SAVITRIBAI PHULE PUNE UNIVERSITY

SYLLABUS

B.Sc. ELECTRONIC SCIENCE

(FOR AFFILIATED COLLEGES)

FACULTY OF SCIENCE AND TECHNOLOGY

UNDER NATIONAL EDUCATION POLICY (NEP 2020)

TO BE IMPLEMENTED FROM

ACADEMIC YEAR 2024-25

Preamble

This syllabus for B. Sc. Electronic Science as per NEP – 2020, is envisioned to enable the undergraduates to respond to the present needs of the industry and prepare them with skills relevantto national and global standards. The framework is designed for origination in teaching learning process and apt evaluation of student learning levels.

Introduction:

B.Sc. Electronic Science program needs to develop basic understanding of philosophy of the Electronic Science stream among the students. The curriculum is designed to help the learners to understand, appreciate, get involved with learning of the subject. The Institute is expected to inspire its faculty to make suitable pedagogical innovations, in addition to teaching/learning processes suggested in the present syllabus, so that the Course/Programme learning outcomes can be achieved.

Significance:

Electronic Science has applications in almost all fields such as defense, industrial automation, communication, automobiles, medical, agriculture, entertainment, home appliances etc. The curriculum for the B.Sc. Electronic Science is systematically planned to create a foundation for the students to build up a successful career in Electronics. Theoretical knowledge and practical training will help the students to handle real world problems in various fields**.**

Eligibility for **UG Honours /UG Honours with Research (Electronic Science):**
Higher Secondary School Certificate (10+2) or its equivalent Examination

Programme Outcomes: B. Sc. Electronic Science

PO1	**To provide in-depth knowledge of scientific and technological aspects of Electronics**
PO2	**To prepare the students to apply the acquired knowledge towards planning, designing and building electronic applications.**
PO3	**Train students to be an entrepreneur or part of the industry, through experiments, projects, hands on training, industrial visits and market surveys.**
PO4	**Enrich knowledge base of students for pursuing higherstudies and taking up research and development in Electronics.**

Structure of the Course: UG Honours with Research in (**Electronic Science**) OR UG Honours degree in major and minor (**Electronic Science**)

Total credits to be completed to award the UG Honours with Research Degree: 176

Credit Framework under Three/Four-Years UG Programme with Multiple Entry andMultiple Exit options:

The structure of the Three/Four-year bachelor's degree programme allows theopportunity to the students to experience the full range of holistic and multidisciplinary education in addition to a focus on the chosen major and minors as per their. The minimum and maximum credit structure for different levels are as given below**:**

Credit Framework

Levels	Qualification Title	Credit Requirements		Semester	Year
		Minimum	Maximum		
4.5	UG Certificate	40	44	2	1
5.0	UG Diploma	80	88	4	2
5.5	Three Year Bachelor's Degree	120	132	6	3
6.0	Bachelor's Degree Honours Or Bachelor's Degree Honours with Research	160	176	8	4

Abbreviations

OE: Open Elective

AEC: Ability Enhancement Course

VEC: value Education Courses

CC: Co-Curricular Courses

IKS: Indian Knowledge System

OJT: On Job Training

FP: Field Project

VSC: Vocational Skill Courses

CEP: Community Engagement Project

The detailed structure for **Electronic Science as a Major Subject** is explained in Table 1 - 3.

