtained and validate them.	2
CO3	Carry out experiments and tabulate the results.	3
CO4	Compare the results of an experiment with the desired output.	4

ELS-311 - Electronic Science Practical-5
(Major-Practical)

Sr. No.	List of Experiments (Any 10)	
1	**Communication Electronics (Any 3/4)** i) AM transmitter and Receiver ii) FM Transmitter and Receiver iii) SSB Modulator and Demodulator iv) Frequency Modulator using VCO	
2	**Design with Linear ICs (Any 3/4)** i) Current Transmitter - 4 to 20mA / light level sensing. ii) V to f / f to V converter iii) Precision rectifier/ Peak detector iv) Second order Active filters – HP/ LP/ BP/ BR v) Function generator vi) Comparator Applications: Level control/Window detector/Power-supply monitor/On-Off control vii) Foldback current limiting viii) Class D amplifier. ix) PLL characteristics / PLL application	

3	**Sensors and Actuators (Any 3/4)** i) Temperature measurements system (any 2 sensors) ii) Light Sensors measurements system (any 2 sensors) iii) Load cell/ Gas sensor system iv) Proximity/ optical sensor system v) Level sensors vi) Displacement Measurement/ Displacement measurement using LVDT. vii) Motor – DC/AC/Stepper/Sensor viii) Solenoid/ Piezo Sensor	
4	i) Power Electronics (Any 3/4) ii) Buck/ Boost regulator iii) DC Chopper / Two Quadrant Chopper iv) Single phase Bridge Inverter v) Single phase Semi-/Full-/-Dual Converter vi) Single phase AC Regulator vii) Light intensity regulator / Fan Regulator viii) AC/DC Static Switches ix) Study of DC Drive	

Or any other equivalent experiment

	ELS-312 - Electronic Science **Practical-6 Major-Practical**	
	Number of Credits: 02 **No. of Hours: 30**	
Course Outcomes (COs) **On completion of the course, the students will be able to:**		**Bloom's cognitive level**
CO1	Write and debug assembly programs for arithmetic, logic, loops, code conversion, subroutines, and timers.	1
CO2	Analyze and simulate circuits in LTspice, including DC circuits, rectifiers, filters, and comparators.	2
CO3	Solve equations, simulate electrical networks, and generate modulation signals in MATLAB/OCTAVE.	3
CO4	Integrate assembly programming, circuit analysis, and simulations to solve problems.	4

ELS-312 - Electronic Science Practical-6
(Major-Practical)

Sr. No.	**List of Experiments (Any 10)**	
1	**Assembly Language Programming – Basic exercise (Any 5)** i) Arithmetic / Logical Problems ii) Loop structure iii) Code conversion iv) Subroutines v) Timer programming	
2	**Basic exercise based on LTSPICE (Any 2)** i) DC circuit analysis ii) Rectifier and diode clamping circuit iii) Passive and active circuits iv) Active and Passive filters v) Schmitt trigger/ Comparator	
3	**Exercises based on MATLAB/OCTAVE (Any 3)** i) Solving mathematical equations ii) 2D and 3D plot generation	
4	iii) Solve node and mesh equations of electrical networks iv) Generate Analog Modulation and Demodulation Signals	

Or any other equivalent experiment

	ELS-331 - Electronic Instruments **VSC-Theory**	
	Number of Credits: 02 **No. of Hours:30**	
Course Outcomes (COs) **On completion of the course, the students will be able to:**		**Bloom's cognitive level**
CO1	Impart with the knowledge of generalized measurement systems	1
CO2	Learn the characteristics of various types of measurement systems and errors in measuring instruments.	2
CO3	Understand the concepts of Ammeters, Voltmeter, and Multimeters	3
CO4	Impart with the basic concepts of CRO and its usage for the measurement of various parameters.	4

ELS-331 - Electronic Instruments
(VSC- Theory)

