Vidya Pratishthan's
Kamalnayan Bajaj Institute of Engineering and Technology
(Autonomous Institute)

Faculty of Science and Technology

Board of Studies

Information Technology

Syllabus

Second Year B.Tech. Information Technology

(2025 Pattern)

(w.e.f. AY: 2026-27)

Institute Vision and Mission

Vision

To achieve Academic Excellence through Persistent and Synergic Collaborations amongst all Stakeholders.

Mission

- To ensure holistic development of students as lifelong learners and problem solvers through value-based quality education.
- To motivate faculty to attain the state-of-the-art knowledge and wisdom in their domain and be a facilitator towards co-creation of knowledge.
- To frame and deploy conducive and empowering policies for multifaceted growth of students, faculty and staff to make them contributors towards excellence.
- To partner with industry for mutually beneficial relations to generate employable and deployable workforce.
- To fulfill the aspirations of alumni, parents, society, region and nation at large by generating technically competent and contributing manpower.

Department Vision and Mission

Vision

To develop globally competent IT professionals through continuous learning.

Mission

- To provide graduates with the programming skills and domain knowledge.
- To collaborate with local, state, national, and international entities in education.
- To develop technically competent professionals with social values and ethics.
- To encourage faculty to acquire state-of-the art knowledge.

Program Educational Objectives	
PEO1	Graduates of the program will possess strong fundamental concepts in mathematics, science, engineering and Technology to address technological challenges.
PEO2	Possess knowledge and skills in the field of Computer Science & Engineering and Information Technology for analyzing, designing and implementing complex engineering problems of any domain with innovative approaches.
PEO3	Possess an attitude and aptitude for research, entrepreneurship and higher studies in the field of Computer Science & Engineering and Information Technology.
PEO4	Have commitment to ethical practices, societal contributions through communities and lifelong learning.
PEO5	Possess better communication, presentation, time management and team work skills leading to responsible & competent professionals and will be able to address challenges in the field of IT at global level.

Program Outcomes		
PO1	Engineering knowledge	Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.
PO2	Problem analysis	Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)
PO3	Design / Development of Solutions	Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)
PO4	Conduct Investigation of Complex Problems	Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).
PO5	Engineering Tool Usage	Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)
PO6	The Engineer and The World	Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).
PO7	Ethics	Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)
PO8	Individual and Collaborative Team work	Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
PO9	Communication	Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences
PO10	Project Management and Finance	Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.
PO11	Life-Long Learning	Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change.(WK8)

Program Specific Outcomes(PSO)	
PSO1	Students will be able to apply engineering principles and practices for the development and maintenance of software system.
PSO2	Students will be able to undertake a team project by following professional ethical practices.
PSO3	Students will be able to make successful career in IT industry meeting the requirement of industries.

SEMESTER-III																
Course Type	Course Code	Course Name	Teaching Scheme			Examination Scheme and Marks							Credits			
			TH	PR	TUT	CAA	ISE	ESE	TW	PR	OR	Total	TH	PR	TUT	Total
PCC	IT25201 TH	Object Oriented Programming	3	-	-	10	30	60	-	-	-	100	3	-	-	4
	IT25201PR	Object Oriented Programming	-	2	-	-	-	-	-	30	-	30	-	1	-	
PCC	IT25202 TH	Logic Design and Computer Organization	3	-	-	10	30	60	-	-	-	100	3	-	-	4
	IT25202PR	Logic Design and Com puter Organization	-	2	-	-	-	-	-	-	30	30	-	1	-	
PCC	IT25203 TH	Discrete Mathematics	3	-	-	10	30	60	-	-	-	100	3	-	-	3
MDM	MD25XXX TH	Multi-disciplinary minor	3	-	-	10	30	60	-	-	-	100	3	-	-	4
	MD25XXX PR	Multi-disciplinary minor	-	2	-	-	-	-	30	-	-	30	-	1	-	
VEC	HS25211 TH	Environmental Studies	2	-	-	10	-	60	-	-	-	70	2	-	-	2
AEC	HS25201 TH	Public Speaking and Aptitude	1	-	-	40	-	-		-	-	40	1	-	-	2
	HS25201 PR	Public Speaking and Aptitude	-	2	-	-	-	-	-	-	30	30	-	1	-	
VSEC	IT25204PR	Python for Data Science	-	2	-	-	-	-		30	-	30	-	1		2
	IT25204 TUT	Python for Data Science	-	-	1	-	-	-	40	-	-	40	-	-	1	
Total			15	10	1	90	120	300	70	60	60	700	15	5	1	21

SEMESTER-IV

Course Type	Course Code	Course Name	Teaching Scheme			Examination Scheme and Marks							Credits			
			TH	PR	TUT	CAA	ISE	ESE	TW	PR	OR	Total	TH	PR	TUT	Total
BSC	BS25203 TH	Advanced Mathematics for IT Engineering	3	-	-	10	30	60	-	-	-	100	3	-	-	3
PCC	IT25211 TH	Design and Analysis of Algorithm	3	-	-	10	30	60	-	-	-	100	3	-	-	3
PCC	IT25212 TH	Data Structures	3	-	-	10	30	60	-	-	-	100	3	-	-	4
	IT25212 PR	Data Structures	-	2	-	-	-	-	-	30		30	-	1	-	
PCC	IT25213 TH	Database Management System	3	-	-	10	30	60	-	-	-	100	3	-	-	4
	IT25213 PR	Database Management System	-	2	-	-	-	-	-	30	-	30	-	1	-	
MDM	MD250 XX TH	Multi-disciplinary minor	2	-	-	10	-	60	-	-	-	70	2	-	-	3
	MD250X X PR	Multi-disciplinary minor	-	2	-	-	-	-	30	-	-	30	-	1	-	
OE	OE25XX X	Open Elective	2	-	-	10	-	60	-	-	-	70	2	-	-	2
CEPFP	IT25214P R	Community Engagement Project	-	4	-	-	-	-	40	-	30	70	-	2	-	2
Total			16	10	0	60	120	360	70	60	30	700	16	5	0	21

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Vidya Pratishthan's
Kamalnayan Bajaj Institute of Engineering and Technology
Board of Studies: Information Technology
Syllabus: Second Year B. Tech. Information Technology
2025 Pattern w.e.f. AY:2026-2027

SEMESTER-III																
Course Type	Course Code	Course Name	Teaching Scheme			Examination Scheme and Marks							Credits			
			TH	PR	TUT	CAA	ISE	ESE	TW	PR	OR	Total	TH	PR	TUT	Total
PCC	IT25201 TH	Object Oriented Programming	3	-	-	10	30	60	-	-	-	100	3	-	-	4
	IT25201PR	Object Oriented Programming	-	2	-	-	-	-	-	30	-	30	-	1	-	
PCC	IT25202 TH	Logic Design and Computer Organization	3	-	-	10	30	60	-	-	-	100	3	-	-	4
	IT25202PR	Logic Design and Computer Organization	-	2	-	-	-	-	-	-	30	30	-	1	-	
PCC	IT25203 TH	Discrete Mathematics	3	-	-	10	30	60	-	-	-	100	3	-	-	3
MDM	MD25XXX TH	Multi-disciplinary minor	3	-	-	10	30	60	-	-	-	100	3	-	-	4
	MD25XXX PR	Multi-disciplinary minor	-	2	-	-	-	-	30	-	-	30	-	1	-	
VEC	HS25211 TH	Environmental Studies	2	-	-	10	-	60	-	-	-	70	2	-	-	2
AEC	HS25201 TH	Public Speaking and Aptitude	1	-	-	40	-	-		-	-	40	1	-	-	2
	HS25201 PR	Public Speaking and Aptitude	-	2	-	-	-	-	-	-	30	30	-	1	-	
VSEC	IT25204PR	Python for Data Science	-	2	-	-	-	-		30	-	30	-	1		2
	IT25204 TUT	Python for Data Science	-	-	1	-	-	-	40	-	-	40	-	-	1	
Total			15	10	1	90	120	300	70	60	60	700	15	5	1	21

