Maratha Vidya Prasarak Samaj's

Karmaveer Adv. Baburao Ganpatrao Thakare College of Engineering

An Autonomous Institute affiliated to Savitribai Phule Pune University, Pune

Udoji Maratha Boarding Campus, Gangapur Road, Nashik - 422 013,

Maharashtra, India

Syllabus

Second Year B.Tech. Computer Engineering (2024 Pattern) V1.1

(As per NEP 2020)

Academic Year 2025-26

(Copy for Student Circulation Only)

Program Specific Outcomes (PSOs).

PSO1: To apply mathematical and Computer Engineering fundamentals.

PSO2: To apply standard practices and strategies for software development and project management.

PSO3: To adapt programming languages, modern computer tools and technologies, and soft skills for career enrichment.

Program Educational Outcomes (PEOs).

PEO1: To inculcate computational and programming skills in the field of Computer Engineering.

PEO2: To prepare the graduates to fulfill professional requirements in industry.

PEO3: To develop the graduates to solve problems related to the society.

Program Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 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 Investigations 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).

Knowledge and Attitude Profile (WK)

WK1: A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.

WK2: Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.

WK3: A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.

WK4: Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.

WK5: Knowledge, including efficient resource use, environmental impacts, whole-life cost, re-use of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.

WK6: Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.

WK7: Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.

WK8: Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.

WK9: Ethics, inclusive behavior and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes.

Second Year B.Tech. Computer Engineering
Curriculum Structure (2024 Pattern) V1.1 Semester - III

Course Code	Course Type	Course Name	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks					Credits			
			TH	PR	TU	CCE	ESE	TW	PR + OR	TOT	TH	PR	TU	TOT
161301	PCC-2	Data Structures	2	2	-	40	60	25	25	150	2	1	-	3
161302	PCC-3	Digital Logic & Computer Organization	2	2	-	40	60	25	25	150	2	1	-	3
161303	PCC-4	Discrete Mathematics	2	-	-	40	60	-	-	100	2	-	-	2
170304/ 170404	MDM-1	Multi-Disciplinary Minor Course-1	2	-	-	40	60	-	-	100	2	-	-	2
171305	OEC-1	Open Elective Course-1	3	2	-	40	60	25	25	150	3	1	-	4
172306/ 172406	EEM-1	EEM Course-1	-	-	2	-	-	50	-	50	-	-	2	2
173307/ 173407	VEC-1	Value Education Course-1	-	2	1	-	-	50	-	50	-	-	2	2
161308	CEP/FP	Community Engagement / Field Project	-	4	-	-	-	50	-	50	-	2	-	2
Total			11	12	3	200	300	225	75	800	11	5	4	20

Group	Course Code	MDM Courses - 1	Course Code	VEC Courses - 1	Course Code	EEM Courses – 1
A	170304A	Engineering Mathematics-III	173307	Universal Human Values	172306	Entrepreneurship Development
B	170404A	Artificial Intelligence	173407	Environmental Studies	172406	Business Economics

Course Code	Open Elective Course – 1
171305A	IPR and Ethics
171305B	Renewable Energy
171305C	Health, Care & Management System
171305D	Smart City and Infrastructure

Second Year B.Tech. Computer Engineering
Curriculum Structure (2024 Pattern) V1.1 Semester - IV

Course Code	Course Type	Course Name	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks					Credits			
			TH	PR	TU	CCE	ESE	TW	PR + OR	TOT	TH	PR	TU	TOT
161401	PCC-5	Operating Systems	2	2	-	40	60	25	25	150	2	1	-	3
161402	PCC-6	Database Management System	2	2	-	40	60	25	25	150	2	1	-	3
161403	PCC-7	Computer Graphics	2	-	-	40	60	-	-	100	2	-	-	2
170304/ 170404	MDM-2	Multi-Disciplinary Minor Course-2	2	-	-	40	60	-	-	100	2	-	-	2
171405	OEC-2	Open Elective Course-2	3	2	-	40	60	25	25	150	3	1	-	4
172306/ 172406	EEM-2	EEM Course-2	-	-	2	-	-	50	-	50	-	-	2	2
173307/ 173407	VEC-2	Value Education Course-2	-	2	1	-	-	50	-	50	-	-	2	2
174408	AEC-2	Ability Enhancement Course-2	-	-	2	-	-	50	-	50	-	-	2	2
161409	VSEC-3	Vocational & Skill Enhancement Course-3	-	4	-	-	-	50	-	50	-	2	-	2
Total			11	12	5	200	300	275	75	850	11	5	6	22

Group	Course Code	MDM Courses – 2	Course Code	VEC Courses – 2	Course Code	EEM Courses – 2
A	170404A	Artificial Intelligence	173407	Environmental Studies	172406	Business Economics
B	170304A	Engineering Mathematics-III	173307	Universal Human Values	172306	Entrepreneurship Development

Course Code	Open Elective Course – 2	Course Code	AEC Course – 2	Course Code	VSEC Course – 3
171405A	Introduction to Cyber Security	174408	Foreign Language	161409	Java Programming

- **Summary of Credits and Total Marks:**

Semester	Credits	Marks
III	20	800
IV	22	850
Total	**42**	**1650**

• Definition of Credit :

The Under Graduate (U.G.) programmes will have credit system. The details of credit will be as follow.
1 Credit = 1 hour/week for lecture
= 2 hours/week for practical
= 1 hour/week for tutorial

- **Description of Various Courses:**

Type of Course	Description
PCC	Programme Core Course
MDM	Multidisciplinary Minor Course
OEC	Open Elective Course
EEM	Entrepreneurship / Economics / Management Course
VEC	Value Education Course
CEP/FP	Community Engagement Project / Field Project
VSEC	Vocational and Skill Enhancement Course (Skill Courses)
AEC	Ability Enhancement Course

Semester - III

Course Code: 161301		Course Name: Data Structures	
Teaching Scheme		**Credit**	**Evaluation Scheme**
Theory : 2 Hours/Week **Practical :** 2 Hours/Week		**2** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 25 Marks** **PR + OR : 25 Marks**

Prerequisite Courses:

- Fundamentals of Programming.

Course Objectives:

- To understand the standard and abstract data representation methods.
- To learn various data structures, operations on it and the memory requirements.
- To apply various data searching and sorting methods.
- To know some basic data structures like list, stack and queue.
- To study some advanced data structures such as trees and graphs.

