SNDT Women's University, Mumbai

Postgraduate Degree / PG Programme
(Syllabus as Per NEP) - Faculty of Science & Technology

Master of Computer Applications – Integrated

(MCA-Integrated)

As Per AICTE

Semester – I and II

Syllabus

(W.E.F. Academic Year 2026-27)

Program Details:

Programme Degree		Master of Computer Applications-Integrated (MCA-Integrated)
Parenthesis if any (Specialization) e.g. History, Human Development, English, etc.		NA
Preamble (Brief Introduction to the programme)		The MCA-Integrated programme of SNDT Women's University, Mumbai, offered under the Faculty of Science & Technology as per NEP and AICTE norms, is designed to provide a strong foundation in computer applications, programming, mathematics, systems, and emerging web-based technologies. The first-year curriculum includes Mathematics Foundation to Computer Science I and II, Problem Solving Techniques, Computer Architecture, Fundamentals of Computer Science, C Programming Lab, Data Structures, Operating Systems, Object-Oriented Programming using Java, Web Technologies, and supporting ability/value courses such as General English, Indian Knowledge System, Environmental Science and Sustainability, Indian Constitution, and relevant laboratories. The programme emphasizes conceptual understanding, hands-on programming, laboratory practice, project-based learning, continuous internal assessment, end-semester examination, communication skills, constitutional values, environmental awareness, and professional readiness. It prepares learners for higher-level courses and careers in software development, systems analysis, web application development, database-driven applications, IT services, and research-oriented computing domains.
Programme Specific Outcomes (POs)		**After completing this programme, Learner will**
	1.	Apply foundational mathematical, logical, and computational concepts to analyse and solve problems in computer applications.
	2.	Design algorithms, pseudocode, flowcharts, and structured programs using problem-solving techniques and C programming fundamentals.

	3.	Explain computer architecture, digital logic, memory organisation, operating system concepts, and system-level mechanisms.
	4.	Implement software solutions using core programming paradigms, data structures, object-oriented programming using Java, and web technologies.
	5.	Apply linear and non-linear data structures, searching, sorting, recursion, hashing, trees, and graphs for efficient problem solving.
	6.	Develop interactive, responsive, and secure web applications using HTML, CSS, JavaScript, XML/AJAX, backend scripting, REST APIs, and databases.
	7.	Apply numerical methods, optimization techniques, linear programming, transportation models, and discrete mathematics to computational problems.
	8.	Demonstrate communication proficiency, constitutional awareness, environmental responsibility, and understanding of Indian Knowledge Systems.
	9.	Plan, implement, test, document, and present laboratory-based and project-based computing solutions using appropriate evaluation rubrics.
	10.	Integrate ethical, legal, sustainability, and professional practices in computing and technology-enabled problem solving.
Eligibility Criteria for Programme		A female student who has passed 10+2 examination with Mathematics/Statistics/ Accountancy as compulsory subject. Obtained at least 45% marks in general category and 40% marks in case of candidates belonging to reserved category, in the above subjects taken together and Valid MAH-MCA Integrated-CET score applicable to that academic year.
Intake (For SNDT WU Departments and Conducted Colleges)		60
Examination passing criteria		Students have to pass both the internal assessment and external assessment separately for each course with minimum 40% passing marks

Semester wise Structure for MCA Integrated Course

SEMESTER I

Sr.No	Course Title		Credits	INT	EXT	Total
10135161	Mathematics Foundations to Computer Science - I	**Major core**	**4**	**50**	**50**	**100**
10935161	Problem Solving Techniques	**VEC**	**2**	**0**	**50**	**50**
10135162	Computer Architecture	**Major Core**	**4**	**50**	**50**	**50**
10135163	Fundamental of Computer Science	**Major Core**	**4**	**50**	**50**	**50**
10835161	General English - I	**AEC**	**2**	**0**	**50**	**50**
11035161	Indian Knowledge System	**IKS**	**2**	**0**	**50**	**50**
11135101	Environmental Science and sustainability	**VAC**	**2**	**50**	**0**	**50**
10735101	C Programing lab	**SEC**	**2**	**50**	**0**	**50**
	Total		**22**	**250**	**300**	**550**

SEMESTER II

Sr.No	Course Title		Credits	INT	EXT	Total
20135161	Mathematics Foundations to Computer Science – II	**Major core**	**4**	**50**	**50**	**100**
20135162	Data Structures	**Major core**	**2**	**0**	**50**	**50**
20135163	Operating Systems	**Major core**	**2**	**0**	**50**	**50**
20135164	Object Oriented Programming using Java	**Major core**	**2**	**0**	**50**	**50**
20935161	Web Technologies	**VEC**	**2**	**0**	**50**	**50**
21135101	Indian Constitution	**VAC**	**2**	**50**	**0**	**50**
20735101	Data Structures lab	**SEC**	**2**	**50**	**0**	**50**
20735102	Operating Systems lab	**SEC**	**2**	**50**	**0**	**50**

20735103	Object Oriented Programming using Java lab	**SEC**	**2**	**50**	**0**	**50**
20735104	Web Technologies lab	**SEC**	**2**	**50**	**0**	**50**
	Total		**22**	**300**	**250**	**550**

SEMESTER – I

Course Code	**1.1**
Course Title	**Mathematics Foundation to Computer Science - I**
Course Credits	**4**
Course Outcomes	**After Completion of this Course, students will be able to** 1. Provide a basic understanding of fundamental mathematical concepts such as sets, functions, matrix algebra, and discrete mathematics. 2. This course enables the students to use mathematical models and techniques to analyze and understand problems in computer science. 3. This course demonstrates how the mathematical principles give succinct abstraction of computer science problems and help them to efficiently analyze
Module 1: Set, Relation and Function	
Learning Outcomes	**After completing this unit, students will be able to:** 1. Apply set operations, relations, and functions to solve mathematical and computational problems. 2. Analyze the properties of relations and functions, including equivalence relations, closures, and different types of functions.
Content Outline	**Set**: Set Operations, Properties of Set operations, Subset, Venn Diagrams, Cartesian Products. Relations on a Set, Properties of **Relations**: Representing Relations using matrices and digraphs, Types of Relations, Equivalence Relation, Equivalence relation and partition on set, Closures of Relations, Warshall's algorithm. **Functions**: Properties of functions (domain, range), composition of functions, surjective (onto), injective (one-to-one) and bijective functions, inverse of functions. Some useful functions for Computer Science: Exponential and Logarithmic functions, Polynomial functions, Ceiling and Floor functions.
Module 2: Counting and Recurrence Relation	
Learning Outcomes	**After completing this unit, students will be able to:** 1. Apply counting principles, permutations, combinations, and the binomial theorem to solve combinatorial problems. 2. Formulate recurrence relations for real-world and computational problems.

Content Outline	Basics of counting, Pigeonhole principle, permutation, combination, Binomial coefficients, Binomial theorem. Recurrence relations, modelling recurrence relations with examples, like Fibonacci numbers, the tower of Hanoi problem. Solving linear recurrence relation with constant coefficients using characteristic equation roots method.
Module 3: Elementary Graph Theory	
Learning Outcomes	**After completing this unit, students will be able to:** 1. Analyze graph structures to identify paths, cycles, connectivity, Euler and Hamiltonian graphs, and spanning trees. 2. Apply graph-theoretic concepts to model and solve problems in computer science and related domains
Content Outline	Basic terminologies of graphs, connected and disconnected graphs, subgraph, paths and cycles, complete graphs, digraphs, weighted graphs, Euler and Hamiltonian graphs. Trees, properties of trees, concept of spanning tree. Planar graphs. Definitions and basic results on the topics mentioned.
Module 4: Matrix Algebra	
Learning Outcomes	**After completing this unit, students will be able to:** 1. Perform matrix operations and compute determinants, inverses, rank, eigenvalues, and eigenvectors. 2. Apply matrices to solve systems of linear equations and other mathematical problems.
Content Outline	Types of matrices, algebra of matrices–addition, subtraction, and multiplication of matrices, determinant of a matrix, symmetric and skew-symmetric matrices, orthogonal matrix, rank of a matrix, inverse of a matrix, applications of matrices to solve system of linear equations, Eigen values and Eigen vectors, Caley-Hamilton theorem.

Evaluation Scheme:

- **Internal Assessment:**
  Depending on the content given in syllabus above a project should be developed of 50 marks. Internal Assessment to be done on the basis of Project Presentations and Report Writing with proper Rubrics (Given below).

The Rubric will have the following Evaluation Parameters:	
Evaluation Parameters	**Marks**
Correct application of counting principles	20
Solution of recurrence relations	10
Presentation, , and	10
Explanation	5
Real-life application	5

The project Internal assessment will be done by conducting project presentation at the department level, where External Examiner appointed by the department will be evaluating the

project.

- **External Assessment:**

  End Semester examination of 50 marks for 2 hours duration will be conducted by the university.

Text Books

1. Garg, Reena, Engineering Mathematics, Khanna Book Publishing Company, 2024. (AICTE Recommended Textbook)
2. Garg, Reena, Advanced Engineering Mathematics, Khanna Book Publishing Company, 2023.
3. Reena Garg, Mathematics - I (Calculus and Linear Algebra), Khanna Book Publishing.
4. Kolman B., Busby R. and Ross S., Discrete Mathematical Structures, 6th Edition, Pearson Education, 2015.
5. Deo Narsingh, Graph Theory with Application to Engineering and Computer Science, Prentice Hall, India, 1979.
6. Vasishtha A. R. and Vasishtha A. K., Matrices, Krishna Prakashan, 2022.

Reference Books

1. Grimaldi Ralph P. and Ramana B. V., Discrete and Combinatorial Mathematics: An Applied Introduction, Fifth Edition, Pearson Education, 2007.
2. Rosen Kenneth H. and Krithivasan Kamala, Discrete Mathematics and its Applications, McGraw Hill, India, 2019.
3. West Douglas B., Introduction to Graph Theory, Second Edition, Pearson Education, 2015

Web Resources

1. https://nptel.ac.in/courses/106103205
2. https://nptel.ac.in/courses/111101115

Course Code	**1.2**
Course Title	**Problem Solving Techniques**
Course Credits	**2**
Course Outcomes	**After Completion of this Course, students will be able to** 1. Understand basic terminology of computers, problem solving, programming Languages and their evolution (Understand) 2. Create specification from problem requirements by asking questions to disambiguate the requirement statement. (Create) 3. Design the solution from specification of a problem and write pseudo code of the algorithm using basic building blocks or structured programming constructs (Sequence, Selection and Repetition statement). (Create) 4. Translate an algorithm into a C computer program (Create) 5. Testing and analysing programs using debugging tools. (Analyze)
Module 1: Introduction to Problem Solving and Algorithm Development	
Learning Outcomes	**After completing this unit, students will be able to:** 1. Identify and classify different computational problems and select appropriate problem-solving approaches. 2. Develop and analyze algorithms by evaluating their correctness, efficiency, and role in solving computational problems.
Content Outline	Problems and Problem Instances, Generalization and Special Cases, Types of Computational Problems, Classification of Problems, Analysis of Problems, Solution Approaches, Algorithm Development, Analysis of Algorithm, Efficiency, Correctness, Role of Data Structures in Problem Solving, Problem-Solving Steps (Understand the Problem, Plan, Execute, And Review), Breaking the Problem into Subproblems, Input/Output Specification, Input Validation, Pre and Post Conditions.
Module 2: Structured Programming and C Fundamentals	
Learning Outcomes	**After completing this unit, students will be able to:** 1. Design algorithms, pseudocode, and flowcharts using sequence, selection, and repetition control structures. 2. Explain the representation of different data types in computer memory, including integers, floating-point numbers, and characters.