Sr. No	MDM Code	MDM Course
1	ET25053	Internet of Things

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SEMESTER-IV

Course Type	Course Code	Course Name	Teaching Scheme			Examination Scheme and Marks							Credits			
			TH	PR	TUT	CAA	ISE	ESE	TW	PR	OR	Total	TH	PR	TUT	Total
BSC	BS25203 TH	Advanced Mathematics for IT Engineering	3	-	-	10	30	60	-	-	-	100	3	-	-	3
PCC	IT25211 TH	Design and Analysis of Algorithm	3	-	-	10	30	60	-	-	-	100	3	-	-	3
PCC	IT25212 TH	Data Structures	3	-	-	10	30	60	-	-	-	100	3	-	-	4
	IT25212 PR	Data Structures	-	2	-	-	-	-	-	30		30	-	1	-	
PCC	IT25213 TH	Database Management System	3	-	-	10	30	60	-	-	-	100	3	-	-	4
	IT25213 PR	Database Management System	-	2	-	-	-	-	-	30	-	30	-	1	-	
MDM	MD250 XX TH	Multi-disciplinary minor	2	-	-	10	-	60	-	-	-	70	2	-	-	3
	MD250X X PR	Multi-disciplinary minor	-	2	-	-	-	-	30	-	-	30	-	1	-	
OE	OE25XX X	Open Elective	2	-	-	10	-	60	-	-	-	70	2	-	-	2
CEPFP	IT25214P R	Community Engagement Project	-	4	-	-	-	-	40	-	30	70	-	2	-	2
Total			**16**	**10**	**0**	**60**	**120**	**360**	**70**	**60**	**30**	**700**	**16**	**5**	**0**	**21**

Sr. No	MDM Code	MDM Course
1	ME25052	Introduction to Robotics and Automation

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Multidisciplinary Minor Courses			
Course Code	**3 Credit Course Name**	**Course Code**	**4 Credit Course Name**
ET25051	Introduction to Embedded system	ET25052	Drone technology
EL25051	Photovoltaic Technology & Solar Power System	AI25051	Introduction to AIML
IT25054	Data Structure	CO25053	Object Oriented Programming
CE25052	Green Building & Smart Cities	GS25052	Linear Algebra and Statistics
ME25051	Introduction to 3D Printing	AI250201	AIML
ME25052	Introduction to Robotics and Automation	ET25054	Microcontroller Architecture
		ME25053	3D Printing
		ME25054	Robotics and Automation
		ET25053	Internet of Things

Open Elective Courses			
Course Code	**2 Credit Course Name**	**Course Code**	**3 Credit Course Name**
OE25004	Industrial Management	OE25015	Design Thinking
OE25002	Professional Leadership	OE25016	Accounting and Finance
OE25003	Organizational Behaviour	OE25017	Sustainability & Climate Change
OE25009	Cyber Laws	OE25018	Agriculture Technology
OE25008	Intellectual Property Rights	OE25019	Architectural Technology
OE25005	Disaster Management		
OE25001	Digital Marketing		

SEMESTER-III

Object Oriented Programming								
Course Code : IT25201			**Course Credits: 04**			**Course type: PCC**		
Teaching Scheme			**Evaluation Scheme**					
TH	**PR**	**TUT**	**CAA**	**ISE**	**ESE**	**TW**	**PR**	**OR**
3	**2**	**-**	**10**	**30**	**60**	**-**	**30**	**-**

Prerequisite Course Mapping:
1. C++ programming

Future Course Mapping:
1. Advanced Java Programming

Course Objective:
1. To understand and apply concepts of object-oriented paradigm.
2. To design and implement models for real life problems by using object-oriented programming.
3. To develop object-oriented programming skills.

Course Outcomes: On completion of the course, learner will be able to
1. **Understand** the Object-Oriented Programming concepts.
2. **Identify** classes, objects, methods, and handle object creation.
3. **Understand** the initialization of objects, and destruction to model real-world problems.
4. **Develop** the Inheritance to achieve the reusability and polymorphism.
5. **Design** a solution using generic function and generic class.
6. **Apply** the concept of files for persistent data storage in real world application.

Syllabus

UNIT No.	Syllabus	Hrs
I	**Introduction to Object Oriented Programming** Limitations of Procedural Programming, Introduction to OOP, Need of Object-Oriented Programming, Fundamentals of Object-Oriented Programming: Objects, Classes, Data Members, Methods, Messages, Data Encapsulation, Data Abstraction and Information Hiding, Inheritance, Polymorphism, Static and Dynamic Binding, Message Passing.	7
II	**Objects and Methods** Visibility/Access Modifiers, Encapsulation, Methods: Adding a Method to Class, Returning a value, Adding a method that takes parameters, Method Overloading, Array of Objects, Memory Allocation: 'new', Memory Recovery: 'delete', Static data members, Static methods, Forward declaration, Class as Abstract Data Types (ADTs), Classes as Objects.	7
III	**Constructors and Destructors** Constructors: Introduction, Use of Constructor, Characteristics of Constructors, Types of Constructor, Constructor Overloading, Dynamic initialization of an object, Constructor with default arguments, Symbolic constants, Destructors and finalize.	7
IV	**Inheritance and Polymorphism** Inheritance**:** Introduction, Need of Inheritance, Types of Inheritance, Benefits of Inheritance , Constructors in derived classes, Method overriding, Abstract classes and Interfaces. Polymorphism and Software Reuse: Introduction, Types of Polymorphism (Compile Time and Run Time Polymorphism), Mechanisms for Software Reuse, Efficiency and Polymorphism	6

V	**Generic Programming and Threading** Generics**:** Generic Programming using generic function and class, Introduction to Language Specific Collection Interface: List Interface and Set Interface, Collection Classes: ArrayList Class and LinkedList Class, Concurrent Programming, Basic Concepts of Concurrent Programming, Threads.	6
VI	**File handling** File Handling: Introduction, Concepts of Stream, Stream Classes, Byte Stream Classes, Character Stream, Classes, Using Stream, and Other Useful I/O Classes, Using the File Class, Input/output Exceptions, Creation of Files, Reading/Writing Character, Reading/Writing Bytes, Handling Primitive Data Types, Concatenating and Buffering Files, Random Access Files.	6
Total Teaching Hours		**39**

List of Practical Assignments:

1. Write a MyDate class which has attributes as day, month, and year. Create five objects of MyDate and display them.
2. Design a class 'Complex 'with data members for real and imaginary part. Provide default and Parameterized constructors. Write a program to perform arithmetic operations of two complex numbers.
3. Design and develop inheritance for a given case study, identify objects and relationships and implement inheritance wherever applicable. Employee class hasEmp_name, Emp_id, Address, Mail_id, and Mobile_noas members. Inherit the classes: Programmer, Team Lead, Assistant Project Manager and Project Manager from employee class. Add Basic Pay (BP) as the member of all the inherited classes with 97% of BP as DA, 10 % of BP as HRA, 12% of BP as PF, 0.1% of BP for staff club fund. Generate pay slips for the employees with their gross and net salary.
4. Identify commonalities and differences between Publication, Book and Magazine classes. Title, Price, Copies are common instance variables and saleCopy is common method. The differences are, Bookclass has author and orderCopies(). Magazine Class has methods orderQty, Current issue, receiveissue().Write a program to find how many copies of the given books are ordered and display total sale of publication.
5. Implement a generic program using any collection class to count the number of elements in a collection that have a specific property such as even numbers, odd number, prime number and palindromes.
6. Design a base class shape with two double type values and member functions to input the data and compute_area() for calculating area of shape. Derive two classes: triangle and rectangle. Make compute_area() as abstract function and redefine this function in the derived class to suit their requirements. Write a program that accepts dimensions of triangle/rectangle and display calculated area. Implement dynamic binding for given case study.
7. Create a banking system where multiple users (threads) try to withdraw and deposit money in the same account. Ensure that the balance remains correct using synchronization.
8. Implement a program for maintaining a database of student records using Files. Student has Student_id,name, Roll_no, Class, marks and address. Display the data for few students.
    1. Create Database
    2. Display Database
    3. Delete Records
    4. Update Record
    5. Search Record

Text Books:

1. An Introduction to Object Oriented Programming (3rd Ed), by Timothy A. Budd, published by Addison-Wesley,2002
2. Java The complete reference, 9th edition, Herbert Schildt, McGraw Hill Education (India) Pvt. Ltd.

Reference Books:

1. Object-Oriented Programming and Java by Danny Poo (Author), Derek Kiong (Author), Swarnalatha Ashok (Author)Springer; 2nd ed. 2008 edition (12 October 2007), ISBN-10: 1846289629, ISBN-13: 978-1846289620,2007 .
2. Cay S Horstmann and Gary Cornell, Core Java Vol-1 and Vol-2, 9th Edition, Pearson Education India, ISBN-10: 9332518904 and 9332518890.
3. Eckel B., "Thinking in Java", 3rd Edition, Pearson Education, 2012.