Course Outcomes:

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

CO1: Select appropriate searching and sorting techniques in the application development.

CO2: Solve problems using stack and queue data structure.

CO3: Apply linked list data structure for solving problems.

CO4: Solve problems based on tree and graph data structure.

CO5: Apply hasing techniques for implementing data structures**.**

Course Content:

Unit-I: Searching and Sorting Techniques **06 Hours**

Overview of data structures, Types of data structures.

Searching: Search Techniques-Sequential Search/Linear Search, Binary Search.

Sorting: Types of Sorting-Internal and External Sorting.

General Sort Concepts: Sort Order, Stability, efficiency.

Comparison Based Sorting Methods: Bubble Sort, Insertion Sort, Selection Sort, Quick Sort, Shell sort, Merge sort.

Non-comparison Based Sorting Methods: Bucket Sort, Radix sort.

Unit-II: Stack and Queue **06 Hours**

Stack: Concept of stack, stack as an ADT using sequential and linked organization,

Applications of stack: recursion, backtracking, converting expressions from infix to postfix or prefix form, evaluating postfix or prefix form.

Queue: Concept of queues as ADT, Implementation of queue using array and linked organization, Concept of circular queue, double ended queue, priority queue, Applications of queue.

Unit-III: Linked List **06 Hours**

Introduction to Static and Dynamic Memory Allocation,

Linked List: Introduction, Realization of linked list using dynamic memory management, operations, Linked List as ADT

Types of Linked List: singly linked, linear and Circular Linked Lists, Doubly Linked List, Doubly Circular Linked List

Primitive Operations on Singly Linked List: Create, Traverse, Search, Insert, Delete, Sort, and Concatenate. Introduction to Generalized linked list (GLL).

Unit-IV: Trees and Graphs **06 Hours**

Tree: Trees and binary trees-concept and terminology, Expression tree, Binary tree as an ADT, binary tree traversals, Binary search tree as ADT (Insert, Search, Delete, level wise Display). Concept of threaded binary tree, Applications of trees. OBST, AVL Trees. Heap: Heap data structure, Min and Max Heap.

Graph as an ADT, Representation of graphs using adjacency matrix and adjacency list, Breadth First Search traversal, Depth First Search traversal, Prim's and Kruskal's algorithms for minimum spanning tree, shortest path using Dijkstra's algorithm.

Unit-V: Hashing **06 Hours**

Hashing Concepts: Hash table, hash function, basic operations, bucket collision, overflow, open hashing, closed hashing, perfect hash function, load density, full table, load factor, rehashing, issues in hashing, Hash functions: Properties of good hash function, division, multiplication, extraction, mid-square, folding and universal

Collision Resolution Strategies: Open addressing and chaining, Hash table overflow: Open addressing and chaining, extendible hashing, closed addressing and separate chaining.

Learning Resources:

Text Books:

1. Horowitz and Sahani, "Fundamentals of Data Structures in C++", University Press, ISBN 10: 0716782928 ISBN 13: 9780716782926.
2. A. Aho, J. Hopcroft, J. Ulman, "Data Structures and Algorithms"‖, Pearson Education,

1998, ISBN-0-201-43578-0.

Reference Books:

1. M. Weiss, “Data Structures and Algorithm Analysis in C++”, 2nd edition, Pearson Education, 2002, ISBN-81-7808-670-0.
2. Y. Langsam, M. Augenstin, A. Tannenbaum, “Data Structures using C and C++”, 2nd Edition, Prentice Hall of India, 2002, ISBN-81-203-1177-9.
3. Varsha H. Patil , “Data Structures using C++” , Oxford University Press ,ISBN-13 : 978-0198066231.
4. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, “Data Structures and Algorithms in Python”, Wiley Publication, ISBN: 978-1-118-29027-9
5. G. A. V. Pai, “Data Structures and Algorithms”, McGraw-Hill Companies, ISBN - 9780070667266.
6. Yashwant Kanetkar and A. Kanetkar, “Let us C++”, BPB Publisher.

Web link for MOOC / NPTEL Links:

1. Data structures and Algorithm By Prof. Naveen Garg | IIT Delhi
   https://nptel.ac.in/courses/106102064
2. Data structures and Program Methodology
   https://nptel.ac.in/courses/106103069
3. Programming and Data Structure
   https://nptel.ac.in/courses/106105085
4. Programming, Data Structures and Algorithms
   https://nptel.ac.in/courses/106106127

Activity Based Learning (Suggested Activities In-Class):

1. Flipped Classroom.
2. Gamification.
3. Online Interactive Tool.
4. Collaborative and Individual Problem based learning.
5. Quizzes/Assignment.

Guidelines for Practicals to be implemented using C++:

1. The course instructor should design assignments by considering the required background knowledge, relevant technologies, practical applications, and current trends related to the subject.
2. Preferably there should be multiple sets of assignments and distributed among batches of students.
3. Giving assignments based on real-life problems can help the students with future projects.

4. Students should be encouraged to use free and open-source software.
5. Instructors can also include an additional assignment or mini-project that goes beyond the syllabus but aligns with the course.

 # Use of coding platform LeetCode / CodeChef / HackerRank is mandatory for all the students.

Course Code: 161302		Course Name: Digital Logic and Computer Organization
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 2 Hours/Week **Practical :** 2 Hours/Week	**2** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 25 Marks** **PR + OR : 25 Marks**

Prerequisite Courses:

- Fundamentals of Electronics Engineering.

Course Objectives:

- To understand the functionality and design of Combinational and Sequential Circuits.
- To understand the structure, function and characteristics of computer systems.
- To identify the system level features and processes of advanced processors.
- To learn instruction set and logic to build assembly language program.

Course Outcomes:

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

CO1: Apply Boolean algebra and logic minimization techniques to simplify combinational logic expressions.

CO2: Apply design techniques to develop Sequential Circuits.

CO3: Study various concepts of Computer architectures and organization.

CO4: Illustrate advanced features of 80386 Microprocessor.

CO5: Apply knowledge of the 80386 instruction set to write and analyze assembly-level programs.

Course Contents

Unit-I: Combinational Logic Design **06 Hours**

Overview of Basic gates and sign magnitude numbers, Minimization techniques, SOP form, POS form; Simplification of logical functions using K-Maps, study of logic functions using different ICs. Codes: BCD, Excess-3, Gray code & their conversions. Logic Design using SSI chips: Half-Adder, Full Adder, Half Subtractor, Full Subtractor, n-bit Binary adder, Code converters, Introduction to MSI chips: Multiplexer, Demultiplexer, Decoder, Encoder, Parity generator, Parity Checker, Comparator.