Content Outline	**Structured Programming Concepts:** Sequence (Input/Output/Assignment), Selection (If, If-Else) And Repetition (For, While, Do-While) Statements, Control Structure Stacking and Nesting. **Different Kinds of Repetitions:** Entry Controlled, Exit Controlled, Counter Controlled, Definite, Indefinite and Sentinel-Controlled Repetitions. Pseudocode and Flowcharts. Definition And Characteristics of Algorithms, Standard Algorithm Format. **Problems Involving Iteration and Nesting:** Displaying Different Patterns and Shapes Using Symbols and Numbers, Generating Arithmetic and Geometric Progression, Fibonacci and Other Sequences, Approximate Values For π, Sin(x), Cos(x), Etc. Using Taylor Series. Different Kinds of Data in The Real World and How They are Represented in The Computer Memory. **Representation of Integers:** Signed Magnitude Form, 1's Complement And 2's Complement. Representation of Real Numbers: IEEE 754 Floating Point Representation. **Representation of Characters**: ASCII, UNICODE. **C Language:** Introduction To Programming Languages, Different Generations of Programming Languages. Typed Vs Typeless Programming Languages, History of C Language, An Empty C Program. C Language Counterparts For Input (scanf()), Output (printf()) Statements, Assignment, Arithmetic, Relational and Logical Operators. If, If-Else Statements, For, While, Do-While Statements. Data Types. Translating Pseudocode/Algorithm to C Program. Incremental Compilation and Testing of The C Program. Simple Problems Involving Input, Output, Assignment Statement, Selection and Repetition. Good Coding Practices.
Module 3: Problem Solving Using C Programming	
Learning Outcomes	**After completing this unit, students will be able to:** 1. Develop C programs to solve numerical and statistical problems using appropriate control structures. 2. Apply decision-making and iterative constructs, including else-if, switch, break, and continue, to implement efficient program logic.
Content Outline	**Problems on Numbers:** Extracting Digits of a Number (Left to Right and Right to Left), Palindrome, Prime Number, Prime Factors, Amicable Number, Perfect Number, Armstrong Number, Factorial, Converting Number from One Base to Another. Statistics (Maximum, Minimum, Sum and Average) on a Sequence of Numbers which are Read using Sentinel- Controlled Repetition using only a few Variables. **C Language:** else-if Ladder, switch Case, Increment/Decrement Operators, break and continue Statements.
Module 4: Modular Programming, Arrays and Functions	
Learning Outcomes	**After completing this unit, students will be able to:** 1. Apply modular programming concepts, including functions and recursion, to develop structured and reusable C programs. 2. Implement one-dimensional and two-dimensional arrays to perform searching, sorting, matrix operations, and statistical computations.

Content Outline	Modular Programming, Top-Down and Bottom-Up Approaches to Problem Solving. Recursion. **Problems on Arrays:** Reading and Writing of Array Elements, Maximum, Minimum, Sum, Average, Median and Mode. Sequential And Binary Search. Any one Sorting Algorithm. Matrix Operations. **C Language:** Function Definition and Declaration (Prototype), Role of Return Statement, One Dimensional and Two-Dimensional Arrays. String Functions. Other Operators, Operator Precedence and Associativity. Debugging.

Evaluation Scheme:

- **External Assessment:**
  End Semester examination of 50 marks for 2 hours duration will be conducted by the university.

Text Books

1. Venkatesh Nagaraju Y, Practical C Programming for Problem Solving, Khanna Book Publishing Company, 2024.
2. AICTE's Programming for Problem Solving (with Lab Manual), Khanna Book Publishing Company, 2024.
3. Harvey Deitel and Paul Deitel, C How to Program, 9th edition, Pearson India, 2015.
4. R G Dromey, How to Solve It by Computer.

Reference Books

1. Brian W. Kernighan and Dennis Ritchie, The C Programming Language, 2nd edition, Pearson, 2015.
2. Jeri Hanly and Elliot Koffman, Problem Solving and Program Design in C, 8th edition, Pearson, 2015.

Course Code	**1.3**
Course Title	**Computer Architecture**
Course Credits	**4**
Course Outcomes	**After Completion of this Course, students will be able to** 1. To Understand the basics of Digital Electronics and Binary Number System 2. To Learn the implementation of Combinational Circuit. 3. To Learn the implementation of Sequential Circuit. 4. To Understand the Organization of basic computers. 5. To Understand the concept of Parallel Processing. 6. To understand the concept of memory organization.
Module 1: Fundamentals of Digital Logic and Number Systems	
Learning Outcomes	**After completing this unit, students will be able to:** 1. Apply Boolean algebra, Karnaugh maps (K-Maps), and logic simplification techniques to design and optimize digital logic circuits.
Content Outline	**Digital Principles:** Definition for Digital signals, Digital logic, Digital computers, Von Neumann Architecture, Boolean Laws and Theorems, K-Map: Truth Tables to K-Map, 2, 3 and 4 variable K Map, K-Map Simplifications, Don't Care Conditions, SOP and POS. **Number Systems:** Decimal, Binary, Octal, Hexadecimal, Number System Conversions, Binary Arithmetic, Addition and subtraction of BCD, Octal Arithmetic, Hexadecimal Arithmetic, Binary Codes, Decimal Codes, Error detecting and correcting codes, ASCII, EBCDIC, Excess- 3 Code, The Gray Code
Module 2: Combinational and Sequential Logic Circuits	
Learning Outcomes	**After completing this unit, students will be able to:** 1. Design and analyze combinational logic circuits such as adders, subtractors, encoders, decoders, multiplexers, and demultiplexers. 2. Analyze the operation of synchronous and asynchronous binary counters in digital systems.
Content Outline	**Combinational Circuits:** Half Adder and Full Adder, Subtractor, Decoders, Encoder, Multiplexer, Demultiplexer **Sequential Circuits:** Flip-Flops- SR Flip- Flop, D Flip-Flop, J-K Flip-Flop, T Flip-Flop. **Register:** 4-bit register with parallel load, Shift Registers- Bidirectional shift register with parallel load **Binary Counters:** 4 bit synchronous and Asynchronous binary counter.
Module 3: Computer Organization and CPU Design	

Learning Outcomes	**After completing this unit, students will be able to:** 1. Explain the organization and operation of a basic computer, including instruction formats, registers, instruction cycles, and addressing modes. 2. Analyze CPU organization, data transfer, program control, and accumulator logic in computer architecture.
Content Outline	**Basic Computer Organization and Design:** Instruction Codes, Computer Registers, Computer Instructions, Timing and Control, Instruction Cycle, Memory-Reference Instructions, Input- Output Interrupt, Complete Computer Description, Design of Basic Computer, Design of Accumulator logic. **Central Processing Unit:** Introduction, General Register Organization, Stack Organization, Instruction Formats, Addressing Modes, Data Transfer and Manipulation, Program Control, Reduced Instruction Set Computer(RISC), RISC Vs CISC.
Module 4: Pipeline Processing, Input-Output and Memory Organization	
Learning Outcomes	**After completing this unit, students will be able to:** 1. Analyze pipelining and parallel processing techniques to improve processor performance. 2. Explain input-output organization, data transfer mechanisms, interrupt handling, and Direct Memory Access (DMA) in computer systems.
Content Outline	**Pipeline and Vector Processing:** Parallel Processing, Pipelining, Arithmetic Pipeline, Instruction Pipeline, RISC Pipeline. **Input-Output Organization:** Peripheral Devices, Input-Output Interface, Asynchronous data transfer, Modes of Transfer, Priority Interrupt, Direct memory Access, Input-Output Processor(IOP). **Memory Organization**: Memory Hierarchy, Main Memory, Auxiliary memory, Associate Memory, Cache Memory, Virtual Memory, Memory Management Hardware.

Evaluation Scheme:

- **Internal Assessment:**

  Depending on the content given in syllabus above a project should be developed of 50 marks. Internal Assessment to be done on the basis of Project Presentations and Report Writing with proper Rubrics (Given below).

The Rubric will have the following Evaluation Parameters:	
Evaluation Parameters	**Marks**
Technical Knowledge & Conceptual Understanding	20
Problem Identification & Objectives	10
Design & Implementation	10
Presentation	5
Documentation & Report	5

The project Internal assessment will be done by conducting project presentation at the department level, where External Examiner appointed by the department will be evaluating the project.

- **External Assessment:**

  End Semester examination of 50 marks for 2 hours duration will be conducted by the university.

Text Books:

1. Donald P Leach, Albert Paul Malvino, Goutam Saha- "Digital Principles & Applications", Tata McGraw Hill Education Private Limited,2011Edition.
2. M. Morris Mano- "Computer System Architecture", Pearson/Phi, Third Edition.

Reference Books:

1. William Stallings- "Computer Organization and Architecture", Pearson/PHI, Sixth Edition,
2. Andrew S. Tanenbaum- "Structured Computer Organization", PHI /Pearson 4th Edition,
3. M.V .Subramanyam, "Switching Theory and Logic Design", Laxmi Publications (P) Ltd.
4. Ikvinderpal Singh, Computer Organization Architecture, Khanna Book Publishing.

Course Code	**1.4**
Course Title	**Fundamental of Computer Science**
Course Credits	**4**
Course Outcomes	**After Completion of this Course, students will be able to** 1. Apply computer fundamentals comprehensively. 2. Analyze and solve problems using programming and software development skills. 3. Evaluate proficiency in programming languages, software 4. development life cycles, and debugging techniques. 5. Design software with strong internet literacy and effective problem-solving skills.
Module 1: Introduction to Computer	
Learning Outcomes	**After completing this unit, students will be able to:** 1. Apply knowledge of essential computer components, including CPU, input/output devices, memory, and storage. 2. Analyze internal data representation, including number systems, binary arithmetic, Boolean algebra, and logic gates.
Content Outline	**Knowing computer:** What is Computer, Basic Applications of Computer; Components of Computer System, Central Processing Unit (CPU), Input/output Devices, Computer Memory, Concepts of Hardware and Software; Concept of Computing, Data and Information, classification of computers, various generations of computers; What is an Operating System; Different Popular Operating Systems; The User Interface **System Software:** System software Vs. Application Software, Types of System Software, Introduction and Types of Operating Systems
Module 2: Computer Architecture	
Learning Outcomes	1. Evaluate the functions of various input/output devices and interfaces within computer systems. 2. Design an understanding of basic computer organization and the roles of CPU, memory, and secondary storage.
Content Outline	**Internal data Representation in Computers and Digital System Design:** Number Systems Used in Computers, Converting from One Number System to Another, Binary Arithmetic, Boolean Algebra, Boolean Functions, Logic Gates, Logic Circuits **Computer Architecture:** Basic Functions of a Computer, Basic Computer Organization, CPU Architectures, Memory Architectures, Secondary Storage, Classification of Secondary Storage, Memory Storage Devices, Input- Output Devices ,Input Devices, Output Devices, I/O Interfaces.
Module 3: Introduction of Computer languages and software	

Learning Outcomes	**After learning the module, learners will be able to** 1. Apply knowledge of computer language evolution and types. 2. Analyze programming constructs, algorithms, and flowcharting skills. 3. Evaluate the roles of language processors, software development, and the SDLC.
Content Outline	**Computer Languages:** Definition, Generations of computer languages, Types of Languages, Language Processors: Assembler, Interpreter, Compiler, Linker and Loader. Programming constructs, Algorithm & flowchart. **Software:** Basic Concepts and Terminologies, What is Software? Relationship between Hardware and Software, Software Development Life Cycle (SDLC), Advantages of SDLC Model, Limitations of SDLC Model, Software Testing and Debugging
Module 4: Introduction to Internet:	
Learning Outcomes	**After completing this unit, students will be able to:** 1. Design an understanding of basic computer networks, internet connectivity, and the architecture of the World Wide Web.
Content Outline	**Introduction to Internet:** WWW and Web Browsers: Basic of Computer networks; LAN, WAN; Concept of Internet; Applications of Internet; connecting to internet; What is ISP; Knowing the Internet; Basics of internet connectivity related troubleshooting, World Wide Web; Web Browsing software, Search Engines; Understanding URL; Domain name; IP Address; Using e-governance website

Evaluation Scheme:

- **Internal Assessment:**

  Depending on the content given in syllabus above a project should be developed of 50 marks. Internal Assessment to be done on the basis of Project Presentations and Report Writing with proper Rubrics (Given below).

