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

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

With effect from Academic Year

2024-2025

Fergusson College (Autonomous), Pune
Proposed Second Year Curriculum as per NEP 2020

Department of Electronic Science

Structure for Major / Minor

Semester	Paper Code	Paper Title	Credits
III	ELS-200 (Major)	Electronic Science Practical-3	2
	ELS-201 (Major)	Principles of Digital Electronics	4
	ELS-211 (Minor)	Applications of Analog and Digital Electronics	2
	ELS-212 (Minor)	Electronic Science Practical – 3	2
	ELS-220 (OE)	Computer Hardware	2
	ELS-230 (VSC)	Python Programming for Electronics	2
	ELS-240 (SEC)	Programming Skills using C	2
	ELS-245 (CEP)		2
	ELS-215 (Minor) CS	Embedded Systems	2
	ELS-216 (Minor) CS	Electronics Practical-3	2

Fergusson College (Autonomous), Pune
Proposed Second Year Curriculum as per NEP 2020

Department of Electronic Science

Structure for Major / Minor

Semester	Paper Code	Paper Title	Credits
IV	ELS-250 (Major)	Electronic Science Practical-4	2
	ELS-251 (Major)	Principles of Analog Electronics	4
	ELS-261 (Minor)	Electronic Instrumentation	2
	ELS-262 (Minor)	Electronic Science Practical-4	2
	ELS-270 (OE)	Renewable Sources of Energy	2
	ELS-280 (VSC)	PCB Design and Fabrication	2
	ELS-290 (SEC)	Circuit Modelling and Simulation	2
	ELS-295 (FP)		2
	ELS-265 (Minor) CS	Fundamentals of IoT	2
	ELS-266 (Minor) CS	Electronics Practical – 4	2

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)

S. Y. B. Sc. Semester III		
ELS-200	**Electronic Science Practical-3 (Major)**	**Credits: 2 Hours: 60**
Course Outcomes (COs) On completion of the course, the students will be able to:		**Blooms Cognitive Level**
CO1	List the components and identify the required test and measuring instruments	1
CO2	Describe the procedure and report the observations	2
CO3	Interpret the results and compare them with expected values	3

Any 10 Experiments

Expt. No.	Title of the Experiment
1.	Basic Logic gates using discrete components, identification and selection of ICs for performing different operations.
2.	Verification of De-Morgan's theorem
3.	Half adder, full adder and Subtractor
4.	4-bit adder/ Subtractor
5.	Study of R-S, J-K, T and D Latch using NAND/NOR gates
6.	Testing of flip-flops using ICs
7.	Multiplexer/ Demultiplexer
8.	Encoder/ Decoder
9.	Counters
10.	Shift register
11.	Rolling display
12.	Diode Matrix ROM/ RAM
13.	Digital to analog converter
14.	Analog to digital converter
15.	Static and dynamic displays
16.	OR Any Other Equivalent Experiment

S. Y. B.Sc. Semester III		
ELS-201	**Principles of Digital Electronics (Major)**	**Credits:** 4 **Hours:** 60
Course Outcomes (COs) On completion of the course, the students will be able to:		**Blooms Cognitive Level**
CO1	Define basic principles of digital electronics, including Boolean algebra, logic gates and binary number system	1
CO2	Explain basic combinational and sequential circuits	2
CO3	Implement sequential logic circuits like counters and shift registers using Flip-flops	3
CO4	Distinguish between characteristics of combinational and sequential circuits	4

Syllabus

Unit	Contents	No. of hours
I	**Fundamentals 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, K map. **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. **Logic families** Types, Fan-in, Fan out, Noise Margin, Power Dissipation, Figure of merit, Speed power product, comparison of RTL, TTL and CMOS families.	**15**
II	**Combinational Circuits** Half adder, full adder, 4-bit binary adder, Subtractor, universal adder Subtractor, Multiplexer, demultiplexer, encoder, decoder, magnitude comparator, parity generator, parity checker, Applications of multiplexer, de multiplexers, encoders and decoders	**15**
III	**Sequential Circuits** Flip Flops- Concept of 1-bit memory cell, latch, operation, waveforms, truth table of S-R, D, J-K, M-S, T flip-flops, race around condition. Counters: Types of triggering, Natural counters, synchronous and asynchronous, up/down counters, modified counters, resetting logic, modulo counters, scaling circuits, Shift registers: Need of shift operations, Modes of operation - SISO, SIPO, PISO, PIPO, universal shift register, ring counter, Johnson counter. Applications – Time delay generator, Serial to Parallel and Parallel to Serial converter, static and dynamic display.	**22**
IV	**Data Converters** DAC: Binary weighted resistor type DAC and R-2R ladder DAC Specifications – Resolution, non-linearity, gain error, settling time ADC: Successive approximation ADC, Dual slope ADC and Flash ADC Specifications of ADC – Resolution, input range, linearity, conversion time Applications of data converters	**8**

References

1. Digital principles and applications, A. P. Malvino, D. P. Leach McGraw Hill Book Co.
2. Modern Digital Electronics, R. P. Jain Tata McGraw Hill publishing co.ltd.
3. Digital Fundamentals, Floyd and Jain, Pearson.
4. 2000 solved problems in Digital Electronics, S. P. Bali, Tata McGraw Hill publishing co. ltd.

