Detailed Curriculum for Undergraduate Degree
B. Tech in Information Technology
(w.e.f. AY: 2025-26)

Part VI: Detailed Curriculum of 3rd semester

Course Name:	**Analog and Digital Electronics**		
Course Code:	ES-EC301	**Category:**	Engineering Science
Semester:	Third	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Knowledge of Basic Electronics
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To provide students with conceptual foundation in simple analog electronic circuits, essential for modern computing and communication systems.
2	To enable students to comprehend the principles of digital electronics, including number systems, Boolean algebra, logic gates, and simplification techniques.
3	To enable students to design and demonstrate combinational and sequential logic circuits using standard digital components such as adders, multiplexers, decoders, flip-flops, counters, and registers.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Revision of Basic Electronics**: (i) Introduction to Diodes and functionality of BJT & FET. VI Characteristics and Working Principles of PN Junction Diode & BJT only. (ii) Types of Transistor Biasing, Load Line, Q Point and Applications of Transistors.	3L
2	**Amplifiers and Oscillators**: (i)Concept of Amplification-Different Classes of Power Amplifiers – (Class-A, B, AB and C – basic concepts with power, efficiency Calculations only). (ii) Concept of Positive Feedback & Negative Feedback. Advantages of Negative Feedback. Simple Numerical Problems on Feedback. (iii) Basics of Oscillations- Criteria for Oscillation-Working Principles of Crystal Oscillator, Wien Bridge Oscillator, Hartley Oscillator, Colpitt Oscillator. (Without Mathematical Derivations).	8L

	(iv) Basics of IC 555 Timer and Applications of IC 555 Timer only.	
3	**Introduction to Digital Electronics:** (i) Concept of Number System, Basic Logic Gates and Universal Logic Gates, Truth Table, BCD, EBCDIC, ASCII, Gray Code, Excess-3 Code, Boolean Algebra, De-Morgan's Theorem and Proof, Canonical Representation of SOP, POS. (ii) Minimization of Logic Expression- By Boolean Algebra and K –map Simplification up to 4 Variables only- Don't-Care Conditions	10L
4	**Combinational Circuits:** (i) Adders- Half Adder& Full Adder, Code Conversion, Decoder, Encoder, Multiplexer, De Multiplexer, Magnitude Comparator.	4L
5	**Sequential Circuits:** (i)Difference between Combinational & Sequential Circuits. Concept of Storage Elements-Latch and Flip Flop. Concept of Clock Pulse &Triggering. (ii) Flip- Flops- JK, D, SR, T, Master Slave Flip Flop, Working Principle with Truth Table, Excitation Table and State Table. (iii) Registers- Working Principles of SISO, SIPO, PISO, PIPO. (iv) Concept of Counter- Asynchronous, Synchronous, Design of MOD N Counter, Construction of state diagram. Concepts of Ring Counter, Up Down Counter.	8L
6	**Converter and Logic Families** (i) A/D and D/A Converter- Basic Concepts of R-2R Ladder, Successive Approximation Type Only. (ii) Logic Families- Performance Comparison of Different Logic Families-TTL, CMOS, RTL, ECL – and Basic Concepts of Propagation Delay Time, Noise Margin, Fan-in, Fan Out, Power Dissipation.	3L
Total		**36L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Explain the operation and characteristics of basic analog electronic devices such as diodes, BJTs, FETs, and Oscillators, amplifiers.
2	Understand the number systems, simplifying methods of Boolean algebra, and logic simplification techniques to solve digital logic problems.
3	Design Combinational logic circuits using logic gates, multiplexers, decoders, and encoders for given specifications
4	Design Sequential logic circuits using flip-flops, counters, and registers.

Learning Resources:	
1	Microelectronics Circuits by A.S. Sedra & K.C. Smith Oxford University Press Publication.

2	Electronic devices and Circuits by Jacob Millman and C.C. Halkias TMH Publications.
3	Fundamentals of Digital Electronics by Anad Kumar, PHI Publication.
4	Digital Integrated Electronics by David H. Taub & D. Shilling, Tata McGraw Hill Publications.
5	Modern Digital Electronics by R.P. Jain, Tata McGraw Hill Publication.
6	Digital Circuits and Systems by Douglas-Hall, Tata McGraw Hill.
7	Digital Fundamentals by Thomas L. Floyd, Pearson Prentice Hall Publication.