Online Resources:

https://onlinecourses.nptel.ac.in/noc25_cs57/preview

Course Code	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
IT25201	CO1	1	1	-	-	2	-	-	-	1	-	-
	CO2	2	2	1	-	2	-	-	-	1	-	-
	CO3	2	2	2	-	2	-	-	-	2	-	-
	CO4	2	2	2	-	3	-	-	-	2	-	-
	CO5	3	3	3	-	2	-	-	-	2	-	-
	CO6	3	2	2	-	3	-	-	-	2	-	-

Logic Design and Computer Organization

Course Code: IT25213	Course Credits: 04	Course type: PCC

Teaching Scheme			Evaluation Scheme					
TH	**PR**	**TUT**	**CAA**	**ISE**	**ESE**	**TW**	**PR**	**OR**
3	**2**	**-**	**10**	**30**	**60**	**-**	**-**	**30**

Prerequisite Course Mapping:
1.Basics of Electronics Engineering

Future Course Mapping:
1. Microprocessor and Microcontroller

Course Objective:
1. To make undergraduates aware of different levels of abstraction of computer systems from a hardware perspective.
2. To design and analyze combinational and sequential logic circuits
3. To make undergraduates understand the functions, characteristics of various components of Computer, in particular processor & memory

Course Outcomes: On completion of the course, learner will be able to
1. Understand basic binary arithmetic & simplify logic expressions.
2. Apply the operations of logic ICs and implement combinational logic functions using ICs
3. Comprehend the operations of basic memory cell types and implement sequential logic functions using ICs.
4. Elucidate the functions & organization of various blocks of CPU.
5. Understand CPU instruction characteristics, enhancement features of CPU.
6. Describe an assortment of memory types (with their characteristics) used in computer systems and basic principle of interfacing input, output devices.

Syllabus

UNIT NO.	Syllabus	Hrs
I	**Introduction to Digital Electronics:** Classification of logic families, Characteristics of digital ICs, Operation of TTL NAND gate, CMOS logic – CMOS NAND, Comparison of TTL & CMOS, Sign Magnitude, 1's complement & 2's complement representation, unsigned binary addition, subtraction using 2's complement. Codes: Binary, BCD, Octal, Hexadecimal, Excess-3, Gray code, Logic minimization: Standard representations for logic functions, k-map representation of logic functions (SOP and POS forms), Simplification of logical functions using K-Maps up to 4 variables.	6
II	**Combinational Logic Design** Design Combinational Logic: Code converters, Half- Adder, Full Adder, Half Subtractor, Full Subtractor, n-bit Binary adder, Multiplexer, Demultiplexer, Decoder, BCD adder, combinational logic designs using MUX and Demux/Decoder.	6
III	**Sequential Logic Design** 1-bit Memory element, Latch, Flip-Flops, Excitation table of Flip-Flops, Conversion of Flip-Flops, Counters: asynchronous, synchronous and modulus N counters, Applications of flip-flops: Registers and counters.	6

IV	**Computer Organization & Processor** Computer organization & computer architecture(typical organization ,Functions , Types), Memory, I/O & system bus, Von Neumann & Harvard architecture, Instruction cycle Processor: Single bus organization of CPU, ALU, Register: address registers, data registers, flags, PC, MAR, MBR, IR & control unit, micro Operations and control signals**.**	7
V	**Processor Instructions & Processor Enhancements** Instruction : Elements of machine instruction, instruction representation, Instruction Format & 0-1-2-3 address formats, Types of operands Addressing modes, Instruction types based on operations, key characteristics of RISC & CISC, Interrupt: its purpose, types, classes & interrupt handling (ISR, multiple interrupts), instruction pipelining, Multiprocessor systems: Processor Architectures, types of MIMD & multicore processor, typical features of multicore:- Intel core i7.	7
VI	**Memory & Input / Output Systems** Memory Systems: Characteristics of memory systems, Memory hierarchy, signals to connect memory to processor, memory read & write cycle, characteristics of semiconductor memory: SRAM, DRAM & ROM, Cache memory, Input / Output Systems: I/O Module, Programmed I/O, Interrupt Driven I/O, Direct Memory Access (DMA).	7
Total Teaching Hours		**39**

List of Practical Assignments:

1. Design and implement 4-bit BCD to Excess-3 code convertor.
2. Design and implement 1 digit BCD adder using IC7483.
3. Design and implement following using multiplexer IC 74153
   1) Full adder 2) Any three variable functions (cascade method).
4. Design and implement Full Subtractor using decoder IC 74138.
5. Design and implement 3 bit Up-Down Asynchronous Counter using IC 7476.
6. Design and implement 3 bit Up-Down Synchronous Counter using IC 7476.
7. Design and implement Modulo 'N' counter using IC7490.
8. Design & simulate ALU with four functions (AND, OR, XOR, ADD).

Text Books:

1. "Modern Digital Electronics", R.P. Jain, Tata McGraw-Hill, Third Edition.
2. "Computer organization and architecture, designing for performance" by William Stallings, Prentice Hall, Eighth edition

Reference Books:

1. "Digital Design", M Morris Mano, Prentice Hall, Third Edition.
2. "Computer organization" ,Hamacher and Zaky, Fifth Edition.
3. "Computer Organization and Design: The Hardware Software Interface" D. Patterson, J. Hennessy, Fourth Edition, Morgan Kaufmann.
4. "Microprocessors and interfacing-programming and hardware" Douglas V. Hall and SSSP Rao, McGraw-Hill ,Third Edition

Online Resources:

NPTEL Course:

1. https://archive.nptel.ac.in/courses/106/105/106105185/#
2. https://archive.nptel.ac.in/courses/106/105/106105163/

Virtual Lab:

simulator Link http://vlabs.iitkgp.ac.in/coa/

Course Code	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
LDCO IT25213	CO1	3	2	2		2	1					
	CO2	3	2	1		1	1					
	CO3	2	2	1		2	1					
	CO4	2				1		1				
	CO5	2				1		1				
	CO6	2				1		1				

Discrete Mathematics								
Course Code : IT25203			**Course Credits: 03**			**Course Type: PCC**		
Teaching Scheme			**Evaluation Scheme**					
TH	**PR**	**TUT**	**ACTIVITY**	**ISE**	**ESE**	**TW**	**PR**	**OR**
3	**–**	**–**	**10**	**30**	**60**	**–**	**–**	**–**

Prerequisite Course Mapping:
1. Basic Mathematics

Future Course Mapping:
1. Design and Analysis of Algorithms

Importance of Course: Concepts and notations from discrete mathematics are useful in studying and describing objects and problems in branches of computer science, such as computer algorithms, programming languages, cryptography, automated theorem proving, and software development.

Course Objectives:
1. To gain sound knowledge to formulate and solve problems with sets and propositions.
2. To understand and solve counting problems by applying elementary counting techniques to solve problems of discrete probability.
3. To understand Graph and Tree terminologies and models to be applied in real life problems.
4. To recognize types of relation, formulate and solve problems with relations and functions.
5. To understand basics of number theory and its applications.
6. To understand the various types' algebraic structures and its applications

Course Outcomes:
1: **Formulate** and apply formal proof techniques and solve the problems with logical reasoning.
2: **Analyze and evaluate** the combinatorial problems by using probability theory.
3: **Apply** the concepts of graph theory to devise mathematical models.
4: **Analyze** types of relations and functions to provide solution to computational problems.
5: **Identify** techniques of number theory and its application.
6: **Identify** fundamental algebraic structures.

UNIT No.	Syllabus	Teaching Hours
I	**Sets**: Sets, Combinations of Sets, Venn Diagram, Finite and Infinite Sets, Countable Sets, Multisets, Cartesian Product, Principle of Inclusion and Exclusion, Mathematical Induction. **Propositions**: Propositions, Logical Connectives, Conditional and Bi-conditional. Propositions, Logical Equivalence, Validity of Arguments by using Truth Tables, Predicates and Quantifiers, Applications of propositional logic	7
II	**Combinatorics:** Rules of Sum and Product, Permutations, Combinations. **Discrete Probability**: Discrete Probability, Conditional Probability, Bayes Theorem, Applications of Combinatorics and Discrete Probability.	7
III	**Relations:** Properties of Binary Relations, Closure of Relations, Warshall's Algorithm, Equivalence Relations, Partitions, Partial Ordering Relations, Lattices. **Functions:** Functions, Composition of Functions, Invertible Functions, Pigeonhole Principle.	7
IV	**Graphs:** Basic Terminologies, Multi-Graphs, Weighted Graphs, Sub Graphs, Isomorphic graphs, Complete Graphs, Regular Graphs, Bipartite Graphs, Operations on Graphs, Paths, Circuits, Hamiltonian and Eulerian graphs, Travelling Salesman Problem, Dijkstra's Algorithm, Planar Graphs, Graph Coloring.	6
V	**Trees:** Tree Terminologies, Rooted Trees, Properties, Prefix Codes, Spanning Trees, Fundamental Cut Sets and Circuits, Max flow –Min Cut Theorem (Transport Network). Binary Trees and traversal, Binary Search Tree and Traversals.	6

VI	**Algebraic Structures:** Introduction Semigroup, Monoid, Group, Abelian Group, Permutation Groups, Ring, Integral Domain, Field. Applications of Algebraic Structures.	6

Text Books :

1. Kenneth H. Rosen. Discrete Mathematics and Its Applications, 7th Edition, McGraw Hill, 2012.
2. C. L. Liu and D. P. Mohapatra, "Elements of Discrete Mathematics", 4th Edition, McGraw-Hill.

