Deccan Education Society's

Fergusson College (Autonomous)
Pune

Learning Outcomes-Based Curriculum

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

as per guidelines of

NEP-2020

for

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

With effect from Academic Year

2023-2024

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, work in groups, exhibits thoughts and ideas effectively in writing and orally.
PO4	**Research-related skills and Scientific temper:** Develop the working knowledge and applications of instrumentation and laboratory techniques. Able to apply skills to design and conduct independent experiments, interpret, establish hypothesis and inquisitiveness towards research.
PO5	**Trans-disciplinary knowledge:** Integrate different disciplines to uplift the domains of cognitive abilities and transcend beyond discipline-specific approaches to address a common problem.
PO6	**Personal and professional competence:** Performing dependently and also collaboratively as a part of team to meetdefined 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.

PSO No.	Program Specific Outcomes (PSOs) Upon completion of this programme the student will be able to
PSO1	**Academic competence:** (i) Apply the knowledge, facts, and rules of basic and applied sciences (Physics, Chemistry, Mathematics and Statistics) for understanding elements of Electronic Science. (ii) Identify basic elements and systems of the real analog world and modern digital world.
PSO2	**Personal and Professional Competence:** (i) Demonstrates the ability to build and test basic blocks of modern digital systems and computers. (ii) Operate basic and advanced tools, equipment and Instruments. (iii) Discuss performance parameters for selection of sensors, actuators, linear and digital ICs.
PSO3	**Research Competence:** (i) Design and build Electronics systems in various domains like Computers, consumer products, medical, transportation, agriculture, and defense. (ii) Formulate and provide creative, innovative, and effective solutions to real world problems using hardware –software co-design tools for microcontroller / embedded systems and IoTs. (ii) Develop and utilizes modern tools (like PSPICE, MATLAB, Simulink) for mathematical modelling and simulation for future ready systems.
PSO4	**Entrepreneurial and Social competence:** Employ the process of thinking independently, taking initiative, working in a team effectively, preparing project reports and developing capability to lead the team through real life projects.

Deccan Education Society's
Fergusson College (Autonomous), Pune
First Year Curriculum as per NEP 2020

Department of Electronic Science

Course Structure

Semester	Paper	Paper Code	Paper Title	Theory / Practical	Credits
I	Major	ELS-101	BASIC CIRCUITS AND NETWORKS	Theory	4
		ELS-100	ELECTRONIC SCIENCE PRACTICAL - 1	Practical	2
	Minor	ELS-111	NETWORK THEOREMS	Theory	2
		ELS-112	ELECTRONIC SCIENCE PRACTICAL - 1	Practical	2
	OE-1	ELS-120	ELECTRONICS FOR EVERY ONE	Theory	2
	OE-2	ELS-121	UNDERSTANDING ELECTRONIC PRODUCTS	Theory	2
	SEC-1	ELS-140	COMPONENTS AND TOOLS	Theory	2
	Minor (CS)	ELS-115	BASIC DIGITAL ELECTRONICS	Theory	2
		ELS-116	ELECTRONICS SCIENCE PRACTICAL - 1	Practical	2
II	Major	ELS-151	SEMICONDUCTOR DEVICES	Theory	4
		ELS-150	ELECTRONIC SCIENCE PRACTICAL - 2	Practical	2
	Minor	ELS-161	ANALOG AND DIGITAL ELECTRONICS	Theory	2
		ELS-162	ELECTRONIC SCIENCE PRACTICAL - 2	Practical	2
	OE-3	ELS-170	E-WASTE MANAGEMENT PRACTICES	Theory	2
	OE-4	ELS-171	MAINTENANCE OF ELECTRONIC PRODUCTS	Theory	2
	Minor (CS)	ELS-165	SEQUENTIAL LOGIC CIRCUITS	Theory	2
		ELS-166	ELECTRONIC SCIENCE PRACTICAL - 2	Practical	2

OE – Open Elective, SEC- Skill Enhancement Course

Teaching and Evaluation (Only for FORMAL education courses)

Course Credits	No. of Hours per Semester Theory/Practical	No. of Hours per Week Theory/Practical	Maximum Marks	CE 40 %	ESE 60%
1	15 / 30	1 / 2	25	10	15
2	30 / 60	2 / 4	50	20	30
3	45 / 90	3 / 6	75	30	45
4	60 / 120	4 / 8	100	40	60

Eligibility: As per the rules and regulations of Savitribai Phule Pune University (SPPU)

F.Y.B.Sc. Semester I		
ELS-101	**Basic Circuits and Networks (Major- Theory)**	**Credits:** 4 **Hours:** 60
	Course Outcomes (COs) On completion of the course, the students will be able to:	**Bloom's Cognitive Level**
CO1	Identify elements of electrical circuits like resistors and their colour code, capacitors, inductors, impedance and admittance, DC-AC signals, and sources	1
CO2	Quote fundamental laws and theorems for electrical circuits	1
CO3	Explain RC and RL circuits	2
CO4	Discuss resonance in Series and Parallel RLC Circuits	2
CO5	Apply the fundamental theorems, laws to translate complicated circuits into simpler equivalent circuits	3
CO6	Illustrate Principal of Duality and two port network	3