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Digital Electronic Circuits	Prof. Goutam Saha	IIT Kharagpur
	Course Link: https://nptel.ac.in/courses/108105132		
2	Analog Electronic Circuit	Prof. Shouribrata Chatterjee	IIT Delhi
	Course Link: https://nptel.ac.in/courses/108102112		

Course Name:	**Data Structure and Algorithms**		
Course Code:	PC-IT301	**Category:**	Professional Core Courses
Semester:	Third	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	ES-CS201(Programming for Problem Solving)
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To learn the basics of abstract data types.
2	To learn the principles of linear and nonlinear data structures.
3	To build an application using sorting and searching

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	Introduction: Basic Terminologies: Abstract Data Type, Elementary Data Organizations, Array Data Structure Operations: insertion, deletion, traversal etc.; Analysis of an Algorithm, Asymptotic Notations; Basic	6L

	Algorithms using array: Searching (linear and binary search) and their complexity analysis.	
2	Stacks and Queues: ADT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks: Expression Conversion and evaluation – corresponding algorithms and complexity analysis. ADT queue, Types of Queue: Simple Queue, Circular Queue, Priority Queue; Operations on each Type of Queues: Algorithms and their analysis.	8L
3	Sorting and Hashing: Objective and properties of different sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Performance and Comparison among all the methods, Hashing: Hash Functions, Separate Chaining, Open Addressing, Rehashing, Extendible Hashing, Hash Indices.	8L
4	Linked Lists: Singly linked lists, Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion into linked list, Deletion from linked list; Doubly linked list: operations on it and algorithmic analysis; Circular Linked Lists: all operations their algorithms and the complexity analysis. Linked representation of Stack and Queue.	8L
5	Trees and Graph: Basic Tree Terminologies, Different types of Trees: Binary Tree, Binary Search Tree, AVL Tree, Threaded Binary Tree; Tree operations on each of the trees and their algorithms with complexity analysis. Applications of Binary Trees. B Tree, B+ Tree: definitions, Heap Sort, algorithms and analysis. Graph: Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis.	10L
Total		**40L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand the fundamental concepts of arrays, different ADTs and algorithm analysis, including searching techniques and asymptotic notations.
2	Apply stack and queue ADTs to implement operations and solve expression-processing problems.
3	Analyze and compare sorting and hashing techniques and select suitable methods for efficient problem solving.
4	Understand and implement linked list data structures and analyze their operations.
5	Apply tree and graph data structures to model and solve computational problems.

Learning Resources:	
1	"Fundamentals of Data Structures of C" by Ellis Horowitz, Sartaj Sahni, Susan Anderson - freed.
2	"Data Structures in C" by Aaron M. Tenenbaum.
3	"Data Structures" by S. Lipschutz.
4	"Data Structures Using C" by Reema Thareja.
5	"Data Structures through C" by Yashwant Kanitkar, BPB House

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Programming, Data Structures and Algorithms using Python	Prof. Madhavan Mukund	Chennai Mathematical Institute
	Course Link: https://nptel.ac.in/courses/106106145		
2	Data Structures and Algorithms	Prof. Naveen Garg	IIT Delhi
	Course Link: https://nptel.ac.in/courses/106102064		

Course Name:	**Computer Organization and Architecture**		
Course Code:	PC-IT302	**Category:**	Professional Core Courses
Semester:	Third	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Basic Electronics
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To develop understanding of number systems, data representation (fixed and floating point), and the fundamental organization and operation of a stored-program computer including instruction execution cycle and system software roles.
2	To enable students to design and analyze arithmetic circuits and understand CPU organization, instruction formats, and addressing modes in both RISC and CISC architectures.
3	To provide knowledge of memory systems, including RAM, ROM, cache, and virtual memory, and to understand memory hierarchy and CPU–memory interfacing techniques.
4	To introduce control unit and pipelining concepts, parallel architectural classifications, performance evaluation techniques, and I/O operations such as interrupts and DMA.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	Basic Computer Organization:- Commonly used number systems. Fixed- and floating-point representation of numbers, Overflow, Underflow. Floating point - IEEE 754 standard. Basic organization of the stored program computer and operation sequence for execution of a program. Role of operating systems and compiler/assembler. Fetch, decode and execute cycle, Concept of operator, operand, registers and storage and Instruction format.	6L