Unit-II: Sequential Logic Design **06 Hours**

Flip-Flop and its types; Registers: SISO, SIPO, PISO, PIPO, Shift Registers, Bidirectional Shift

Register, Counters: Asynchronous counter, Synchronous Counter, BCD Counter, Modulus counter. Models- Moore and Mealy, State diagram and State Table, Sequence Generator and Sequence Detector.

Unit-III: Computer Evolution and Performance 06 Hours

Computer Organization and Architecture, Structure and Function, Evolution of Intel processor architecture: 4 bits to 64-bits, performance assessment. A top-level view of Computer function and interconnection, Computer Components, Interconnection structure, bus interconnection, Computer Arithmetic, Booth's algorithm, Floating point representation and operations – IEEE standard, arithmetic operations, guard bits and truncation.

Unit-IV: Processor Architecture 06 Hours

Brief History of Intel Processors, 80386 DX Features and Architecture, Multiprocessor systems: Taxonomy of Parallel Processor Architectures, two types of MIMD clusters & SMP (organization & benefits) & multicore processor (various Alternatives & advantages of multicores), typical features of multi-core Intel Core i7.

Unit-V: 80386DX- Basic Programming Model and Instruction Set 06 Hours

Programmers Model, operating modes, addressing modes and data types. Applications Instruction Set- Data Movement Instructions, Binary Arithmetic Instructions, Decimal Arithmetic Instructions, Logical Instructions, Control Transfer Instructions, String and Character Transfer Instructions, Instructions for Block Structured Language, Flag Control Instructions, Coprocessor Interface Instructions, Segment Register Instructions, Miscellaneous Instructions.

Learning Resources:

Text Books:

1. “Modern Digital Electronics”, R.P. Jain, Tata McGraw-Hill, Third Edition.
2. W. Stallings, “Computer Organization and Architecture: Designing for performance”, Pearson Education /Prentice Hall of India, 2003, ISBN 978-93-325-1870-4, 7th Edition.
3. Douglas Hall, “Microprocessors & Interfacing”, McGraw Hill, Revised 2 Edition, 2006 ISBN 0-07-100462-9.

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.

5. Brey, Barry B, - 8086/8088, 80286, 80386 and 80486 Assembly Language Programming,Prentice Hall, ISBN: 13: 9780023142475.

E-Books

1. https://www.springer.com/gp/book/9783030361952
2. https://www.mheducation.co.uk/ebook-fundamentals-of-digital-logic-9780077144227-emea

Web link for MOOC / NPTEL Links:

1. Digital Circuits, by Prof. Santanu Chattopadhyay, https://swayam.gov.in/nd1_noc19_ee51/preview
2. Digital Circuits and Systems, Prof. S. Srinivasan. https://nptel.ac.in/courses/117/106/117106086
3. Microprocessors and Interfacing By Prof. Shaik Rafi Ahamed | IIT Guwahati https://swayam.gov.in/nd1_noc20_ee11/preview
4. Switching Circuits And Logic Design By Prof. Indranil Sengupta W. https://swayam.gov.in/nd1_noc20_cs67/preview

List of Practicals:

Group-A: (Any Seven)

1. Design and implement combinational circuits (Any 4).
2. Design and implement sequential circuits (Any 3).
3. Study of Shift registers (SISO, SIPO, PISO, PIPO).

Group-B: (Any Four)

Perform any four assignments of X86 assembly language programming.

Activity Based Learning (Suggested Activities In-Class):

1. Flipped Classrooms.
2. Virtual Laboratory.
3. Quizzes /Assignments.

Course Code: 161303	Course Name: Discrete Mathematics	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 2 Hours/Week	**2**	**CCE :** 40 Marks **ESE :** 60 Marks

Prerequisite Courses:

- Basic and Intermediate mathematics

Course Objectives:

- To use appropriate set, function, and relation models to understand practical examples, and interpret the associated operations and terminologies in context.
- Determine the number of logical possibilities of events.
- Learn logic and proof techniques to expand mathematical maturity.
- Formulate problems precisely, solve the problems, apply formal proof techniques, and explain the reasoning clearly.

Course Outcomes:

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

CO1: Solve problems by applying set theory, propositional logic, and formal proof techniques.

CO2: Illustrate problems logically by using function and relation models.

CO3: Analyze the number of possible outcomes using permutations and combinations.

CO4: Solve computing problems using appropriate graph and tree algorithms.

CO5: Evaluate algebraic structures and coding theory.

Course Contents

Unit-I: Set Theory and Logic **06 Hours**

Introduction and Significance of Discrete Mathematics in Computer Engineering.

Sets: Naïve Set Theory (Cantorian Set Theory), Axiomatic Set Theory, Need for Sets Representation, Operations, cardinality, types. Principle of inclusion and exclusion, Countability of Rational Numbers Using Cantor Diagonalization Argument, power set.

Propositional Logic: Logic, Propositional Equivalences, Application of Propositional Logic, Proof by Mathematical Induction, and Strong Mathematical Induction.

Case study: Alan Turing and the Birth of Modern Computation.

Unit-II: Relations and Functions **06 Hours**

Relations: Properties, n-ary Relations and Their Applications, Representation, Closures of Relations, Equivalence Relations, Partial Orderings, partitions, Hasse Diagram, Lattices, Chains and Ant chains, Transitive Closure and Warshall's Algorithm.

Functions: Surjective, Injective, and Bijective functions, Inverse Functions, Compositions of

Functions, The Pigeonhole Principle.

Case study: Relations and Functions in Operating System Process Management.

Unit-III: Permutations, Combinations and Discrete Probability 06 Hours

The Basics of Counting, rule of Sum and Product, Permutations and Combinations, Binomial Coefficients and Identities, Generalized Permutations and Combinations, Algorithms for generating Permutations and Combinations, Discrete Probability, Conditional Probability, Bayes' Theorem, Information and Mutual Information.

Case Study: Cryptography and Password Generation using Combinatorics and Probability.

Unit-IV: Graphs and Trees 06 Hours

Graphs: Graph models, terminology and special types, graph isomorphism, connectivity, Euler and Hamilton Paths, single source shortest path- Dijkstra's algorithm, planar graphs, graph Colouring.