Unit	Contents	No. of hours
I	**Basic Circuit Concepts**: Voltage and Current Sources, **Resistors:** Fixed and Variable resistors, Characteristics, Colour coding of resistors, resistors in series and parallel. **Inductors:** Fixed and Variable inductors, Self and mutual inductance, Faraday's law and Lenz's law of electromagnetic induction, Energy stored in an inductor, Inductance in series and parallel, **Capacitors:** Principles of capacitance, Parallel plate capacitor, Permittivity, Definition of Dielectric Constant, Dielectric strength, Energy stored in a capacitor, capacitors in series and parallel, factors governing the value of capacitors	**15**
II	**Circuit Analysis:** Kirchhoff's Current Law (KCL), Kirchhoff'sVoltage Law (KVL), Node Analysis, Mesh Analysis. **DC Transient Analysis:** RC Circuit- Charging and discharging with initial charge, RL Circuit with Initial Current, Time Constant, RL and RC Circuits with Sources	**15**
III	**AC Circuit Analysis:** Sinusoidal Voltage and Current, Definition of Instantaneous, Peak, Peak- Peak, Root Mean Square and Average Values. Voltage-Current relationship in Resistor, Inductor and Capacitor, Sinusoidal Circuit Analysis for RL, RC and RLC Circuits. Resonance in Series and Parallel RLC Circuits, Frequency Response of Series and Parallel RLC Circuits, Quality (Q) Factor and Bandwidth. PassiveFilters: Low Pass, High Pass, Band Pass and Band Stop.	**15**
IV	**Network Theorems**: Principal of Duality, Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Reciprocity Theorem, Millman's Theorem, Maximum Power Transfer Theorem, Two port networks - impedance (Z) Admittance (Y), Transmission parameters-A, B, C, D	**15**

References

1. Electronic Principles , A. P. Malvino, Tata McGraw Hill
2. S. A. Nasar, Electric Circuits, Schaum's outline series, Tata McGraw Hill (2004).
3. Electrical Circuits, M. Nahvi and J. Edminister, Schaum's Outline Series, Tata McGraw Hill(2005).
4. Robert L. Boylestad, Essentials of Circuit Analysis, Pearson Education (2004).
5. W. H. Hayt, J. E. Kemmerly, S. M. Durbin, Engineering Circuit Analysis, Tata McGraw Hill(2005).
6. Alexander and M. Sadiku, Fundamentals of Electric Circuits, McGraw Hill (2008).

ELS-100	Electronic Science Practical-1 (Major- Practical)	Credits: 2 Hours: 60
	Course Outcomes (COs) **On completion of the course, the students will be able to:**	**Bloom's Cognitive Level**
CO1	List the components required for carrying out the experiment.	1
CO2	Identify the required test and measuring instruments	1
CO3	Describe the procedure for performing the experiment.	2
CO4	Report the observations recorded for experiment	2
CO5	Interpret the results and compare them with expected values	2, 3, 4

Any 10 Experiments

Expt. No.	Title of the Experiment
1.	Study of Series and Parallel combination of Resistors
2.	Verification of Kirchhoff's Voltage Law
3.	Verification of Kirchhoff's Current Law
4.	Verification of Thevenin's Theorem
5.	Verification of Norton's theorem
6.	Verification of Superposition Theorem
7.	Verification of the Maximum Power Transfer Theorem
8.	Measurement of Amplitude, Frequency & Phase difference using CRO
9.	Designing of a Low Pass RC Filter and study of its Frequency Response
10.	Designing of a High Pass RC Filter and study of its Frequency Response
11.	Designing of Low - Pass RL Filter and study of its Frequency Response
12.	Designing of High - Pass RL Filter and study of its Frequency Response
13.	RC Circuits: Time Constant of Differentiator and Integrator
14.	Study of frequency Response of a series LCR circuit and determination of -(a) Resonant Frequency (b) Impedance at Resonance (c) Band Width (d) Quality Factor Q
15.	Study of frequency Response of a parallel LCR circuit and determination of -(a) Resonant Frequency (b) Impedance at Resonance (c) Band Width (d) Quality Factor Q

Or Any Other Equivalent Experiment

F.Y.B.Sc. Semester I		
ELS-111	**Network Theorems** **(Minor - Theory)**	**Credits:** 2 **Hours:** 30
	Course Outcomes (COs) **On completion of the course, the students will be able to:**	**Bloom's Cognitive Level**
CO1	Identify various circuit elements and components.	1
CO2	State fundamental laws and network theorems	1
CO3	Describe different methods used in circuit analysis.	2
CO4	Explain the significance of network theorems in simplifying complex electrical circuits.	*2*
CO5	Calculate the time constants for RC and RL circuits.	3
CO6	Apply network theorems to simplify and solve different electronic circuits.	3

Unit	Contents	No. of hours
I	**Basic Circuit Concepts**: Voltage and Current Sources, **Resistors:** Fixed and Variable resistors, Characteristics, Colour coding of resistors, resistors in series and parallel. **Inductors:** Fixed and Variable inductors, Self and mutual inductance, Faraday's law and Lenz's law of electromagnetic induction, Energy stored in an inductor, Inductance in series and parallel, **Capacitors:** Principles of capacitance, Parallel plate capacitor, Permittivity, Definition of Dielectric Constant, Dielectric strength, Energy stored in a capacitor, capacitors in series and parallel	**5**
II	**Circuit Analysis:** Kirchhoff's Current Law (KCL), Kirchhoff's Voltage Law (KVL), Node Analysis, Mesh Analysis. **Network Theorems**: Principal of Duality, Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Reciprocity Theorem, Millman's Theorem, Maximum Power Transfer Theorem, **DC Transient Analysis:** RC Circuit- Charging and discharging with initial charge, RL Circuit with Initial Current, Time Constant, RL and RC Circuits with Sources	**15**
III	**AC Circuit Analysis:** Sinusoidal Circuit Analysis for RL, RC and RLC Circuits. Frequency Response of Series and Parallel RLC Circuits, Quality (Q) Factor and Bandwidth. Passive Filters: Low Pass, High Pass, Band Pass and Band Stop.	**10**