The Rubric will have the following Evaluation Parameters:	
Evaluation Parameters	**Marks**
Problem Identification & Objectives	10
Understanding of Concepts	10
Project Design & Methodology	20
Presentation & viva	5
Documentation & Report	5

The project Internal assessment will be done by conducting project presentation at the department level, where External Examiner appointed by the department will be evaluating the project.

Two sample projects are given below and it is expected from students to choose a good and

advance project topic that aligns with their interests and abilities to work on.

Project 1. Computer Hardware and Architecture

- Study and comparison of computer generations
- Build a model of a computer system showing input, output, memory, and CPU
- Comparative analysis of desktop, laptop, tablet, and smartphone architectures

Project 2. Number Systems and Logic Gates

- Number system converter (manual or software-based)
- Logic gate-based mini projects (security alarm, voting system, traffic light controller)
- Design of combinational circuits using logic gates

- **External Assessment:**
  End Semester examination of 50 marks for 2 hours duration will be conducted by the university.

Reference:

1. Sinha, P. K., & Sinha, P. (2004). Computer Fundamentals. BPB Publications.
2. Srivastava, C. (2010). Fundamentals of Information Technology. Kalyani Publishers.
3. Rajaraman, V. (2003). Fundamentals of Computers (4th ed.). PHI Publication.
4. Jain, R. K. (2010). Fundamentals of Programming. S. Chand Publication.

Course Code	**1.5**
Course Title	**General English - I**
Course Credits	**2**
Course Outcomes	**After Completion of this Course, students will be able to** 1. The student will acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills
Module 1: Vocabulary Building	
Learning Outcomes	1. Apply prefixes and suffixes to form new words and use them appropriately in written and spoken communication 2. Identify and use commonly accepted abbreviations and acronyms in academic, professional, and technical contexts.
Content Outline	The concept of Word Formation, Root words from foreign languages and their use in English, Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives, Synonyms, antonyms, and standard abbreviations.
Module 2: Basic Writing Skills	
Learning Outcomes	**After learning the module, learners will be able to** 1. Construct grammatically correct and coherent sentences and paragraphs by effectively using sentence structures, phrases, clauses, punctuation, and organizational principles in written communication. 2. Develop clear, concise, and well-organized documents by applying techniques for precise writing and ensuring logical coherence and readability.
Content Outline	Sentence Structures, Use of phrases and clauses in sentences, Importance of proper punctuation, Creating coherence, Organizing principles of paragraphs in documents, Techniques for writing precisely
Module 3: Identifying Common Errors in Writing	
Learning Outcomes	1. Apply the rules of grammar, including subject–verb agreement, noun–pronoun agreement, articles, and prepositions, to produce grammatically accurate sentences in written and spoken communication.
Content Outline	Subject-verb agreement, Noun-pronoun agreement, Misplaced modifiers, Articles, Prepositions, Redundancies
Module 4: Nature and Style of sensible Writing	
Learning Outcomes	1. Demonstrate effective oral communication skills by applying appropriate pronunciation, intonation, stress, rhythm, and active listening techniques in everyday, academic, and workplace interactions

Content Outline	Describing, Defining, Classifying, providing examples or evidence, writing introduction and conclusion, Module V: Writing Practices, Comprehension, Précis Writing, Essay Writing **Oral Communication Listening** Comprehension, Pronunciation, Intonation, Stress and Rhythm, Common Everyday Situations: Conversations and Dialogues, Communication at Workplace, Interviews, Formal Presentations

Evaluation Scheme:

- **External Assessment:**
  End Semester examination of 50 marks for 2 hours duration will be conducted by the university.

Text/Reference Books:

1. AICTE's Prescribed Textbook: Communication Skills in English (with Lab Manual), Anjana Tiwari, Khanna Book Publishing Co., 2023.
2. Effective Communication Skills. Kul Bhushan Kumar, Khanna Book Publishing, 2022.
3. Practical English Usage. Michael Swan. OUP. 1995.
4. Remedial English Grammar. F.T. Wood. Macmillan.2007
5. On Writing Well. William Zinsser. Harper Resource Book. 2001
6. Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
7. Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011. 8. Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press

Alternative NPTEL/SWAYAM Course:

S.No.	NPTEL/SWAYAM Course Name	Instructor	Host Institute
1	English language for competitive exams	Prof. Aysha iqbal	IIT MADRAS
2	Technical English for engineers	Prof. Aysha iqbal	IITM

Course Code	**1.6**
Course Title	**Indian Knowledge System**
Course Credits	**2**

*For Detailed Course Refer APPENDIX

External Assessment:
End Semester examination of 50 marks for 2 hours duration will be conducted by the university.

Course Code	**1.7**
Course Title	**Environmental Science and Sustainability**
Course Credits	**2**
Course Outcomes	**After Completion of this Course, students will be able to** 1. Explore the basic environmental concepts and issues relevant to the business and management field. 2. Recognize the interdependence between environmental processes and socio-economic dynamics. 3. Determine the role of business decisions, policies, and actions in minimizing environmental degradation. 4. Identify possible solutions to curb environmental problems caused by managerial actions. 5. Develop skills to address immediate environmental concerns through changes in business operations, policies, and decisions.
Module 1: Understanding Environment, Natural Resources, and Sustainability	
Learning Outcomes	**After completing this unit, students will be able to:** 1. Evaluate and recommend sustainable resource management practices for addressing challenges related to deforestation, water conservation, energy security, food security, and equitable resource utilization in personal, societal, and business contexts.
Content Outline	Fundamental environmental concepts and their relevance to business operations; Components and segments of the environment, the man-environment relationship, and historical environmental movements. Concept of sustainability; Classification of natural resources, issues related to their overutilization, and strategies for their conservation. Sustainable practices in managing resources, including deforestation, water conservation, energy security, and food security issues. The conservation and equitable use of resources, considering both intergenerational and intergenerational equity, and the importance of public awareness and education
Module 2: Ecosystems, Biodiversity, and Sustainable Practices	
Learning Outcomes	1. Describe the structure, functions, and ecological significance of various natural ecosystems, including the concepts of ecosystem resilience, homeostasis, and carrying capacity.
Content Outline	Various natural ecosystems, learning about their structure, functions, and ecological characteristics. The importance of biodiversity, the threats it faces, and the methods used for its conservation. Ecosystem resilience, homeostasis, and carrying capacity, emphasizing the need for sustainable ecosystem management. Strategies for in situ and ex situ conservation, nature reserves, and the significance of India as a mega diverse nation
Module 3: Environmental Pollution, Waste Management, and Sustainable Development	
Learning Outcomes	1. Explain the causes, effects, and environmental, social, and business impacts of various types of pollution, climate change, ozone depletion, greenhouse effect, acid rain, and disaster events.

Content Outline	Various types of environmental pollution, including air, water, noise, soil, and marine pollution, and their impacts on businesses and communities. Causes of pollution, such as global climate change, ozone layer depletion, the greenhouse effect, and acid rain, with a particular focus on pollution episodes in India. Importance of adopting cleaner technologies; Solid waste management; Natural and man-made disasters, their management, and the role of businesses in mitigating disaster impacts.
Module 4: Social Issues, Legislation, and Practical Applications	
Learning Outcomes	1. Analyze the significance of environmental legislation, judicial interventions, environmental justice, and demographic challenges in addressing environmental issues and supporting sustainable development.
Content Outline	Dynamic interactions between society and the environment, with a focus on sustainable development and environmental ethics. Role of businesses in achieving sustainable development goals and promoting responsible consumption. Overview of key environmental legislation and the judiciary's role in environmental protection, including the Water (Prevention and Control of Pollution) Act of 1974, the Environment (Protection) Act of 1986, and the Air (Prevention and Control of Pollution) Act of 1981. Environmental justice, environmental refugees, and the resettlement and rehabilitation of affected populations; Ecological economics, human population growth, and demographic changes in India.

Evaluation Scheme:

Internal Assessment:

Depending on the content given in syllabus above a project should be developed of 50 marks. Internal Assessment to be done on the basis of Project Presentations and Report Writing with proper Rubrics (Given below).

The Rubric will have the following Evaluation Parameters:	
Evaluation Parameters	**Marks**
Content knowledge and understanding	20
Creativity & Innovation	10
Research & Data Collection	10
Presentation	5
Report writing or Documentation	10

The project Internal assessment will be done by conducting project presentation at the department level, where External Examiner appointed by the department will be evaluating the project.

References:

Text Books (Latest Editions):

1. Poonia, M.P. *Environmental Studies* (3rd ed.), Khanna Book Publishing Co.

2. Bharucha, E. *Textbook of Environmental Studies* (3rd ed.) Orient Blackswan Private Ltd.
3. Poonia, M.P. & S.C. Sharma, Environmental Engineering, Khanna Publishing House.
4. Kant & Kant, Air Pollution Control, Khanna Publishing House.
5. Gupta, O.P., Elements of Environmental Pollution Control, Khanna Publishing House.
6. Dave, D., & Katewa, S. S. *Text Book of Environmental Studies.* Cengage Learning India Pvt
7. Rajagopalan, R. *Environmental studies: from crisis to cure (20th ed.)*Oxford University
8. Miller, G.T. & Spoolman S. *Living in the Environment*. (20th ed.). Cengage.
9. Basu, M., & Xavier Savarimuthu, S. J.*Fundamentals of environmental studies*. Cambridge University Press.
10. Roy, M. G.*Sustainable Development: Environment, Energy and. Water Resources*
11. Pritwani, K. *Sustainability of business in the context of environmental management.*
12. Wright, R.T. & Boorse, D.F. *Environmental Science: Toward A Sustainable Futur* Pearson.
13. S.C. Sharma, Disaster Management, Third Edition, Khanna Publishing House.

Web links:

1. https://www.ourplanet.com
2. https://www.undp.org/content/undp/en/home/sustainable-development-goals.html
3. www.myfootprint.org
4. https://www.globalchange.umich.edu/globalchange1/current/lectures/kling/ecosystem/ecosystem.html

Course Code	**1.8**
Course Title	**C Programming Lab**
Course Credits	**2**

Evaluation Scheme:

- **Internal Assessment:**

  Depending on the content given in syllabus above a project should be developed of 50 marks. Internal Assessment to be done on the basis of Project Presentations and Report Writing with proper Rubrics (Given below).

The Rubric will have the following Evaluation Parameters:	
Evaluation Parameters	**Marks**
Functionality (Core Features)	20
Code Quality (Structure, Readability)	10
GUI Design & User Experience	10
Input Handling & Error Management	5
Report writing or Documentation	5

The project Internal assessment will be done by conducting project presentation at the department

level, where External Examiner appointed by the department will be evaluating the project.

Two sample projects are given below and it is expected from students to choose a good and advance project topic that aligns with their interests and abilities to work on.

Project 1: Student Record Management System To develop a C program that stores, retrieves, modifies, and deletes student records using file handling, structures, arrays, and functions.
Project 2: Mini Banking System Create a menu-driven C program to simulate a simple banking system using functions, arrays, structures, and file operations.

SEMESTER–II

Course Code	**2.1**
Course Title	**Mathematics Foundation to Computer Science - II**
Course Credits	**4**
Course Outcomes	**After Completion of this Course, students will be able to** 1. Apply logic and proof techniques in mathematical reasoning. 2. Understand algebraic structures such as groups and semigroups. 3. Utilize numerical methods for solving equations, interpolation, and integration.
Module 1: Logic and Methods of Proofs	
Learning Outcomes	**After completing this unit, students will be able to:** 1. Apply propositional logic, logical connectives, truth tables, quantifiers, and normal forms to analyze logical statements. 2. Determine the validity and logical equivalence of propositions using tautologies, contradictions, contingencies, CNF, and DNF.
Content Outline	Propositions, logical operations (basic connectives), compound statements, construction of truth table, quantifiers, conditional statements, tautology, contradiction, contingency, logical equivalence. Conjunctive Normal Forms (CNF) and Disjunctive Normal Forms (DNF). **Methods of proofs:** Rules of inference for propositional logic, modus ponens, modus tollens, syllogism, proof by contradiction, Mathematical Induction
Module 2: Algebraic Structures	
Learning Outcomes	**After completing this unit, students will be able to:** 1. Explain the fundamental concepts and properties of algebraic structures, including semigroups, monoids, groups, and subgroups. 2. Identify and classify algebraic structures based on their defining properties and operations. 3. Analyze cyclic groups and solve problems involving finite algebraic structures.
Content Outline	Semi-group, Monoid, Group, Subgroup, Cyclic group.
Module 3: Numerical Methods	
Learning Outcomes	**After completing this unit, students will be able to:** 1. Apply numerical techniques to obtain approximate solutions of algebraic and transcendental equations. 2. Analyze numerical errors and select appropriate numerical methods for solving engineering and scientific problems.
Content Outline	Concept and importance of errors in numerical methods. **Solution of algebraic and transcendental equations:** Bisection method and Newton-Raphson methods. **Numerical Interpolation**: Newton's Forward and Newton's Backward interpolation formula and Lagrange's formula. **Numerical Integration:** Trapezoidal rule and Simpson's 1/3 rule Only formula and problem solving for all the topics mentioned above.