Reference Books :

1. Bernard Kolman, Robert C. Busby, Sharon Cutler Ross, "Discrete mathematical structures", 6th edition, Prentice Hall of India.
2. Edgar G. Goodaire, Michael M. Parmenter, "Discrete Mathematics with Graph Theory", 3rd Edition, Pearson Education.
3. Tremblay J. S., "Discrete mathematical structures with application", 3rdEdition, Tata McGraw Hill.
4. Lipschutz Seymour, "Discrete mathematics", 4th Edition, Tata McGraw-Hill.
5. Johnsonbaugh Richard, "Discrete Mathematics", 7th edition, Pearson.
6. Narsingh Deo, "Graph Theory with Applications to Engineering and Computer Science", Dover publication

Online Resources:

NPTEL Course "Discrete Mathematics" By Prof. Sudarshan Iyengar, Prof. Neeldhara | IIT Ropar, IIT Gandhinagar.
https://onlinecourses.nptel.ac.in/noc20_cs37/unit?unit=41&lesson=42

Course Code	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
IT25203	CO1	3	2	2	-	-	-	-	-	-	-	-
	CO2	2	2	3	-	-	-	-	-	-	-	-
	CO3	3	2	2	2	2	-	-	-	-	-	-
	CO4	2	--	--	--	--	2	-	1	--	--	--
	CO5	2	3	--	2	2	--	--	-	-	-	-
	CO6	2	2	3	-	-	-	-	-	-	-	-

Environmental Studies								
Course Code : HS25211			**Course Credits: 02**			**Course type: HSSM**		
Teaching Scheme			**Evaluation Scheme**					
TH	**PR**	**TUT**	**CAA**	**ISE**	**ESE**	**TW**	**PR**	**OR**
2	**-**	**-**	**10**	**-**	**60**	**-**	**-**	**-**

Course Objective:

1. Understand the fundamental concepts of environmental science and its relevance to engineering.
2. Analyze the environmental impact of various engineering industries
3. Learn about sustainable engineering practices, pollution control and waste management
4. Study environment laws in India and global initiatives environmental conservation.
5. Explore corrective measures and preventive technologies for mitigating environmental damage.

Course Outcomes:

1. Gain an understanding of environmental issues related to engineering industries.
2. Analyze the impact of engineering industries on the environment
3. Learn sustainable engineering solutions for mitigating environmental damage.
4. Be aware of Indian and global initiatives for environmental protection
5. Develop a sense of responsibility towards environmental conservation in their professional field.

Syllabus

Tut No.	Syllabus	Hrs
1.	**Introduction to Environmental Studies** Importance of Environmental Studies, Components of the Environment: Atmosphere, Hydrosphere, Lithosphere, and Biosphere, Ecosystems and Biodiversity: Types, Importance, and Conservation, Sustainable Development Goals (SDGs) and Role of Engineers in Sustainability, Renewable and Non-Renewable Resources, Water Resources: Overuse, Pollution, and Engineering Solutions, Energy Resources: Fossil Fuels, Nuclear Power, and Renewable Energy Alternatives, Land Resources: Soil Degradation, Deforestation, and Urbanization.	6
2.	**Impact of Engineering Industries on Environment** Manufacturing & Automobile Industry: Air pollution, Carbon emissions, Waste disposal, Chemical & Pharmaceutical Industry: Water and soil contamination, Hazardous waste, Construction & Infrastructure: Land degradation, Dust pollution, Waste generation, Electronics & IT Industry: E-waste, Energy consumption, Semiconductor waste, Power Generation (Thermal, Hydropower, Nuclear): Pollution, Waste heat, Radiation hazards, Causes and Effects of Climate Change, Global Warming and Greenhouse Effect.	7
3.	**Engineering Solutions for Environmental Mitigation and Sustainable Practices** Carbon Capture and Storage (CCS), Green Chemistry & Eco-friendly Materials, Sustainable Design & Life Cycle Assessment (LCA), Energy-efficient Technologies & Smart Grids, Case Studies on Successful Pollution Reduction. Waste Management Strategies: Solid Waste and Biomedical Waste Management, E-Waste: Sources, Impact, and Recycling, Hazardous Waste Handling and Treatment, Circular Economy and Zero-Waste Technologies. Sustainable Engineering Practices: Renewable Energy Technologies (Solar, Wind, Biomass, Hydropower), Green Buildings and Sustainable Architecture, Electric Vehicles and Smart Transportation Systems, Sustainable Agriculture and Water Conservation Technologies.	7
4.	**Environmental Initiatives in India and Worldwide** National Initiatives: Swachh Bharat Abhiyan, Namami Gange, National Green Tribunal (NGT), Corporate Social Responsibility (CSR) & Environmental Compliance. Environmental Activism and the Role of NGOs, Environmental Laws and Policies in India, The Environmental Protection Act, 1986, Role of Central Pollution Control Board (CPCB)	6

	and State Pollution Control Boards (SPCB), International Environmental Agreements (Kyoto Protocol, Paris Agreement, COP Summits), Global Initiatives: UNEP, IPCC, World Bank Environmental Policies.	
Total Teaching Hours		**26**

List of Activities for reference:

Unit 1: Introduction to Environmental Studies

1. **Ecosystem Study Report –** Visit a local park, water body, or forested area and document its ecosystem components (flora, fauna, food chains).
2. **Sustainability Case Study –** Choose one of the Sustainable Development Goals (SDGs) and prepare a report on its implementation in India.
3. **Renewable vs. Non-Renewable Resources –** Prepare a comparative chart listing sources, usage, and sustainability factors.
4. **Water Conservation Survey –** Conduct a survey in your neighborhood or campus to assess water consumption and suggest conservation strategies.

Unit 2: Impact of Engineering Industries on Environment

1. **Industrial Impact Assessment –** Select an engineering industry (automobile, chemical, IT, etc.) and analyze its environmental impact.
2. **Carbon Footprint Calculation –** Calculate the carbon footprint of your daily activities (electricity, transportation, food, etc.) and suggest ways to reduce it.
3. **Climate Change Awareness Video –** Create a short video (2–3 min) explaining global warming and its impact.
4. **Case Study on Pollution Control Failures –** Research a real-world incident of industrial pollution (e.g., Bhopal Gas Tragedy, Minamata Disease) and analyze the causes and consequences.

Unit 3: Engineering Solutions for Environmental Mitigation and Sustainable Practices

1. **Waste Management Audit –** Conduct a waste audit in your college or home, classify the waste generated, and propose a waste management plan.
2. **E-Waste Collection Drive –** Organize a drive to collect and safely dispose of e-waste in your locality. Submit a report on the amount collected and its disposal method.
3. **Renewable Energy Model –** Create a working or conceptual model of a solar panel, wind turbine, or biomass plant.
4. **Green Building Analysis –** Identify a green building in your city (or college) and analyze its energy-efficient features.

Unit 4: Environmental Initiatives in India and Worldwide

1. **Report on National Environmental Policies –** Summarize key environmental laws in India and their effectiveness.
2. **International Climate Agreements Presentation –** Prepare a presentation on major agreements like the Paris Agreement, Kyoto Protocol, and their impact on India.
3. **NGO/CSR Initiative Study –** Research an NGO or corporate social responsibility (CSR) initiative focused on environmental protection and prepare a report.
4. **Swachh Bharat Implementation Review –** Visit a local area, document cleanliness conditions, and suggest improvements under Swachh Bharat Abhiyan.

Evaluation Criteria (10 Marks Total)

- Depth of Research & Analysis (3 Marks)
- Presentation & Clarity (3 Marks)
- Creativity & Practical Application (2 Marks)
- Timely Submission (2 Marks)

Text Books:

1. Benny Joseph, *Environmental Studies*, McGraw Hill Education, 3rd Edition, 2021.
2. Anubha Kaushik & C.P. Kaushik, Environmental Studies, New Age International Publishers, 5th Edition, 2022.