Credit distribution structure for three/ four-year Honours/ Honours with Research Degree Programme

For Major Courses – Refer Table 1, 2 and 3 For all Other Courses – Refer table 4

Table 1: Credit distribution structure for Major Courses for Level at 4.5 and 5.0

Level/ Degree	Semester	Course Type	Course Code	Course Title	Remark	Credit	No. of Hrs. to be engaged
4.5 UG Certificate	I	Subject-I: Electronic Science	ELS-101-T	Fundamentals of Analog Electronics	Theory	2	30
			ELS-102-P	Practical Course-I	Practical	2	60
		Open Elective	OE -101-ELS	Basics of Computer Hardware	Theory	2	30
		Skill Enhancement Course (SEC)	SEC-101-ELS	Electronic Circuit Building and Testing	Practical	2	60
		Generic IKS	IKS-100-T	Indian Knowledge System	Theory	2	30
	II	Subject-I: Electronic Science	ELS-151-T	Fundamentals of Digital Electronics	Theory	2	30
			ELS-152-P	Practical Course-II	Practical	2	60
		Open Elective	OE-151-ELS	Basics of Computer Hardware	Theory/ Practical	2	30/60
		Skill Enhancement Course (SEC)	SEC-151-ELS	PCB Designing and Fabrication	Practical	2	60
5.0 UG Diploma	III	Major Core	ELS-201-MJ	Analog Circuit Design	Theory	2	30
			ELS-202-MJ	Digital Circuit Design	Theory	2	30
			ELS-203-MJP	Practical Course-III	Practical	2	60
		Vocational Skill Courses	ELS-221-VSC	Circuit Simulation-I	Practical	2	60
		Field Project	ELS-231-FP	Field Project	Field Work	2	60
		Open Elective	OE-201-ELS	Open Elective	Theory	2	30
		IKS (Major Subject Specific)	IKS-200-T		Theory	2	30
	IV	Major Core	ELS-251-MJ	Linear Integrated Circuits	Theory	2	30
			ELS-252-MJ	Microcontroller Programming and Applications	Theory	2	30
			ELS-253-MJP	Practical Course-IV	Practical	2	60
		VSC	ELS-271-VSC	Circuit Simulation-II	Practical	2	60

Table 2: Credit Distribution Structure for Major Courses at Level 5.5

		Community Engagement Project	ELS-281-CEP	Community Engagement Project	Socio-Economic Survey + Activities	2	60
Level/ Degree	**Semester**	**Course Type**	**Course Code**	**Course title**	**Remark**	**Credit**	**No. of Hrs. to be engaged**
		Open Elective	ELS-301-MJ OE-251-ELS	Principles of Semiconductor Devices Open Elective	Theory / Practical	2	30 / 30/60
			ELS-302-MJ	Embedded System Design	Theory	2	30
		Major Core	ELS-303-MJ	Instrumentation and Process Control	Theory	2	30
			ELS-304-MJ	Communication Electronics	Theory	2	30
			ELS-305-MJP	Practical Course-V	Practical	2	60
	V		ELS-306-MJP	Practical Course-VI	Practical	2	60
		Major Elective	ELS-310-MJ	Nanoelectronics	Theory – (Select any one)	2	30
			ELS-311-MJ	Fiber Optic Communication		2	30
			ELS-313-MJP	Major Elective Practical Lab-I	Practical	2	60
		Vocational Skill Courses	ELS-321-VSC	Sensors, Actuators and Signal Conditioning	Theory / Practical	2	30/60
5.5 UG Degree		FP/CEP	ELS-331-FP		Field Project work	2	60
		Major Core	ELS-351-MJ	Advanced Embedded Systems	Theory	2	30
			ELS-352-MJ	Digital System Design using Verilog	Theory	2	30
			ELS-353-MJ	Power Electronics	Theory	2	30
			ELS-354-MJ	Digital Communication	Theory	2	30
	VI		ELS-355-MJP	Practical Course-VII	Practical	2	60
			ELS-356-MJP	Practical Course-VIII	Practical	2	60
		Major Elective	ELS-360-MJ	Internet of Things (IoT)	Theory (Select anyone)	2	30
			ELS-361-MJ	Signals and Systems		2	30
			ELS-362-MJP	Major Elective Practical Lab -II	Practical	2	60

		VSC	ELS-371-VSC	PLC Programming	Theory / Practical	2	30/60
		On Job Training	ELS-381-OJT			4	30 hr / Cr