Module 4: Optimization Techniques	
Learning Outcomes	**After completing this unit, students will be able to:** 1. Formulate linear programming models for real-world optimization problems and obtain optimal solutions using graphical and simplex methods. 2. Analyze the duality concept and interpret optimal solutions of linear programming problems.
Content Outline	**Linear programming:** Introduction, LP formulation, Graphical method for solving LPs with two variables, Special cases in graphical methods, Simplex method, Duality. **Transportation problem:** Definition, Linear form, North-west corner method, Least cost method, Vogel's approximation method for finding feasible solution, MODI method for finding optimum solution.

Evaluation Scheme:

- **Internal Assessment:**

  Depending on the content given in syllabus above a project should be developed of 50 marks. Internal Assessment to be done on the basis of Project Presentations and Report Writing with proper Rubrics (Given below).

The Rubric will have the following Evaluation Parameters:	
Evaluation Parameters	**Marks**
Functionality (Core Features)	20
Code Quality (Structure, Readability)	10
GUI Design & User Experience	10
Input Handling & Error Management	5
Report writing or Documentation	5

  The project Internal assessment will be done by conducting project presentation at the department level, where External Examiner appointed by the department will be evaluating the project.

  Two sample projects are given below and it is expected from students to choose a good and advance project topic that aligns with their interests and abilities to work on.

  Project 1: Cryptography and Coding Theory with Group Theory This project focuses on applying group theory concepts to cryptography and error detection. Students will explore how algebraic structures such as groups, semigroups, and monoids are used in the field of cryptography, with a specific focus on RSA encryption. Additionally, students will implement error detection methods in coding theory using group properties.

- **External Assessment:**

  End Semester examination of 50 marks for 2 hours duration will be conducted by the University.

Text Books

1. Kolman B., Busby R. and Ross S., Discrete Mathematical Structures, 6th Edition, Pearson Education, 2015.
2. Sastry S. S., Introductory Methods of Numerical Analysis, Fifth Edition, PHL, 2022.
3. Garg, Mathematics - I Calculus & Linear Algebra, Khanna Publishing House, 2021.
4. Taha Hamdy A., Operations Research: An Introduction, Eighth Edition, Pearson Prentice Hall, 2003.
5. S.B. Singh, Discrete Structures, Khanna Book Publishing, 2023 (AICTE Recommended Textbook)

Reference Books

1. Rosen Kenneth H. and Krithivasan Kamala, Discrete Mathematics and its Applications, McGraw Hill, India, 2019.
2. Chakravorty J. G. and Ghosh P. R., Linear Programming and Game Theory, Moulik Library, 2017.
3. Sharma J. K., Operations Research: Theory and Applications, Fourth Edition, Macmilllan Publishers, 2007.

Web Resources

1. https://nptel.ac.in/courses/111107127
2. https://www.math.iitb.ac.in/~siva/si50716/SI507lecturenotes.pdf

Course Code	**2.2**
Course Title	**Data Structures**
Course Credits	**2**
Course Outcomes	**After Completion of this Course, students will be able to** 1. Understand the fundamental concepts of Data Structures and their applications. 2. Develop problem-solving skills using Data Structures. 3. Implement Data Structures using C programming language.
Module 1: Introduction to Data Structures and Arrays	
Learning Outcomes	**After completing this unit, students will be able to:** 1. Implement array operations, including traversal, insertion, deletion, searching, sorting, and merging for one-dimensional and multi-dimensional arrays. 2. Compare searching and sorting algorithms based on their efficiency and suitability for different applications.
Content Outline	**Introduction and Overview:** Definition, Classification and Operations of Data Structures. Algorithms: Complexity, Time-Space Tradeoff. **Arrays:** Definition and Classification of Arrays, Representation of Linear Arrays in Memory, Operations on Linear Arrays: Traversing, Inserting, Deleting, Searching, Sorting and Merging. **Searching:** Linear Search and Binary Search, Comparison of Methods. **Sorting:** Bubble Sort, Selection Sort, and Insertion Sort. Two-Dimensional Arrays, Representation of Two- Dimensional Arrays in Memory, Matrices and Sparse Matrices, Multi-Dimensional Arrays.
Module 2: Linked Lists and Hashing Techniques	
Learning Outcomes	**After completing this unit, students will be able to:** 1. Implement singly, doubly, and circular linked lists and perform fundamental operations such as insertion, deletion, traversal, and searching. 2. Apply linked lists to solve practical problems, including polynomial representation and manipulation. 3. Analyze hashing techniques and implement collision resolution methods using open addressing and chaining.
Content Outline	**Linked Lists:** Definition, Comparison with Arrays, Representation, Types of Linked lists, Traversing, Inserting, Deleting and Searching in Singly Linked List, Doubly Linked List and Circular Linked List. Applications of Linked Lists: Addition of Polynomials. **Hashing and Collision:** Hashing, Hash Tables, Types of Hash Functions, Collision, Collision Resolution with Open Addressing and Chaining.
Module 3: Stacks, Queues and Recursion	

Learning Outcomes	**After completing this unit, students will be able to:** 1. Apply stacks, queues, and recursion to solve computational problems such as expression evaluation, recursive algorithms, and scheduling applications. 2. Analyze the advantages and limitations of different stack and queue implementations for various applications.
Content Outline	**Stacks:** Definition, Representation of Stacks using Arrays and Linked List, Operations on Stacks using Arrays and Linked List, Application of Stacks: Arithmetic Expressions, Polish Notation, Conversion of Infix Expression to Postfix Expression, Evaluation of Postfix Expression. **Recursion:** Definition, Recursive Notation, Runtime Stack, Applications of Recursion: Factorial of Number, GCD, Fibonacci Series and Towers of Hanoi. **Queues:** Definition, Representation of Queues using Array and Linked List, Types of Queue: Simple Queue, Circular Queue, Double-Ended queue, Priority Queue, Operations on Simple Queues and Circular Queues using Array and Linked List, Applications of Queues.
Module 4: Graphs and Trees	
Learning Outcomes	**After completing this unit, students will be able to:** 1. Implement binary search trees and AVL trees to perform insertion, deletion, searching, and balancing operations.
Content Outline	**Graphs:** Definition, Terminology, Representation, Traversal. **Trees:** Definition, Terminology, Binary Trees, Traversal of Binary Tree, Binary Search Tree, Inserting, Deleting and Searching in Binary Search Tree, Height Balanced Trees: AVL Trees, Insertion and Deletion in AVL Tree.

Evaluation Scheme:

- **External Assessment:**

  End Semester examination of 50 marks for 2 hours duration will be conducted by the university.

Text Books

1. R.B. Patel, “Expert Data Structures with C”, Khanna Book Publishing Company, 2023 (AICTE Recommended Textbook)
2. Seymour Lipschutz, “Data Structures with C”, Schaum’s Outlines, Tata McGraw-Hill, 2011.
3. Yashavant Kanetkar, "Data Structures Through C", 4th Edition, BPB Publications, 2022.

Reference Books

1. Reema Thareja, “Data Structures Using C", Second Edition, Oxford University Press, 2014.
2. Ellis Horowitz, Sartaj Sahni, and Susan Anderson-Freed, "Fundamentals of

Data Structures in C", Second Edition, Universities Press, 2007.

Web Resources

1. **GeeksforGeeks** - Data Structures Tutorial
2. **Khan Academy** - Algorithms Course

Course Code	**2.3**
Course Title	**Operating Systems**
Course Credits	**2**
Course Outcomes	**After Completion of this Course, students will be able to** 1. Explain the fundamentals of the operating system. 2. Comprehend multithreaded programming, CPU scheduling, process management, process synchronization, memory, deadlocks, and storage management. 3. Compare the performance of CPU scheduling algorithms CO4: Identify the features of I/O and File handling methods.
Module 1: Introduction to Operating Systems and System Structures	
Learning Outcomes	**After completing this unit, students will be able to:** 1. Differentiate various types of operating systems, including batch, multiprogramming, time-sharing, distributed, parallel, and real-time systems. 2. Describe operating system structures, system calls, and system programs involved in managing computer resources.
Content Outline	**Operating Systems Overview**: Definition, Evaluation of O.S, Components & Services of OS, Structure, Architecture, types of Operating Systems, Batch Systems, Concepts of Multiprogramming and Time Sharing, Parallel, Distributed and real time Systems. **Operating Systems Structures:** Operating system services and systems calls, system programs, operating system structure, operating systems generations.
Module 2: Process Management and Scheduling	
Learning Outcomes	**After completing this unit, students will be able to:** 1. Apply CPU scheduling algorithms such as FCFS, SJF, and Round Robin to schedule processes efficiently. 2. Evaluate the performance of different scheduling algorithms using appropriate scheduling criteria.
Content Outline	**Process Management:** Process Definition, Process states, Process State transitions, Process Scheduling, Process Control Block, Threads, Concept of multithreads, Benefits of threads, Types of threads. **Process Scheduling:** Definition, Scheduling objectives, Scheduling algorithms, CPU scheduling Preemptive and Non-preemptive Scheduling algorithms (FCFS, SJF and RR), Performance evaluation of the scheduling Algorithms
Module 3: Process Synchronization and Deadlocks	

Learning Outcomes	**After completing this unit, students will be able to:** 1. Analyze process synchronization problems and implement synchronization mechanisms using semaphores and monitors. 2. Apply deadlock prevention, avoidance, detection, and recovery techniques, including the Banker's algorithm, to resource allocation problems.
Content Outline	**Process Synchronization:** Introduction, Inter-process Communication, Race Conditions, Critical Section Problem, Mutual Exclusion, Semaphores, Monitors. **Deadlocks:** System model, deadlock characterization, deadlock prevention, avoidance, Banker's algorithm, Deadlock detection, and recovery from deadlocks.
Module 4: Memory Management and I/O Systems	
Learning Outcomes	**After completing this unit, students will be able to:** 1. Apply virtual memory concepts and page replacement algorithms to optimize memory utilization. 2. Analyze disk organization and implement appropriate disk scheduling algorithms to improve I/O performance.
Content Outline	**Memory Management:** Logical and Physical address map, Swapping, Memory allocation, MFT, MVT, Internal and External fragmentation and Compaction, Paging, Segmentation. **Virtual Memory:** Demand paging, Page Replacement algorithms, Allocation of frames, thrashing. **I/O Management:** Principles of I/O Hardware: Disk structure, Disk scheduling algorithms.

Evaluation Scheme:

- **External Assessment:**

  End Semester examination of 50 marks for 2 hours duration will be conducted by the university.

Text Books:

1. Ekta Walia, Operating Systems Concepts, Khanna Publishing House, 2022 (AICTE Recommended Textbook)
2. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne (2006), Operating System Principles, 7th edition OR Later edition, Wiley India Private Limited, New Delhi.
3. Stallings (2006), Operating Systems, Internals and Design Principles, 5th edition, Pearson Education, India.

Reference Books:

1. Andrew S Tanenbaum, Modern Operating Systems, Third Edition, Prentice Hall India.
2. Sumitabha Das, UNIX Concepts and Applications, 4th Edition, Tata McGraw-Hill.