References :

1. S. A. Nasar, Electric Circuits, Schaum's outline series, Tata McGraw Hill (2004).
2. Electrical Circuits, M. Nahvi and J. Edminister, Schaum's Outline Series, Tata McGraw Hill(2005).
3. Robert L. Boylestad, Essentials of Circuit Analysis, Pearson Education (2004).
4. W. H. Hayt, J. E. Kemmerly, S. M. Durbin, Engineering Circuit Analysis, Tata McGraw Hill(2005).
5. Alexander and M. Sadiku, Fundamentals of Electric Circuits, McGraw Hill (2008).

F.Y.B.Sc. Semester I		
ELS-112	**Electronic Science Practical-1 (Minor- Practical)**	**Credits: 2 Hours: 60**
	Course Outcomes (COs) On completion of the course, the students will be able to:	**Bloom's Cognitive Level**
CO1	List the components required for carrying out the experiment.	1
CO2	Identify the required test and measuring instruments	1
CO3	Describe the procedure for performing the experiment.	2
CO4	Report the observations recorded for experiment	2
CO5	Interpret the results and compare them with expected values	2, 3, 4

Any 10 Experiments

Expt. No.	Title of the Experiment
1.	Study of Series and Parallel combination of Resistors
2.	Verification of Kirchhoff's Voltage Law
3.	Verification of Kirchhoff's Current Law
4.	Verification of Thévenin's Theorem
5.	Verification of Norton's theorem
6.	Verification of Superposition Theorem
7.	Verification of the Maximum Power Transfer Theorem
8.	Measurement of Amplitude, Frequency & Phase difference using CRO
9.	Designing of a Low Pass RC Filter and study of its Frequency Response
10.	Designing of a High Pass RC Filter and study of its Frequency Response
11.	Designing of Low - Pass RL Filter and study of its Frequency Response
12.	Designing of High - Pass RL Filter and study of its Frequency Response
13.	RC Circuits: Time Constant of Differentiator and Integrator
14.	Study of frequency Response of a series LCR circuit and determination of -(a) Resonant Frequency (b) Impedance at Resonance (c) Band Width (d) Quality Factor Q
15.	Study of frequency Response of a parallel LCR circuit and determination of -(a) Resonant Frequency (b) Impedance at Resonance (c) Band Width (d) Quality Factor Q

Or Any Other Equivalent Experiment

F.Y.B.Sc. Semester I		
ELS-120	**Electronics for Everyone (OE-1)**	**Credits:** 2 **Hours:** 30
	Course Outcomes (COs) On completion of the course, the students will be able to:	**Bloom's Cognitive Level**
CO1	State the applications of electronics in various fields.	1
CO2	List electronic devices used in electronic systems.	1
CO3	Explain the functions and use of common electronic systems.	2
CO4	Discuss the role of electronics in different application domains.	2
CO5	Write the generic features and specifications of electronic systems.	3

Unit	Contents	No. of hours
I	**Introduction to Electronics and Consumer Electronics** Definition of electronics and its importance in daily life, Overview of consumer electronics and their applications in home, entertainment, communication, and office environments, Basic components of electronics products and their functions Identify and describe different modes of communication used in aviation and space exploration.	**8**
II	**Electronic Systems in Transportation and Retail** Role of electronics in intelligent transportation systems (ITS), Applications of electronics in the automotive industry, including engine injection, ignition, security, and other systems, electronic retailing and its impact on the sale of goods.	**8**
III	**Communication and Aerospace** History and importance of electronics in communication, Applications of electronics in enhancing communication, including the internet and smartphones, Overview of avionics and aerospace electronics, including flight warning and management systems, control and navigation systems, and power and communication systems: Military, Defence, and Robotics.	**8**
IV	**Military, Defence and Robotics** Overview of military and defence electronics and their applications in combat, Examples of advanced technologies used in military and defence sectors, Introduction to automation and robotics, including their use in manufacturing and packaging industries	**6**

References:

(i) https://www.iresearchnet.com/research-paper-topics/technology-research-paper-topics/electronics

(ii) https://testbook.com/physics/applications-of-electronics#:~:text=Electronics%20or%20electrical%20components%20are,appliances%20are%20powered%20by%20electricity.