S. Y. B. Sc. Semester III		
ELS-211	**Applications of Analog and Digital Electronics (Minor)**	**Credits:** 2 **Hours:** 30
Course Outcomes (COs) On completion of the course, the students will be able to:		**Blooms Cognitive Level**
CO1	Define the characteristics and behaviour of common analog and digital components	1
CO2	Explain the analog and digital circuits along with circuit diagrams	2
CO3	Describe DAC and ADC with their specifications	2
CO4	Implement counters and shift registers using Flip-Flops	3

Syllabus

Unit	Contents	No. of hours
I	**Diode Circuits** Clipper and clamper circuits, Voltage doubler and multiplier, Rectifiers (half and full wave), rectifier with capacitor-filter, Zener regulator. **Amplifiers** BJT amplifier: types and design, dc and ac load line analysis, frequency response, Multistage amplifiers, tuned amplifiers: Working and applications, Class A, B, AB and C amplifiers, crossover distortion, heat sink. **Feedback and Oscillators** Barkhausen criteria for oscillations, types of oscillators and circuits	**7**
II	**Operational Amplifier and Parameters** Op-Amp parameters: ideal and IC741, Open and closed loop configuration, Frequency response of an op-amp in open loop and closed loop configurations, Inverting and Non-inverting amplifier, Concept of feedback, negative and positive feedback, advantages and disadvantages **Op amp Circuits** Summing and difference amplifier, Integrator, Differentiator, V to I and I to V converter; Basic comparator, Schmitt Trigger, Precision rectifier, Signal generators: Phase shift oscillator, Wein bridge oscillator, Square wave generator	**8**
III	**Sequential Circuits** Counters: Types of triggering, Counters - Natural counters: synchronous and asynchronous, up/down counters, modified counters, resetting logic, modulo counters, scaling circuits, Shift registers: Need of shift operations, Modes of operation - SISO, SIPO, PISO, PIPO, universal shift register, ring counter, Johnson counter. Applications – Time delay generator, Serial to Parallel and Parallel to Serial converter	**8**
IV	**Data Converters** DAC: Binary weighted resistor type DAC and R-2R ladder DAC Specifications – Resolution, non-linearity, gain error, settling time ADC: Successive approximation ADC, Dual slope ADC and Flash ADC Specifications of ADC – Resolution, input range, linearity, conversion time, Applications of data converters	**7**

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. Digital principles and applications, A. P. Malvino, D. P. Leach McGraw Hill Book Co.
5. Modern Digital Electronics, R. P. Jain Tata McGraw Hill publishing co.ltd.
6. Digital Fundamentals, Floyd, Jain, Pearson.
7. 2000 solved problems in digital Electronics, S. P. Bali, Tata McGraw Hill publishing co. ltd.

S. Y. B.Sc. Semester III		
ELS-212	**Electronic Science Practical-3 (Minor)**	**Credits: 2 Hours: 60**
Course Outcomes (COs) On completion of the course, the students will be able to:		**Blooms Cognitive Level**
CO1	List the components and identify the required test and measuring instruments	1
CO2	Describe the procedure and report the observations	2
CO3	Interpret the results and compare them with expected values	3

Any 10 Experiments

Expt. No.	Title of the Experiment
1.	Voltage doubler and multipliers
2.	Clipping and clamping circuits.
3.	Half wave rectifier and Full wave rectifier.
4.	Voltage divider bias for BJT and Single Stage CE amplifier
5.	Inverting and non-inverting amplifier using op-amp.
6.	Integrator and differentiator using op-amp
7.	Radio frequency oscillator / Crystal oscillator using BJT
8.	Wien bridge / Phase Shift Oscillator
9.	Study of R-S, J-K, T and D Latch using NAND/NOR gates
10.	Testing of flip-flops using ICs
11.	Counters - Study and application
12.	Shift register - Study and application
13.	Digital to analog converter
14.	Analog to digital converter
15.	Square and triangular wave generator
16.	Demo of SMPS and UPS and Technical specifications of the equipment used in Laboratory.

S. Y. B. Sc. Semester III		
ELS-220	**Computer Hardware (OE)**	**Credits:** 2 **Hours:** 30
Course Outcomes (COs) On completion of the course, the students will be able to:		**Blooms Cognitive Level**
CO1	Recall the basic components of computer system	1
CO2	Identify various storage and I/O devices	1
CO3	Explain the architecture and operation of various parts of computer	2
CO4	Discuss the functions of various operating systems and application soft wares.	2

Syllabus

Unit	Contents	No. of hours
I	Understanding the Computer Introduction, Evolution of Computers, Generations of Computers, Classification of Computers, Computing Concepts, The Computer System, Applications of Computers Computer Organization and Architecture Introduction, Central Processing Unit, Internal Communications, Memory and Storage Systems Memory Representation, Random Access Memory, Read Only Memory, Storage Systems, Magnetic Storage Systems, Optical Storage Systems, Magneto Optical Systems, Solid-state Storage Devices, Storage Evaluation Criteria Input Devices Introduction, Keyboard, Pointing Devices, Scanning Devices, Optical Recognition Devices, Digital Camera, Voice Recognition System, Data Acquisition Sensors, Media Input Devices Output Devices Display Monitors, Printers, Impact Printers, Non-impact Printers, Plotters, Voice Output Systems, Projectors, Terminals,	**10**
II	Computer Codes Decimal System, Binary System, Hexadecimal System, Octal System, 4-bit Binary Coded Decimal (BCD) Systems, 8-bit BCD Systems, 16-bit Unicode Computer Software Types of Computer Software, System Management Programs, System Development Programs, Standard Application Programs, Unique Application Programs Operating Systems	**10**