Course Code	**2.4**
Course Title	**Object Oriented Programming using Java**
Course Credits	**2**
Course Outcomes	**After Completion of this Course, students will be able to**: 1. To introduce the object oriented programming system concepts 2. To introduce syntax and semantics of Java programming language 3. To develop modular programs using Java 4. To setup JDK environment to create, debug and run Java programs
Module 1: Fundamentals of Object-Oriented Programming and Java	
Learning Outcomes	**After completing this unit, students will be able to:** 1. Describe the Java programming environment, program structure, JVM, tokens, statements, and command-line arguments. 2. Develop simple Java programs using classes, comments, mathematical functions, and basic input/output constructs.
Content Outline	**Fundamentals of Object Oriented Programming:** Basic Concepts of Object Oriented Programming (OOP), Benefits and Applications of OOP. **Java Evolution:** Java Features, Difference between Java, C and C++, Javaand Internet, Java Environment. **Overview of Java Language:** Introduction to Simple Java Program, Use ofComments and Math function, Application of two classes, Java Program Structure, Java Tokens and statements, Implementing Java programAnd JVM, Command Line Arguments.
Module 2: Java Language Fundamentals	
Learning Outcomes	**After completing this unit, students will be able to:** 1. Apply operators, expressions, and control structures to solve programming problems using decision-making and looping constructs.
Content Outline	**Constants, Variables and Data Types:** Constants, Variables, Data Types, Declaration of Variables, Giving values to Variables, Symbolic Constants, Typecasting. **Operators & Expressions:** Arithmetic operators, Relational operators, Logical operators, Assignment operators, Increment & Decrement operators, conditional operators, Bitwise operators, Arithmetic Expressions, Evaluation of Expressions, Type Conversions in Expressions, Operator Precedence & Associativity. **Decision Making, Branching & Looping:** Decision Making with Control Statements, Looping statements, Jump in loops, Labelled loops.
Module 3: Classes, Objects, Arrays, and Inheritance	

Learning Outcomes	**After completing this unit, students will be able to:** 1. Design and implement Java programs using classes, objects, constructors, methods, and method overloading and overriding. 2. Apply arrays, strings, vectors, wrapper classes, and enumerated types for efficient data handling.
Content Outline	**Classes, Objects and Methods:** Defining Class, Methods Declaration, Constructors, Methods Overloading, Overriding Methods, Inheritance **Arrays, Strings and Vectors:** 1D arrays, Creating an Array, 2D arrays, Strings, Vectors, Wrapper Classes, Enumerated Types **Inheritance:** Defining, extending classes, and Implementing Interfaces. Multiple inheritance and polymorphism.
Module 4: Packages and Exception Handling	
Learning Outcomes	**After completing this unit, students will be able to:** 1. Create and manage Java packages, including user-defined packages, for modular application development. 2. Implement exception handling mechanisms using try, catch, throw, throws, and finally to develop robust Java programs.
Content Outline	**Packages:** Basics of packages, System packages, Creating and accessingpackages, Creating user defined packages, Adding class to a package. **Exception Handling:** Using the main keywords of exception handling: try, catch,throw, throws and finally; Nested try, Multiple catch statements, Creating user defined exceptions

Evaluation Scheme:

- **External Assessment:**

  End Semester examination of 50 marks for 2 hours duration will be conducted by the university.

Text Books

1. Balaguruswamy E. (2023). Programming with JAVA: A Primer. 7th edition. India: McGraw Hill Education
2. Schildt, H. (2022). Java: The Complete Reference. 12th edition.McGraw-Hill Education.

Reference Books

1. Arunesh Goyal, The Essentials of JAVA, Khanna Book Publishing Company Private Limited, 2012.
2. Tanweer Alam, Core JAVA, Khanna Book Publishing Company Private Limited, 2015.
3. Y. Daniel Liang, Introduction to Java Programming, 7th Edition, Pearson,2008.
4. S. Malhotra and S. Choudhary, Programming in Java, 2nd Edition, Oxford University Press, 2014.

Web Resources

1. https://www.w3schools.com/java/.
2. http://www.java2s.com/.
3. https://onlinecourses.nptel.ac.in/noc22_cs47/preview

Course Code	**2.5**
Course Title	**Web Technologies**
Course Credits	**2**
Course Outcomes	**After Completion of this Course, students will be able to** 1. Analyze HTML and CSS proficiency to create visually appealing web pages. 2. Evaluate the use of JavaScript to enhance interactivity and add dynamic functionality to web pages. 3. Implement authentication, security, and performance optimization.
Module 1: Introduction to HTML and CSS	
Learning Outcomes	**After completing this unit, students will be able to:** 1. Understand the basics of web technologies and how websites work 2. Develop structured web pages using HTML. 3. Apply CSS for styling and layout of web pages. 4. Implement responsive design for different screen sizes.
Content Outline	Introduction to HTML, history of HTML, Objective, basic Structures of HTML, Header Tags, body tags, Paragraph Tags. Tags for FORM Creation, TABLE, FORM, TEXTAREA, SELECT, IMG, IFRAME FIELDSET, ANCHOR. Lists in HTML, Introduction to DIV tag, NAVBAR Design. Introduction to CSS, types, Selectors, and Responsiveness of a web page. Introduction to Bootstrap, downloads/linking, using classes of Bootstrap, understanding the Grid System in Bootstrap. Introduction to www, Protocols and Programs, Applications and development tools, web browsers, DNS, Web hosting Provider, Setting up of Windows/Linux/Unix web servers, Web hosting in cloud, Types of Web Hosting.
Module 2: Introduction to JavaScript	
Learning Outcomes	**After completing this unit, students will be able to:** 1. Write basic JavaScript programs for web interactivity. 2. Use variables, loops, and functions for logic-based execution. 3. Handle user events (click, input, hover) and form validation.
Content Outline	Introduction to JavaScript: Functions and Events, Document Object model traversing using JavaScript. Output System in JavaScript i.e. Alert, throughput, Input box, Console. Variables and Arrays in JavaScript.Date and String handling in JavaScript. Manipulating CSS through JavaScript: Form Validation like Required validator, length validator, Pattern validator. Advanced JavaScript, Combining HTML, CSS and JavaScript events and buttons, controlling your browser.
Module 3: Introduction to AJAX and XML	

Learning Outcomes	**After completing this unit, students will be able to:** 1. Explain the concepts, advantages, limitations, and applications of AJAX in developing dynamic and interactive web applications. 2. Apply XML technologies, including DTD, XML Schema, XSL, XSLT, and XHTML, to structure, validate, and transform web data.
Content Outline	Purpose, advantages and disadvantages, AJAX based Web applications and alternatives of AJAX. **Introduction to XML:** uses, Key concepts, DTD 8 schemas, XSL, XSLT, and XSL Elements and transforming with XSLT. Introduction to XHTML. **JSON:** Introduction to JSON, Keys and Values, Types of Values, Arrays, Objects
Module 4: Backend Development & Databases	
Learning Outcomes	**After completing this unit, students will be able to:** 1. Understand the client-server architecture and server-side scripting. 2. Implement backend logic using a server-side language (e.g., Python, PHP, Node.js). 3. Integrate databases with web applications using SQL & NoSQL databases.
Content Outline	Introduction to Backend Development, Understanding Client-Server Architecture, Role of Backend in Web Applications, Overview of Server-Side Programming Languages (Python, PHP, Node.js) Server-Side Scripting Basics, Introduction to Express.js (Node.js) or Flask (Python), Handling HTTP Requests and Responses (GET, POST, PUT, DELETE), Working with RESTful APIs Databases for Web Applications, Relational Databases (SQL) – MySQL, PostgreSQL, NoSQL Databases – MongoDB, Firebase, Connecting Web Apps with Databases **Authentication & Session Management, User Authentication:** JWT, OAuth, Session-based Authentication.

Evaluation Scheme:

- **External Assessment:**

  End Semester examination of 50 marks for 2 hours duration will be conducted by the University.

Text Books

1. Laura Lemay, Mastering HTML, CSS & Java Script Web Publishing, BPB Publications, 2016
2. Thomas A. Powell, The Complete Reference HTML & CSS, Fifth Edition, 2017
3. Powell, T. (2008). HTML and XHTML: The Complete Reference. Tata McGraw Hill.
4. Powell, T., & Schneider, F. (2004). JavaScript 2.0: The Complete Reference (2nd ed.). Tata McGraw Hill.
5. Casciaro, M., & Mammino, L. (2016). Node.js Design Patterns. Packt Publishing.
6. Bradshaw, S., Brazil, E., & Chodorow, K. (2019). MongoDB: The Definitive Guide. O'Reilly

Media.

Reference Books

1. Silvio Moreto, Bootstrap 4 By Example, ebook, 2016.
2. Tanweer Alam, Web Technologies, Khanna Book Publishing, 2011.

Web Resources

1. www.javatpoint.com
2. www.w3schools.com
3. https://www.geeksforgeeks.org/web-technology/

Course Code	**2.6**
Course Title	**Indian Constitution**
Course Credits	**2**
Course Outcomes	**After Completion of this Course, students will be able to** 1. Constitutional Framework: Analyze the Indian Constitution's history, Preamble, Fundamental Rights, and basic structure. 2. Union Government Structure: Describe the roles of the President, Prime Minister, and the legislative bodies (Lok Sabha and Rajya Sabha). 3. State Government Mechanisms: Examine the powers of the Governor, Chief Minister, and the State Secretariat. 4. Local Administration: Assess the functioning of local government bodies like District Administration, Municipal Corporations, and Zila Panchayats. 5. Electoral Processes: Analyze the role of the Election Commission in conducting free and fair elections. 6. Application of Knowledge: Apply constitutional principles to contemporary political issues and evaluate governance effectiveness.
Module 1: The Constitution - Introduction	
Learning Outcomes	**After completing this unit, students will be able to:** 1. Explain the historical development and salient features of the Constitution of India. 2. Interpret the Preamble, Fundamental Rights, Fundamental Duties, and Directive Principles of State Policy. 3. Analyze the significance of constitutional values in promoting democracy, justice, equality, and responsible citizenship.
Content Outline	The History of the Making of the Indian Constitution Preamble and the Basic Structure, and its interpretation Fundamental Rights and Duties and their interpretation State Policy Principles
Module 2: Union Government	
Learning Outcomes	**After completing this unit, students will be able to:** 1. Describe the structure and functions of the Union Government under the Constitution of India. 2. Analyze the roles, powers, and responsibilities of the President, Prime Minister, Council of Ministers, Lok Sabha, and Rajya Sabha.
Content Outline	Structure of the Indian Union President – Role and Power Prime Minister and Council of Ministers Lok Sabha and Rajya Sabha

Module 3: State Government	
Learning Outcomes	**After completing this unit, students will be able to:** 1. Describe the roles and responsibilities of the Governor, Chief Minister, Council of Ministers, and State Secretariat. 2. Analyze the relationship between the Union and State Governments within the federal system.
Content Outline	Governor – Role and Power Chief Minister and Council of Ministers State Secretariat
Module 4: Local Administration and Election Commission	
Learning Outcomes	**After completing this unit, students will be able to:** 1. Describe the structure and functions of local self-government institutions in India. 2. Assess the importance of decentralization and local governance in delivering public services and promoting participatory democracy. 3. Describe the roles and responsibilities of the Chief Election Commissioner in conducting free and fair elections. 4. Analyze the significance of independent electoral institutions in strengthening democratic governance and electoral integrity.
Content Outline	**Local Administration** - District Administration, Municipal Corporation, Zilla Panchayat **Election Commission** - Role and Functioning , Chief Election Commissioner ,State Election Commission

- **Internal Assessment:**
  Depending on cases given below Internal Assessment to be done with proper Rubrics (Given below).