Unit No.	Title of Unit and Contents	No. of hours
1	**Fundamentals of measurements:** Introduction, Significance of measurements, methods of measurements, instruments and measurement systems, Functions of instruments and measurement systems, Applications of measurement systems. Measurement Errors: Introduction Gross errors and systematic errors, Absolute and relative errors, basic concepts of accuracy, Precision, Resolution and Significant figures, Measurement error combinations. (relevant problems)	**10**
2	**Ammeters, Voltmeter and Multimeters:** DC ammeter (principle only), DC voltmeter, multi-range voltmeter, extending voltmeter ranges, Loading, Peak responding and True RMS voltmeters. (relevant problems) Digital Multimeter, Digital frequency meters: Basic circuit of a Digital frequency meter, Basic circuit for frequency measurement. Oscilloscopes: Introduction, Basic principles, CRT features, Block diagram and working of each block, Typical CRT connections, Dual beam and dual trace CROs, Electronic switch. Digital storage oscilloscopes: Basic DSO operation Only Bridge Circuits for Measurement of R, L & C: DC bridges: Introduction, Wheatstone's	**15**

	bridge, Kelvin Bridge AC bridges: Capacitance Comparison Bridge, inductance Comparison Bridge, Maxwell's bridge, Schering Bridge. (relevant problems)	
3	**Power supplies** Fixed and variable power supplies - CVCC, SMPS and UPS (on-line and off-line), typical functions and specifications.	**5**

Learning Resources- References

Sr. No.	References
1.	Electronic Instrumentation, H. S. Kalsi, TMH (2006)
2.	Electronic Instrumentation and Measurement Techniques, W.D. Cooper and A. D. Helfrick, Prentice- Hall (2005)

	ELS-332 - Electronic Science Practical-7 (Project) VSC-Theory	
	Number of Credits: 02 No. of. Hours:30	
Course Outcomes (COs) On completion of the course, the students will be able to:		**Bloom's cognitive level**
CO1	Define the aim and objectives of a project.	1
CO2	Predict the appropriate hardware/software platforms required for the execution of the project and carry out the literature survey related to the selected project.	2
CO3	Carry out the testing and compare the actual outcome with an expected outcome	3
CO4	Complete the development of the system required to fulfill the objectives of the project.	4

ELS-332 - Electronic Science Practical-7 (Project)
(VSC- Practical)

Sr. No.	Guideline of the project course	
	For Practical course- Remaining (Minimum 10) experiments based on Practical Courses I and II. Or **For the project course**, students can select a project related to any domain relevant to electronic Science. The student should report about the progress of a project to the guide at least once a week. A long book of the continuous progress of the work should be maintained by the candidate. A copy of the 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, **CE**) as well as end-semester examination (**ESE**) are as follows: **For CE:** 1. Project Selection, Reference work, first presentation 2. System development, designing, testing 3. Report writing, Demonstration and presentation 4. Overall Performance **For ESE:** 1. Self-Expression, and Communication Skill 2. Demonstration and Presentation 3. Viva voce.	

	ELS-321 - Signal Conditioning Techniques **Minor-Theory**	
	Number of Credits: 02 **No. of Hours:30**	
Course Outcomes (COs) **On completion of the course, the students will be able to:**		**Bloom's cognitive level**
CO1	Cite sensors or transducers, their characteristics, limitations, and selection criteria. for signal conditioning.	1
CO2	Apply signal amplification, filtering, and conditioning techniques to design and analyze instrumentation systems.	2
CO3	Analyze ADC and DAC systems, focusing on resolution, sampling rates, and signal processing.	3
CO4	Design signal isolation, surge protection, and grounding systems for improved instrumentation safety.	4

ELS-321 - Signal Conditioning Techniques
(Minor-Theory)

Unit No.	Title of Unit and Contents	No. of hours
1	**Introduction to Signal Conditioning** Overview of Signal Conditioning: Importance in Measurement and Instrumentation, Signal Types: Analog and Digital, Characteristics of Signals: Amplitude, Frequency, Phase, Noise. Sensors and Transducers: Role of Sensors in Signal Conditioning, Types of Sensors (Temperature, Pressure, Displacement, etc.), Selection Criteria for Sensors, Sensor Characteristics and Limitations.	**06**
2	**Signal Amplification:** Types of Amplifiers: Operational, Instrumentation, Differentia, Amplifier Configurations and Characteristics, Noise Reduction in Amplifiers, Voltage and Current Amplifiers. Filtering Techniques: Basics of Filtering, Types of Filters: Low-pass, High-pass, Band-pass, Band-stop, Active and Passive Filters, Filter Design Principles.	**10**
3	**Analog-to-Digital Conversion (ADC) and Digital-to-Analog Conversion (DAC)** Importance of ADC and DAC in Signal Processing, ADC Techniques: Flash, Successive Approximation, Delta-Sigma, DAC Techniques: R-2R	**10**