	History of Operating Systems, Functions of Operating Systems, Process Management, Memory Management, File Management, Device Management, Security Management, Types of Operating Systems, Providing User Interface, Popular Operating Systems Soft wares-Report writing, editing, tables, databases and presentation soft wares, multimedia software, language translator software.	
III	Programming Languages History of Programming Languages, Generations of Programming Languages, Characteristics of a Good Programming Language, Categorization of High-level Languages, Popular High-level Languages, Factors Affecting the Choice of a Language The Internet and World Wide Web History of Internet, Internet Applications, Understanding the World Wide Web, Web Browsers, Browsing the internet, using a Search Engine, Email Service, Protocols Used for the Internet and AI tools	**10**

References:

1. E. Balagurusamy, Fundamentals of Computers, McGraw Hill.
2. Rajaraman V and Adabala N, Fundamentals of Computers,6th Edition, PHI.
3. Priti Sinha, Pradeep K., Sinha, Computer Fundamentals, 8th Edition, bpb Publications.
4. Reema Thareja, Fundamentals of Computers, 3rd Edition, Oxford Press.
5. Anita Goel, Computer Fundamentals, Pearson.

Course Code and Title: - ELS-230: Python Programming for Electronics (VSC)

Teaching and Evaluation

Sem.	Subject Code	Title	No. of Hrs. per Week (Total-30 Hrs.)	Max. Marks	CE 40 %	ESE 60%	Credits
III	**ELS-230**	**Python Programming for Electronics**	**2**	**50**	**20**	**30**	**2**

Vocational Skill Course (VSC)

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.**

Skill Sets:

ELS-230	**Python Programming for Electronics (VSC)**	**Credits:** 2 **Hours:** 30
Students will acquire the following skills on completion of the course:		
1.	Installation of python on PC/ laptop	
2.	Understand basic syntax, variable data types and basic operations.	
3.	Learn loops and conditional statements.	
4.	How to define and use functions to organise code to perform given task.	
5.	Familiarize with lists, tuples and dictionaries	
6.	Learn how to manipulate tuples and dictionaries	
7.	Understand how to take user input and display output	
8.	Develop debugging skills to identify and fix errors in code developed.	
9.	Explore commonly used libraries as well as learn how to import and use these libraries.	
10.	Acquire the skills to find and use python documentation and online resources for problem solving.	

Syllabus

Unit	Contents	No. of hours
I	**Installation, Data Types and Input/output** Importance of Python, Installing Python in Windows/ Ubuntu, Executing Python programs, Comments in Python, Internal working of Python, Python character set, Tokens, Python Core Data Types, The print () function, Assignment of values to variables, The input() function, The eval() function.	**5**
II	**Operators and Control Statements** Operators- Arithmetic Operators, Operator precedence and Associativity, Bitwise	**5**

	operator, The compound assignment operator; Decision statements- Boolean operators, Boolean Expressions and Relational operators, Decision making statements; Loop Control Statements-while loop, range() function, for loop; break statement, continue statement.	
III	**Functions and Lists** Functions- Syntax and basics of a function, use of a function, parameters and arguments in a function, the local and global scope of a variable, the return statement, recursive functions, the lambda function; Lists- Creating Lists, accessing the elements of a List, List slicing, Python in-built functions for lists, List Comprehension, List Methods, passing list to a function, Returning a list to function.	**5**
IV	**Basic Exercises** 1. Implement a Python program to Calculate GCD of two numbers. 2. Implement a Python Program to calculate the square root of a number by Newton's Method. 3. Implement a Python Program to find the largest number from a list of numbers. 4. Implement a Python Program to perform Liner search 5. Implement a Python Program to perform Binary search 6. Implement a Python Program to perform insertion sort. 7. Implement a Python Program to perform selection sort. 8. Implement a Python program to multiply matrices. 9. Implement a Python program to calculate the most frequent words in a text from a file. 10. Implement a Python program to find if string is palindrome or not. etc.	**15**

References:

1. Let us Python by Y C Kanetkar, 10th Edition, BPB Publications.
2. Coding Projects in Python, A step by step guide to creating your own Python Projects, DK, Penguin Random House, 1st American Edition, 2017.
3. Learn Python the HardWay, 3rd Edition, Zed A Shaw, Addison-Wesley, 2014
4. Learning Python,5th Edition, O'Reilley,2013
5. Python Programming for Beginners, 2015 Corey Kidd.
6. Python 3, www.tutorialspoint.com
7. www.python.org
8. https://www.codeacademy.com/learn/learn-python
9. https://www.w3schools.com/python
10. https://www.learnpython.org
11. https://www.geeksforgeeks.org/python-programming-language

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]**

ELS-240: Programming Skills using C
(SEC)
Teaching and Evaluation

Sem.	Subject Code	Title	No. of Hrs. per Week (Total-30 Hrs.)	Max. Marks	CE 40 %	ESE 60%	Credits
III	**ELS-240**	**Programming Skills using C**	**2**	**50**	**20**	**30**	**2**

Skill Enhancement Course (SEC)

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.**

Skill Sets:

ELS-240	**Programming Skills using C**	**Credits:** 2 **Hours:** 30
Students will acquire the following skills on completion of the course:		
1.	Learn basic syntax and structure of C language	
2.	Understand variables and data types	
3.	Learn to use operators and expressions	
4.	Write control structures (if statements, loops)	
5.	Understand arrays and strings	
6.	Compare arithmetic, relational and logical operators	
7.	Get familiar with input/output operations	
8.	Get familiar with standard C libraries	
9.	Handle errors and debugging techniques	
10.	Practice problem-solving through coding exercises	