Table 3: Credit distribution structure for Major Courses at Level 6.0

Level/ Degree	Semester	Course Type	Course Code	Course Title	Remark	Credit	No. of Hrs. to be engaged
6.0 UG Honours with Research Degree in Major and Minor	VII	Major Core	ELS-401-MJ	RF and Microwave	Theory	4	60
			ELS-402-MJ	Optoelectronics	Theory	2	30
			ELS-403-MJP	Practical Course-VIII	Practical	2	60
			ELS-404-MJP	Practical Course-IX	Practical	2	60
		Major Elective	ELS-410-MJ	Consumer Electronics	Theory (Select any one)	2	30
			ELS-411-MJ	Electronics for Robotics		2	30
			ELS-412-MJP	Major Elective Practical Lab -III	Practical	2	60
		Research Methodology	ELS-405-MJ	Research Methodology	Theory	4	60
		Research Project	ELS-406-MJP	Research Project	Project	4	120
	VIII	Major Core	ELS-451-MJ	Internet of Things	Theory	4	60
			ELS-452-MJ	Electronics for E-Mobility	Theory	2	30
			ELS-453-MJP	Practical Course-X	Practical	2	60
			ELS-454-MJP	Practical Course-XI	Practical	2	60
		Major Elective	ELS-461-MJ	VLSI	Theory (Select any one)	2	60
			ELS-462-MJP	Mechatronics		2	60
			ELS-412-MJP	Major Elective Practical Lab -IV	Practical	2	60
		Research Project	ELS-481-RP	ResearchProject	Project	8	240

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Title of the Course : Fundamentals of Analog Electronics						
Year: I				**Semester: I**		
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks
		Theory	Practical			

						CIE	ESE	Total
Subject-I	**ELS-101-T**	**02**	**00**	**02**	**30**	**15**	**35**	**50**

Course Outcomes: After completion of the course, the students will be able to

1. Identify basic Component and systems used in analog circuits
2. Explain fundamental laws and elements of electrical circuits
3. Understand DC circuit theorems and networks
4. Understand AC circuits and related terminologies with examples

Detailed Syllabus:

Unit	Topics	Lectures
I	**Introduction to Electronic Components and Basic Circuits** Active and passive electronic components, Series and parallel combination of Resistor capacitor and inductors.Ohms law, Potential divider arrangement different types of signal in electronics step response of RC circuit RC time constant RC circuit with square wave input Filter circuit Low pass and high pass filter LCR circuit.	**10**
II	**Network Theorems** Introduction of KCL and KVL, Ideal voltage and current sources, Thevenin and Norton theorem. Maximum power transfer theorem superposition theorem. Numerical problem based on these Network theorem.	**05**
III	**Junction Diodes and Its Applications** P-N junction diode: symbol pins depletion layer , barrier potential working of forward and reverse condition I-V characteristics. Zener diode : I-V characteristics of zener diode equivalent circuit of zener diode Breakdown mechanism of zener diode . Photo diode: Circuit and I-V characteristics LED: Circuit symbol construction and I-V characteristics Applications: Half wave, Full wave and bridge rectifier circuit diagram working and waveforms.	**10**
IV	**Bipolar Junction Transistor and Applications** Basics of Transistor: symbol Terminals types basic operation, Configurations and characteristics. JFET. Application : Transistor as a switch and Amplifier.	**05**

Reference Books :

1. Basic Electronics: Bernard Grob, McGraw Hill Publication,8th Edition.
2. Essentials of Circuit Analysis: Robert Boylestad, Pearson College Div.
3. Principles of Electronics: V. K. Mehta S. Chand and Co.
4. Electronic Principles: Albert Melvino, David J Bates, McGraw Hill 7th Edition 2012.
5. A Textbook of Applied Electronics (Multicolour Edition), Dr. R S Sedha, 3rd Edition.