	Ladder, Weighted Resistor, Resolution and Sampling Rate. Isolation and Protection- Need for Signal Isolation, Techniques: Optical Isolation, Transformer Isolation, Surge Protection, Grounding and Shielding.	
4	**Signal Conditioning Circuits** Bridge Circuits: Wheatstone Bridge, Temperature Measurement Bridges, Analog Signal Processing Circuits, Signal Modulation and Demodulation, Use of Multiplexers and Demultiplexers.	**04**

Learning Resources- References

Sr. No.	References
1.	Electronic Instrumentation, H. S. Kalsi, TMH (2006)
2.	Electronic Instrumentation and Measurement Techniques, W.D. Cooper and A. D. Helfrick, Prentice- Hall (2005).

	ELS-345 - Field Project **FP-Theory/ Practical**	
	Number of Credits: 02 **No. of Hours:30**	
Course Outcomes (COs) **On completion of the course, the students will be able to:**		**Bloom's cognitive level**
CO1	**Community Engagement Programme / Field Project Guideline**	1
CO2		2
CO3		3
CO4		4

<u>As per the guidelines, to be given by the college</u>

T. Y. B. Sc. SEM VI		
	ELS 351 - Communication Systems **Major Theory**	
	Number of **Credits: 02 No. of** **Hours:30**	
Course Outcomes (COs) **On completion of the course, the students will be able to:**		**Bloom's cognitive level**
CO1	Identify various blocks in electronic Communication systems and name their basic functions	1
CO2	Explain the construction of various antennas, types of digital communication techniques	2
CO3	Apply the communication systems principles for digital and data communication.	3
CO4	Classify various antennae used in day-to-day life.	4

ELS-351 - Communication Systems
(Major- Theory)

Unit No.	Title of Unit and Contents	No. of hours
1	**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
2	**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
3	**Digital data transmission** Characteristics of the data transmission system, digital codes-Unipolar, bipolar, RZ, NRZ, AMI, Manchester, Differential Manchester, error detection and correction techniques.	6

4	**Modems and Telecommunication systems** 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	4

Learning Resources- References

Sr. No.	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)
3.	Digital and Analog Communication Systems (8th edition), Leon W. Couch, Pearson (2013)
4.	Modern Digital and Analog Communication Systems (4th edition), B. P. Lathi, Zhi Ding, Oxford University Press (2009)
5.	Communication Systems (5th edition), Simon Haykin, McGraw Hill Education (2009)
6.	Wireless Communications: Principles and Practice (2nd edition), Theodore S. Rappaport, Pearson (2002).

	ELS-352 - Designing with Verilog Major-Theory	
	Number of Credits: 02 No. of Hours:30	
Course Outcomes (COs) On completion of the course, the students will be able to:		**Bloom's cognitive level**
CO1	Identify, define, state, list, and name the terminologies of Verilog HDL	1
CO2	Describe various concepts, methodologies, and blocks of Verilog HDL	2
CO3	Illustrate various concepts and terminologies in Verilog programming to realize the actual designing of combinational and sequential circuits.	3
CO4	Analyze the given Verilog description to understand and debug the simulation and results	4

ELS-352 - Designing with Verilog
(Major- Theory)

Unit No.	Title of Unit and Contents	No. of hours
1	**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 design methodology, Bottom-up design methodology, 4 levels of abstraction in Verilog- Behavioral level, Dataflow level, Gate level, and Switch level, the concept of Verilog module, I/O 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, keywords, 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.	**14**

	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.	
2	**Designing of combinational circuits using Verilog** Multiplexer, Demultiplexer, Encoder, Decoder, Half Adder, Full Adder etc. in various levels of abstraction	**7**
3	**Designing of sequential circuits using Verilog** Various types of Flip Flops, Counters, and Shift register etc in various levels of abstraction	**7**
4	**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**