(iii) https://www.google.co.in/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwjqieTn--iCAxVszjgGHRn5CtkQFnoECAkQAQ&url=https%3A%2F%2Fwww.jetir.org%2Fpapers%2FJE

TIR1904907.pdf&usg=AOvVaw3m1pgIV7itnmp5iEcPWhyn&opi=89978449

(iv) https://www.google.co.in/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwjqieTn--iCAxVszjgGHRn5CtkQFnoECAwQAQ&url=https%3A%2F%2Ftestbook.com%2Fphysics%2Fapplications-of-electronics&usg=AOvVaw1aawCnOvnXzJuBRqth30LV&opi=89978449

F.Y.B. Sc. Semester I		
ELS-121	**Understanding Electronic Products (OE-2)**	**Credits:** 2 **Hours:** 30
	Course Outcomes (COs) On completion of the course, the students will be able to:	**Bloom's Cognitive Level**
CO1	List the different electronic products used in homes and offices.	1
CO2	State the features, specifications, and selection criteria of electronic products	1
CO3	Discuss the basic principles of electronic products.	2
CO4	Choose electronic products for specific application.	3
CO5	Compare of general specifications of electronic products.	4

Contents	No. of hours
Basic Principle, features, specifications, and selection criteria of following electronic products. (Any 12 Products) • Telephone EPABX, Cell Phone, Optical Fiber Cable, • Calculators, Digital Clocks, In-Car Computers, • Washing Machine, Air-Conditioner, Refrigerators, • Microwave Oven, Mixer, Grinder, Food Processor, • Automatic Garage Door Controller, Photocopier, • Set Top Box, Digital TV, • Water Heater, Dehumidifier	**30**

References

1. Troubleshooting and Repairing Major Appliances, Eric Kleinert, Third Edition, McGraw Hill
2. Troubleshooting Electronic Equipment, R.S. Khandpur, McGraw Hill (2007)
3. Consumer Electronics, S.P. Bali, Pearson (2008).

F.Y.B.Sc. Semester I		
ELS-140	**Components and Tools (SEC-1)**	**Credits:** 2 **Hours:** 30
	Course Outcomes (COs) On completion of the course, the students will be able to:	**Bloom's Cognitive Level**
CO1	List different electronic / electrical components and tools.	1
CO2	State technical specifications of various components	1
CO3	Classify different components based on technical specifications	2
CO4	Identify various components and tools	2
CO5	Write various applications of components and tools	3
CO6	Demonstrate the use of different tools	3

Unit	Contents	No. of hours
I	**Components:** Overview and classification of electronic components and their functions **Resistors:** Symbol, colour code, types such as carbon composition, metal film, wire wound variable resistor, potentiometers, presets, logarithmic, linear, multiturn potentiometers, thermistor, LDR, - technical specifications (Wattage, Temperature coefficients) **Capacitors:** General information, symbol, colour code, types such as air, paper, electrolytic, mica, tantalum, polystyrene, fixed and variable capacitors, specifications of capacitors, Power factor, working voltage, measurement of capacitance. **Inductors:** General Information, symbol, types such as air core, iron core, ferrite core, AC mains choke, frequency response of inductor, method of measurement of inductance using Universal Bridge **Batteries:** Dry cells, Lead acid accumulators, Nickel Cadmium cells, standard cells, principle, specifications, lifetime, calculation of time and ratings **Fuses and Relays:** Fast and slow blow fuses, Pilot lamps, Relays- symbol, types and specifications, reed, and electromagnetic relays **Miscellaneous Components:** Circuit Boards: Stripboard, tagboard, PCB, Breadboard, General Purpose PCB, Jumpers, SMD and SMT **Switches:** SPDT, DPDT, band switches, touch switches, thumb wheel switches, micro-switches, specifications, application areas **Transformers:** Principle, types, and symbols - single phase/three phase transformer, auto-transformer and isolation transformers, Audio, IF and RF transformer **Microphones:** symbol, types, variable resistance (carbon), variable capacitance (condenser), variable inductance (moving coil), Electret. **Loudspeakers:** symbol, types, and specifications (frequency response, impedance, power rating, size, directionality) of midrange-speaker, tweeter, woofer	**20**
II	**Tools in Electronics Laboratories:** Wire stripping pliers, Adjustable stripping plier, Needle nose plier, slip joint plier, Adjustable slip plier, tweezers, Anti-static tweezers, Wire cutter, Utility knife, Screwdriver, Hand drill, Power drill, Wire Wrapping tool, Wrapping tape, Hacksaw, File, Vice / Jammer, Soldering gun,	**10**

	Crimping tool, Different types of soldering guns, Desoldering pump, Continuity tester, Electric tester.	

References

1. Grob's Basic Electronics, Mitchel E. Schultz, 11th Edition, McGraw Hill.
2. Practical Electronics: Components and Techniques, J.M. Hughes, O'Reilly Media, Inc., (2015).
3. Troubleshooting and Repairing Major Appliances, Eric Kleinert, Third Edition, McGraw Hill.
4. Troubleshooting Electronic Equipment, R.S. Khandpur, McGraw Hill (2007).
5. Consumer Electronics, S.P.Bali, Pearson (2008).

Skill Sets:

ELS-140	**Components and Tools**	**Credits:** 2 **Hours:** 30
Students will acquire the following skills on completion of the course:		
1.	List various components.	
2.	Classify various components.	
3.	State functions of various components.	
4.	Recognize various electronic symbols & their meanings.	
5.	State important specifications of each component.	
6.	Know the uses of various components.	
7.	How to select components for real life applications?	
8.	To identify type and value of components through visual inspection.	
9.	Prepare a list of various tools required for electronic circuit assembly.	
10.	Identify different types of wires and connections.	