Trees: Introduction, properties, Binary search tree, decision tree, prefix codes and Huffman coding, cut sets, Spanning Trees and Minimum Spanning Tree, Kruskal's and Prim's algorithms, The Max flow- Min Cut Theorem (Transport network).

Case Study: Social Network Graphs, Airline Route Optimization, Electric Circuit Design using Spanning Trees, Web Graph, Google Map, Game Tree, Mini-Max Tree.

Unit-V: Algebraic Structures and Coding Theory 06 Hours

The structure of algebra, Algebraic Systems, Semi Groups, Monoids, Groups, Homomorphism and Normal Subgroups, Rings, Integral Domains and Fields, coding theory, Polynomial Rings and polynomial Codes,

Case study: Cyclic Redundancy Check (CRC), Hamming codes, and Reed-Solomon codes in digital communication, Brief introduction to Galois Theory –Field Theory and Group Theory.

Learning Resources:

Text Books:

1. C. L. Liu and D. P. Mohapatra, "Elements of Discrete Mathematics", SiE Edition, Tata McGraw-Hill, 2008, ISBN 10:0-07-066913-9
2. R. Johnsonbaugh, "Discrete Mathematics", 5th Edition, Pearson Education, 200, ISBN 81 – 7808 – 279 – 9.

Reference Books:

1. N. Biggs, "Discrete Mathematics", 3rd Edition, Oxford University Press, ISBN 0 –19 –850717 – 8.
2. Kenneth H. Rosen, "Discrete Mathematics and its Applications", 6th edition, McGraw-Hill, 2007, ISBN 978-0-07-288008-3.
3. E. Goodaire and M. Parmenter, "Discrete Mathematics with Graph Theory", 2nd

edition, Pearson Education, 2003, ISBN 817808 8274.

4. Semyour Lipschutz & Marc Lipson, “Discrete Mathematics”, McGraw-Hill, 3rd Special Indian Edition, ISBN-13: 978-0-07-060174-1.
5. B. Kolman, R. Busby and S. Ross, “Discrete Mathematical Structures”, 4th Edition, Pearson Education, 2002, ISBN 81-7808-556-9.
6. N. Deo, “Graph Theory with Applications to Engineering and Computer Science”, Prentice Hall of India, 1990, 0 – 87692 – 145 – 4.

Weblink for MOOC / NPTEL Links:

1. Discrete Mathematics by Prof. Sudarshan Iyengar | IIT Ropar
   https://onlinecourses.nptel.ac.in/noc25_cs26/preview
2. Discrete Mathematics by Minirani S.
   https://onlinecourses.swayam2.ac.in/cec24_ma18/preview
3. Discrete Mathematics for CS by Prof. Nitin Saxena | IIT Kanpur
   https://onlinecourses.nptel.ac.in/noc25_cs27/preview

Activity Based Learning (Suggested Activities In-Class):

1. Flipped Classroom.
2. Gamification.
3. Online Interactive Tool.
4. Collaborative and Individual Problem based learning.
5. Quizzes/Assignment.

Course Code: 170304A	Course Name: Engineering Mathematics-III	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 2 Hours/Week	**2**	**CCE :** 40 Marks **ESE :** 60 Marks

Prerequisite Courses:

- Differential and Integral calculus, Differential equations of first order and first degree.

Course Objectives:

- To make the students familiarize with concepts and techniques in Ordinary Differential Equations, numerical methods, Laplace transform, Z-transform.
- To equip students with the techniques to understand advanced level mathematics and its applications that would enhance analytical thinking power, useful in their disciplines.

Course Outcomes:

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

CO1: Solve higher order linear differential equations using appropriate techniques.

CO2: Apply Laplace transform and Z-Transform to solve differential equations, difference equations.

CO3: Apply vector calculus concepts to analyze problems and solve system of linear equations by using numerical methods.

CO4: Analyze discrete and continuous random variables using Binomial, Poisson and Normal distributions.

CO5: Analyze data through hypothesis tests like Chi-square and *t*-tests.

Course Contents

Unit-I: Linear Differential Equations **04 Hours**

Linear Differential Equations (LDE) of n^{th} order with constant coefficients, complementary function, particular integral by using shortcut methods.

Unit-II: Transforms **06 Hours**

Laplace Transform: Laplace Transform, Inverse Laplace Transform & their theorems, Applications of LT for solving linear differential equations.

Z – Transform: Z-transforms and its region of convergence, properties of Z-transform, inverse Z-Transforms and its properties, application of Z-transform to solve difference equations.

Unit-III: Vector Calculus and Numerical Methods **08 Hours**

Vector Differentiation: Scalar and vector fields, vector differential operator, gradient,

divergence & curl, solenoid, irrotational and scalar potential.

Vector Integration: Line integrals, surface integrals, Gauss's divergence theorem and Stoke's theorem (without proof).

Interpolation: Newton's forward interpolation, Newton's backward interpolation, Lagrange's interpolation.

Solution to System of Linear Simultaneous Equations:

Direct method: Determinant method, matrix inversion method, Gauss-Jordan method, Gauss-elimination method.

Iterative method: Gauss Jacobi, Gauss –Seidel method.

Unit-IV: Probability 06 Hours

Introduction to probability, random variable, discrete random variable, continuous random variable, binomial distribution, Poisson distribution, normal distribution.

Unit-V: Sampling and Inference 06 Hours

Testing of hypothesis, null hypothesis, alternate hypothesis, critical region, two types of errors, level of significance, Chi-square test for the goodness of fit, Student's t-test for single mean.

Learning Resources:

Text Books:

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

Reference Books:

1. Advanced Engineering Mathematics by Erwin Kreyszig (Wiley Eastern Ltd.).
2. Advanced Engineering Mathematics by M. D. Greenberg (Pearson Education).
3. Advanced Engineering Mathematics by Peter V. O'Neil (Thomson Learning).
4. Thomas' Calculus by George B. Thomas, (Addison-Wesley, Pearson).

Weblink for MOOC / NPTEL Links:

1. Advanced Probability Theory by Prof. Niladri Chatterjee, IIT Delhi
   https://onlinecourses.nptel.ac.in/noc25_ma04/preview
2. Transform Calculus and its applications in DE by Prof. Adrijit Goswami, IIT Kharagpur
   https://onlinecourses.nptel.ac.in/noc25_ma56/preview
3. Numerical Methods by Prof. Ameeya Kumar Nayak, Prof. Sanjeev Kumar,IIT Roorkee
   https://onlinecourses.nptel.ac.in/noc25_ma83/preview

Course Code: 170404A	Course Name: Artificial Intelligence	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 2 Hours/Week	**2**	**CCE :** 40 Marks **ESE :** 60 Marks

Prerequisite Courses:

- Fundamentals of Programming Language.