2	Design of some Arithmetic unit:-Ripple carry adder, Serial Adder and Carry Look Ahead Adder, Binary Adder-Subtractor. Binary Incrementer Circuit, Binary Decrementer Circuit, Arithmetic Circuit, Arithmetic Logic Shift Unit Design of ALU, Fixed point multiplication -Booth's algorithm, Fixed point division - Restoring and non-restoring algorithms CPU Organization: Single Accumulator Based CPU Organization, Stack Organization, General Register Organization, Instruction Length, Addressing Modes, Instruction Set, RISC & CISC Characteristics.	10L
3	Memory Organization: Basic Concepts, Semiconductor RAM Memories, Read Only Memories, Speed, Size, and Cost Static and dynamic memory, Memory hierarchy,CPU-memory interfacing. Associative memory. Cache memory-Cache Mapping Associative Mapping, Direct Mapping, Set Associative Mapping, Virtual memory, Paging, Segmentation and Page replacement Algorithm.	10L
4	Design of control unit - hardwired and micro programmed control. I/O operations - Concept of handshaking, Polled I/O, interrupt and DMA.	4L
5	Pipelining & parallel Architectural Classification: Basic Concepts, Instructions and Arithmetic Pipeline, Data Hazards, Control Hazards and Structural Hazards. Parallel Architectural Classification-Flynn's Classification, Feng's Classification, Handler's Classification. ILP,TLP, Speed –up Performance Laws-Amdahl's Law, Gustrfson's Law, Sun and Ni's Law.	6L
Total		**36L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Explain number systems, data representation (fixed and floating point including IEEE 754), and analyze the basic organization of a stored-program computer along with instruction execution cycle and role of system software.
2	Design and analyze arithmetic circuits (adders, subtractors, ALU, Booth's multiplication, division algorithms) and interpret different CPU organizations, instruction formats, and addressing modes including RISC and CISC architectures.
3	Analyze memory systems including RAM, ROM, cache, and virtual memory, and evaluate memory hierarchy, mapping techniques, and page replacement algorithms for efficient CPU–memory interaction.
4	Explain control units (hardwired and micro programmed) and analyze I/O techniques including handshaking, polled I/O, interrupts, and DMA.
5	Explain pipelining concepts, hazard handling, parallel architectural classifications, and evaluate system performance using speed-up laws.

Learning Resources:	
1	Mano, M.M., "Computer System Architecture", PHI.
2	Hayes J. P., "Computer Architecture & Organisation", McGraw Hill
3	Hamacher, "Computer Organisation", McGraw Hill

4	William Stallings "Computer Organization and Architecture Designing for Performance", Prentice Hall of India
5	Computer organization and Architecture – T. K Ghosh

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Computer Organization and Architecture	Prof. Jatindra Kumar Deka	IIT Guwahati
	Course Link: https://nptel.ac.in/courses/106103068		

Course Name:	**Mathematics-III**		
Course Code:	BS-M301	**Category**	Basic Science Course
Semester:	Third	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	High School Mathematics, BS-M101, BS-M201
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To understand probability distributions of random variables
2	To apply statistical techniques for data analysis and inference
3	To use Fourier analysis for signal and system representation

Course Contents:		
Module No.	**Description of Topic**	**Conduct Hrs.**
1	**Probability Distribution:** (i) Introduction to probability theory (ii) Discrete and continuous random variables: Probability mass function (p.m.f.) and probability density function (p.d.f.) of single random variable; Cumulative distribution function (c.d.f.); (iii) Expectation, variance of random variables and their properties **Some special types of distributions** (i) **Discrete probability distribution:** Binomial and Poisson distributions; Mean and variance (ii) **Continuous probability distribution:** Uniform, Exponential and Normal distributions; Mean and variance	8L
2	**Bivariate Probability Distribution, Correlation & Regression:**	8L