Evaluation Process
1. Student must attend weekly Skill Enhancement Course conducted by the college. 2. Internal marks (20 Marks) and External marks (30 Marks) will be based on skills imparted. 3. End Semester Evaluation will be done by external examiner. 4. No formal written examination will be conducted. 5. Evaluation methods will vary as per the requirements of the course. **6. Student is responsible to complete the required number of credits.**

Proposed Evaluation Methods:

1. For CE: Attendance and Active Participation **[10 Marks]**
2. For CE: Activity/ Assignment/ Survey Report etc. **[10 Marks]**
3. For ESE: Skill demonstration **[20 Marks]**
4. For ESE: Skill demonstration **[10 Marks]**

F.Y. B. Sc. (CS) Semester I		
ELS-115	**Basic Digital Electronics (Minor- Theory)**	**Credits: 2 Hours: 30**
	Course Outcomes (COs) On completion of the course, the students will be able to:	**Bloom's Cognitive Level**
CO1	Identify logic gates with symbols and truth tables.	1
CO2	State De Morgan's theorems and laws of Boolean Algebra	1
CO3	Discuss circuit diagram and working of different logic circuits.	2
CO4	Use the various rules and laws of Boolean Algebra for designing digital circuits.	3
CO5	Modify (simplify) digital circuits using K-map.	3
CO6	Differentiate basic digital circuits.	4

Unit	Contents	No. of hours
I	**Logic gates** Introduction to analog signals and digital signals, Positive and Negative logic, Logic gates: definition, symbols, truth tables, Boolean expressions, pulsed operation of NOT, OR, AND, NAND, NOR, EX-OR, EX-NOR gates	**3**
II	**Number system and codes** Decimal, binary, octal, hexadecimal number systems, Conversion of numbers from one number system to another including decimal / binary points, Binary addition, subtraction, multiplication, division, 1's and 2's complement method of subtraction BCD code numbers and their limitations, gray code, ASCII code	**8**
III	**Boolean Algebra** Rules and laws of Boolean algebra, logic expression, De Morgan's theorems, their proof, Sum of products form (min. terms), Product of sum form (max. terms), Simplification of Boolean expressions using Boolean algebra and Karnaugh map upto 4 variables.	**8**
IV	**Arithmetic and logical circuits** Half adder, Full adder circuit and its operation, Parallel binary adder, Half Subtractor, and full Subtractor	**4**
V	**Combinational Circuits** Multiplexer (2:1 and 4:1), De-multiplexer (1:2 and 1:4), Encoder, Priority encoder, Decoder, BCD to seven segment decoder	**7**

Learning Resources:

1. Modern Digital Electronics: Jain R.P., Tata McGraw Hill
2. Digital Principles and Applications: Malvino Leach, Tata McGraw-Hill.
3. Digital Computer Electronics, Malvino
4. Digital System Design, Morris Mano, Pearson Education (2014)
5. Fundamentals of Logic Design, Charles H. Roth, Jr. and Larry L. Kinney
6. Digital Principals, Schaum's outline series, Tata McGraw Hill (2006)
7. Digital Fundamentals: Floyd T.M., Jain R.P., Pearson Education

F. Y. B. Sc. (CS) Semester I		
ELS-116	**Electronic Science Practical-1 (Minor- Practical)**	**Credits: 2 Hours: 60**
	Course Outcomes (COs) On completion of the course, the students will be able to:	**Bloom's Cognitive Level**
CO1	Recall the circuit diagrams using different symbols of logic gates	1
CO2	Discus the working of circuits used in experiments.	2
CO3	Carry out the experiment to achieve the given objectives.	3
CO4	Analyze observations of each experiment.	4
CO5	Validate observed outputs with expected theoretical outputs.	5

Any 10 Experiments

Sr. No.	**Title of Experiment / Practical**
1	Study of logic gates
2	Binary to gray code and gray to binary code conversion
3	Verification of De-Morgan's Theorems
4	Interconversion of logic gates using NAND gate
5	Interconversion of logic gates using NOR gate
6	Study of Half adder and full adder
7	Study of Half Subtractor and full subtractor
8	Study of multiplexer and demultiplexer
9	Simplification of Boolean expressions using Boolean algebra and Karnaugh map and its implementation using logic gates
10	4-bit Parallel Adder
11	BCD to seven segment decoder
12	Study of priority encoder IC 74148
13	Construction of 1- bit comparator
14	Implementation of Boolean Functions using Multiplexer
15	Octal to binary Encoder

Or Any Other Equivalent Experiment

F.Y.B.Sc. Semester II		
ELS-151	**Semiconductor Devices (Major-Theory)**	**Credits:** 4 **Hours:** 60
Course Outcomes (COs) On completion of the course, the students will be able to:		**Bloom's Cognitive Level**
CO1	List the basic types of materials used in electronic applications.	1
CO2	Identify symbols and name terminals of diode, BJT, UJT, JFET and MOSFET, SCR, DIAC, TRIAC	1
CO3	Explain the types of semiconductors, concept of Fermi level and describe constructional features, behavior and characteristics of basic semiconductor devices such as diode, BJT, UJT, JFET and MOSFET, SCR, DIAC, TRIAC	2
CO4	Discuss the biasing principles of semiconductor devices like diode and BJT	2
CO5	Illustrate concept of intrinsic, n-type, p-type extrinsic semiconductors.	3
CO6	Implement diodes and BJT for various applications	3