Course Objectives:

- To introduce fundamental concepts of Artificial Intelligence (AI) and its real-world applications across various engineering domains.
- To explore problem-solving strategies using AI techniques such as search, logic, and decision-making.
- To familiarize students with the basics of machine learning and data-driven decision systems.
- To demonstrate how AI is used in engineering design, automation, prediction, and optimization.
- To enable students to appreciate ethical considerations and societal impact of AI in engineering.

Course Outcomes:

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

CO1: Explain the basic principles and scope of Artificial Intelligence and its relevance to different engineering disciplines.

CO2: Apply search algorithms for solving simple engineering problems.

CO3: Understand and differentiate between types of machine learning and data representations.

CO4: Identify and analyze AI applications in domains such as predictive maintenance, smart cities, automation, and control systems.

CO5: Recognize ethical, social, and professional issues in deploying AI solutions in engineering contexts.

Course Contents

Unit-I: Introduction to Artificial Intelligence **06 Hours**

Definition and scope, history and evolution of AI, AI in daily life and industry, relevance of AI to different engineering disciplines, basics of intelligent agents and environments.

Unit-II: AI Problem Solving and Search Techniques 06 Hours

Problem formulation and state space, Uninformed search (BFS, DFS), Informed search (Greedy, A*); **Use cases:** Path planning for robots, resource allocation in construction, fault detection in electrical circuits.

Unit-III: Fundamentals of Machine Learning 06 Hours

Supervised vs Unsupervised learning vs Reinforcement Learning, concept of training, testing and validation. **Common algorithms:** Regression, k-NN, k-means, Introduction to neural networks, **Applications:** Quality control, load forecasting, image classification, Introduction to AI Tools (e.g., Python, scikit-learn, TensorFlow overview/ Excel / Google Colab).

Unit-IV: AI Applications in Engineering Domains 06 Hours

AI in design and optimization (e.g., generative design), AI for predictive maintenance and diagnostics, smart manufacturing, building management systems and IoT, AI in traffic management and construction safety, AI in healthcare devices and embedded systems.

Unit-V: Ethical, Legal and Societal Aspects 06 Hours

AI and Ethics: Bias, fairness, and transparency, data privacy and security concerns.

Social Impact of Automation: Job displacement, decision accountability. Responsible AI practices and guidelines, regulatory aspects in India and globally (brief overview).

Learning Resources:

Text Books:

1. Artificial Intelligence, Elaine Rich, Kevin Knight, Shivashankar B. Nair, ISBN: 9780070087705, Tata McGraw-Hill Education, 2009.
2. Introduction to Machine Learning, Ethem Alpaydin, ISBN: 9780262028189, MIT Press, 2014.
3. Machine Learning, Tom M. Mitchell, ISBN: 9780070428072, McGraw-Hill, 1997.

Reference Books:

1. Artificial Intelligence: A Modern Approach, Stuart Russell and Peter Norvig, ISBN: 9780136042594, Pearson Education, 2010.
2. Introduction to Machine Learning with Python: A Guide for Data Scientists, Andreas C. Müller and Sarah Guido, ISBN: 9781449369415, O'Reilly Media, 2016.
3. The Elements of Statistical Learning, Trevor Hastie, Robert Tibshirani, and Jerome Friedman, ISBN: 9780387848570, Springer, 2009.
4. Deep Learning, Ian Goodfellow, Yoshua Bengio, and Aaron Courville, ISBN: 9780262035613, MIT Press, 2016.

Weblink for MOOC / NPTEL Links:

1. Google AI Education
   https://ai.google/education/

2. MIT OpenCourseWare – Artificial Intelligence
   https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-034-artificial-intelligence-fall-2020/
3. Coursera – AI For Everyone by Andrew Ng (Beginner Friendly)
   https://www.coursera.org/learn/ai-for-everyone
4. Microsoft Learn – AI Fundamentals
   https://learn.microsoft.com/en-us/training/paths/introduction-artificial-intelligence/
5. IBM SkillsBuild (Free Courses on AI & Data Science)
   https://skillsbuild.org/
6. Google Colab (for coding practice)
   https://colab.research.google.com/

Suggested In-Class Activities

Unit No.	Activity	Description
I	AI Around You	Group activity: Identify and present 5 real-life examples of AI in their domain (mechanical, civil, etc.).
II	Search Algorithm Simulation	Paper-based or Python/Excel simulation of BFS/DFS/A* for maze/pathfinding problems.
III	Hands-on with ML Tools	Use Google Colab to run a simple regression/classification example (k-NN or linear regression).
III	Model Demo with Data	Upload a dataset (e.g., student marks) and perform basic ML predictions in class.
IV	Domain Use Case Analysis	Groups present how AI is used in their engineering field (1 use case each).
V	Ethics Debate	Conduct a structured debate: *"Will AI lead to massive job loss in engineering?"*
V	AI Ethics Case Study	Review and discuss an AI failure (e.g., biased facial recognition, self-driving accidents).

Course Code: 171305A	Course Name: Intellectual Property Rights and Ethics	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Practical :** 2 Hours/Week	**3** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 25 Marks** **PR + OR : 25 Marks**

Prerequisite Courses:

- --.

Course Objectives:

- To understand basics of intellectual property rights (IPR).
- To learn copyright, trademarks and industrial design.
- To inculcate the ethical behaviour in the personal and professional lives.
- To facilitate the holistic development (life and profession) of students.

Course Outcomes:

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

CO1: Understand the basics of intellectual property rights.

CO2: Learn the patent filing process.

CO3: Understand the copyright/trademark/industrial design and filing process.

CO4: Understand the importance of ethics in their personal and professional life.

CO5: Learn the workplace responsibilities and rights as an engineer in the industry**.**

Course Content:

Unit-I: Introduction to IPR **08 Hours**

Concept of property, concept and relevance of IPR, importance of IPR in socio-economic development and technological innovation, prosecution of patent, patent infringement, geographical indications, patent search.

Unit-II: Contents of IPR **08 Hours**

Meaning of patent, concept of novelty, inventiveness and utility, inventions not patentable, process and product patents, prosecution of patent, patent infringement.