Learning Resources- References

Sr. No.	References
1.	Verilog HDL - A guide to digital design & synthesis, Samir Palnitkar, Pearson Second Edition (2011)
2.	Digital Design: with an introduction to Verilog HDL, 5/e, M. Morris Mano, Michel D. Ciletti, Pearson Education (2013)
3.	Fundamentals of digital logic with verilog design, Stephan Brown and Zvonko Vranesic, McGraw

	ELS-353 - Industrial Automation Major-Theory	
	Number of Credits: 02 No. of Hours:30	
Course Outcomes (COs) On completion of the course, the students will be able to:		**Bloom's cognitive level**
CO1	Define or identify the basic elements of the process control system for automation, two-position, multi-position, and floating control modes, PID, Batch process PLC, ladder diagrams, function blocks, statement lists, and SCADA.	1
CO2	Discuss various operational modes of process controllers and compare their performance, principle of operation, and selection criteria for PLCs and SCADA	2
CO3	Illustrate control parameters to calculate error and variable range for a given system, controller modes, and ladder diagrams to design basic logic gates in PLC programming and SCADA in modern industrial automation.	3
CO4	Explain process characteristics, various controller modes, batch–process, PLC, ladder diagrams, and SCADA system.	4

ELS-353 - Industrial Automation
(Major- Theory)

Unit No.	Title of Unit and Contents	No. of hours
1	**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, Introduction to Industry 4.0	**6**
2	**Controller modes** Discontinuous controller modes: Two position mode, multi-position 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	**8**

	process	
3	**Programmable logic Controllers and PLC Programming** Historical background, programmable controller and features, principle of operation, architecture, memory, Input/output module regarding sink or source, output module relay, transistor, triac, power supply, selection of PLC, 24V DC input interfaces, sourcing devices, sinking devices, output interface configurations, and wiring. Programming methods- ladder diagrams, function blocks, statement list, programming a PLC, ladder relay programming (digital gates, Boolean expression, flip flop),	**12**
4	**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, Introduction to IIoT	**4**

Learning Resources- References

Sr. No.	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. Practical SCADA for Industry David Bailey BEng, Bailey and Associates, Perth, Australia (2003)

	ELS-354 - Optoelectronics **Elective-Theory**	
	Number of Credits: **02 No. of Hours:30**	
Course Outcomes (COs) **On completion of the course, the students will be able to:**		**Bloom's cognitive level**
CO1	Describe the phenomena such as polarization, diffraction, interference, and coherence related to the wave nature of light.	1
CO2	Distinguish between various types of luminescence by method of excitation.	2
CO3	Outline the selection criterion of display devices, optical sources, and photodetectors for various applications.	3
CO4	Categorize various types of optical sources, photodetectors, and display devices. Explain various measurement techniques used for characterization of optical fiber.	4

ELS-354 - Optoelectronics
(Elective - Theory)

Unit No.	Title of Unit and Contents	No. of hours
1	**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.	**4**
2	**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.	**10**

3	**Photodetectors** Thermal detectors – thermoelectric, bolometer, pneumatic, pyroelectric. Photon devices – photo emissive devices, vacuum photodiodes, photomultiplier tube, photoconductive detectors, PN detector, PIN detector, avalanche photodiode, detector arrays, solar cell.	**4**
4	**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**

Learning Resources- References

Sr. No.	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).

	ELS-355 - Computer Hardware and Networks **Elective-Theory**	
	Number of Credits: **02 No. of Hours:30**	
Course Outcomes (COs) **On completion of the course, the students will be able to:**		**Bloom's cognitive level**
CO1	Identify various parts of computer hardware and networks	1
CO2	Discuss the architecture of the computer motherboard and IO devices	2
CO3	Demonstrate the steps of assembling a PC.	3
CO4	Analyze and explain the characteristics and topologies of computer networks	4

ELS-355 - Computer Hardware and Networks
(Elective - Theory)

Unit No.	Title of Unit and Contents	No. of hours
1	**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, 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.	**12**
2	**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	**12**

	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.	
3	**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.