Unit	Contents	No. of hours
I	**Semiconductor Basics** Introduction to Semiconductor Materials, Intrinsic Semiconductors and Extrinsic semiconductors, n type and p type semiconductors with reference to energy levels, Donors, Acceptors, concept of Fermi Level, concept of majority and minority carriers	**10**
II	**Junction Diode** PN junction diodes - Symbol, pins, unbiased diode, depletion layer, barrier potential, working in forward bias and reverse bias, concept of break down, diode equation, I-V characteristics, knee voltage, break down voltage, bulk resistance, Zener diode, light emitting diode, photo diode, solar cell, metal varactor diode Metal semiconductor junction- ohmic and rectifying contacts, Schottky diode, applications of various diodes	**15**
III	**Bipolar Junction Transistor (BJT)** Symbol, pins, basic types- PNP and NPN, unbiased transistor, Biased Transistor, transistor currents, concept of current gain, α, β of BJT, configurations CE, CB and CC, with respect to CE configuration I-V characteristics-base curve and collector curves, load line, operating point, Biasing techniques - voltage divider bias, emitter bias, collector feedback bias and base bias applications.	**20**
IV	**Field Effect Transistors:** JFET, Construction, Pinch-Off and Saturation Voltage, Output Characteristics. MOSFET, types of MOSFETs, Circuit symbols, Working and Characteristic curves of Depletion type MOSFET (both N channel and P Channel) and Enhancement type MOSFET (both N channel and P channel)	**15**

References:

1. Basic Electronics, Grob, Tata McGraw Hill.
2. Electronic Devices, T. L. Floyd, Pearson Education Asia.
3. Electronic Principles, Malvino, Tata McGraw Hill.

F.Y.B.Sc. Semester II		
ELS-150	**Electronic Science Practical-2 (Major- Practical)**	**Credits: 2 Hours: 60**
Course Outcomes (COs) On completion of the course, the students will be able to:		**Bloom's Cognitive Level**
CO1	List the components required for carrying out the experiment.	1
CO2	Identify the required test and measuring instruments	1
CO3	Describe the procedure for performing the experiment.	2
CO4	Report the observations recorded for experiment	2
CO5	Interpret the results and compare them with expected values	2, 3, 4

Any 10 Experiments

Expt. No.	Title of the Experiment
1.	I-V Characteristics of Diode and its application
2.	I-V Characteristics of Zener Diode and its application
3.	Output Characteristics of the CE configurations of BJT and its application
4.	Output Characteristics of the CC configuration of BJT and its application
5.	Transfer and Output Characteristics of JFET
6.	Transfer and Output Characteristics of MOSFET.
7.	I-V Characteristics of UJT and application
8.	I-V Characteristics of SCR
9.	I-V Characteristics of LED
10.	Reverse characteristics of photodiode for different light intensities
11.	Solar cell characteristics
12.	Study of varactor diode
13.	Energy bandgap measurement of Ge diode
14.	I-V Characteristics of DIAC
15.	I-V Characteristics of TRIAC

Or Any Other Equivalent Experiment

F.Y.B.Sc. Semester II		
ELS-161	**Analog and Digital Electronics (Minor-Theory)**	**Credits:** 2 **Hours:** 30
Course Outcomes (COs) On completion of the course, the students will be able to:		**Bloom's Cognitive Level**
CO1	Identify the symbols and pins of a PN junction diode and BJT.	1
CO2	Recall the symbols and truth tables of basic logic gates.	1
CO3	Explain the behaviour and characteristics of logic gates based on their truth tables.	2
CO4	Describe the working of BJT in different modes	2
CO5	Choose a suitable biasing scheme for particular application	3
CO6	Design and implement basic arithmetic circuits for addition and subtraction.	3

Unit	Contents	No. of hours
I	**Basics of Analog Electronics** Intrinsic and Extrinsic Semiconductors, PN Junction diode- construction, Symbol, Working, IV characteristics, Zener, Light Emitting diode, Photodiode. Construction and working of Bipolar Junction Transistors, Modes of BJT (CE, CC, CB), transistor equation; α, β and their relationship, junction biasing, Input, output and transfer characteristics of BJT in CE mode, Transistor Biasing (Voltage divider and emitter biasing only), DC load line, Q point, transistor as switch.	**10**
II	**Basics of Digital Electronics** **Number Systems:** Decimal, Binary, Octal, Hexadecimal, representation of integer, fraction and mixed numbers, Mutual conversions, Binary addition, complement of binary numbers, Binary subtraction using 1's and 2's complement method **Logic gates:** Logic, symbol and truth table of OR, AND, NOT, NAND, NOR, XOR and XNOR gates. **Boolean algebra:** Boolean Laws, double inversion, Duality and De Morgan's theorems, Use of NAND and NOR gate as universal building blocks. **Combinational Logic Circuits:** Half Adder, Full adder, Half subtracter and Full subtracter, 4-bit Full adder/ subtracter **Sequential Logic Circuits:** Introduction to Flip-Flops, Various types, Symbols, Truth Tables and Timing diagrams of SR, JK, D, T Type of FFs and their applications	**20**

References:

1. Basic Electronics, Grob, Tata McGraw Hill.
2. Electronic Devices, T. L. Floyd, Pearson Education Asia.
3. Electronic Principles, Malvino, Tata McGraw Hill.
4. Basic Electronics, Grob, Tata McGraw Hill.
5. Electronic Devices, T. L. Floyd, Pearson Education Asia.
6. Electronic Principles, Malvino, Tata McGraw Hill.
7. Digital principles and applications, A. P. Malvino, D. P. Leach McGraw Hill Book Co.
8. Modern Digital Electronics, R. P. Jain Tata McGraw Hill publishing co.ltd.
9. Digital Fundamentals, Floyd, Jain, Pearson.
10. 2000 solved problems in digital Electronics, S. P. Bali, Tata McGraw Hill publishing co. ltd.