	Discrete bivariate distribution (i) Joint probability distribution of two discrete random variables, marginal distribution; (ii) Expectation, variance, covariance; Independent random variables; **Continuous bivariate distribution** (i) Joint probability distribution of two continuous random variables, marginal distribution; (ii) Expectation, variance, covariance; Independent random variables; **Correlation & Regression:** Karl Pearson's Correlation Coefficient, Rank Correlation, Regression lines	
3	**Statistics:** **Sampling distribution** (i) Population and sampling distribution; statistic, standard error and confidence interval; (ii) Point and interval estimation; unbiased and consistent estimator; maximum likelihood estimate; (iii) Chebyshev's inequality; **Test of hypothesis** (i) Simple and composite hypothesis. Critical region. Level of significance; (ii) Type I and Type II errors; (iii) One sample and two sample tests for means and proportions, t-test, χ^2-test for goodness of fit.	12L
4	**Fourier Series and Fourier Transform:** **Fourier Series** (i) Periodic function and periodic extension of a function; Odd and even functions; (ii) Special wave forms: square wave, half wave rectifier, full wave rectifier, saw-toothed wave, triangular wave (graphical illustration only); (iii) Euler's formulae for Fourier series; Fourier series of functions of period 2π; Fourier series of functions of period 2L; Dirichlet's conditions (iv) Half range Sine and Cosine series (v) Parseval's identity (statement only) **Fourier Transform** (i) Definition of Fourier transform; Properties of Fourier transform: Linearity, Shifting, change of scale property; Fourier transform of some elementary functions; Fourier transform of derivatives; (ii) Fourier sine and cosine transform (iii) Inverse Fourier transform and convolution theorem.	8L
Total		**36L**

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

1	Apply the concepts of probability distributions to model random phenomena and compute probabilities, moments, and expectations for discrete and continuous random variables.
2	Analyze bivariate distributions to determine marginal and conditional distributions, correlation, and apply regression analysis for modeling relationships between two variables.
3	Apply principles of inferential statistics to estimate population parameters, test statistical hypotheses, and interpret results using appropriate confidence levels and significance tests.
4	Analyze and solve problems using Fourier series and Fourier transforms, and apply these techniques to represent periodic functions and analyze signals in engineering and scientific applications.

Learning Resources:	
1	"Advanced Engineering Mathematics" by Erwin Kreyszig, John Wiley & Sons.
2	"Advanced Engineering Mathematics" by Michael Greenberg, Pearson.
3	"Higher Engineering Mathematics" by B.S. Grewal, Khanna Publishers.
4	"Mathematical Methods of Science and Engineering" by Kanti B. Dutta, Cenage Learning .
5	"Advanced Engineering Mathematics" by Reena Garg, Chandrika Prasad, Khanna Publishers.
6	"Statistical Methods (Combined Volume)" by N.G. Das, Tata-McGraw Hill.
7	"A First Course in Probability" by S. Ross, Pearson Education India.
8	"An Introduction to Probability Theory and its Applications, Vol. 1" by W. Feller, Wiley.

Alternative NPTEL/SWAYAM Courses:			
Sl. No.	**NPTEL Course Name**	**Instructor**	**Host Institute**
1	Applied Multivariate Statistical Modeling	Prof. Jhareswar Maiti	IIT Kharagpur
2	Probability –I with Examples Using R	Prof. Siva Athreya	ISI Bangalore

Course Name:	**Analog and Digital Electronics Laboratory**		
Course Code:	ES-EC391	**Category:**	Engineering Science
Semester:	Third	**Credit:**	1.5
L-T-P:	0-0-3	**Pre-Requisites:**	Knowledge of Basic Electronics
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To acquire the basic knowledge of analog and digital electronic componentsthrough hands-on experimentation and observation.
2	To implement digital circuits including combinational and sequential logic circuits, using standard ICs and Components.
3	To illustrate different electronic circuit and their application in practice.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	Realization of Basic Gates using Universal Logic Gates.	3P
2	Implementation of the given Boolean function using logic gates in both SOP and POS forms.	3P
3	Construction of Half Adder & Full Adder Circuit using Logic Gates and verify its output.	3P
4	Constructions of simple Decoder & Multiplexer circuits using logic Gates and verify its output.	3P
5	Realization of RS / JK / D flip flops using logic gates.	3P
6	Design a Shift Register using D Flip Flop and verification of truth table.	3P
7	Realization of Synchronous Up/ Down Counter.	3P
8	Realization of MOD N Counter.	3P
9	Design a BCD to Seven Segment Decoder.	3P
10	Study of Timer circuit using NE555 and configuration of Mono-stable and astable Multi-vibrator.	3P
11	Study of Oscillator with frequency of Oscillation Measurement.	3P
12	Design a Binary to Gray Code Converter or Design of a Magnitude Comparator.	3P
Total		**36P**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand the operation of basic important analog electronic Circuits.
2	Understand and design various combinational and sequential Circuits.
3	Understand the basic digital circuits and to verify their operation.
4	Develop skill to build, and troubleshoot digital circuits.