Syllabus

Unit	Contents	No. of hours
I	**C Programming Language:** Introduction, Character set, Tokens, keywords, identifier, constants, basic data types, variables: declaration & assigning values. Structure of C program, Arithmetic operators, relational operators, logical operators, assignment operators, increment and decrement operators, conditional operators, bit wise operators, expressions and evaluation of expressions, type cast operator, implicit conversions, precedence of operators. Arrays-concepts, declaration, accessing elements, storing elements, two-dimensional and	5

	multidimensional arrays. Input output statement and library functions (math and string related functions)	
II	Decision making, branching & looping: Decision making, branching and looping: if, if-else, else-if, switch statement, break, for loop, while loop and do loop. Functions: Defining functions function arguments and passing, returning values from functions. Structures: defining and declaring a structure variable, accessing structure members, initializing a structure, copying and comparing structure variables, array of structures, arrays within structures, structures within structures, structures and functions. Pointers.	5
III	Assignments 1. Generate the Fibonacci series up to the given limit N and print the number of elements in the series. 2. Develop a program that displays calendar for given month and year. 3. Reverse a given string for example "hello" 4. Checks whether given year is a leap year or not. 5. Convert a binary number into its decimal equivalent 6. Find minimum and maximum of N numbers. 7. Find the GCD of two integer numbers. 8. Calculate factorial of a given number. 9. Find all the roots of a quadratic equation Ax2 + Bx + C = zero for non – zero coefficients A, B and C. Else report error. 10. Calculate the value of sin (x) and cos (x) using the series. Also print sin (x) and cos (x) value using library function. 11. Generate and print prime numbers up to an integer N. 12. Sort given N numbers in ascending order. 13. Develop a program to draw the characteristics of PN junction diode, BJT, UJT and FET. 14. Solve network theorem problems using C Programming. 15. Develop C program to draw the electronic component symbol library. 16. Develop C program to draw charging and discharging of a capacitor.	20

References

1. Balagurusamy, Programming in ANSI C, 2nd edition, TMH.
2. Byron S Gottfried, Programming with C, Schaum Series
3. Brian W. Kernighan, Dennis M. Ritchie, The C Programming Language, Prentice Hall
4. Yashavant Kanetkar, Let Us C, BPB Publications

Proposed Evaluation Methods:

5. For CE: Attendance and Active Participation **[10 Marks]**
6. For CE: Activity/ Assignment/ Survey Report etc. **[10 Marks]**
7. For ESE: Skill demonstration **[20 Marks]**
8. For ESE: Skill demonstration **[10 Marks]**

NEP 2020 - Based Curriculum

of

Electronics (Minor)

for

Computer Science

With effect from Academic Year

2024-2025

Fergusson College (Autonomous), Pune
Proposed Second Year Curriculum as per NEP 2020

Structure for Electronics Minor for Computer Science Department

Semester	Paper Code	Paper Title	Type	Credits
III	ELS - 215	EMBEDDED SYSTEMS	THEORY	2
	ELS - 216	ELECTRONICS PRACTICAL- 3	PRACTICAL	2
IV	ELS - 265	FUNDAMENTALS OF IoT	THEORY	2
	ELS - 266	ELECTRONICS PRACTICAL- 4	PRACTICAL	2

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

S.Y B.Sc. (Computer Science) – Semester III		
ELS - 215	**Embedded Systems (Minor-CS-Theory)**	**Credits: 02 Hours : 30**
Course Outcomes (COs) On completion of the course, the students will be able to:		**Blooms cognitive level**
CO1	Describe the hardware and software unit of Embedded System.	1
CO2	Explain the design process of Embedded system.	2
CO3	Demonstrate the interfacing peripheral devices to Embedded Controller	3
CO4	Categorize different sensors as per the need of the application.	4
CO5	Explain the interfacing techniques for embedded system.	4

Unit No.	Unit title and Contents
I	**Hardware and software units of Embedded system (8 Lectures)** 1.1 Definition of embedded system 1.2 Classification of embedded systems 1.3 Processors of embedded into a system 1.4 Hardware Units of embedded system 1.5 Software embedded into a system 1.6 Architecture of Embedded System 1.7 Design process in embedded system
II	**Architecture of Embedded Controller (10 Lectures)** 2.1 Introduction to RISC and CISC 2.2 Microcontroller architecture 2.3 Counter/ timers and interrupts 2.4 Serial communication 2.5 Addressing modes and instruction set 2.6 Assembly language programs 2.7 I/O Interfacing
III	**Sensors, Data converters, Actuators and Interfacing (12 Lectures)** 3.1 Classification of sensors (Active and passive, analog and digital), 3.2 Specifications of sensor: Accuracy, range, linearity, sensitivity, resolution, reproducibility, 3.3 Temperature sensors (LM-35, AD590), piezoelectric humidity sensor (DHT11), optical sensor (LDR), displacement sensor (LVDT), Passive Infrared sensor (PIR), Touch sensor, Ultrasonic sensor, Gas Sensor 3.4 Analog to Digital and Digital to Analog Converter 3.5 Actuators: LED, solenoid, Motor, servomotor, LCD, OLED, TFT, electronic switches and relay 3.6 Interfacing Techniques: Parallel, serial

References:

1. Embedded Systems SoC,IoT, AI and Real – Time Systems, 4th edition: Raj Kamal, MacGrawHill Education (India) Pvt. Ltd.
2. Embedded Systems Architecture, Programming and Design, 2nd edition: Raj Kamal, MacGrawHill Education (India) Pvt. Ltd.
3. Sensors & Transducers: Dr. A. D. Shaligram: CTC publications
4. The 8051 microcontroller and embedded systems using assembly and C, second edition, Muhammad Mazidi, Janice Gillispie Mazidi, Rolin D. McKinlay, Pearsons Publication

S.Y B.Sc. (Computer Science) – Semester III		
ELS - 216	**Electronics Practical -3 (Minor- CS-Practical)**	**Credits: 02 Hours : 60**
Course Outcomes (COs) On completion of the course, the students will be able to:		**Bloom's cognitive level**
CO1	Identify components and devices used in the circuit.	2
CO2	Use instruction set of microcontroller to write and execute assembly language programs.	3
CO3	Use embedded C /equivalent language for interfacing different devices to microcontroller.	3
CO4	Implement the understanding of architecture of microcontroller to interface different Input / Output devices.	3
CO5	Test embedded C /equivalent language programs for interfacing I/O devices to microcontroller.	4
CO6	Relate the output generated from the interfacing I/O devices to microcontroller.	4

Sr. No.	Title of Experiment / Practical
1	Introduction to Integrated Development Environment
2	Arithmetic problems using Assembly language programming
3	Logical problems using Assembly language programming
4	Testing Boolean operations using Assembly language programming
5	Testing data transfer operations using Assembly language programming
6	Testing program branching operations using Assembly language programming
7	Code conversion problems using Assembly language programming
8	Blinking of LEDs interfaced to microcontroller.
9	Traffic light control by microcontroller.
10	Interfacing Seven Segment Display with microcontroller.
11	Interfacing LCD with microcontroller.
12	Speed and Direction Control of stepper motor interfaced to microcontroller.
13	Interfacing a switch with microcontroller to control Bulb using relay
14	Square Wave generation Using microcontroller
15	Triangular Wave generation Using microcontroller
16	Or Any Other Equivalent Experiment

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Pune

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as per guidelines of

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for

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

SEMESTER - IV

With effect from Academic Year

2024-2025

S. Y. B. Sc. Semester IV		
ELS-250	**Electronic Science Practical -4 (Major)**	**Credits: 2 Hours: 60**
Course Outcomes (COs) On completion of the course, the students will be able to:		**Blooms Cognitive Level**
CO1	List the components and identify the required test and measuring instruments	1
CO2	Describe the procedure and report the observations	2
CO3	Interpret the results and compare them with expected values	3

Any 10 Experiments

Expt. No.	Title of the Experiment
1.	Study of clipping and clamping circuits
2.	Study of the half wave rectifier and Full wave rectifier
3.	Study of power supply using C filter and Zener diode.
4.	Voltage multipliers
5.	Audio amplifier – transistorized (<1W)
6.	Power amplifier (>5W)
7.	Audio frequency oscillator
8.	Radio frequency oscillator
9.	Measurement of Gain, Bandwidth and feedback factor in feedback circuits
10.	Crystal oscillator
11.	Op amp inverting and non-inverting amplifier.
12.	Op amp adder, Subtractor
13.	Integrator and differentiator using op-amp
14.	First Order Low/High-pass filter using op-amp
15.	Phase Shift Oscillator using op-amp
16.	OR Any Other Equivalent Experiment

S. Y. B. Sc. Semester IV		
ELS-251	**Principles of Analog Electronics (Major)**	**Credits:** 4 **Hours:** 60
Course Outcomes (COs) On completion of the course, the students will be able to:		**Blooms Cognitive Level**
CO1	Define the characteristics and behaviour of BJTs and op amps	1
CO2	Explain the diode, BJT and op amp circuits along with circuit diagrams	2
CO3	Illustrate types of feedback in amplifiers and oscillators	3
CO4	Analyse various op amp application circuits	4

Syllabus

Unit	Contents	No. of hours
I	**Diode Circuits** Clipper and clamper circuits, Voltage doubler and multiplier, Rectifiers (half and full wave), rectifier with capacitor-filter, Zener regulator, block diagram of power supply **Amplifiers** BJT amplifier: types and design, dc and ac load line analysis, h and r parameter model, frequency response, Multistage amplifiers, Effect on gain and bandwidth for CE amplifiers, Comparison of parameters of CC, CB and CE amplifiers Single tuned amplifiers: Circuit diagram, Working and Frequency Response and applications, Class A, B, AB and C amplifiers, crossover distortion, heat sink.	**15**
II	**Feedback and Oscillators** Concept of feedback, negative and positive feedback, advantages and disadvantages of negative feedback, voltage (series and shunt), current (series and shunt) feedback amplifiers, Effect of negative feedback on gain, stability, nonlinearity, Z_{in}, Z_{out}, bandwidth, Applications of negative and positive feedback. Barkhausen criteria for oscillations, Study of Wein bridge oscillator, phase shift oscillator, Colpitts oscillator, Hartley oscillator and Crystal oscillator, UJT – characteristics and relaxation oscillator.	**15**
III	**Operational Amplifier and Parameters** Transistorized differential amplifiers, constant current bias, current mirror, push pull amplifier, op amp block diagram, Op-Amp parameters: ideal and IC741, Open and closed loop configuration, Frequency response of an op-amp in open loop and closed loop configurations, Inverting, Non-inverting amplifier, Summing and difference amplifier, V to I and I to V converter	**15**
IV	**Op amp, Timer and Regulator Application Circuits** Integrator, Differentiator, Basic comparator, Voltage limiters, Schmitt Trigger, Precision rectifier, log and antilog amplifiers, active filters, S/H circuit, Signal generators: Phase shift oscillator, Wein bridge oscillator, square wave generator, triangle wave generator, saw tooth wave generator, Timer IC555 block diagram, Multivibrators – types ,op amp based and timer based, 3-pin regulators: fixed and variable	**15**