Patent search, IPR filing process and documents, IPR commercialization and portfolio management.

Unit-III: Copyrights and Trademarks **08 Hours**

Copyright: Meaning & scope, concept of originality.

Trademarks and Industrial Design: certification marks, property marks, well known marks, domain name protection.

Unit-IV: Ethics **08 Hours**

Concepts and principles, personal and professional ethics, emotional intelligence, code of conduct, roots of unethical behavior and ethics for engineers & managers.

Unit-V: Workplace Responsibilities and Rights **08 Hours**

Moral development, codes of ethics, ethical decision making, ethical dilemmas.

Learning Resources:

Text Books:

1. WeGo Library Foundation Book (2025): Top 16 Secrets of Wealth Creation by Patent
2. Prabuddha Ganguli, (2001): Intellectual Property Rights. Tata McGraw Hill.
3. Mayall, Industrial Design, McGraw Hill.

Reference Books:

1. W.R. Cornish, (2013): Intellectual Property: Patents, Copyright, Trade Marks and Allied Rights. Sweet and Max Well London
2. Fernando AC (2018). Business Ethics and Corporate Governance (2nd Ed). Pearson, Education India
3. Martin MW & Schinzinger R (2005). Ethics in Engineering (4th Ed). McGraw Hill.

Web link for MOOC / NPTEL Links:

1. https://ipindia.gov.in/
2. https://onlinecourses.nptel.ac.in/noc22_hs04/preview
3. https://nptel.ac.in/courses/127105008

List of Practicals:

1. Search any five product or process recent patents from Indian patent website, prepare and give the presentation on it.
2. Prepare the patent filing draft of any one process patent.
3. Prepare the patent filing draft of any one product patent.
4. Demonstrate the trademark for any five industrial designs based on market survey
5. Case study on copyright filing.
6. Case study on trademark/industrial design filing.

Course Code: 171305B	Course Name: Renewable Energy	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Practical :** 2 Hours/Week	**3** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 25 Marks** **PR + OR : 25 Marks**

Prerequisite Courses:

- Engineering Physics, Engineering Chemistry, Engineering Mathematics.

Course Objectives:

- To understand the principle of renewable energy generation such as hydro, solar, wind and bio-mass energy.
- To identify potential of renewable energy.
- To understand working of technologies to harness renewable energy.

Course Outcomes:

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

CO1: Describe the basics of renewable energy.

CO2: Explain the constructional details and working of hydro-electric power plant.

CO3: Describe the fundamentals and technology to harness solar energy.

CO4: Explain the wind energy conversion system.

CO5: Discuss the bio-energy conversion pathways.

Course Content:

Unit-I: Introduction to Renewable Energy **08 Hours**

Energy scenario in the World, energy scenario in India, need of renewable energy, scenario of renewable energy generation in India and government policies, fundamentals of hydro, solar, wind, biomass, geothermal, tidal, ocean thermal, magneto hydro-dynamic and hydrogen energy.

Unit-II: Hydroelectric Energy **08 Hours**

Basics of hydrology, Hydroelectric Power Plant (HEPP): Classification, site selection, types of turbines, spillways, surge tanks, advantages and disadvantages, major HEPPs in India, hydroelectric energy scenario in India.

Unit-III: Solar Energy **08 Hours**

Terminology, solar radiation data, solar energy collectors, solar energy storage, power conditioning equipment, economics of solar photovoltaic power plant, advantages and

disadvantages of solar energy, solar energy scenario in India.

Unit-IV: Wind Energy **08 Hours**

Wind availability data, basic components of wind mills, aerodynamics and design of wind turbine, performance operating characteristics, wind solar hybrid power plants, cost economics, wind energy scenario in India.

Unit-V: Biomass Energy **08 Hours**

Biomass types and characterization, biomass energy potential in India, Biomass energy pathways – chemical and thermal, conversion technologies - digester and gasifier, biofuels, biomass energy scenario in India.

Learning Resources:

Text Books:

1. R.K.Rajput, Power Plant Engineering, Laxmi Publications New Delhi.
2. G. D. Rai, Energy Sources, Khanna Publications.

Reference Books:

1. B. H. Khan, Non-Conventional Energy Sources, Second Edition. Tata Mc-Graw Hill.
2. S P Sukhatme and J P Nayak, Solar Energy: Principles of Thermal Collection and Storage, McGraw-Hill Education, 2017.
3. G. N. Tiwari, Solar Energy: Fundamentals, Design, Modelling and Applications, Alpha Science, 2002.
4. J. F. Manwell, J. G. McGowan and A. L. Rogers., Wind Energy Explained- Theory, Design and Application. John Wiley and Sons Ltd.
5. Prabir Basu, Biomass Gasification, Pyrolysis and Torrefaction, Academic Press, Elsevier, 2013.

Web link for MOOC / NPTEL Links:

1. https://nptel.ac.in/courses/103103206
2. https://nptel.ac.in/courses/103103207
3. https://nptel.ac.in/courses/108108078

Web References:

1. Website of International Energy Agency
   https://www.iea.org/energy-system/renewables
2. Website of Ministry of New and Renewable Energy
   https://mnre.gov.in/en/
3. India_2020_Energy_Policy
   https://iea.blob.core.windows.net/assets/2571ae38-c895-430e-8b62-bc19019c6807/India_2020_Energy_Policy_Review.pdf

List of Practicals:

1. Plotting of PV and IV curve of solar panel using simulation.
2. Finding Maximum Power Point Tracking (MPPT) of solar panel using simulation.
3. Design and component selection for solar photovoltaic power plant with net metering.
4. Measurement of wind speed using anemometer.
5. Visit to solar PV power plant / wind turbine power plant.
6. Visit to hydroelectric power plant / biomass power plant.
7. Case study on biomass digester or biomass gasifier and analysis of properties of products.
8. Case study on government policies on adoption of renewable energy.

Course Code: 171305C		Course Name: Health, Care and Management Systems
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Practical :** 2 Hours/Week	**3** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 25 Marks** **PR + OR : 25 Marks**

Prerequisite Courses:

- Basic of Biology and Human Body.

Course Objectives:

- To introduce the basics of human body systems relevant to healthcare.
- To understand common health issues and their engineering solutions.
- To explore biomedical instruments and hospital technologies.
- To gain awareness of digital healthcare systems and hospital management.

Course Outcomes:

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

CO1: Understand the structure and function of key human body systems relevant to healthcare and diagnosis.