Learning Resources:

1	Introduction to Analog & Digital Circuits Lab Manual by Brian Dean, Kendall Hunt Pub Co.
2	Analog And Digital Electronics,, by Charles H. Roth, Jr., Larry L. Kinney | Raghunandan G. H
3	Hands on Electronics by Kalpan Daniel M Cambridge University Press

Course Name:	**Data Structure and Algorithms Laboratory**		
Course Code:	PC-IT391	**Category:**	Professional Core Courses
Semester:	Third	**Credit:**	1.5
L-T-P:	0-0-3	**Pre-Requisites:**	ES-CS291(Programming for Problem Solving)
Full Marks:	100		
Examination Scheme:	Semester Examination:60	Continuous Assessment:35	Attendance: 05

Course Objectives:	
1	To develop skills to design and analyze simple linear and nonlinear data structures
2	To strengthen the ability to identify and apply the suitable data structure for the given real world problem
3	To gain knowledge in practical applications of data structures

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Lab 1: Implementation of array operations with searching techniques	8P
2	Lab 2: Implementation of stacks including operations- insertion, deletion, expression- prefix, infix, postfix, their evaluation and conversion. Lab 3: Implementation of different queues like Simple Queue, Circular Queue, Priority Queue including operations- insertion, deletion.	12P
3	Lab 4: Implementation of sorting techniques. Lab 5: Implementation of hash tables.	8P
4	Lab 6: Implementation of linked lists: Singly Linked Lists, Circular Linked Lists, Doubly Linked List including insertion, deletion and reversal a linked list Lab 6: Implementation of stacks & queues using linked lists	8P
5	Lab 7 : Recursive traversal of Trees Lab 8: Threaded binary tree traversal Lab 9 : AVL tree implementation	9P
6	Lab 10: Hash tables implementation Lab 11: Sorting techniques	12P
Total		**36P**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Implement array operations and apply searching techniques to solve basic computational problems.
2	Apply stack and queue data structures, including circular queues, to perform insertion, deletion, and expression evaluation operations.
3	Implement and analyze sorting and hashing techniques for efficient data organization and retrieval.
4	Apply tree data structures, including recursive traversal, threaded binary trees, and AVL trees, to solve hierarchical data problems.
5	Implement and analyze hashing and sorting techniques for efficient data organization and retrieval.

Learning Resources:	
1	"Fundamentals of Data Structures of C" by Ellis Horowitz, Sartaj Sahni, Susan Anderson - freed.
2	"Data Structures in C" by Aaron M. Tenenbaum.
3	"Data Structures" by S. Lipschutz.
4	"Data Structures Using C" by Reema Theraja.
5	"Data Structures through C" by Yashwant Kanitkar, BPB House

Course Name:	**Computer Organization and Architecture Laboratory**		
Course Code:	PC-IT392	**Category:**	Professional Core Courses
Semester:	Third	**Credit:**	1.5
L-T-P:	0-0-3	**Pre-Requisites:**	Concept of Basic Electronics
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives: This course will enable students to	
1	Design Adder/Subtractor composite unit.
2	Design a BCD adder.
3	Design a composite ALU
4	Design of a 'Carry-Look-Ahead' Adder circuit
5	Cascade two RAM ICs