F.Y.B.Sc. Semester II		
ELS-162	**Electronic Science Practical-2 (Minor- Practical)**	**Credits: 2 Hours: 60**
Course Outcomes (COs) On completion of the course, the students will be able to:		**Bloom's Cognitive Level**
CO1	List the components required for carrying out the experiment.	1
CO2	Identify the required test and measuring instruments	1
CO3	Describe the procedure for performing the experiment.	2
CO4	Report the observations recorded for experiment	2
CO5	Interpret the results and compare them with expected values	2, 3, 4

Any 10 Experiments

Expt. No.	**Title of the Experiment**
1.	I-V Characteristics of PN junction Diode and its applications
2.	I-V Characteristics of Zener Diode and its applications
3.	I-V Characteristics of LED and its applications
4.	Study of BJT as a Switch
5.	Output Characteristics of the CE configuration of BJT and its applications
6.	Output Characteristics of the CC configuration of BJT and its applications
7.	To verify the truth tables of Logic Gates (NOT, AND, OR)
8.	To verify the truth tables of Logic Gates (NAND, NOR, EXOR)
9.	Study of NAND / NOR gates as Universal Gates
10.	Verify De Morgan's theorems
11.	To convert a Boolean expression into logic gate circuits and assemble the circuits using logic gate IC's.
12.	Verify the truth tables of Half and Full Adder using logic gates and ICs

13.	Study of EXOR gate: (EXOR gate using Basic gates, EXOR gate using NAND gates, Testing of IC 7486
14.	Study of 4-bit binary full adder using IC7483
15.	Study of RS Flip-Flop using NAND / NOR gates

Or Any Other Equivalent Experiment

F.Y.B.Sc. Semester II		
ELS-170	**E-Waste Management Practices (OE-3)**	**Credits:** 2 **Hours:** 30
Course Outcomes (COs) On completion of the course, the students will be able to:		**Bloom's Cognitive Level**
CO1	Define and identify the key components of electronic waste, including hazardous materials and valuable resources. List the effects of e-waste on environment and health.	1
CO2	Recall the environmental impact of improper e-waste disposal, emphasizing the importance of recycling technologies. State the need and requirements of the e-waste management	1
CO3	Explain the basic principles of e-waste recycling.	2
CO4	Describe the processes involved in e-waste collection, from consumer drop-off to institutional collection points.	2
CO5	Illustrate the advantages and limitations of various e-waste recycling technologies, considering factors like resource recovery, energy consumption, and scalability.	3
CO6	Interpret the awareness of e-waste and e-waste management practices in society.	3

Unit	**Contents**	**No. of hours**
I	**Introduction to E-Waste Management** Definition and types of e-waste, Current e-waste scenario in India and the world, Environmental and health hazards of e-waste, Regulatory framework for e-waste management in India, Scope of the course.	**6**
II	**E-Waste Collection and Segregation** Collection and transportation of e-waste, Segregation of e-waste based on material type, Importance of proper segregation, Hands-on practice on e-waste segregation.	**6**
III	**E-Waste Recycling Technologies** Recycling technologies for different types of e-waste, advantages, and limitations of different recycling technologies, Environmental impact of recycling technologies, Case studies of successful e-waste recycling initiatives	**6**

IV	**E-Waste Management Strategies** Extended Producer Responsibility (EPR), Reverse logistics for e-waste management, Innovative e-waste management practices, Importance of public awareness and outreach.	**6**
V	**E-Waste Management and Sustainable Development** The link between e-waste management and sustainable development goals, Role of e-waste management in achieving a circular economy, Business opportunities in e-waste management, Prospects of e-waste management in India.	**6**

References :

1. Ministry of Environment, Forest and Climate Change, Government of India. (2016). E-Waste Management Rules, 2016. Retrieved from http://www.moef.gov.in/sites/default/files/E%20Waste%20Management%20Rules%202016.pdf
2. United Nations University. (2017). The Global E-Waste Monitor 2017: Quantities, Flows, and Resources. Retrieved from https://collections.unu.edu/eserv/UNU:6349/Global-E-waste_Monitor_2017_20_09_2017.pdf
3. United Nations University. (2020). Global E-Waste Statistics Partnership. Retrieved from https://ewastemonitor.info/
4. Central Pollution Control Board, Ministry of Environment, Forest and Climate Change, Government of India. (2018). E-Waste Management in India: Issues and Challenges. Retrieved from http://www.cpcb.nic.in/uploads/Projects/BMW/ewaste_report.pdf
5. Chatterjee, S., Kumar, A., & Vats, A. (2018). E-waste management in India: A review. Journal of Cleaner Production, 181, 279-291.
6. Golev, A., Schmeda-Lopez, D. R., Corder, G. D., & Giurco, D. (2016). E-waste recycling: Where does it go from here? Resources, Conservation and Recycling, 109, 68-77.
7. Achillas, C., Aidonis, D., & Vlachokostas, C. (2013). A review of e-waste management practices in the developed and developing world: State-of-the-art and future perspectives. Resources, Conservation and Recycling, 74, 58-67.
8. Kojima, M., & Yoshida, A. (2020). E-waste management in developing countries: Five key elements for success. World Bank Blogs. Retrieved from https://blogs.worldbank.org/sustainablecities/e-waste-management-developing-countries-five-key-elements-success
9. Sharma, A., & Singh, M. (2016). E-waste management: An Indian perspective. Journal of Environmental Management, 178, 83-91.
10. World Health Organization. (2016). Children's Health and the Environment: Addressing the Exposome. Retrieved from https://www.who.int/ceh/publications/children-exposome/en/