Reference Books:

1. Electronic devices and circuit theory (11th edition), Robert Boylestad and Louis Nashelsky, Pearson (2013)
2. Electronic Principles, Albert Malvino and David Bates, Mc Graw Hill (2016)
3. Swayam Portal, Analog Electronic Circuits, Prof. Shouri Chatterjee, https://swayam.gov.in/nd1_noc19_ee38/preview
4. Op-Amps and Linear IC's, R. A. Gayakwad, Pearson Education (2003)
5. Operational amplifiers and Linear Integrated circuits, R. F. Coughlin and F. F. Driscoll, Pearson Education (2001)
6. Electronic Principals, A. P. Malvino, Tata McGraw-Hill, (2003)

S. Y. B. Sc. Semester IV		
ELS-261	**Electronic Instrumentation (Minor)**	**Credits:** 4 **Hours:** 60
Course Outcomes (COs) On completion of the course, the students will be able to:		**Blooms Cognitive Level**
CO1	Identify various test and measuring instruments and their applications	1
CO2	Explain the specifications and operating principles of instruments	2
CO3	Discuss types of oscilloscope and power supplies with the help of block/ circuit diagrams.	2
CO4	Solve designing problems regarding error calculations, ammeter, voltmeter.	3

Syllabus

Unit	Contents	No. of hours
I	**Measurement principles and basic instruments** Qualities of Measurement: Specifications of instruments, their static and dynamic characteristics, Error (Gross error, systematic error, absolute error and relative error) and uncertainty analysis. Statistical analysis of data and curve fitting; Basic Measurement Instruments: PMMC instrument, galvanometer, DC measurement - ammeter, voltmeter, ohm meter, AC measurement, Digital voltmeter systems, digital multimeters, digital frequency meter system (different modes and universal counter)	**15**
II	**Oscilloscopes and signal generators** Oscilloscopes: CRT, wave form display and electrostatic focusing, time base and sweep, synchronization, measurement of voltage, frequency and phase by CRO, Oscilloscope probes, Dual trace oscilloscope, DSO Block diagram, principle and working, Advantages and applications, CRO specifications (bandwidth, sensitivity, rise time); Signal Generators: Audio oscillator, Pulse Generator, Function generators (Principle, block diagram, working and specifications)	**8**
III	**Power supplies** Fixed and variable power supplies – block diagram, unregulated and regulated power supply, CVCC, SMPS and UPS (on-line and off-line), typical functions and specifications	**7**

Books:

1. Electronic Instrumentation, H. S. Kalsi, TMH (2006)

2. Electronic Instrumentation and Measurement Techniques, W.D. Cooper and A. D. Helfrick, Prentice- Hall (2005).

S. Y. B. Sc. Semester IV		
ELS-262	**Electronic Science Practical-4 (Minor)**	**Credits: 2 Hours: 60**
Course Outcomes (COs) On completion of the course, the students will be able to:		**Blooms Cognitive Level**
CO1	List the components and identify the required test and measuring instruments	1
CO2	Describe the procedure and report the observations	2
CO3	Interpret the results and compare them with expected values	3

Any 10 Experiments

Expt. No.	Title of the Experiment
1.	Component testing
2.	Convert galvanometer into voltmeter and ammeter
3.	Multirange voltmeter and ammeter
4.	Study of front panels of AMM and DMM.
5.	Estimation of errors
6.	Study of front panel of function generator and CRO/DSO
7.	Measurements of signal parameters – phase, rise time, fall time, duty cycle etc.
8.	Study of fixed power supply
9.	Study of variable power supply
10.	Study of CVCC power supply
11.	Application of bridges for sensor interfacing
12.	Wheatstone's bridge
13.	Study of temperature sensors
14.	Study of photo sensors
15.	Application of opt couplers
16.	OR Any Other Equivalent Experiment

S. Y. B. Sc. Semester III		
ELS-270	**Renewable Sources of Energy (OE)**	**Credits:** 2 **Hours:** 30
Course Outcomes (COs) On completion of the course, the students will be able to:		**Blooms Cognitive Level**
CO1	Cite renewable and non-renewable sources of energy	1
CO2	Discuss working principle of various solar, wind, biomass based, ocean, thermal, hydro, geothermal - energy systems	2
CO3	Describe the use of renewable energy sources	2