Reference Books:

1. R. Rajagopalan, Environmental Studies: From Crisis to Cure, Oxford University Press, 3rd Edition, 2021.
2. Erach Bharucha, Textbook of Environmental Studies for Undergraduate Courses, University Press, 3rd Edition, 2021.
3. Suresh K. Dhameja, Environmental Science and Engineering, S.K. Kataria & Sons, 2nd Edition, 2020.

Additional Reports & Resources:

1. Government of India – Ministry of Environment, Forest & Climate Change (MoEFCC) Reports (Website)
2. United Nations Environment Programme (UNEP) Reports (Website)
3. IPCC Climate Change Reports (Website)
4. Central Pollution Control Board (CPCB) Reports (Website)

Public Speaking and Aptitude								
Course Code : HS25201			**Course Credits: 02**			**Course type: AEC**		
Teaching Scheme			**Evaluation Scheme**					
TH	**PR**	**TUT**	**CAA**	**ISE**	**ESE**	**TW**	**PR**	**OR**
-	**2**	**1**	**40**	**-**	**-**	**-**	**-**	**30**

Course Objective:

1. To develop fluency in spoken English by improving vocabulary, pronunciation, intonation and conversational skills for effective communication.
2. To enhance presentation skills by focusing on body language ,voice modulation , strategic pauses, and empathetic communication for impactful public speaking
3. To strengthen quantitative aptitude through problem-solving techniques in data interpretation, numerical computation, and statistics.
4. To Develop logical and spatial reasoning skills for better analytical thinking and problem–solving in competitive exam

Course Outcomes:

1. Communicate effectively in various spoken interactions, including telephone conversations and discussions.
2. Deliver structured and engaging presentations with appropriate body language, voice modulation, and confident speech techniques.
3. Solve quantitative problems efficiently using data interpretation, numerical computation, and statistical analysis techniques.
4. Apply logical reasoning and spatial aptitude skills to analyze complex problems.

Syllabus

Tut No.	Syllabus	Hrs
1.	**Spoken English** Pre-Assessment, Vocabulary made easy, the Power of Words, Introduction to Word Accent, Introduction to Rhythm: Intonation, Rising Intonation, Falling Intonation, Introduction & Specific scenarios: Telephone Skills: Taking & Making Calls, Voice, Intonation, and Language, Conversations: The Role of Questions	4
2.	**Impactful Presentations:** Body Language: Introduction, Mechanics and Style Voice Modulation: Voice Projection, replacing Fillers, and Emphasis Power of Pause: Pause to engage audience in Conversation, Combine Pause & Repetition Techniques, Demonstrate Confidence & Control, establish Presence Empathy: Essential Human Quality, Practice Heartful Communication, impact of Communication, How to deliver memorable speech.	4
3.	**General Aptitude for all Competitive Exams** **Quantitative Aptitude** Data interpretation: data graphs (bar graphs, pie charts, and other graphs representing data), 2- and 3-dimensional plots, maps, and tables Numerical computation and estimation: ratios, percentages, powers, exponents and logarithms, permutations and combinations, and series Mensuration and geometry Elementary statistics and probability **Analytical Aptitude** Logic: deduction and induction, Analogy, Numerical relations and reasoning. **Spatial Aptitude** Transformation of shapes: translation, rotation, scaling, mirroring, assembling, and grouping Paper folding, cutting, and patterns in 2 and 3 dimensions.	6
Total Teaching Hours		**14**

List of Practical Assignments for reference:

Session 1: Vocabulary & Word Accent Mastery
- Pre-Assessment: Conduct a quick spoken test to evaluate pronunciation and fluency.
- Vocabulary exercises using flashcards & interactive word-building games.

Session 2: Intonation & Rhythm in Speech
- Introduction to rising and falling intonation with examples.
- Roleplay exercises for practicing intonation in different scenarios (expressing surprise, asking questions, etc.).
- Rhythm practice: Reading passages with proper pauses and stress patterns.

Session 3: Telephone Skills & Professional Conversations
- Practicing making and taking calls with simulated dialogues.
- Focus on voice modulation, clarity, and polite expressions.

Session 4: Body Language & Stage Presence
- Mirror exercises to improve facial expressions and gestures.
- Practicing posture, movement, and eye contact while speaking.

Session 5: Voice Modulation & Power of Pause
- Exercises on voice projection and eliminating fillers.
- Practicing pauses strategically to enhance speech impact.
- Repetition and emphasis techniques using speech excerpts.

Session 6: Empathy & Heartfelt Communication
- Interactive storytelling to practice emotional connection.
- Exercises on active listening and empathetic responses.
- Speech practice: delivering a short talk with an emotional appeal.

Session 7: Quantitative Aptitude – Data Interpretation & Computation
- Solving numerical problems based on bar graphs, pie charts, and tables.
- Quick estimation exercises using ratios, percentages, and logarithms.
- Group challenges on permutations and combinations.

Session 8: Analytical Aptitude – Logical & Numerical Reasoning
- Deduction and induction puzzles.
- Solving analogy-based reasoning questions.
- Speed tests for numerical relations and reasoning.

Session 09: Spatial Aptitude – Shape & Pattern Recognition
- Hands-on paper folding and cutting exercises.
- Visualization tasks for rotation, scaling, and mirroring of shapes.
- Solving pattern-based problems in 2D and 3D space.

Session 10:
- Mock test from online test series of companies like TCS, Infosys employability tests like CoCubes, AMCAT etc.

Text Books:
1. "A Course in Phonetics and spoken english"-T.Balasubramanian
2. "Effective Technical Communication"- M.Ashraf Rizvi
3. "Quantitative Aptitude for Competitive Examinations"-R.S.Agrawal

Reference Books:
1. "High School English Grammar & Composition"- Wren & Martin
2. "How to Speak, How to Listen "-Mortimer J.Adler
3. "Logical and Analytical Reasoninig"- A.K.Gupta

Online Resources:
1. Mastering Speaking and Presentations: A Case based approach by Prof.Seema Singh https://onlinecourses.nptel.ac.in/noc25_hs96/preview

Python for Data Science								
Course Code : IT25204			**Course Credits: 02**			**Course type: VSEC**		
Teaching Scheme			**Evaluation Scheme**					
TH	**PR**	**TUT**	**CAA**	**ISE**	**ESE**	**TW**	**PR**	**OR**
-	**2**	**1**	**-**	**-**	**-**	**40**	**30**	**-**

Prerequisite Course Mapping:

1. Basics of Python.

Future Course Mapping:

1. Machine Learning. Data Science and Business Analytics.

Course Objective:

1. To learn python basics.
2. To understand looping constructs in Python.
3. To understand data analysis with NumPy.
4. To acquire the knowledge of Pandas library.
5. To learn and understand data visualization.
6. To learn object oriented concepts in python and machine learning.

Course Outcomes:

1. To understand various ways for python program installation.
2. To implement loops in python.
3. To analyze data using the Numpy library.
4. To practice data analysis using the Pandas library.
5. To implement data visualization.
6. To apply OOP and ML concepts in python.

Syllabus

Tut No.	Syllabus	Hrs
1.	**Introduction to Python for Data Science and Environment Setup**(Python installation, Anaconda, Jupyter Notebook, Google Colab) Python Syntax, Variables and Data Types	1
2.	Input–Output Operations, Keywords, Indentation and Operators	1
3.	Python Data Structures – Lists, Tuples and Dictionaries	1
4.	Conditional Statements in Python (if, if–else, nested if, match-case)	1
5.	Looping Constructs and Control Flow (for, while, break, continue, pass)	1
6.	Functions in Python – Definition, Calling, Return and Scope	1
7.	NumPy Fundamentals – Array Creation and Array Attributes	1
8.	NumPy Array Operations – Indexing, Slicing and Mathematical Functions	1
9.	Introduction to Pandas – Series and DataFrame	2
10.	Data Manipulation in Pandas – Data Cleaning, Sorting, Merging and Selection	1
11.	Data Visualization using Matplotlib (Line, Bar, Scatter, Histogram, Boxplot)	1
12.	Object Oriented Programming in Python and Introduction to Machine Learning	1
Total Teaching Hours		**13**

List of Practical Assignments:

1. Python Installation and setup development.
   a) Install python using pip install.
   b) Install Anaconda navigator, conda for python libraries and virtual environment.
   c) Google colab, Jupyter Notebook for python program development.
2. Create list and perform the following operations: create, insert, modify and delete using match case statement.
3. Accept n numbers from user and find maximum and minimum from the list. Print sum and average of elements of the list.
4. Write a program to accept marks obtained by students and find his/her result grade.
5. To accept number from user and perform following operations on it
   a) Read a number
   b) Print it in reverse order
   c) Read string
   d) Check palindrome of string
6. Using numpy create an array and perform these operations.
   a) Create an array using list
   b) Create 2D array
   c) Retrieve elements from the array
   d) Reverse order of elements of the array
   e) Create a 3 by 3 array and reshape it into 1 by 9 array
   f) Perform element wise addition/subtraction/multiplication
   g) Find square of every element in array
   h) Select element in array based on condition
7. Use pandas library and perform following operations on data set. Use Facebook metric dataset.
   a) Create data subsets
   b) Merge data
   c) Sort data
   d) Transpose
   e) Shape and reshape
8. Perform data visualization using matplotlib library on Facebook metric dataset.
9. Perform following program in python using OOP's concept:
   a) Create a class Car
   b) Create a method drive
   c) Call method to access attributes