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Familiarity with IC-chips, e.g. a) Multiplexer b) Decoder, c) Encoder b) Comparator Truth Table verification and clarification from Data-book.	9P
2	Design an Adder/Subtractor composite unit.	3P
3	Design a BCD adder.	3P
4	Design a 2 bit Carry Look Ahead (CLA) Adder	3P
5	Use a multiplexer and 4-bit Parallel binary adder unit to design a 4-bit Arithmetic Unit.	3P
6	Use a multiplexer unit to design a composite ALU.	3P
7	Use ALU chip for multibit arithmetic operation	3P
8	Implement read write operation using RAM IC.	3P
9	Cascade two RAM ICs for vertical expansion.	3P
10	Cascade two RAM ICs for horizontal expansion.	3P
Total		**36P**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand and verify the functionality of basic digital ICs such as Multiplexer, Decoder, Encoder, and Comparator through truth tables and data book analysis.
2	Design and analyze combinational circuits including Adder–Subtractor units, BCD adders, and arithmetic units using multiplexers and parallel binary adders.
3	Develop and implement composite Arithmetic Logic Unit (ALU) using multiplexers and perform multi-bit arithmetic operations using ALU ICs.
4	Apply memory interfacing concepts by performing read/write operations using RAM ICs and implementing memory expansion techniques (horizontal and vertical cascading of RAM).

Learning Resources:	
1	Laboratory Manual

Course Name:	**IT Workshop using Python**		
Course Code:	PC-IT393	**Category:**	Professional Core
Semester:	Third	**Credit:**	2.5
L-T-P:	1-0-3	**Pre-Requisites:**	Knowledge of Programming Logic and Programming Experience with any high level language(Preferable)

Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	Understand about the details of Scripting languages.
2	Make students learn to use SciLab, MATLAB, R and Python and its libraries to provide the solutions for the real life problems.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	Lab1: Familiarization with Python environment with simple computational problems using different operators, expressions. Lab 2: Problems involving using Conditional Statements (if-else, nested if-else), Iterative problems using while, do-while, for loops, and using switch-case and nested loop.	8P
2	Lab 3: Concepts of Lists/Array/Vectors and problems using 1-D and 2-D array, use of Tuple and Dictionaries, String manipulation, and use of functions and modules, and Object-Oriented concepts. Lab 4: Concepts of Data Manipulation and related problems, and Problems involving Exception handling, File handling operations and plotting of data. Lab 5: Familiarization with Python environment for problems and use cases, involving regression, classification, and clustering models and data science related problems.	12P
3	Lab 6 & 7: **Data Acquisition and Data Cleaning and Preparation for a real-life problem**: Gather relevant raw data in CSV files from various sources in the internet. Fix errors in the dataset, handle missing values (imputation), remove duplicates, and manage outliers.	8P
4	Lab 8: **Exploratory Data Analysis (EDA)**: Use statistical tests and Python visualization libraries (like Seaborn or Matplotlib) to find patterns and relationships, using regression, classification, or clustering. Lab 9: **Feature Engineering and Model Development**: Select, transform, and create new features that improve model performance. Choose and train a model for regression, classification, or clustering. Lab 10: **Model Evaluation and Deployment**: Assess performance on a separate validation set using metrics appropriate, and implement the validated model on a web application using frameworks like Flask or Streamlit.	12P
5	Lab 11: Mini-projecton real-life data science related problems. Lab 12: Mini-projecton real-life data science related problems.	8P
Total		**48P**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand the details of Scripting languages
2	Design real life problems and think creatively about solutions
3	Develop Solutions for advanced applications using R/Matlab/Python

Learning Resources:	
1	Python Programming: Using Problem Solving Approach" by Reema Thareja
2	Data Structure and Algorithmic Thinking with Python" by Narasimha Karumanchi
3	Michael J. Crawley. Statistics: An Introduction using R. Wiley, 2nd edition, 2014. ISBN 978-1-118-94109-6.
4	Sarah Stowell. Using R for Statistics. Apress, 2014. ISBN 978-1484201404
5	http://www.mathworks.com/help/releases/R2014b/pdf_doc/matlab/getstart.pdf
6	https://www.scilab.org/sites/default/files/Scilab_beginners.pdf