Syllabus

Unit	Contents	No. of hours
I	**Introduction to Energy Studies** Introduction, Energy science and Technology, Forms of Energy, Importance of Energy Consumption as Measure of Prosperity, Per Capita Energy Consumption, Environmental consequences of fossil fuel use, Needs of renewable energy (RE), Types and Limitations of RE sources, Conventional and Non-Conventional Energy Resources, Current Indian and international energy scenario of conventional and RE sources.	**4**
II	**Wind and Solar energy** Introduction, History of Wind Energy, Wind Energy Scenario of World and India. Basic principles of Wind Energy Conversion Systems (WECS), Classification of WECS, Components of WECS and working, applications of WECS - stand alone, grid connected and hybrid, Site selection criteria, Wind farm Solar Radiation, Radiation Measurement, Principle of Radiation into Heat Conversion, Solar Water Heating system, Solar Cookers, Solar driers, Solar Still, Solar Furnaces, Solar Greenhouse. Solar Photovoltaic, Solar Cell Classification, Characteristics, Construction of module, panel and array. Solar PV Systems (stand-alone and grid connected), Solar PV Applications. Government schemes and policies.	**10**
III	**Biomass Energy** Introduction, Biomass energy, Photosynthesis process, Biomass fuels, Biomass energy conversion technologies and applications, Urban waste to Energy Conversion, Biomass Gasification, Types and application of gasifier, Biomass to Ethanol Production, Biogas production from waste biomass, Types of biogas plants, Factors affecting biogas generation, Energy plantation, Environmental impacts and benefits, Future role of biomass, Biomass programs in India.	**8**
IV	**Hydro Power and Other Renewable Energy Sources** Hydropower: Classification of hydropower schemes, Classification of water turbine, Essential components of hydroelectric system Environmental and social impacts. Tidal Energy: Principle of Tidal Power, Components of Tidal Power Plant, Classification of Tidal Power Plants. Ocean Thermal Energy: Introduction, Ocean Thermal Energy Conversion (OTEC), Principle of OTEC system, Methods of OTEC power generation. Geothermal Energy: Introduction, Capacity and Potential, Resources of	**8**

	geothermal energy. Fuel cell: Working Principle, types, construction and applications, hybrid Energy Systems.	

References:

1. B. H. Khan, Non-Conventional Energy Resources, Tata McGraw Hill.
2. Twidell, J.W. and Weir, A. Renewable Energy Sources, EFN Spon Ltd., UK, 2006.
3. G.D. Rai, Non-Conventional Energy Sources, Khanna Publications, New Delhi, 2011.
4. Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", Oxford University Press, 1996.
5. Sukhatme. S.P., Solar Energy, Tata McGraw Hill, New Delhi, 1997.
6. Khandelwal, K.C., Mahdi, S.S., Biogas Technology – A Practical Handbook, TMH, 1986.
7. Garg, Prakash, Solar Energy, Fundamentals and Applications, Tata McGraw Hill.
8. Freris. L.L., "Wind Energy Conversion Systems", Prentice Hall, 1990.

Course Code and Title: ELS-280: PCB Design and Fabrication
(VSC)
Teaching and Evaluation

Sem.	Subject Code	Title	No. of Hrs. per Week (Total-30 Hrs.)	Max. Marks	CE 40 %	ESE 60%	Credits
IV	ELS-280	PCB Design and Fabrication	2	50	20	30	2

Vocational Skill Course (VSC)

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.**

Skill Sets:

ELS-280	PCB Design and Fabrication (VSC)	**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.	

Syllabus

Unit	Contents	No. of hours
I	**Basics of PCBs** Introduction to PCBs, advantages of PCB, classification of PCBs, electronic components (discrete ICs, SMDs) symbols, dimensions, packages, connectors and cables.	4
II	**PCB Design Considerations** Important design elements, mechanical design considerations, electrical design considerations, conductor patterns, component placement rules, conductor width thickness, spacing and shape, supply and ground connections.	4

III	**PCB Layout Design and Artwork Generation** Grid systems, layout scale, layout sketch/design, materials and aids required for manual layout design, manual layout procedure. Layout design considerations: electrical considerations, mechanical considerations, placement rules, layout design, design rules for analog and digital circuits, basic approach to manual artwork, general design guidelines: conductor orientation, conductor routing, conductor spacing, hole diameter and solder pad diameter, artwork generation guidelines: no conductor zone, pad center holes, conductor and solder pad joints.	**14**
IV	**Preparing PCB** Laminates and types, Image transfer techniques, photo printing, etching techniques, mechanical operations, cutting methods, punching, drilling, assembly, soldering.	**8**

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).
1. Consumer Electronics, S.P.Bali, Pearson (2008).

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]**

Course Code and Title: ELS-290: Circuit Modelling and Simulation (SEC)

Teaching and Evaluation

Sem.	Subject Code	Title	No. of Hrs. per Week (Total-30 Hrs.)	Max. Marks	CE 40 %	ESE 60%	Credits
III	**ELS-290**	**Circuit Modelling and Simulation**	**2**	**50**	**20**	**30**	**2**

Skill Enhancement Course (SEC)

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.**

Skill Sets:

ELS-290	**Circuit Modelling and Simulation**	**Credits:** 2 **Hours:** 30
Students will acquire the following skills on completion of the course:		
1.	Understand basic electrical passive components	
3.	Study fundamental circuit analysis techniques (laws and circuit theorems)	
4.	Familiar with circuit simulation software such as Pspice/ LTspice/ Proteus/ CircuitLab	
5.	Learn to create and analyze simple DC circuits	
6.	Understand transient analysis for time-varying signals	
7.	Study AC circuit analysis, including impedance and frequency response	
8.	Study the models of active devices and simulate various electronic circuits	
9.	Learn to interpret simulation results and troubleshoot circuit behavior	
10.	Explore topics like simple digital circuit simulation	
10.	Practice circuit design and simulation through hands-on projects and exercises	

Syllabus

Unit	Contents	No. of hours
I	**Introduction to PSpice/ or any equivalent simulator** Laying out a Schematic, Libraries, Moving Components, Display Properties, New Simulation, Main Operational Icons, Simulation Settings	**4**
II	**DC and AC Electric Circuit Analysis** Basic Definitions and Terminology, PSpice Examples, Transient Circuits AC Electric Circuit Analysis - AC Circuit Theory, Capacitive and inductive	**6**