Text Books:

1. Python programming using problem solving approach, Reema Thareja, Oxford university press
2. Python data science essentials,Alberto Boschetti,Luca Massaron,Third edition
3. Foundational Python for Data science,Kennedy R.Behrman,Addison-Wesley

Reference Books:

1. Python for Data Analysis, Wes MC kinney,1 Edition,O'relly
2. Mastering python for data science,Samir Madhvan

Online Resources:

https://onlinecourses.nptel.ac.in/noc22_cs32/preview

Course Code	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
IT25204	CO1	1	1	1	-	2	-	-	-	1	1	-
	CO2	2	2	1	-	3	-	-	-	1	1	-
	CO3	2	2	2	-	3	-	-	-	2	1	-
	CO4	2	2	2	-	3	-	-	-	2	1	1
	CO5	3	3	3	-	2	-	-	-	2	1	1
	CO6	3	2	2	-	3	-	-	-	2	1	-

SEMESTER-IV

Advanced Mathematics for IT Engineering								
Course Code : BS25203			**Course Credits: 04**			**Course type: BSC**		
Teaching Scheme			**Evaluation Scheme**					
TH	**PR**	**TUT**	**CAA**	**ISE**	**ESE**	**TW**	**PR**	**OR**
3	-	-	10	30	60	-	-	-

Prerequisite Course Mapping: Differential & Integral calculus, Taylor series, Differential equations of first order and first degree, Fourier series, Collection, Classification & Representation of data.

Future Course Mapping:
1. Machine Learning
2. Deep Neural Network

Course Objectives:
To provide the students with concepts and techniques in Linear differential equations, Fourier transform, Statistical methods, and Probability theory. The aim is to equip them with the techniques to understand advanced-level mathematics and its applications that would be useful in their discipline and enhance their thinking power.

Course Outcomes:
1. Solve higher-order linear differential equations using appropriate techniques useful for modeling in their field.
2. Understand the concepts of Fourier transform.
3. Understand and apply the various concepts of statistical methods of correlation, and regression and Apply them in their field.
4. Apply the concepts of appropriate Probability and Probability distribution for data analysis and predictions in multiple data sets.
5. Solve Algebraic, Transcendental equations and System of linear equations using numerical techniques.
6. Compute Interpolating polynomials, numerical differentiation, and integration, numerical solutions of ordinary differential equations used in modern scientific computing.

UNIT No.	Syllabus	Hrs
I	**Unit I: Linear Differential Equations (LDE) and Applications** Introduction, Solution of LDE, General method, short-cut method, Method of variation of parameters, Cauchy's, Legendre's DE, Simultaneous DE.	7
II	**Unit II: Fourier and Z Transform** Fourier Transform: General Fourier transform, Fourier Sine and Cosine transform, and inverse transforms. Z-Transform: Theorems and Properties of Z-transform, and Inverse Z-transform. Applications of Z-transforms to solve difference-equations.	7
III	**Unit III Statistics** Statistics: Measures of dispersion, Moments, Skewness and Kurtosis, Correlation and Regression analysis. Curve fitting: Fitting of straight lines and related curves.	7
IV	**Unit IV: Probability and Probability Distributions** Theorems on probability, Random variables, Probability Mass function, Probability Density function, Mathematical Expectation. Binomial, Poisson, and Normal distribution and applications.	7
V	**Unit V: Numerical methods for Algebraic equations and System of Equations** Numerical Solution of Algebraic and Transcendental Equations: Bisection, Secant, Regula-Falsi, Newton–Raphson and Successive Approximation Methods. Numerical Solutions of System of linear equations: Gauss elimination, LU Decomposition, Cholesky, Jacobi and Gauss-Seidel Methods.	7

VI	**Unit VI: Numerical methods for calculus** Interpolation: Finite Differences, Newton's and Lagrange's Interpolation formula, Numerical Differentiation. Numerical Integration: Trapezoidal and Simpson's rules. Solution of Ordinary differential equations: Euler's, Modified Euler's, Runge-Kutta 4th order.	7

Textbooks:

1. Higher Engineering Mathematics by B.V. Ramana (Tata McGraw-Hill).
2. Higher Engineering Mathematics by B. S. Grewal (Khanna Publication, Delhi).

Reference Books:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 10ed, Wiley India
2. M. D. Greenberg, "Advanced Engineering Mathematics", 2nd e Pearson Education
3. Peter V. O'Neil, "Advanced Engineering Mathematics", 7ed, Cengage Learning
4. S. L. Ross, "Differential Equations", 3e, Wiley India
5. Sheldon M. Ross, "Introduction to Probability and Statistics for Engineers and Scientists", 5e, Elsevier Academic Press
6. M. K. Jain, S. R. K. Iyengar, and R. K. Jain, "Numerical Methods for Scientific and Engineering Computation", 5e, (New Age International Publication).
7. Draper, N. R. and Smith, H. "Applied Regression analysis", (1998) (John Wiley) Third Edition.
8. S.P. Gupta, Sultan Chand and Sons, "Statistical Methods", New Delhi, 2009.

Design and Analysis of Algorithms								
Course Code : IT25211			**Course Credits: 03**			**Course type: PCC**		
Teaching Scheme			**Evaluation Scheme**					
TH	**PR**	**TUT**	**CAA**	**ISE**	**ESE**	**TW**	**PR**	**OR**
3	**-**	**-**	**10**	**30**	**60**	**-**	**-**	**-**

Prerequisite Course Mapping:
Data Structures, Basic Mathematics (Induction), Probability Theory

Future Course Mapping:
Distributed Computing , Advanced Algorithms

Course Objectives:
1. To understand problem-solving paradigms and classification of computational problems.
2. To analyze time and space complexity of algorithms using asymptotic notations.
3. To design efficient algorithms using various paradigms like Divide & Conquer, Greedy, and Dynamic Programming.
4. To apply algorithmic strategies to real-world problems.
5. To understand computational complexity theory including P, NP, and NP-completeness.

Course Outcomes:
1. Analyze computational complexity using asymptotic notations.
2. Apply Divide & Conquer as well as Greedy approach to design algorithms.
3. Apply Dynamic Programming to solve optimization problems.
4. Design and implement solutions using Backtracking techniques for combinatorial problems.
5. Evaluate and compare Branch and Bound strategies for solving problems.
6. Analyze and Classify P, NP, NP-complete, NP-Hard problems.

UNIT No.	Syllabus	Hrs
I	**Introduction:** Analysis of Algorithms, Efficiency- Analysis framework, asymptotic notations. Proof Techniques: Proof by induction, contradiction, direct proof, contraposition etc. Introduction to Brute Force method & Exhaustive search, Analysis of Non-recursive and recursive algorithms: Solving Recurrences.	7
II	**Divide and conquer method and Greedy strategy:** Divide & Conquer method: Merge sort, Quick sort. Binary search, Finding Minimum and Maximum, Large integer Multiplication. Greedy Method: MST for graph, Single-Source Shortest Paths: Dijkstra's Algorithm, Fractional Knapsack problem, Job Sequencing.	7
III	**Dynamic Programming:** General strategy, optimal substructure, 0/1 knapsack Problem, Bellman-Ford Algorithm, Multistage Graph problem, Optimal Binary Search Trees, Travelling Salesman Problem.	7
IV	**Backtracking:** General method, Recursive backtracking algorithm, Iterative backtracking method. 8-Queen problem, Sum of subsets, Graph coloring, Hamiltonian Cycle, 0/1 Knapsack Problem.	6
V	**Branch and bound:** The method, Control abstractions for Least Cost Search, Bounding, FIFO branch and bound, LC branch and bound, 0/1 Knapsack problem – LC branch	6

	and bound and FIFO branch and bound solution, Travelling Salesperson Problem (TSP).	
VI	**Classes of algorithms:** Computational Complexity: Non-Deterministic algorithms, The classes: P, NP, NP- Complete, NP-Hard, Satisfiability problem, NP Complete Problems.	6
Total Teaching Hours		**39**

Text Books:

1. Thomas H Cormen and Charles E.L Leiserson, Introduction to Algorithms, PHI, ISBN: 81-203-2141-3.
2. S. Sridhar, Design and Analysis of Algorithms, Oxford, ISBN 10 : 0-19-809369-1.