F. Y. B. Sc. Semester II		
ELS-171	**Maintenance of Electronic Products (OE-4)**	**Credits:** 2 **Hours:** 30
Course Outcomes (COs) On completion of the course, the students will be able to:		**Bloom's Cognitive Level**
CO1	List different electronic products used in home	1
CO2	State different skills required for preventive maintenance, serving and repairing home appliances	1
CO3	Discuss different types of electrical, electronic and gas related components	2
CO4	Explain different techniques used to diagnose the problem in home appliances	2
CO5	Write the procedure for installation of different home appliances	3
CO6	Use appropriate safety measures while servicing and repairing home appliances	3

Unit	Contents	No. of hours
I	Fundamentals of Service Selecting, purchasing, and installing major home appliances – Electric and gas ranges, cooktops and ovens, refrigerators and Freezers, dishwashers, laundry equipment, air-conditioners	**5**
II	Safety measures, tools needed, customer satisfaction, communication skills, basic techniques to diagnose a problem	**5**
III	Basic components related to electrical, electronics and gas and safety	**5**
IV	Appliance Service, installation, and preventive maintenance procedures for following (any 5 appliances) Automatic Dishwashers, Garbage Disposers, Automatic Electric Dryers, Electric ranges, Cooktops and Ovens, Microwave Oven, Refrigerators and Freezers, Automatic Ice makers, Room Air-conditioners, Dehumidifier	**15**

References:

1. Troubleshooting and Repairing Major Appliances, Eric Kleinert, Third Edition, .McGraw Hill
2. Troubleshooting Electronic Equipment, R.S. Khandpur, .McGraw Hill (2007)
3. Consumer Electronics, S.P. Bali, Pearson (2008).

F.Y.B.Sc. (CS) Semester II		
ELS-165	**Sequential Logic Circuits (Minor-Theory)**	**Credits:** 2 **Hours:** 30
Course Outcomes (COs) On completion of the course, the students will be able to:		**Bloom's Cognitive Level**
CO1	Reproduce the fundamental concepts of sequential logic circuits.	1
CO2	Describe the functioning of various synchronous and asynchronous logic circuits.	1
CO3	Discuss the design of sequential circuits.	2
CO4	Explain multi bit shift register, counter and their ICs.	2
CO5	Classify digital memories used in computer system.	3
CO6	Demonstrate memory organization.	3

Unit	Contents	No. of hours
I	**Flip flops** Difference between combinational and sequential circuits, the Concept of clock and types, synchronous and asynchronous circuits, Latch, S-R-latch, D-latch, Difference between latch and flip-flop, S-R, J-K, and D flip-flop their operation and truth tables, race around condition, Master-slave JK flip flop, T flip flop, and their operation using timing diagram and truth tables	**10**
II	**Sequential Circuits** The basic building block of the counter, Ripple counter, up counter, down counter, Up- Down counter, Concept of modulus counters, Decade counter, Shift registers: SISO, SIPO, PISO, PIPO, Ring counter, Universal 4-bit shift register	**10**
III	**Memory organization** Memory Architecture, Types of memory, Memory parameters (Access time, speed, capacity, cost), Concept of Address Bus, Data Bus, Control Bus, Memory Hierarchy, Memory address map Vertical & horizontal Memory expansion (increasing the capacity, increasing word size)	**10**

References:

1. Modern Digital Electronics: Jain R.P., Tata McGraw Hill
2. Digital Principles and Applications: Malvino Leach, Tata McGraw-Hill.
3. Digital Fundamentals: Floyd T.M., Jain R.P., Pearson Education
4. Computer Architecture: Morris Mano

F.Y.B.Sc. (CS) Semester II		
ELS-166	**Electronic Science Practical-2 (Minor-Practical)**	**Credits: 2 Hours: 60**
Course Outcomes (COs) On completion of the course, the students will be able to:		**Bloom's Cognitive Level**
CO1	Describe the circuit diagrams using different symbols of flip-flops	1
CO2	Reproduce the circuits of individual experiments.	1
CO3	Explain operations of Shift register, counter, and digital memory.	2
CO4	*Illustrate* observations of each experiment based on the aim and objectives of an experiment.	2
CO5	Demonstrate the working of experiments.	3
CO6	Implement concepts of sequential circuits in memory operation.	3

Any 10 Experiments

Expt .No.	Title of the Experiment
1	Study of R-S and D Latch
2	Study of R-S and D flip-flops
3	Testing of flip-flops using ICs
4	Shift register IC 7495: SISO, SIPO
5	Shift register IC 7495: PIPO, PISO
6	Modulo (2, 5, 10) counter using IC 7490
7	Modulo (3, 4, 7) counter using IC 7490
8	Study of Up counter IC 74192/93
9	Study of Down counter IC 74192/93
10	Three-bit synchronous counter
11	Rolling display
12	Diode Matrix ROM
13	Study of RAM
14	Study of IC7493 as Asynchronous Counter
15	Any Other Equivalent Experiment