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Title of the Course : Practical Course-I								
Year: I				**Semester: I**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
Subject-I	**ELS-102-P**	**00**	**02**	**02**	**60**	**15**	**35**	**50**

Course Outcomes: After completion of this course student will able to

1. Understand how to identify electronic components?
2. Understand DC circuit theorems and networks
3. Understand AC circuits and related terminologies with examples

List of Experiments: (Any 15)

1. Introduction to electronic components and instruments
2. Study of series and parallel combinations of resistors.
3. Study of series & parallel combinations of capacitors & inductors.
4. Use of Multimeter for testing of electronic components.
5. Study of Voltage divider and Current divider circuits.
6. Study of CRO and signal generator.
7. Measurement of Amplitude, Frequency & Phase difference using CRO.
8. Verification of Kirchoff's Law.
9. Verification of Thevenin's Theorem.
10. Verification of the Maximum Power Transfer Theorem.
11. Verification of Norton Theorem.
12. Build and test low and high pass RC filter
13. Study of the I-V Characteristics of Diode.
14. Study of the I-V Characteristics of the CE configuration of BJT
15. Study of half wave, full wave and bridge rectifier
16. Trasistor as switch.

References: Basic Electronics: Bernard Grob, McGraw Hill Publication,8th Edition.

Essentials of Circuit Analysis: Robert Boylestad, Pearson College Div.

Principles of Electronics: V. K. Mehta S. Chand and Co.

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Title of the Course :	**Basics of Computer Hardware**							
Year: I				**Semester: I**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
OE	**OE -101-ELS**	**02**	**00**	**02**	**30**	**15**	**35**	**50**

Course Outcomes: After completion of the course, the students will be able to

1. Understand computer system and its operations.
2. Enhance the knowledge of different devices used in the computer with respect to their applications.
3. Understand the use of system software and applications software.
4. Able to troubleshoot the computer hardware or software problems.

Detailed Syllabus:

Unit	Topics	Hours
I	**Fundamental of Computers** Computer: definition, block diagram of computer system, need, features, characteristics; Generation of computers; Classifications of computer systems: main-frames, microcomputer, minicomputers, supercomputer; Types of computer: desktop, laptop, server, tablet; Application areas of computers.	**8**
II	**Components of Computer** Microprocessor: block diagram, working, features, classification of microprocessor, generation of microprocessor, packaging of microprocessor, types of processor. Motherboard: block diagram, working, features, chipset, components, connectors, slots, ports, classification of motherboard, concept of PCB, types of motherboard. Memory: definition, features, types of memory, memory hierarchy; Primary memory: RAM, ROM; Concept of cache memory; Secondary memory: floppy disk, hard disk, CD, DVD, pen drive, memory card, external memory.	**12**
III	**Computer Peripherals** Input devices: definition, characteristics, classification; Keyboard: features, types; Mouse: features, types; Scanning devices: scanner, O.M.R., touch screen; Microphone; Webcam. Output devices: definition, characteristics, classification; Monitor: features, types; Printer: features, classification, types; Projector; Speaker; Concept of computer assembling and disassembling.	**10**

Suggested Readings/Material:

1. Computer Fundamentals, P. K. Sinha, BPB Publications, Sixth Edition.

2. Introduction to Information Technology, V. Rajaraman, PHI, Second Edition.

3. Fundamental of Information Technology, Chetan Shrivastava, Kalyani Publishers.

4. Computers Today, Suresh K Basandra, Galgotia Publications.

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Title of the Course : Electronic Circuit Building and Testing								
Year: I				Semester: I				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
SEC	**SEC 101 ELS**	**00**	**02**	**02**	**60**	**15**	**35**	**50**

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

1. Understand how to identify, use and construct electronic circuits with circuit elements
2. Develop skill of assembling simple electronic circuits
3. Test assembled electronic circuit

Detailed Syllabus:

List of Experiments (Any 15)