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Programming, Data Structures And Algorithms Using Python (8 Weeks course)	Prof. Madhavan Mukund	Chennai Mathematical Institute
	Course Link: [https://onlinecourses.nptel.ac.in/noc26_cs79/preview]		
2	Python for Data Science (4 Weeks course)	Prof. Ragunathan Rengasamy	IIT Madras
	Course Link: [https://onlinecourses.nptel.ac.in/noc26_cs80/preview]		
3	The Joy of Computing using Python (12 Weeks course)	Prof. SudarshanIyengar	IIT Ropar
	Course Link: [https://onlinecourses.nptel.ac.in/noc26_cs84/preview]		
4	Data Analytics with Python (12 Weeks course)	Prof. A Ramesh	IIT Roorkee
	Course Link: [https://onlinecourses.nptel.ac.in/noc26_cs86/preview]		
5	Scientific Computing using Python (In Hindi) (12 Weeks course)	Prof. Mani Mehra, Prof. Vivek K. Aggarwal	IIT Delhi, Delhi Technological University
	Course Link: [https://onlinecourses.nptel.ac.in/noc26_ma26/preview]		

Course Name:	**Environmental Science**		
Course Code:	AU-BS371	**Category:**	Audit Course
Semester:	Third	**Credit:**	0
L-T-P:	2-0-0	**Pre-Requisites:**	10 + 2

Full Marks:	100		
Examination Scheme:	Teacher Assessment: 70 (30 + 40)	Participation in Events: 15	Attendance: 15

Course Objectives:	
1	To solve various engineering problems applying ecosystem to produce eco-friendly products.
2	To use relevant air, noise, water and soil control method to solve domestic and industrial problems.
3	To recognize relevant energy sources required for domestic and industrial applications.
4	To solve local solid and e-waste problems.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Ecosystem:** Structure of ecosystem, Food chain and food web, Aquatic and terrestrial ecosystem, Carbon, Nitrogen, Sulphur and Phosphorous cycle, Depletion of ozone.	2L
2	**Environmental Degradation:** Air Pollution: Natural and manmade sources of air pollution, Effects and control (Bag filter, Cyclone separator, Electrostatic Precipitator) Noise Pollution: Sources and effects of pollution, measurement of pollution level, Noise pollution Rules-2000 Water Pollution: Types of water pollutants, BOD and COD, Waste Water Treatment (Primary, Secondary and Tertiary methods). Soil Pollution: Causes, Effects and Preventive measures of soil pollution, E- waste, Plastic waste	7L
3	**Renewable sources of Energy:** Solar Energy: Basics of Solar energy, Solar Pond, Solar water heater, solar dryer, Solar stills. Biomass: Biogas production mechanism, Utilization and storage of biogas. Wind Energy: Current status and future prospects of wind energy. New Energy sources: Hydrogen energy, Ocean energy resources, Tidal energy conversion.	7L
4	**Solid Waste Management, ISO 14000 & Environmental Management:** Solid waste: Municipal solid waste, Biomedical waste, Metallic and Non-metallic wastes, Hazardous waste, Collection and disposal of municipal solid waste, Waste to wealth Concept of carbon footprint Environmental management in fabrication industry ISO14000: Implementation in industries, Benefits.	8L

Total:	**24L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand the ecosystem and terminology and solve various engineering problems applying ecosystem knowledge to produce eco-friendly products.
2	Analyse the air, water, soil and noise pollution, and control measures and acts.
3	Understand different renewable energy resources and efficient process of harvesting.
4	Understand solid waste management, ISO 14000 & Environmental Management.

Learning Resources:	
1	"Fundamentals of Environment and Ecology" by D. De & D. De, S Chand Publication
2	"Text Book of Environmental Studies" by E. Bharucha, Byju's
3	"Environmental Studies" by S. C. Sharma and M. P. Poonia, Khanna Book Publishing
4	"Environmental Studies" by M. Basu, Cambridge University Press
5	"Fundamentals of renewable energy processes" by A. Vieira & D. Rosa, Academic Press Inc
6	"Principles Solar Engineering" by F. Kreith and J. F. Kreider, CRC Press.

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Environmental Science	Prof. Shamik Chowdhury, Prof. Sudha Goel	IIT Kharagpur
	Course Link: https://nptel.ac.in/courses/109105203		
2	Introduction to Environmental Engineering and Science - Fundamental and Sustainability Concepts	Prof. Brajesh K Dubey	IIT Kharagpur
	Course Link: https://nptel.ac.in/courses/127105018		

Detailed Curriculum for Minor Degree under Department of Information Technology (w.e.f. AY: 2025-26)

Part VII: Detailed Syllabus of 3rd semester for Minor Degree

No Minor paper in 3rd Semester