The Rubric will have the following Evaluation Parameters:	
Evaluation Parameters	**Marks**
Understanding of Constitutional Concepts	10
Case Analysis and Critical Thinking	20
Problem Solving and Recommendations	10
Presentation and Communication	5
Report writing or Documentation	5

Cases

- Rustom Cavasjee Cooper v. Union of India, (1970) 1 SCC 248
- State of Rajasthan v. Mohan Lal Vyas, AIR 1971 SC 2068 (confirmation of a private monopoly, not a violation of fundamental right)
- Mithilesh Garg v. Union of India, (1992) 1 SCC 168 : AIR 1992 SC 221 (Right to carry

on business, not breached when it is liberalised)

- Chintamanrao v. The State of Madhya Pradesh, AIR 1951 SC 118 (scope of reasonable restrictions in relation to trade and occupation)
- Cooverjee B. Bharucha v. Excise Commissioner, Ajmer, AIR 1954 SC 220 (the reasonableness of the restriction imposed may depend upon the nature of the business and prevailing conditions including public health and morality)
- T. B. Ibrahim v. Regional Transport Authority. Tanjore, AIR 1953 SC 79
- Harman Singh v. RTA, Calcutta, AIR 1954 SC 190
- Dwarka Prasad Laxmi Narain v. State of U.P., AIR 1954 SC 224
- State of Bombay v. R.M.D. Chamarbaugwala, AIR 1957 SC 699
- Parbhani Transport Coop. Society Ltd. v. Regional Transport Authority, Aurangabad, AIR 1960 SC 801
- State of Bombay v. R. M. D. Chamarbaugwala, (1957) S.C.R. 874,
- G.K.Krishnan vs State of Tamil Nadu, 1975 SCC (1) 375
- Automobile Transport (Rajasthan) Ltd. Vs State of Rajasthan, AIR 1962 SC 1406

References

Suggested Learning Resources:

1. Ethics and Politics of the Indian Constitution by Rajeev Bhargava, Oxford University Press, New Delhi, 2008
2. The Constitution of India by B.L. Fadia Sahitya Bhawan; New edition (2017)
3. Introduction to the Constitution of India by DD Basu Lexis Nexis; Twenty-Third, 2018 edition

Suggested Software/Learning Websites:

a. https://www.constitution.org/cons/india/const.html
b. http://www.legislative.gov.in/constitution-of-india
c. https://www.sci.gov.in/constitution
d. https://www.toppr.com/guides/civics/the-indian-constitution/the-constitution-of-india/

Course Code	**2.7**
Course Title	**Data Structure Lab**
Course Credits	**2**

Evaluation Scheme:

- **Internal Assessment:**

  Depending on the content given in syllabus above a project should be developed of 50 marks. Internal Assessment to be done on the basis of Project Presentations and Report Writing with proper Rubrics (Given below).

The Rubric will have the following Evaluation Parameters:	
Evaluation Parameters	**Marks**
Functionality (Core Features)	20
Code Quality (Structure, Readability)	10
GUI Design & User Experience	10

Input Handling & Error Management	5
Report writing or Documentation	5

The project Internal assessment will be done by conducting project presentation at the department level, where External Examiner appointed by the department will be evaluating the project.

Course Code	**2.8**
Course Title	**Operating System Lab**
Course Credits	**2**

Evaluation Scheme:

- **Internal Assessment:**

Depending on the content given in syllabus above a project should be developed of 50 marks. Internal Assessment to be done on the basis of Project Presentations and Report Writing with proper Rubrics (Given below).

The Rubric will have the following Evaluation Parameters:	
Evaluation Parameters	**Marks**
Project Design & Planning	10
Implementation & Functionality	15
Testing & Performance Analysis	10
Presentation & Viva Voce	10
Report writing or Documentation	5

The project Internal assessment will be done by conducting project presentation at the department level, where External Examiner appointed by the department will be evaluating the project.
Two sample projects are given below and it is expected from students to choose a good and advance project topic that aligns with their interests and abilities to work on.
Project 1: CPU Scheduling Visualizer
Project 2: Process Synchronization Simulator

Course Code	**2.9**
Course Title	**Object Oriented Programming using Java Lab**
Course Credits	**2**

Evaluation Scheme:

- **Internal Assessment:**

Depending on the content given in syllabus above a project should be developed of 50 marks. Internal Assessment to be done on the basis of Project Presentations and Report Writing with proper Rubrics (Given below).

The Rubric will have the following Evaluation Parameters:

Evaluation Parameters	Marks
Functionality (Core Features)	20
Code Quality (Structure, Readability)	10
GUI Design & User Experience	10
Input Handling & Error Management	5
Report writing or Documentation	5

The project Internal assessment will be done by conducting project presentation at the department level, where External Examiner appointed by the department will be evaluating the project.

Two sample projects are given below and it is expected from students to choose a good and advance project topic that aligns with their interests and abilities to work on.

Project 1: Student Management System (Console-Based Application) Create a console-based application that manages student records using object-oriented design, file handling, and exception handling.

Project 2: Library Book Inventory System with JDBC Build a Java application to manage a simple library inventory using MySQL and JDBC.

Course Code	**2.10**
Course Title	**Web Technologies Lab**
Course Credits	**2**

Evaluation Scheme:

- **Internal Assessment:**
  Depending on the content given in syllabus above a project should be developed of 50 marks. Internal Assessment to be done on the basis of Project Presentations and Report Writing with proper Rubrics (Given below).

The Rubric will have the following Evaluation Parameters:	
Evaluation Parameters	**Marks**
Functionality (Core Features)	20
Code Quality (Structure, Readability)	10
GUI Design & User Experience	10
Input Handling & Error Management	5
Report writing or Documentation	5

The project Internal assessment will be done by conducting project presentation at the department level, where External Examiner appointed by the department will be evaluating the project.
Two sample projects are given below and it is expected from students to choose a good and advance project topic that aligns with their interests and abilities to work on.

Project 1: Personal Portfolio Website Create a multi-page responsive personal portfolio website using HTML, CSS, and JavaScript to showcase skills, projects, contact information, and a feedback form.

Project 2: Online Student Feedback System (Frontend Only) Develop a responsive, single-page application (SPA-style) for collecting student feedback using HTML, CSS, and JavaScript. This simulates a lightweight web app interface.

Project 3: CampusConnect - College Portal System Full-Stack Web Application

APPENDIX

Indian Knowledge Systems(IKS)

IKS-I: Indian Knowledge Systems and Traditions

Course Objectives

- To sensitize the students about context in which they are embeded i.e. Indian culture and civilisation including its Knowledge System and Tradition.
- To help student to understand the knowledge, art and creative practices, skills and values in ancient Indian system.
- To help to study the enriched scientific Indian heritage.
- To introduce the contribution from Ancient Indian system & tradition to modern science & Technology

Detailed contents:

Module 1: Introduction to IKS

(Any eight of total sessions assigned for Literary activity) Introductory lecture on the **any eight** topics below:

1. Indian Knowledge System
2. Indian Culture & Civilization
3. Ancient Indian Chemistry
4. Ancient Indian Metallurgy
5. Ancient Indian Mathematics
6. Ancient Indian Astronomy
7. Indian Astronomical Instruments
8. Indian Knowledge System (Upveda: Ayurveda)
9. Indian Knowledge System (Upveda: Gandharveda)
10. Indian Knowledge System (Vedangas: Shiksha, Kalpa, Vyakrana)
11. Indian Knowledge System (Vedangas: Jyotisha, Nirukta, Chandas)
12. Indian Architecture I: Sthapatya-Veda
13. Indian Architecture II: Temples
14. Indian Architecture III: Town & Planning
15. Indian Philosophical System

Module 2: Introduction to Creative Practices

(Twenty Lectures with at least Five different topics of total session under Creative activity)

Introductory lecture on the topics below:

1. Dhatuvada: art of metallurgy
2. Akara jnana: art of mineralogy
3. Vastuvidya: art of engineering
4. Yantramatrika: art of mechanics
5. Takshana: art of carpentry
6. Chalitakayoga: art of practicing as a builder of shrines
7. Raupyaratnapariksha: art of testing silver and jewels
8. Maniraga jnana: art of tinging jewels

9. Sucivayakarma: art of needleworks and weaving
10. Vadya vidya: art of playing on musical instruments
11. Geet vidya : art of singing
12. Nritya vidya: art of dancing
13. Natya vidya: art of theatricals
14. Alekhya vidya: art of painting
15. Viseshakacchedya vidya: art of painting the face and body with color
16. Udakavadya: art of playing on music in water
17. Manasi kavyakriya: art of composing verse
18. Bhushanayojana: art of applying or setting ornaments
19. Citrasakapupabhakshyavikarakriya: art of preparing varieties of delicious food
20. Dasanavasanangaraga: art of applying preparations for cleansing the teeth, cloths and painting the body
21. Utsadana: art of healing or cleaning a person with perfumes
22. Vastragopana: art of concealment of cloths
23. Balakakridanaka: art of using children's toys
24. Tandulakusumabalivikara: art of preparing offerings from rice and flowers
25. Pushpastarana: art of making a covering of flowers for a bed

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6. Rao, N. 1970. The Four Values in Indian Philosophy and Culture. Mysore: University of Mysore.
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IKS-II: Indian Culture and Civilization

Course Objectives

- To introduce fundamentals of Ancient Indian Educations to understand the pattern and purpose of studying vedas, vedangas, upangas, upveda, purana & Itihasa
- To help students to trace, identify and develop the ancient knowledge systems.
- To help to understand the apparently rational, verifiable and universal solution from ancient Indian knowledge system for the holistic development of physical, mental and spiritual wellbeing
- To build in the learners a deep rooted pride in Indian knowledge, committed to universal human right, well-being and sustainable development.

Detailed contents:

Module 1: Introduction to IKS

Caturdaśa Vidyāsthānam, 64 Kalas**,** Shilpa Śāstra, Four Vedas, Vedāṅga, Indian Philosophical Systems, Vedic Schools of Philosophy (Sāṃkhya and Yoga, Nyaya and Vaiśeṣika, Pūrva-Mīmāṃsā and Vedānta), Non-Vedic schools of Philosophical Systems (Cārvāka, Buddhist, Jain), Puranas (Maha-puranas, Upa-Puranas and Sthala-Puranas), Itihasa (Ramayana, Mahabharata), Niti Sastras, Subhasitas

Module 2: Foundation concept for Science & Technology

Linguistics & Phonetics in Sanskrit (panini's), Computational concepts in Astadhyayi Importance of Verbs, Role of Sanskrit in Natural Language Processing, Number System and Units of Measurement, concept of zero and its importance, Large numbers & their representation, Place Value of Numerals, Decimal System, Measurements for time, distance and weight, Unique approaches to represent numbers (Bhūta Saṃkhya System, Kaṭapayādi System), Pingala and the Binary system, Knowledge Pyramid, Prameya – A Vaiśeṣikan approach to physical reality, constituents of the physical reality, Pramāṇa, Saṃśaya

Module 3: Indian Mathematics & Astronomy in IKS

Indian Mathematics, Great Mathematicians and their contributions, Arithmetic Operations, Geometry (Sulba Sutras, Aryabhatiya-bhasya), value of π, Trigonometry, Algebra, Chandah Sastra of Pingala,

Indian Astronomy, celestial coordinate system, Elements of the Indian Calendar Aryabhatiya and the Siddhantic Tradition Pancanga – The Indian Calendar System Astronomical Instruments (Yantras) Jantar Mantar or Raja Jai Singh Sawal.

Module 4: Indian Science & Technology in IKS [Duration: 8 Lectures]

Indian S & T Heritage ,sixty-four art forms and occupational skills (64 Kalas) Metals and Metalworking technology (Copper, Gold, Zinc, Mercury, Lead and Silver), Iron & Steel, Dyes and Painting Technology), Town & Planning Architecture in India, Temple Architecture, Vastu Sastra,

Module 5: Humanities & Social Sciences in IKS [Duration: 8 Lectures]

Health, Wellness & Psychology, Ayurveda Sleep and Food, Role of water in wellbeing Yoga way of life Indian approach to Psychology, the Triguṇa System Body-Mind-Intellect-Consciousness Complex. Governance, Public Administration & Management reference to ramayana, Artha Sastra, Kauṭilyan State

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IKS-III: Indian Vision for Human Society (Vishva Kalyan thru Vasudhaiva Kutumbkam)

Course Objectives

- To help the learner to understand the concept of "vasudhaiva kutumbkam" and its realization process as an base for the development of vision for a humane society.
- To help to identify the universality in humans and its coexistence in existence
- To introduce the sense of responsibility, duties and participation of individual for establishment of fearless society.
- To help to understand the apparently rational, verifiable and universal solution from ancient Indian knowledge system for the holistic development of physical, mental and spiritual wellbeing of one and all, at the level of individual, society, nation and ultimately the whole world.