Reference Books:

1. Horowitz and Sahani, Fundamentals of computer Algorithms, Galgotia, ISBN 81-7371-612-9.
2. R. C. T. Lee, SS Tseng, R C Chang, Y T Tsai, Introduction to Design and Analysis of Algorithms, A Strategic approach, Tata McGraw Hill, ISBN-13: 978-1-25-902582-2. ISBN-10: 1-25-902582-9.
3. Anany Levitin, Introduction to the Design & Analysis of Algorithm, Pearson, ISBN 81- 7758-835-4.
4. Gilles Brassard, Paul Bratle, Fundamentals of Algorithms, Pearson, ISBN 978-81-317-1244-3.

Online Resources:

https://onlinecourses.nptel.ac.in/noc20_cs27
https://onlinecourses.nptel.ac.in/noc19_cs47

Course Code	CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
IT25211	CO1	3	3	-	2	-	3	-	-	-	-	1
	CO2	3	3	2	1	1	1	-	-	1	-	1
	CO3	3	3	3	1	1	1	-	-	1	-	1
	CO4	3	3	3	1	1	-	-	-	2	-	1
	CO5	3	3	3	2	1	1	-	-	1	-	-
	CO6	3	3	-	1	-	-	-	-	-	-	-

Data Structures								
Course Code : IT25212			**Course Credits: 04**			**Course type: PCC**		
Teaching Scheme			**Evaluation Scheme**					
TH	**PR**	**TUT**	**CAA**	**ISE**	**ESE**	**TW**	**PR**	**OR**
3	2	-	10	30	60	-	30	-

Prerequisite Course Mapping:
1. Fundamentals of Data Structures

Future Course Mapping:
1. Design and Analysis of Algorithm

Course Objectives:
1. To develop a logic for graphical modeling of the real life problems.
2. To suggest appropriate data structure and algorithm for graphical solutions of the problems.
3. To understand advanced data structures to solve complex problems in various domains.
4. To operate on the various structured data.
5. To build the logic to use appropriate data structure in logical and computational solutions.

Course Outcomes:
1. **Design** algorithms to address programming challenges, choose the right strategy for each application, and assess time and space complexity
2. **Understand** the fundamental concepts of linked lists and their use in real world problem solving
3. **Utilize** non-linear data structures to address problems across different domains.
4. **Develop** and **apply** algorithms for insertion, and deletion operations in threaded binary tree and implementation of AVL and heap.
5. **Apply** non-linear data structures for solving real time problems in various domains.
6. **Design** and **apply** the objectives and advantages of an effective hashing scheme for practical applications.

UNIT No.	Syllabus	Teaching Hours
I	**Introduction to Algorithm Analysis:** Complexity of algorithm: Space complexity, Time complexity, Asymptotic notation- Big-O, Theta and Omega, finding complexity using step count method, Algorithmic Strategies: Introduction to algorithm design strategies- Divide and Conquer- Merge Sort, Backtracking, Branch and Bound and Greedy strategy, Dynamic Programming-Fibonacci series.	7
II	**Linked List:** Introduction to Static and Dynamic Memory Allocation, Linked List: Introduction, of Linked Lists, Linked List as ADT, Types of Linked List: Singly Linked Lists, Doubly Linked List, Circular Linked List, Primitive Operations on Linked List- Create, Traverse, Search, Insert, Delete, Sort, Concatenate. Implementation of stack and queue using Linked List, Generalized Linked List (GLL) concept, Representation of Polynomial using GLL.	7
III	**Tree:** basic terminology, General tree and its representation, representation using sequential and linked organization, Binary tree- properties, converting tree to binary tree, binary tree traversals (recursive and non-recursive)- inorder, preorder, post order, depth first and breadth first, Operations on binary tree. ,binary Search Tree (BST), BST operations,	7
IV	**Advanced Tree Structures and Heaps:** Threaded binary search tree- concepts, threading, insertion and deletion of nodes in threaded binary search tree. Concept of AVL tree, LL, RR, RL and LR Rotations. Heap implementation, Heap Sort, Heap as a Priority Queue.	6

V	**Graph:** Basic Concepts, Storage representation, Adjacency matrix, adjacency list, adjacency multi list. Traversals-depth first and breadth first, Minimum spanning Tree, Greedy algorithms for computing minimum spanning tree- Prims and Kruskal Algorithms, Dijkstra's Single source shortest path.	6
VI	**Hashing:** Hash Table- Concepts-hash table, hash function, basic operations, bucket, collision, probe, synonym, overflow, open hashing, closed hashing, perfect hash function, Collision resolution strategies- open addressing and chaining, Hash table overflow- open addressing and chaining, extendible hashing, closed addressing and separate chaining.	6

List of Practical Assignments:

1. Implement singly link list with following operations:
    a. Create, insert node at the front, middle and end, delete at the front, middle and end, reverse
2. Implement binary tree and perform tree traversals non-recursively.
3. Implement binary search tree and perform following operations on it:
    a. create
    b. display
    c. insert
    d. height
    e. mirror image
    f. delete
    g. leaf nodes
4. Implementation of heap sort.
5. Represent a given graph using adjacency matrix/ adjacency list to perform DFS and BFS.
6. Implementation of prims/kruskal's algorithm to find minimum spanning tree of a given graph.
7. Implementation of hash table and handle collisions using linear probing.
8. Design a mini project using Dijkstra's algorithm to find shortest path between two nodes.

Text Books:

1. Horowitz and Sahani, "Fundamentals of Data Structures in C++", University Press, ISBN 10: 0716782928 ISBN 13: 9780716782926.
2. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, "Data Structures and Algorithms in Python", Wiley Publication, ISBN: 978-1-118-29027-9
3. M Folk, B Zoellick, G. Riccardi, "File Structures‖, Pearson Education", ISBN:81-7758-37-5
4. Peter Brass, "Advanced Data Structures"‖, Cambridge University Press, ISBN: 978-1-107-43982-5

Reference Books:

1. A. Aho, J. Hopcroft, J. Ulman, "Data Structures and Algorithms"‖, Pearson Education, 1998, ISBN-0-201-43578-0.
2. Michael J Folk, "File Structures an Object Oriented Approach with C++‖", Pearson Education, ISBN: 81-7758-373-5.
3. Brassard and Bratley, "Fundamentals of Algorithmic", Prentice Hall India/Pearson Education, ISBN
4. Sartaj Sahani, "Data Structures, Algorithms and Applications in C++"‖, Second Edition, University Press, ISBN:81-7371522 X.
5. G A V Pai, "Data Structures and Algorithms"‖, McGraw-Hill Companies, ISBN -9780070667266.

Online Resources:

1. https://nptel.ac.in/courses/106/102/106102064/
2. https://nptel.ac.in/courses/106/105/106105085
3. https:// nptel.ac.in/courses/106/106/106106127
4. https://www.ebookphp.com/advanced-data-structures-epub-pdf/
5. https://www.ebookphp.com/data-structures-and-algorithms-professional-edition-beginners-guide-epubpdf/

Course Code	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
IT25212	CO1	3	2	2	2	1	-	1	1	-	-	2
	CO2	3	2	3	2	1	-	1	1	-	-	1
	CO3	3	2	3	2	1	-	1	1	-	-	1
	CO4	3	2	2	2	1	-	1	1	-	-	1
	CO5	3	2	3	2	1	-	1	1	-	-	1
	CO6	3	2	3	2	1	-	1	1	-	-	1

Database Management System								
Course Code : IT25213			**Course Credits: 04**			**Course type: PCC**		
Teaching Scheme			**Evaluation Scheme**					
TH	**PR**	**TUT**	**CAA**	**ISE**	**ESE**	**TW**	**PR**	**OR**
3	**2**	**-**	**10**	**30**	**60**	**-**	**30**	**-**

Prerequisite Course Mapping:
1. Discrete Mathematics
2. Fundamentals of data structure and algorithm

Future Course Mapping:
1. Advanced Database Management System
2. Data Science

Course Objective:
1. To understand the fundamental concepts of database management systems
2. To learn and practice different PL-SQL concepts
3. To understand systematic database design approaches
4. To acquire the skills to handle data
5. To learn and understand various Database Architectures and its use for application development.
6. To learn advances in database management systems

Course Outcomes:
1. Analyze and Design Database Management System using ER Model
2. Implement database queries using database languages
3. To apply normalization concept during the database design
4. Apply transaction management concepts in real life examples
5. To apply NOSQL concepts for database generation
6. Apply advances in DBMS for solving real life problems