1. Identification, Specification of Electronic components- Fuse, MCB, Relays, Batteries, Switches, Cables, Connectors, Speaker, Mic
2. Identification, Specification of Electronic components- Relay, Photodiode, Thermistor, Heat sinks, PCBs
3. Measurement of resistor using color code and Multimeter
4. Testing of Diode and Transistor
5. Study of Breadboard and Tagboard
6. Voltage and Current divider Circuit
7. LED Circuit: Intensity Variation
8. Light sensitive switching: Application of LDR
9. Wiring of light circuit using Two-way switches. (Staircase wiring)
10. Testing of Diode and Transistor
11. Study of Breadboard and Tagboard
12. One-way light bulb
13. Slow light bulb. (Charging and discharging of Capacitor)
14. Burglar alarm (Use of IR led and photodiode)
15. Touch Sensor circuit
16. Fire alarm circuit (Use of Thermistor)
17. LED Flasher circuit (Transistorized astable multivibrator)

References:

1. https://www.elprocus.com/simple-electronic-circuits-for-beginners/
2. https://circuitdigest.com/electronic-circuits

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Title of the Course : Fundamentals of Digital Electronics								
Year: I				Semester: II				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
Subject-I	**ELS-151-T**	**02**	**00**	**02**	**30**	**15**	**35**	**50**

Course Outcomes (CO): After completion of the course, the students will be able to

3. Solve problems based on inter-conversion of number systems.
4. Understand different logic gates.
5. Understand the working principle and application of different arithmetic circuits
6. Understand types of digital circuits.

Detailed Syllabus

Unit	Topics	Lectures
I	**Number Systems, Digital codes and Boolean Algebra** Introduction to Decimal, Binary and Hexadecimal number systems and their interconversions, Binary addition, subtraction, multiplication, division, concept of 1's and 2's complements, BCD code, Excess-3 Code, Gray Code, Gray to Binary and Binary to Gray conversion. Rules and laws of Boolean algebra, De Morgan's theorem, simplification of Logic equations using Boolean algebra rules.	**10**
II	**Logic Gates and Arithmetic Circuits** Introduction to logic gates (Basic and Derived), Universal Logic Gates, half adder, full adder, half subtractor, full subtractor, four- bit parallel adder, universal adder / subtractor.	**05**
III	**Combinational Circuits** Multiplexer (2:1, 4:1), demultiplexer (1:2, 1:4) and their applications, concept of tree multiplexing, Code converters: Decimal to binary and BCD to decimal, Encoders& decoders: priority encoder, BCD to seven segment decoder.	**05**
IV	**Sequential Circuits** Flip flops: Introduction, clocked RS, JK, Master slave JK, D and T Flip Flop. Counters: Asynchronous counter, synchronous counter, up down counter, w timing diagram concept of modulus counters, Decade counter. Shift registers: Introduction, SISO, SIPO, PISO, PIPO shift registers, ring counter, universal 4-bitshift register and Applications of shift registers.	**10**

Reference Books:

1. Digital Design - M. Morris Mano, PHI, New Delhi.
2. Digital Systems Principles and Applications - Ronald J. Tocci.
3. Digital electronics - G. K. Kharate, Oxford University Press.
4. Fundamentals of Digital Circuits - Anand Kumar.
5. Digital Principles and Applications - Malvino and Leach, TMG Hill Edition.
6. Digital Electronics: Jain R.P., Tata McGraw Hill
7. Digital Fundamentals: Floyd T.M., Pearson Education

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Title of the Course : Practical Course-II								
Year: I				**Semester: II**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
Subject-I	**ELS-152-P**	**00**	**02**	**02**	**30**	**15**	**35**	**50**

Course Outcomes: After completion of the course, the students will be able to

1. Understand the different types of logic gates
2. Understand the difference between sequential and combinational circuits.
3. Understand the different modes of shift registers.
4. Understand the various types of code converters.