Detailed contents:

Module 1: The world view & Vision of Human Society

The concept of non-duality of Prakriti (Jad) and Purush (Chetana), human as coexistence of Jad & Chetan, Pancha-mahabhutas, the root of sorrow and suffering, freedom from sorrow, salvation, eternal peace truth (vyaharika satya), ultimate truth. The acceptance of various systems of philosophy for realization of truth and complementariness in society in ancient Indian system.

Module 2: Aspiration and Purpouse of Individual and Human Society

Aims of Human life; at individual level and societal level. At societal level; Four purusarthas Dharma, Artha, Kama, Moksha. Individual level; Abhyudaya (progress), Nihsreyasa (perfection) Pravrtti , Nivrtti. Dharma; Dharma sutras (Gautama, apastamba, baudhayana, vasistha). Dharma-Shastra; (manusmriti, naradamrti, visnusmrti, yajnavalkya smriti) sociology, different stages of life like studenthood, householdership, retirement and renunciation, rites and duties, judicial matters, and personal laws (Aachara, Vyavahara, Prayaschitta). Artha; Kautliya Arthashastra, Kamandakiya Nitisara, Brihaspati Sutra, Sukra Niti, Moksha: Human liberation (Ignorance to Knowledge)

Module 3: Program for Ensuring Human Purpose: at Individual and Societal level –I

Fundamental concept of Nitishastra: Satyanishtha Aur Abhiruchi (Ethics, Integrity & aptitude). The true nature of self; Shiksha Valli, Bhrigu Valli (concept of Atman-Brahman (self, soul). The true constitution of Human: Ananda Valli (Annamaya Kosha, Pranamaya Kosha, Manomaya Kosha, Vijnanamaya Kosha, Anandamaya Kosha). The four states of consciousness (Waking state, Dreaming state, Deep Sleep State, Turiya the fourth state), Consciousness (seven limbs and nineteen mouths), Prajna, Awarness. The Life Force *Prana (*Praana-Apaana-Vyaana-Udaana- Samaana)

Module 4: Program for Ensurimg Human Purpose: at Individual and Societal level - II

Differentiating *Vidya* and *Avidya*, human bondages, Higher and Lower Knowledge (Para Vidhya & Apara Vidhya). Concept of Sattva, Rajas, Tamas and need of balancing the same, Patanjali yog sutra; Yama, Niyama, Asanas, pranayams, pratyahara, dharna, dhyana, Samadhi, Sixteen category of padartha, pramans (pratyaksh, anuman, upaman, shabda). Saadhana chatushtayam (viveka, vairagya, mumukshatavam, shadsampathi (sama, dama, uparama, titiksha, shradha, samadhana), Understanding Nitya karma, Naimittika Karma, Kamya karma, prayaschitta karma, Nishidha Karma.

Meditation and Progressive meditation (Narada's education), Ativadin to self-knowledge, Jyan yog, Karma yog, sanyas yog in aspect to harmonious practice in society

Module 5: Practices for Ensuring Human Purpose – III

Practice in philosophy, architecture, grammar, mathematics, astronomy, metrics, sociology, economy and polity, ethics, geography, logic, military science, weaponry, agriculture, mining, trade and commerce, metallurgy, shipbuilding, medicine, poetics, biology and veterinary science.

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IKS-IV: Indian Science, Engineering and Technology (Past, Present and Future)

Course Objectives

- To familiarize learners with major sequential development in Indian science, engineering and technology.
- To review & strengthen the ancient discovery and research in physics, chemistry, maths, metallurgy, astronomy, architecture, textile, transport, agriculture and Ayurveda etc.
- To help students to trace, identify and develop the ancient knowledge systems to make meaningful contribution to development of science today
- To help to understand the apparently rational, verifiable and universal solution from ancient Indian knowledge system for the scientific, technological and holistic development of physical, mental and spiritual wellbeing.

Detailed contents:

Module 1: Indian Traditional Knowledge; Science and Practices

Introduction to the Science and way of doing science and research in India, Ancient Science in Intra & Inter Culture Dialogue & coevolution.

Traditional agricultural practices, Traditional water-harvesting practices, Traditional Livestock and veterinary Sciences Traditional Houses & villages, Traditional Forecasting, Traditional Ayurveda & plant based medicine, Traditional writing Technology

Module 2: Ancient Indian Science (Physics, Chemistry, Maths)

Physics in India: Vaisheshika darshan Atomic theory & law of motion, theory of panchmahabhoota, Brihath Shathaka (divisions of the time, unit of distance), bhaskarachaya (theory of gravity, surya siddhanta & sidhanta shriomani), Lilavati (gurutvakashan Shakti).

Chemistry in India Vatsyayana, Nagarjuna,Khanda, Al-Biruni, Vagbhaṭa – building of the ras-shala (laboratory), working arrangements of ras-shala, material and equipment, Yaśodhara Bhaṭṭa-process of distillation, apparatus, saranasamskara, saranataila

Mathematics in India: Baudhayana's Sulbasutras, Aryabhaṭa, Bhaskaracharya-I, Severus Sebokht, Syria, Brahmagupta, Bhaskaracharya-II, Jyeṣṭhadeva

Module 3: Ancient Indian Science (metallurgy, Astronomy, Architecture)

Metallurgy in India: Survarṇa(gold) and its different types, prosperities, Rajata(silver), Tamra(copper), Loha(iron), Vanga(tin), Naga / sisa(lead), Pittala(brass)

Astronomy in India Vedang Jyotish, aryabhatta siddhanta, Mahabhaskriya, Laghubhaskariya, vatesvarasiddhanta, Sisyadhivrddhida, Grahashyay, Goladhyaya, Karabakutuhala **(**Aryabhaṭa, Varahamihira, Brahmagupta, Vaṭesvara, Bhaskara, Paramesvara, NilakaṇṭhaSomayaji, Jyeṣṭhadeva, ŚankaraVarman)

Architecture in India: Nagara (northern style), Vesara (mixed style), and Dravida (southern style), Indian vernacular architecture, Temple sytle, cave architecture, rock cut architecture, kalinga architecture, chandels architecture, rajput architecture, jain architecture, sikh architecture, Maratha architecture Indo-Islamic architectural, Indo-Saracenic revival architecture, Greco Buddhist style.

Module 4: Ancient Indian Science (Textile, Agriculture, Transport)

Textile Technology in India: Cotton (natural cellulose fiber), silk, wool (natural protein fibers), bast and leaf fibers, mridhudhautadhupitambaram (meaning a practice of fumigating the fabric with incence smoke before use as a part of the finishing process), sitadhautavasanayugala (bleached white–a finishing process); suchhastah, sutradharah (needle and thread – tools for stiching). dyeing, washing spinning and weaving technology,Agriculture in India: krishisuktas, Krishiparashara, Brihatsamhita, Types of crops, Manures, Types of land- devamatruka, nadimatruka, use of animals in warfare, animal husbandry, Animals for medicines. Ancient transport in India

Module 5: Ancient Indian Science (Ayurveda & Yoga)

Ayurveda for Life, Health and Well-being**:** Introduction to Ayurveda: understanding Human body and Pancha maha bhuta, the communication between body & mind, health regimen for wellbeing, introduction to yoga (raja yoga, astang yoga, gyan yoga), understanding of Indian psychological concept, consciousness, tridosha & triguna.

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IKS-V: Indian Town Planning and Architecture

Course Objectives

- To develop the knowledge and analysis on the understanding of eco-friendly, robust and scientific planning and architecture system of ancient India.
- To understand the importance of functional, aesthetic, psychological, culture and socio religious concept of ancient India architecture.
- To help the learners to trace, identify and develop the approach, process and material used in town and planning, construction and architecture
- To review and analyse the importance and significance of visual and performing arts and design in temples, houses, forts, caves and community places.
- To understand the various eco-friendly technology accepted in ancient civilization

Detailed contents:

Module 1: The Introduction to ancient Architecture

Introduction to relationship between Man, Nature, Culture and city forms. Study of determinants (Natural and man-made) influencing location, growth & pattern of human settlements including types of settlements growth (Organic and Planned) and settlement forms.

Architecture as satisfying human needs: functional, aesthetic and psychological outline of components and aspects of architectural form-site, structure, skin, materials, services, use, circulation, expression, character, experience.

Understanding of the causative forces - the cultures, history, socio religious practices and institution, political and economic conditions, issues of land, climate and technology, Historical and Primitive Architecture.

Module 2: Ancient Architecture as Expression of Art & Design

Relationship between Art and Design with man, space and environment. Expression in Art and Architecture – concept of space, sense of enclosure-openness, robustness, dynamism, spatial geometry, Eco-friendliness.

Architecture through use of elements of visual arts such as point, line, plane, form, space, colour, texture, light, solids and voids, shadow and shade etc. Understanding of effect of scale, proportions, order, material effects such as textures, patterns, light, sound, temperature etc in architectural spaces.

Allied visual and performing arts and its relationship to build environments using colour theory, symbolism, glass painting, scriptural writing, clay moulding, stone carving.

Important Indian architecture as per elements space & form **Form:** specific geometry form (sphere, cube, pyramid, cylinder and cone and its sections as well as their derivatives) **Space:** build form space, open space, Internal and External space, Continuous spaces Centralized, Linear, Radial Clustered, Grid space Different type of Materials used for construction in Ancient Indian architecture.

Clay products: Classification of bricks, Fire Brick, Fly Ash Bricks, Tiles, Terra-cotta, Earthenware, Porcelain, Stoneware. **Stones:** Uses of Stones, Qualities of Good Building Stones, Dressing, Common Building Stones of India. **Glass:** Different glass Forms and their Suitability, **Timber**: Different Forms and their Suitability **Metals:** Ferrous & Nonferrous Metals and Alloys, and, their Suitability, limitations, precautions **Paints and Varnishes:** Different types and their Suitability, limitations, precautions

Module 3: Ancient Architecture Principle & Planning

Design: Principles of designing – Composition of Plan. Inception and development of the early Hindu temple form with reference to Vedic and Buddhist planning principles and design elements; Development of regional styles and manifestations thereof; Evolution of temple complexes and temple towns;

Planning: Residence- site selection, site orientation- aspect, prospect, grouping, circulation, privacy, furniture requirements, services and other factors. Vastu shastra and its importance in building interrelationship with human, nature and cosmos

Town Planning: Town plans of Harappa, Mohenjodaro, Pataliputra, Delhi. Vastu shastra and its application in city layout.

Module 4: Ancient Architecture-I

The settlement planning pattern, elements, associated forms, typical Vedic village, towns (Dandaka, Nandyavartha etc.), typology of Shelters and civic buildings of ancient architecture in reference to following civilization: Indus

Valley, Aryan/vedic Civilisation, Buddhist Architecture, Indo Aryan & Dravidian Architecture.

Role of Shilpasasthras and Arthashasthra in settlement planning.

Important architecture: Great baths, Development of fortification, walled towns, structures developed eg: Stupas, Viharas, Chaityas, Stambhas, Toranas, sacred railing etc.

Study of worshipping places with especial reference to Indo Aryan / Nagara style & Dravidian style (Chola, Chalukya, Pallava, Satavahana, Hoysala, Vijayanagara etc.), design of shikharas & gopuram, rock-cut and structural examples of temples.