Syllabus

Unit No.	Syllabus	Hrs
I	**Introduction to DBMS and ER Model** Data, Types of Data, Database, Types of Databases, Applications and Purpose of Database systems, Data Abstraction, Data Independence,View of data, Database Languages, Database System Structure, Data Models. **ER Model :**Entity, Types of Entities, Attributes, Types of attributes, Relationship, Constraints, Key, ER Diagram, EER Diagram, Converting ER and EER Diagram to tables.	7
II	**Introduction to SQL and PL/SQL** **SQL:** SQL Data Types and Literals, DDL, DML, DCL,TCL, SQL Operators, Characteristics and Advantages , DML statements: create, update, delete. select query and clauses, Index and Sequence in SQL, Views: Creating, Dropping, Set operation, Joins in SQL. **PL/SQL:**Stored Procedures and Functions, Cursors, Triggers	7
III	**Introduction to Relational Database Design** **Relational Model:** Basic concepts, Attributes, Domains, CODD'S Rules. Relational Integrity. **Database Design**: Features of good relational design, Normalization, Atomic Domains and 1NF, Decomposition using functional dependencies, 2NF, 3NF and BCNF.	7
IV	**Database Transaction Management** Introduction to database transaction, transaction states, ACID Properties, **Schedule:** Serial Schedule, **Serializability**: Conflict and View, Cascaded Abort, recoverable and non recoverable schedules. **Concurrency Control:** Lock based, Timestamp based.Deadlock handling. **Recovery Methods**:Shadow Paging, Log based recovery,checkpoints	6

V	**NOSQL Database** Introduction to distributed database system, advantages, disadvantages, CAP Theorem, Types of Data: structures, semi structured and unstructured data. NOSQL database: Introduction, need, features, Types of NOSQL Databases: key value store, wide column store, document store, graph, BASE properties,comparative study of NOSQL and RDBMS, MONGO DB:CRUD Operations	6
VI	**Advances in DBMS** Emerging databases: active and deductive databases, semantic databases, complex data type:semi structured data, nested data types, JSON, XML Spatial Data: geographic data, geometric data, big data introduction, HBase	6
Total Teaching Hours		**39**

List of Practical Assignments:

1. Design ER Diagram for any project.
2. Design and Develop SQL DDL statements which demonstrate the use of SQL objects such as Table, View, Index, Sequence, Synonym, different constraints etc.
3. Write at least 10 SQL queries on the suitable database application using SQL DML Statements. Note: Instructor will design the queries which demonstrate the use of concepts like Insert,Select,Update, Delete.
4. Write at least 10 SQL queries for suitable database applications using SQL DML statements. Note: Instructor will design the queries which demonstrate the use of concepts like all types of Join ,Sub-Query.
5. Write stored procedure and function.
6. Implement all types of Cursors: Implicit, Explicit and Parameterized cursor.
7. Implement Trigger:Row level and Statement level trigger, Before and After Triggers.
8. Implement CRUD operations using MongoDB.

Text Books:

1. Database System Concepts by Silberschatz A., Korth H., Sudarshan S. , 6th edition.
2. Data Mining :Concepts and Techniques ,Jiawei Han, Micheline Kamber, Jian Pei.

Reference Books:

1. C J Date, “An Introduction to Database Systems”, Addison-Wesley, ISBN: 0201144719
2. S.K.Singh, “Database Systems: Concepts, Design and Application”, Pearson Education, ISBN 978-81-317-6092-5
3. Joy A. Kreibich, “Using SQLite”, O'REILLY, ISBN: 13:978-93-5110-934-1
4. Ivan Bayross, “SQL, PL/SQL the Programming Language of Oracle”, BPB Publications ISBN: 9788176569644, 9788176569644

Online Resources:

https://onlinecourses.nptel.ac.in/noc26_cs39/preview

Course Code	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
IT25213	CO1	1	1	1	-	-	-	-	-	1	1	-
	CO2	2	2	1	-	-	-	-	-	1	2	-
	CO3	2	2	2	-	-	-	-	-	2	2	-
	CO4	2	2	2	-	1	-	-	-	2	1	-
	CO5	3	3	3	-	1	-	-	-	2	1	-
	CO6	3	2	2	-	1	-	-	-	2	-	1

Community Engagement Project								
Course Code : IT25214			**Course Credits: 02**			**Course type: CEPFP**		
Teaching Scheme			**Evaluation Scheme**					
TH	**PR**	**TUT**	**CAA**	**ISE**	**ESE**	**TW**	**PR**	**OR**
-	**4**	**-**	**-**	**-**	**-**	**40**	**-**	**30**

Prerequisite Course Mapping:

1. Programming Language
2. Basic knowledge of problem solving
3. Engineering fundamentals

Future Course Mapping:

Major Project, Internship , Industry Project

Course Objectives:

1. Identify and analyze environmental and societal issues faced by local communities
2. Apply engineering and technological knowledge to address community needs.
3. Design and implement innovative, feasible, and sustainable solutions.
4. Work effectively in teams with individual responsibility and contribution.
5. Communicate technical ideas and social impact effectively.

Course Outcomes:

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

1. **Analyze** real-world community and environmental problems.
2. **Formulate** problem statements based on community needs.
3. **Design** feasible solutions using engineering principles
4. **Implement** solutions using appropriate tools and technologies
5. **Demonstrate team work** and Work collaboratively with defined roles
6. **Analyze outcomes,** communicate document technical and societal outcomes

Introductory information:

The Community Engagement Project (CEP) is an activity-based, experiential learning course. The course emphasizes direct engagement with local communities to identify real-world societal and environmental problems and develop technology-enabled solutions using engineering principles.

Guidelines to Faculty and Students:

- The course is activity and project-based
- Students must engage directly with communities through field visits, surveys, or interactions.
- Each project must address a societal or environmental problem.
- Faculty members act as mentors and evaluators throughout the project duration.
- Regular monitoring and guidance meetings should be conducted.
- Emphasis should be on feasibility, sustainability, and societal impact rather than complexity.

Group Structure:

1. Project groups shall consist of 2 to 4 students.
2. Each group shall be assigned a faculty guide.
3. Each student must demonstrate individual contribution to the project work.

Selection of Project/Problem:

1. The project must be selected based on real-world community needs.
2. Field visits and interaction with community stakeholders are strongly encouraged.
3. The problem statement should focus on environmental, societal, or public-interest challenges.
4. The selected problem statement must be approved by the faculty guide.

Project report contains:

i. Certificate from the institute
ii. Certificate sponsoring organization (If any)
iii. Acknowledgement
iv. Abstract
v. List of Abbreviations (As applicable)
vi. List of Figures (As applicable)
vii. List of Graphs (As applicable)
viii. List of Tables (As applicable)

1. Introduction and background of the problem
2. problem identification
3. Literature review
4. Problem definition and objectives
5. Proposed solution methodology
6. Implementation / demonstration details
7. Results, impact analysis, and observations
8. Limitations and future scope
9. Conclusion
10. References

Appendices

a) Plagiarism Report of Paper and Project report
b) Base Paper(s) [If any]
c) Tools used / Hardware Components specifications (If any)

Evaluation Criteria:

Continuous Activity Assessment (CAA) shall be awarded based on students' regular participation in community engagement activities, attendance, interaction with faculty guide, maintenance of project diary/logbook, and demonstrated involvement during field work.

Term Work shall be evaluated based on problem identification, planning and design, and quality of documentation.

Review-I: Problem Identification (Within first month of Semester) [15 Marks]

- Problem identification and relevance: 05 Marks
- Community survey and data collection : 05 Marks
- Literature review and planning: 05 Marks

Review-II: Project Design and implementation [15 Marks]

- Projects will be evaluated based on the effectiveness of the solution designed and developed using coding, modeling, product design or other relevant processes for identified problem statement: [10 Marks]
- Presentation and question /answers : **[05 Marks]**

Suggested Community Engagement Domains

- Waste management and recycling
- Water quality monitoring
- Renewable and clean energy
- Digital literacy and education
- Smart village initiatives
- Environmental monitoring
- Assistive technologies
- Public health and safety
- Disaster preparedness,
- Sustainable agriculture

Course Code	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
IT25214	CO1	2	3	-	2	-	-	1	1	3	2	-
	CO2	2	3	-	2	-	-	1	1	3	2	-
	CO3	2	2	3	2	1	1	1	1	3	2	2
	CO4	2	2	3	2	2	2	1	1	3	2	2
	CO5	-	-	-	3	2	3	-	2	-	-	-
	CO6	-	-	-	2	2	3	1	2	-	-	-