	Reactance Plot, Capacitor/ inductor Current and Voltage Waveforms, AC Circuit Theorems, Thevenin's Theorem, Norton Theorem, basic Exercises, Series and parallel Tuned Circuit, Current Response, Example, Semiconductor Devices and Characteristics – Diode, Zener Diode, Silicon-Controlled Rectifier, BJT, JFET, MOSFET.	
III	Simulation of following circuits (Schematic entry of circuits using standard packages. Analysis- transient, AC, DC, etc.): 1. DC network analysis -Potential divider, KVL, KCL, Thevenin theorem, Norton theorem and superposition Theorem 2. Integrator & Differentiator (I/P PULSE) – Frequency response of RC circuits. 3. Diode, BJT, FET, MOSFET Characteristics. 4. Simulate and study half-wave, full-wave, and bridge-rectifier using PSPICE windows 5. Simulate and study diode clipper and clamper circuits 6. Three pin Voltage Regulators (fixed and variable). 7. Simulate and study emitter bias and fixed bias BJT/ JFET circuits 8. Simulate RC Coupled amplifiers - Transient analysis and Frequency response 9. Simulate op amp/ 555timer -Multivibrators. 10. Simulate Oscillators (RF and AF). 11. Simulate active low pass, high pass, and band pass filters 12. Analog circuit simulation using SPICE. 13. Digital Circuit simulation using SPICE. 14. Design of PCB with artwork software.	**20**

References

2. Muhammad H. Rashid, Introduction to Pspice Using Orcad for Circuits and Electronics, Prentice-Hall of India Pvt.Ltd, 2004.
3. Paul Tobin, PSpice for Circuit Theory and Electronic Devices, Morgan & Claypool Publishers, 2007.
4. Nassir H. Sabah, Circuit Analysis with PSpice A Simplified Approach, CRC Press
5. Electronics Fundamentals Circuits, Devices and Applications Thomas L. Floyd David L. Buchla, Pearson
6. Nassir H. Sabah, ELECTRONICS BASIC, ANALOG, AND DIGITAL with PSpice, CRC Press

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]**

NEP 2020 - Based Curriculum

of

Electronics (Minor)

for

Computer Science

SEMESTER - IV

With effect from Academic Year

2024-2025

Course Code and Title

S.Y B.Sc. (Computer Science) – Semester IV		
ELS - 265	**Fundamentals of Internet of Things (IoT) (Minor-CS-Theory)**	**Credits: 02 Hours : 60**
Course Outcomes (COs) On completion of the course, the students will be able to:		**Bloom's cognitive level**
CO1	Define IoT.	1
CO2	Discuss the basic IoT reference model.	2
CO3	Use of communication devices for IoT.	3
CO4	Analyze IoT systems.	4
CO5	Compare IoT enabling Technologies.	4
CO6	Design of M2M architecture.	6

Unit No.	Unit Title and Contents
I	**Architecture of Internet of Things(IoT) (12 Lectures)** 1.1 Definition of IoT 1.2 History of IoT 1.3 Examples of IoT 1.4 Single Board Computer 1.5 Architecture of IoT: Components, six-layer architecture model 1.6 Data Collection and storage 1.7 Cloud Platforms 1.8 IoT communication protocols: wireless, wired communication protocols, comparison of communication technologies 1.9 Internet connectivity
II	**IoT connectivity Technologies (10 Lectures)** 3.1 Introduction 3.2 IEEE 802.15.4 3.3 ZigBee 3.4 Bluetooth 3.5 LoRa 3.6 RFID 3.7 NFC 3.8 NB-IoT 3.9 Sigfox 3.10 Wifi

III	**IoT enabling Technologies** **(8 Lectures)** 2.1 Wireless Sensor network 2.2 M2M Architecture, 2.3 Basic Nodal Capabilities 2.4 Industrial Internet of Things (IIoT) 2.5 Cyber Physical System (CPS)

References:

1. Simone Cirani, Gianluigi Ferrari, Marco Picone, Luca Veltri. Internet of Things: Architectures, Protocols and Standards, 1 st edition, Wiley Publications, 2019.
2. Bahga, Arshdeep, and Vijay Madisetti. Internet of Things: A hands-on approach, 1st edition, University press, 2014
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.

S. Y. B. Sc. Semester IV		
ELS-266	**Electronics Practical-4 (Minor-CS-Practical)**	**Credits: 2 Hours: 60**
Course Outcomes (COs) On completion of the course, the students will be able to:		**Blooms Cognitive Level**
CO1	Identify components and devices used in the circuit.	2
CO2	Use of actuators.	3
CO3	Demonstrate the working of sensor.	3
CO4	Implement the IoT connectivity technologies	3
CO5	Test programming techniques for data transfer to cloud. .	5
CO6	Design smart home system	6

Any 10 Experiments

Expt. No.	Title of the Experiment
1.	Hands on Python programming/HTML
2.	Internet Controlled LEDs
3.	DHT 11 temperature monitor system
4.	LDR to control LED ON/OFF
5.	Distance measurement using HC-SR04
6.	Human motion detection using PIR
7.	Soil Moisture sensor interfacing
8.	Clockwise/anticlockwise rotation of stepper motor/servomotor
9.	DC motor interfacing for smart irrigation
10.	ZigBee communication
11.	LoRa interfacing
12.	RFID interfacing
13.	Home automation System
14.	Web page design for IoT application
15.	Sensor Data transfer to cloud
16.	OR Any Other Equivalent Experiment