Learning Resources- References

Sr. No.	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

	ELS-356 - Embedded Systems Elective-Theory	
	Number of Credits: 02 No. of Hours:30	
Course Outcomes (COs) On completion of the course, the students will be able to:		**Bloom's cognitive level**
CO1	Understand the fundamentals of embedded systems, Including architecture, classification, design challenges, and microcontroller selection.	1
CO2	Explain AVR microcontrollers' architecture, features, and functionalities, including registers, memory, and peripherals.	2
CO3	Develop embedded C programs for AVR microcontrollers, focusing on timers, interrupts, serial communication, and real-time scheduling concepts.	3
CO4	Design and implement embedded system applications using interfacing techniques for peripherals like LEDs, sensors, motors, and communication protocols.	4

ELS-356 - Embedded Systems
(Elective - Theory)

Unit No.	Title of Unit and Contents	No. of hours
1	**Introduction to Embedded System** Introduction to Embedded systems, 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 and Harvard architecture, types of microcontrollers, selection of Microcontrollers.	**04**
2	**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, Timer, interrupt, UART, watchdog timer.	**06**

3	**AVR programming in C** Concept of IDE, Data types, time delays in C, arithmetic operations, logical operations, data serialization, memory allocation, programming timers, serial port programming, and interrupt programming.	**08**
4	**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**

Learning Resources- References

Sr. No.	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.

	ELS-357 - Biomedical Instrumentation **Elective-Theory**	
	Number of Credits: **02 No. of Hours:30**	
Course Outcomes (COs) **On completion of the course, the students will be able to:**		**Bloom's cognitive level**
CO1	Understand the principles of bio-potentials and the electrical activity of excitable cells, including ENG, EMG, ECG, and EEG.	1
CO2	Explain the types, functions, and practical considerations of bio-potential electrodes for recording.	2
CO3	Analyze bioelectric recording systems, including amplifier design, noise sources, and writing systems.	3
CO4	Evaluate clinical laboratory instrumentation for blood tests and ensure electrical safety in medical devices to prevent hazards.	4

ELS-357 - Biomedical Instrumentation

(Elective - Theory)

Unit No.	Title of Unit and Contents	No. of hours
1	**Bio-potentials** Electrical activity of excitable cells -Central nervous system functional organization of peripheral nervous system -ENG, EMG, ECG, EEG	10
2	**Bio potential electrodes and Recording systems** 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. 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.	10
3	**Instrumentation for clinical laboratory** Blood: Introduction, Tests: Blood cell counter (conducting method) Chemical tests: Colorimeter (filter-photometer), flame photometer, spectrophotometer. Automation of chemical tests	5
4	**Electrical safety** 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	5

	voltage, ground fault circuit interrupter. Isolation of patient-connected parts. Isolated power distribution system	

Learning Resources- References

Sr. No.	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)

	ELS-361 - Electronic Science Practical- 8 Major-Practical	
	Number of Credits: 02 No. of. Hours:30	
Course Outcomes (COs) On completion of the course, the students will be able to:		**Bloom's cognitive level**
CO1	Define the objectives of a given experiment.	1
CO2	Summarize the observations taken during the experimentation and tabulate the results.	2
CO3	Demonstrate the use of automation systems.	3
CO4	Compare the results of conducted experiments with the expected outcomes	4

ELS-361 - Electronic Science Practical-8
(Major-Practical)

Sr. No.	List of the Experiments (Any 10)	
1	**Modern Communication Systems (Any 3/4)** i) BPSK Modulation and Demodulation ii) QPSK Modulation and Demodulation iii) Pulse Code Modulation and Demodulation iv) Delta Modulation and Demodulation v) Time division multiplexing and Demultiplexer vi) Various line codes (Data Formats) vii) Various line codes with decoding	
2	**Industrial Automation (Any 3/4)** i) ON – OFF controller ii) Two Position controller iii) P/ PI/ PID control iv) PLC Ladder Programming – Basic logic gates v) PLC Ladder Programming – Timers, counters, and shift registers vi) ON – OFF controller using PLC vii) PLC Applications: Elevator cart / Bottle filling / Sorting system /Water level controller	
3	**Optoelectronics (Any 3/4)** i) Characteristics of LEDs ii) Characteristics of Photodetectors.	