CO2: Identify common health issues and explain their causes, symptoms.

CO3: Describe the working principles and applications of basic biomedical instruments used in diagnosis and monitoring.

CO4: Analyze the role of advanced medical devices and imaging systems in clinical decision-making and treatment.

CO5: Explain the components of hospital management system and significance of digital health technologies like Electronic Health Records (EHR), telemedicine and emergency tracking**.**

Course Content:

Unit-I: Introduction to Human Body Systems 08 Hours

Overview of Major Body Systems: Heart and blood circulation (Cardiovascular system), Breathing system (Respiratory system), Nervous system, Muscular system. Five senses. Working of eyes and ears. Kidney and its functions.

Unit-II: Common Health Problems and Causes 08 Hours

Health Issues Related to: Heart: Cardiac arrest, high/low blood pressure, Brain: Neurological disorders, Eye and ear: Vision issues, hearing loss, Lungs: Respiratory problems, Muscles:

Movement disorders, Blood flow. Kidneys: Kidney failure, Bones: Fractures.

Unit-III: Basic Engineering Devices in Healthcare 08 Hours

Electro-Cardiography (ECG), Blood pressure monitor, Electro-Encephalography (EEG), Eye tools: Visual Acuity, Ear tools: audiometer, Lung tools: Spirometer, Muscle activity: Electro-Myography (EMG), Blood flow meters, Dialysis machine (artificial kidney).

Unit-IV: Advanced Technologies in Hospitals 09 Hours

Digital X-ray machine, Pacemaker, Defibrillator, Ventilator, Ultrasound imaging, Computer Tomography (CT scan), Magnetic Resonance Imaging (MRI), Robotic-assisted surgery.

Unit-V: Hospital Management System 07 Hours

Patient registration process, Health records: paper-based vs. electronic, Software used in hospitals, Electronic Health Records, Telemetry and telemedicine, Emergency systems (e.g., ambulance tracking), Real-world examples of hospital IT systems.

Learning Resources:

Text Books:

1. R. S. Khandpur, Handbook of Biomedical Instrumentation, Tata McGraw Hill.
2. C. N. Chatterjee, Human Physiology (Vol 1 & 2), Medical Allied Agency.

Reference Books:

1. Leslie Cromwell, Biomedical Instrumentation and Measurements, Prentice-Hall of India.
2. John Enderle & Joseph Bronzino, Introduction to Biomedical Engg., Academic Press.
3. Anne Waugh & Allison Grant, Ross and Wilson Anatomy and Physiology in Health and Illness, Elsevier.

Web link for MOOC / NPTEL Links:

1. Biomedical Instrumentation
   https://nptel.ac.in/courses/108/105/108105101/
2. Human Anatomy and Physiology
   https://www.khanacademy.org/science/health-and-medicine
3. Coursera – Introduction to Medical Imaging
   https://www.coursera.org/learn/medical-imaging
4. Anatomy and medical illustration videos.
   https://www.youtube.com/@armandohasudungan
5. Simple demos of biomedical concepts.
   https://www.youtube.com/@BiomedicalEngineersTV/videos
6. WHO eLearning Resources https://openwho.org/

List of Practicals:

1. Measure your own blood pressure using a digital Sphygmomanometer/APP.
2. Record and analyze heart rate using a pulse sensor/App.
3. To study ECG waveform and understand its parts.
4. To study Spirometer and understand its waveforms
5. To study and understand EEG waveforms.
6. To study and understand EMG waveforms.
7. To study Audiometer and understand Audiogram.
8. Case study on Hospital Information Systems (any one): Patient Registration (using MS Excel), EHR, Telemedicine, Emergency Systems and Healthcare IT Tools.
9. Presentation / report on a visit to a nearby clinic, use of a Health App or study of a related healthcare facility.

Course Code: 171305D		Course Name: Smart City and Infrastructure
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Practical :** 2 Hours/Week	**3** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 25 Marks** **PR + OR : 25 Marks**

Prerequisite Courses:

- Basic of Computer Knowledge, Indian Knowledge System.

Course Objectives:

- To introduce the concept and components of smart cities, including infrastructure, technology and sustainability.
- To enable the students to apply the basic need and planning concept to solve various infrastructure problems such as transportation, water supply and waste management, etc.
- To apply emerging technologies such as IoT, GIS and data analytics in designing and developing smart city infrastructure solutions.
- To encourage critical thinking through case studies and real-world examples of smart city projects, focusing on challenges and best practices.

Course Outcomes:

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

CO1: Describe concept, features and components of smart cities with relevant examples.

CO2: Demonstrate the structure and regulatory mechanisms of smart city development in context of Indian and international benchmarks.

CO3: Apply GIS and remote sensing techniques for spatial analysis and infrastructure planning in smart cities.

CO4: Relate smart transportation technologies and their role in improving urban mobility and sustainability.

CO5: Suggest smart solutions for urban water, air and waste management using IoT technologies.

Course Content:

Unit-I: Introduction to Smart Cities **08 Hours**

Definition and key features of smart cities, smart infrastructure components, urban planning's role in smart cities, challenges and opportunities in smart city development, successful smart city case studies from around the World.

Unit-II: Planning and Development of Smart Cities **08 Hours**

Smart city mission of India, global standards and performance benchmarks, practice codes, smart city planning and development, financing smart cities development, governance of smart cities, SDG goals.

Unit-III: Applications of GIS and Remote Sensing **08 Hours**

Fundamentals of GIS and remote sensing, role of GIS in urban planning and development, spatial data analysis and visualization for smart cities, applications in infrastructure management: roads, utilities and land use.

Unit-IV: Smart Urban Transportation Infrastructure **08 Hours**

Smart transportation systems, Intelligent Transportation Systems (ITS): sensors and communication, AI and machine learning in traffic management, public transport integration with smart technologies, EV infrastructure and sustainable urban mobility, successful smart transportation project case studies.

Unit-V: Smart Technologies for Sanitation Infrastructure **08 Hours**

Water demand and supply planning in smart cities, smart water grids: real-time monitoring, IoT integration in water and sewer management, air quality management and smart solid waste management.

Learning Resources:

Text Books/Guidelines:

1. Smart Cities Mission, India: Localizing Sustainable Development Goals, UN-Habitat. MoHUA, GoI. 2023.
2. Smart Cities, Mission Statement & Guidelines, Ministry of Urban Development Government of India, June 2015.