List of Experiments:

1. Design and verify the basic gates as AND, OR, NOT.
2. Design and verify the universal gates as NOR and NAND gates.
3. To study logic gate ICs: 7400, 7402, 7404, 7408, 7432, 7486Verification of De Morgan's theorems
4. Study of RS and D flip flop.
5. Study Mod-2, Mod-5 and Mod-10 counters using IC7490.
6. Study of Half and Full Adder.
7. Study of Half and Full Subtractor.
8. Four-bit parallel adder using IC 7483.
9. Study of Binary to Gray and Gray to Binary code converter.
10. Decimal to Binary Encoder.
11. Study of BCD to 7-segment decoder.
12. Study of 1:2 Multiplexer
13. Study of 2:1 Demultiplexer
14. Study of different modes of shift registers using IC 7495.
15. Study 4-bit up/down counter.
16. Priority encoder
17. Hexadecimal to BCD converter
18.

References:

1. Digital Systems Principles and Applications - Ronald J. Tocci.
2. Digital electronics - G. K. Kharate, Oxford University Press.
3. Fundamentals of Digital Circuits - Anand Kumar.
4. Digital Principles and Applications - Malvino and Leach, TMG Hill Edition.

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Title of the Course :	**Basics of Computer Hardware Lab**							
Year: I				**Semester: II**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
OE	**OE-151-ELS**	**00**	**02**	**02**	**60**	**15**	**35**	**50**

Course Outcomes: After completion of the course, the students will be able to

1. Identify computer hardware parts and connect peripherals
2. Describe function of input and output peripheral devices.
3. Understand the use of different types of storage devises.
4. Able to troubleshoot the computer hardware problems.

Detailed Syllabus:

List of Experiments

1. Study of read and write action of RAM (using IC 2112/4 or equivalent).
2. Study of diode matrix ROM.
3. Study of computer hardware system.
4. Study of ALU using IC 74181.
5. Study of Motherboard and CPU.
6. Study of keyboard and mouse.
7. Study of types of printers and scanners.
8. Study of display devices.
9. Study semiconductor storage devices. (RAM/SSD/Pen Drive/Memory Card)
10. Study optical storage devices.
11. Study magnetic storage devices.
12. Study of SMPS.
13. Study of UPS.
14. Assembling and Disassembling of Computer.
15. Study of different cables and connectors for interfacing various peripheral devices.

References:

1. Digital electronics - G. K. Kharate, Oxford University Press.
2. Fundamentals of Digital Circuits - Anand Kumar.
3. Digital Principles and Applications - Malvino and Leach, TMG Hill Edition.
4. Digital Electronics: Jain R.P., Tata McGraw Hill
5. Digital Fundamentals: Floyd T.M., Pearson Education

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Title of the Course : PCB Designing and Fabrication								
Year: I				Semester: II				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
SEC	**SEC-151-ELS**	**00**	**02**	**02**	**60**	**15**	**35**	**50**

Course Outcomes:

On completion of the course, student will be able to

1. To prepare PCB layout for given circuit
2. Use software for creating layout.
3. Make PCB and solder components on PCB

Detailed Syllabus:

Group A: List of Experiments (Compulsory)

1. Preparation of layout and artwork layout planning.
2. Study of PCB software.
3. Principle of a simple PCB.
4. Etching and Drilling of PCB.
5. Preparation and mounting components.

Group B: Making PCBs of following Circuits (any 10)

1. Light switching using LDR
2. Water level controller circuit.(Use of Transistor)
3. Binary to Gray Converter
4. Half adder
5. Full adder
6. Rectifier - Half wave, Full wave (Bridge)
7. Seven Segment Display driver interface
8. Decade counter
9. 2:1 Multiplexer
10. 1:2 Demultiplxer
11. LED Flasher circuit

References: 1. Basic Electronics: Bernard Grob, McGraw Hill Publication,8th Edition.

2. Essentials of Circuit Analysis: Robert Boylestad, Pearson College Div.

3. Principles of Electronics: V. K. Mehta S. Chand and Co.