	iii) Diffraction experiments using a laser. iv) Study of propagation loss in optical fibers v) Study of bending loss in fibers vi) Setting up of fiber optic voice link vii) Measurement of Numerical Aperture viii) Fiber in sensor application ix) Design of fiber optic Transmitter x) Design of fiber optic Receiver	
4	**Or any other Equivalent experiment**	

	ELS-362 - Electronic Science **Practical-9 Major-Practical**	
	Number of Credits: 02 **No. of. Hours: 60**	
Course Outcomes (COs) **On completion of the course, the students will be able to:**		**Bloom's cognitive level**
CO1	Identify the experimental skills	1
CO2	Discuss the logic for implementation of a software program	2
CO3	Demonstrate the program strategy using an algorithm/flowchart.	3
CO4	Analyze the program for different input parameters	4

ELS-362 - Electronic Science Practical-9
(Major-Practical)

Sr. No.	List of the Experiments (Any 10)	
1	**Embedded Systems (Any 5)** i) Interfacing of LED/ LED Array ii) Interfacing Seven Segment Display iii) Interfacing LCD/ GLCD iv) Sensor interfacing (Temperature, Humidity, etc) v) Intensity Control of LED using PWM vi) Interfacing Stepper Motor / DC motor vii) Key switches / Keyboard viii) Interfacing DAC ix) Interfacing Dot Matrix display x) Serial communication	
2	**Verilog (Any 5)** i) Multiplexer and Demultiplexer ii) Arithmetic Circuits iii) Code Converter iv) Flip Flops v) Design Shift Register vi) Design Counter vii) ALU viii) Designing of Traffic light Controller using FSM ix) FSM application-I x) FSM application –II	

Or any other equivalent experiment

	ELS-382 - Electronic Science Practical-10 (Project) **VSC**	
	Number of Credits: 02	

Electronic Science Practical-10 (Project)

As per the guidelines, to be given by the college

	ELS-371 - Instrument Maintenance **Minor-Theory**	
	Number of Credits: 02 **No. of Hours:30**	
Course Outcomes (COs) **On completion of the course, the students will be able to:**		**Bloom's cognitive level**
CO1	Understand and describe the fundamentals of electronic equipment maintenance and troubleshooting procedures.	1
CO2	Analyze and diagnose common faults in home and laboratory equipment based on their working principles and internal systems.	2
CO3	Apply troubleshooting techniques and safety protocols to perform basic maintenance on electronic equipment.	3
CO4	Evaluate the operational efficiency and performance of electronic equipment, recommending corrective actions for ensuring optimal functioning.	4

ELS-371 - Instrument Maintenance
(Minor-Theory)

Unit No.	Title of Unit and Contents	No. ofnhours
1	**Introduction to electronic equipment maintenance** Electronic equipment used in daily life and their internal systems, equipment in electronic laboratories, problems associated with equipment handling, need for maintenance, introduction to troubleshooting.	**06**
2	**Fundamentals of troubleshooting procedures** Reading drawings and diagrams, equipment failures and their causes, maintenance terminology, fault-finding aids, Troubleshooting techniques,grounding systems, and corrective actions.	**08**
3	**Basic level maintenance of home equipment – Water pump, Washing machine, and Generator** Introduction, working principle, minimum failure safe operation, routine maintenance, common faults, and their troubleshooting.	**08**
4	**Basic level maintenance of laboratory equipment –** Digital Multi-Meters (DMM), Digital Storage Oscilloscopes (DSO) and Power Supply Introduction, working principle, minimum failure safe operation, routine maintenance, common faults, and their troubleshooting.	**08**

Learning Resources- References

Sr. No.	References
1.	"Modern Electronic Equipment: Troubleshooting, Repair, and Maintenance" by R. S. Khandpur
2.	“Electronic Instruments and Systems: Principles, Maintenance, and Troubleshooting” by R. G. Gupta.