Module 5: Ancient Architecture-II

Evolution of Hindu Temples in different period: Gupta, Aihole, Badami, Pattadakkal, Mahabalipuram, Indo Aryan Style in Orrisa, Khajuraho, Gujarah, Rajasthan. Dravidian Style in Chola, Chalukyan, Pandya, Pallava, Hoysala Style, Revival of Hindu architecture of South India at Vijaynagara and Madurai

Tradition Indian villages & House: Regional house construction, interior & importance e.g. Rajasthani house, bhungas of kutch, nalukettu of kerala, Ikra of assam, manduva logili or illu of Andra Pradesh, wadas of Maharashtra, Mud houses of Madhya Pradesh, kathkuni of himachal Pradesh, khanjaghara of orisa, Taq and dhajji diwari of Kashmir etc.

Scientific achievements though ancient architect: Jantar Mantar, Musical Pillars of Vitthal temple, Sundial of konark temple, construction of eight shiva temple in straight line from Kedarnath to rameshwaram at longitude 79ºE 41’54, Veerbhadra temple with 70 hanging pillars, Ellora caves excavating the mountain, Jaipur plan pink city etc.

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5. Binode Behari Dutt, Town planning in ancient India, Life Span Publishers & Distributors
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10. B Dagens, Mayamata: An Indian Treatise on Housing Architecture and Iconography (An Updated Edition with revised Glossary), Motilal banrsidas, 2017
11. V K Bansal, Maha Vastu, Om Book Internation 2011
12. SS Das, The Miracles of Vaastu Shastra, pustak mahal, delhi, 2013,
13. Anant Shashikala, The Penguine Guide to Vaastu, the classical Indian science of architecture & design, penguin India, 2000

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IKS-VI: Indian Mathematics and Astronomy

Course Objectives

- To provide information about great mathematicians and astronomers who given significant contribution in Indian mathematics and astronomy.
- To help students to trace, identify, practice and develop the significant Indian mathematic and astronomical knowledge.
- To help to understand the astronomic significance with the human holistic development of physical, mental and spiritual wellbeing
- Enumerate the main characteristics of education system in Vedic and post Vedic period to enrich the intellectual imagination and diminish the dogmatic assurance which closes the mind against speculation

Detailed contents:

Module 1: The Introduction to Ancient Mathematics & Astronomy

Introduction to Brief introduction of inception of Mathematics & Astronomy from vedic periods. Details of different authors who has given mathematical & astronomical sutra (e.g. arytabhatta, bhaskara, brahmagupta, varamahira, budhyana, yajanvlkya, panini, pingala, bharat muni, sripati, mahaviracharya, madhava, Nilakantha somyaji, jyeshthadeva, bhaskara-II, shridhara)

Periodical enlisting of Mathematical & Astrological achievement in India. Evolution of Indian Numerals (Brahmi (1^{st} century), Gupta (4^{th} century) & Devanagri Script (11^{th} century)

Module 2: Ancient Mathematics –I

Veda & Sulvasutras (Pythagoras theorem, Square root & Squaring Circle) (baudhayana sulbhasutra, apastamba sulbhasutra, katyayana sulbhasutra, manava sulbhasutra, maitrayana sulbhasutra, varaha sulbhasutra, vadhula sulbhasutra , Pingala's chandasutras, sunya, yaat-tavat, Aryabhata (Aryabhatiya, Asanna, ardha-jya, kuttaka,), bhaskara (trigonometory,shridhara,

mahavira), Bhaskara Acharya (Sidhantashiromani), Varamahira panchasiddhantika.

Module 3: Ancient Mathematics –II

Brahamgupta (vargaprakrati, bhramasphuta siddhanta, bhavana), ayatavrtta, ganitasarasamgraha, lilavathi, ganesadaivajna, randavantika, suryasidhhanta, grahalaghava, sadratnamala, mandavrtta, sighrartta, Bijaganita, Bakshali manuscript

Golavada, Madhyamanayanaprakara, Mahajyanayanaprakara (Method of Computing Great Sines), Lagnaprakarana, Venvaroha, Sphutacandrapti, Aganita-grahacara , Chandravakyani (Table of Moon-mnemonics)

Module 4: Ancient Astronomy –I

Parahita system of astronomy and drk system of astronomy, Manda samskara, sighra samskara.

Vedanga Jyotisha (astronomical calculations, calendrical studies, and establishes rules for empirical observation), Aryabhatiya (earth rotation, shining of moon), Brahmasphutasiddhanta (motion of planets), varahmihira (pancasiddhantika), Mahabhaskariya, lahubhaskariya & arybhatiya bhashya (Planetary longitudes, heliacal rising and setting of the planets, conjunctions among the planets and stars, solar and lunar eclipses, and the phases of the Moon), Sisyadhiveddhida (grahadhyaya, goladhyaya), siddhantasiromani, karanakutuhala (planetary positions, conjunctions, eclipses, cosmography), siddhantasekhara, yantra-kirnavali, Sphuṭanirṇaya, Uparagakriyakrama.

Module 5: Ancient Astronomy –II

Positional astronomy (sun, planets, moon, coordinate systems, precision of the equinox and its effects, eclipses, comets and meteors), Mahayuga & Kalpa system Yuga system, ayanas, months, tithis and seasons, time units, sun and moon's motion, planet position, ayanachalana, zero-precision year, katapayaadi system, Indian nakshatra system, astronomy

Instruments for naked eye astronomy (vedic observatories). The principal and application of Samrat Yantra, Jai Prakash Yantra, Disha Yantra, Rama Yantra, Chakra Yantra, Rashiwalya Yantra, Dingash Yantra, Utaansh Yantra

Reference:

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16. R Mercier, Studies on the Transmission of Medieval Mathematical Astronomy (Variorum Collected Studies), routledge publication, 2004

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IKS-VII: Indian Aesthetics (including Music and Music Instruments)

Course Objectives

- To provide information about the foundations of Indian aesthetics as integral part of Indian culture
- To help to understand the importance of Indian aesthetics in individual realization of the truth arises by realizing the harmony within.
- To help learner to trace, identify and develop the Indian aesthetics to correlate human creative practices
- To build the learners a deep rooted pride in Indian aesthetic knowledge, committed to universal human right, well-being and sustainable development.

Detailed contents:

Module 1: The Introduction to Indian Aesthetics

The nature of aesthetics, principle, its relation to philosophy and literature:

Indian traditions. Sadanga its origin and Applications of Six limbs in Indian Aesthetics Introduction to Alamkara, Rasa, Dhvani, Vakrokti, Auchitya

Module 2: Ancient Music and Music Instruments-I

Rasa Siddhanta, the concept of Rasa, constituent of rasa (Bhav, abhinay, Sthayibhava, Vibhava, Vyabhicharibhava), number of rasa, Rasasvadana Bharata's Natya Shastra and its Critics, Abhinavagupta's Rasa Siddhanta., Kāvyaprayojana, Sādhāranikarana, Sahrdaya, Rasavighna.

DhvaniSiddhanta, the Concept of Dhvani, Sphota, Pratibhā, classification of dhvani (Laukika Vyangya, Alaukika Vyangya, Avivaksita Vacya, Vivaksitanyapara Vacya) Anandavardana's Dhanyaloka, with reference to Abhidha, lakshana, Vyanjana and Tatpary, extension of dhvani siddhanta to music, dance and drama.

Alamkara Siddhanta, proponent, classification of alamkara, sabdalamkara (Anuprāsa, Yamaka, Ślesha, Dhvanyātmakatā), Arthālamkāra (Upamā, Drstanta, Virodha)

Module 3: Ancient Music and Music Instruments-II

VakroktiSiddhanta, Kuntaka's Vakroktijivita, Classification of Vakrokti (Varna-vinyasa vakrata (Phonetic Obliquity), Pada-purvardha vakrata (Lexical Obliquity) & Pada-parardha vakrata (Grammatical Obliquity), Vakya-vakrata (Sentential obliquity), Prakarana-vakrata (Episodic obliquity), Prabandha-vakrata (Compositional obliquity))
Different Classes of Musical Instrument as per Natyashastra of Bharat, Gana Vadya, Avanaddha Vadya, sushira vadya, tata/tantu vadya.
Brief introduction to following indian instruments
Veena, Ghatam, Gootuvadhyam, Flute, Thavil, Nadaswaram, Mridangam, Plain-drum, Harmonium, Sitar, Sarod, Shehnai, Tabla, Maddalam, violin, morsing, Tambura.

Module 4: Ancient Dance & Drama

Natyaveda: inception from Veda (pathya words(rigveda), abhinaya gestures (Yajureda), geet music (samaveda), rasa emotions (atharvaveda), Natya Shastra, Nata-nritya, geet- nritya, roop-nritya, bhav-nritya

Indian traditional and fork dances (bharatnatyam, kuchipudi, kathakali, yakshagan, Bhangra, Bihu, Ghumura Dance, Sambalpuri, Chhau and Garba

Module 5: Ancient Art

Architecture, sculptures & popular art forms of Pallava& Cholas period, Chalukya & Rastrakuta period, Chandela/Hosalya period, Rajput period. Rock

cut architecture, cave architecture, stupa, temples, sculpture

Hindu Shilpa texts as per Vishnudharmotara-puran, Samaranana, Sutracharana, Sukranitisara, Silparatham

Reference:

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IKS-VIII: Indian Health, Wellness and Psychology (including Ayurved)

Course Objectives

- Understanding the fundamental principles of Indian health systems such as Ayurveda and yoga which are useful in maintaining the health of a healthy person
- Practical implementation of health principles to correct the intake of our food, air, water and sunlight to achieve perfect health.
- Understanding traditional way of cleansing the body regularly, strengthening body with Yogic exercises, maintaining the internal balance to prevent diseases.
- Understanding our unique Mind Body Constitution and choosing the right lifestyle suitable to maintain the internal balance.
- Understanding the influence of external environment on internal health and ways to synchronise our body and mind with nature to ensure smooth functioning of all organ systems of our body.
- Understanding mind and its dynamics through knowledge of Ayurveda and Yoga and using the knowledge to maintain harmony between body and mind to achieve perfect mental health.

Detailed contents:

Module 1: Understanding human body [Duration: 8 Lectures]

Introduction to Ayurveda, the Knowledge of Life, Health and treatment aspects in Ayurveda, Influence of Pancha maha bhuta on Internal environment of Human being, Understanding composition of Human body through the concept of Dosha Dhatu Mala, Understanding Prakruthi , the Mind – Body Constitution.

Module 2: Understanding the communication between body & Mind

Establishing communication between body and mind by understanding the language of body. Understanding the concept of Agni, Koshta, Sara and Ojas and their relevance in enhanching our immunity to protect from various infections. Looking at the world through the lenses of Dravya, Guna and Karma Applying the principle of Samanya and Visesha in every aspect of life to achieve perfect health.

Module 3: Introduction to Health Regimen

Understanding Swastha vritta, the healthy regimen to maintain state of wellbeing Dinacharya, the Daily regimen including Daily detoxification, exercise, Intake of Food, Water, Air and Sunlight, work and ergonomics, Rest and sleep hygiene. Ritu charya, the seasonal regimen, Sadvritta and the concept of social wellbeing, understanding trividha upastambhas, three pillars to health, Concept of Shadrasa in choosing appropriate nourishment to the body and mind.

Module 4: Introduction to Yoga

Definition, Meaning and objectives of Yoga, Relevance of yoga in modern age. Brief Introduction of Hatha yoga, Raja yoga, Karma yoga, Gyana Yoga, Bhakti yoga Understanding eight steps of Ashtanga yoga, Understanding Shatkriyas , the six cleansing procedures of Yoga

Module 5: Introduction to Indian Psychology

Concept of Manas in Ayurveda and understanding Mind Body harmony, Triguna based Psychology in Ayurveda and Yoga, Influence of Tri dosha on Mind, Mind body intellect and consciousness complex, Understanding Consciousness and solution to issues within Human Mind.

Reference:

1. The Charaka Samhita
2. The Susruta Samhita
3. Teh Ashtanga Hridaya
4. Dr Deepak Chopra, Perfect Health--Revised and Updated: The Complete Mind Body Guide, Harmony publication, 2001
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8. The Gheranda samhita
9. BKS Iyengar, Light on Yoga: The Classic Guide to Yoga by the World's Foremost Authority, thronson publication, 2006
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