	ELS-395 - On Job Training **OJT-Theory**	
	Number of Credits: 02 **No. of Hours:30**	

As per the guidelines, to be given by the college

Deccan Education Society's

Fergusson College (Autonomous) Pune

Learning Outcomes-Based Curriculum

For 3/4 years B.Sc./B.Sc. (Honours) Programme

as per the guidelines of

NEP-2020

for

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

SEM V and SEM VI

With effect from the Academic Year

2025-2026

	ELS-322 - Wireless Communication **Minor-Theory**	
	Number of Credits: 02 **No. of Hours:30**	
Course Outcomes (COs) **On completion of the course, the students will be able to:**		**Bloom's cognitive level**
CO1	Describe digital modulation techniques for different applications.	1
CO2	Discuss and summarize developments from 1G to 5G Cellular systems.	2
CO3	Apply the knowledge of different wireless systems to know the features of various technologies.	3
CO4	Compare different generations of Cellular communication systems.	4

ELS-322 - Wireless Communication
(Minor - Theory)

Unit No.	Title of Unit and Contents	No. of hours
1	**Data Transmission and Multiple Access Techniques** ASK, FSK,BPSK, QPSK,QAM Introduction to multiple access: FDMA, TDMA, CDMA, Spread Spectrum techniques: Frequency Hopping Spread Spectrum (FHSS), Direct Sequence Spread Spectrum (DSSS)	**10**
2	**Introduction to wireless communication: Mobile Communication** Need of wireless communication systems, Wired versus wireless communication, Antenna: Introduction, Need, working Principle, Parameters of antenna: Gain, directivity, Radiation pattern, Beam width, Bandwidth, Front to Back Ratio (FBR), Fundamentals of cellular system**:** Cell structure **(**Hexagonal cell geometry), Cluster, Co-channel interference, Frequency reuse concept. Cellular systems from 1G to 5G, LTE, IEEE wireless protocol 802.11 GSM: Architecture, Call routing, Mobility management, Hand off	**14**
3	**GPS system** Introduction, Components of GPS system (space segment, control segment, user segment), GPS receiver, Applications.	**6**

Learning Resources- References

Sr. No.	References
1.	Communication Electronics Principles and Applications – Louis E. Frenzel, Tata McGraw Hill Education Private Limited, 3rd Edition.
2.	Data Communications and Networking – Behrouz A Forouzan, Tata McGraw Hill Education Private Limited, Fourth Edition
3.	Wireless Communication and Networks – William Stallings, Pearson Education, Second Edition.
4.	Mobile Computing, Asoke K Talukder, Roopa R Yavagal, TMH
5.	Mobile Communications, Jochen Schiller, Pearson Education, 2nd Edition
6.	Wireless Communications and Networks, 3G and beyond, ITI SahaMisra, TMH. 2nd Edition.
7.	Principle of wireless Networks by Kaveh Pahlavan and Prashant Krishnamurthy, Pearson Education, 2002.

	ELS-372 - IoT Applications **Minor -Theory**	
	Number of Credits: 02 **No. of Hours:30**	
Course Outcomes (COs) **On completion of the course, the students will be able to:**		**Bloom's cognitive level**
CO1	Identify hardware and software components of IoT applications.	1
CO2	Discuss the flow diagram for IoT applications.	2
CO3	Apply correct methodology as per IoT applications.	3
CO4	Analyze different parameters required to test IoT applications.	4

ELS-372 - IoT Applications
(Minor-Theory)

Unit No.	Title of Unit and Contents	No. of hours
1	**Home Automation** Smart Lightening Smart Appliances Intrusion Detection Smoke/ Gas Detectors	**10**
2	**Smart Cities** Smart Parking Smart Lightening Smart Road	**10**
3	**Smart Environment Monitoring** Weather Monitoring Air Pollution Monitoring Green House Control	**10**

Learning Resources- References

Sr. No.	References
1.	Bahga, Arshdeep, and Vijay Madisetti. Internet of Things: A hands-on approach, 1st edition, University press, 2014
2.	Simone Cirani, Gianluigi Ferrari, Marco Picone, Luca Veltri. Internet of Things: Architectures, Protocols and Standards, 1 st edition, Wiley Publications, 2019.
3.	Vermesan, Ovidiu, and Peter Friess, eds. Internet of things-from research and innovation to market deployment, 1st edition, Aalborg: River publishers, 2014.
4.	Tsiatsis, Vlasios, Tsiatsis, Vlasios, Stamatis Karnouskos, Jan Holler, David Boyle, and Catherine Mulligan, Internet of Things: technologies and applications for a new age of intelligence, 2nd edition, Academic Press, 2018.
5.	Any three researchapers on each IoT application.