Reference Books:

1. Role of Edge Analytics on Sustainable Smart City Development: Challenges and Solutions by G. R. Kanagachidambaresan.
2. Solving Urban Infrastructure Problems Using Smart City Technologies: Handbook on Planning, Design, Development, and Regulation by John R. Vacca.
3. Sustainable Smart Cities in India: Challenges and Future Perspectives (The Urban Book Series) by Poonam Sharma and Swati Rajput.
4. Smart Cities: Big Data, Civic Hackers, and the Quest for a New Utopia by Anthony M. Townsend.
5. GIS for Urban and Regional Planning by Peter O'Connell.
6. Artificial Intelligence in the 21st Century by Stephen Lucci and Danny Kopec.
7. Internet of Things for Smart Cities: Technologies, Big Data and Security by Zaigham

Mahmood.

Web link for MOOC / NPTEL Links:

1. https://onlinecourses.swayam2.ac.in/ntr25_ed38/preview
2. https://www.edx.org/learn/urban-planning/world-bank-group-e-learning-course-on-smart-city?index=product&queryId=5033b061a1acb99dd13abd8a53491c99&position=1
3. https://www.coursera.org/learn/smart-cities

List of Practicals/Assignments:

1. Prepare a report and presentation on a selected Indian smart city.
2. Analyze and evaluate smart city governance structures and funding models, highlighting major strategies, strengths, and concerns.
3. Introduction to GIS and remote sensing in smart city planning
4. Prepare a case study report on how AI and Machine Learning are used for traffic congestion management in a smart city project.
5. Identify the applications for smart solid waste management with IoT.
6. Introduction to EPANET software and its application in smart city development.
7. Field visit at smart city project and prepare technical report.
8. Mini Project: Identify problems in the infrastructure facility of city and propose a smart solution for the identified problem.

Course Code: 172306	Course Name: Entrepreneurship Development	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Tutorial : 2 Hours/Week	**2**	**TW :** 50 Marks

Prerequisite Courses:

- Professional Communication Skills.

Course Objectives:

- To equip to recognize the importance of entrepreneurship in economic and social development.
- To assist students in validating innovative business ideas.
- To inculcate principles of financial feasibility, revenue model, and funding options in an entrepreneurial context.
- To facilitate to pitch the business ideas effectively and develop a structured business plan.

Course Outcomes:

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

CO1: Explain the concept of entrepreneurship and its importance in economic and social development.

CO2: Identify, evaluate, and validate innovative business ideas using market research techniques.

CO3: Analyze startup funding options, revenue models, and financial feasibility of new businesses.

CO4: Demonstrate the ability to pitch business ideas effectively to potential stakeholders.

CO5: Develop a structured business plan incorporating all key aspects of entrepreneurship**.**

Course Content:

Unit-I: Understanding Entrepreneurship 04 Hours

Definition and importance of entrepreneurship, characteristics of successful entrepreneurs, types of entrepreneurs (innovators, imitators, social entrepreneurs, corporate entrepreneurs, etc.), entrepreneurial mindset and problem-solving approach, startup ecosystem in India – govt. Schemes (Startup India, Mudra, etc.).

Unit-II: Business Idea Generation and Validation 04 Hours

Sources of business ideas (personal experience, market gaps, innovations, etc.), design thinking approach to problem solving, concept of ideation, prototyping and experimentation, feasibility

analysis: market feasibility, technical feasibility, financial feasibility.

Unit-III: Market Research and Business Model Canvas 04 Hours

Introduction to market research – primary vs. Secondary data, competitive analysis and market segmentation, understanding customer pain points and buying behavior, business model canvas and lean startup approach.

Unit-IV: Startup Finance and Funding 04 Hours

Introduction to startup funding (bootstrapping, angel investment, VC, IPO), revenue models and financial planning for startups, break-even analysis and risk management in startups.

Unit-V: Pitching and Business Prototyping 04 Hours

Essentials of a good startup pitch, how to develop a prototype or Minimum Viable Product (MVP), how to persuade investors and customers.

Learning Resources:

Text Books:

1. Entrepreneurship Development and Small Business Enterprises – Poornima M. Charantimath. Pearson Publication.
2. Innovation and Entrepreneurship – Peter F. Drucker, Harper Business.
3. Startup Success: The Indian Way – Prachi Garg, Bloomsbury India.
4. Entrepreneurship: New Venture Creation – David H. Holt, Prentice Hall India

Reference Books:

1. Entrepreneurship: Theory, Process, and Practice – Donald F. Kuratko and T.V. Rao, Cengage India.
2. Make in India: The Road Ahead – I.K. Menon, Rupa Publications.

Web link for MOOC / NPTEL Links:

1. Steve Jobs' Stanford Commencement Speech. www.www.youtube.com/watch?v=Hd_ptbiPoXM.
2. How to Generate Business Ideas. www.onlinecourses.nptel.ac.in/noc21_mg63/preview
3. Business Model Canvas Explained. www.youtube.com/watch?v=z6-Ly8Bl4Hc
4. Basics of Startup Funding. www.razorpay.com/blog/business-banking/all-about-startup-funding/
5. How to Pitch a Startup Idea. www.onlinecourses.nptel.ac.in/noc25_ge11/preview..

List of Activities:

1. **Meet the Entrepreneur – Guest Lecture and Interview**: Arrange an interactive session with a local entrepreneur. Students will prepare interview questions, conduct discussions, and submit a report. Expected Outcome: Understanding real-world

entrepreneurial challenges and decision making. Case Study: Dhirubhai Ambani – The Entrepreneurial Journey.

2. **Idea Lab – Brainstorming and Idea Pitching:** Students will brainstorm ideas, assess feasibility, and pitch concepts. Expected Outcome: Enhanced creativity, ability to identify opportunities. Case Study: Airbnb's Pivot Story.
3. **Market Pulse – Conducting a Market Survey: S**tudents will conduct market surveys, analyse responses, and interpret insights. Expected Outcome: Understanding of market demand and consumer preferences. Case Study: Zomato's Market Entry Strategy
4. **Investor's Desk – Creating a Business Plan and Financial Projection:** Students draft a business plan with basic financial estimates. Expected Outcome: Understanding financial viability of a startup. Case Study: OYO Rooms – Funding Rounds
5. **Startup Shark Tank – Business Pitch Presentation:** Students prepare and present a business pitch to a jury. Expected Outcome: Confidence in pitching ideas and persuasive communication. Case Study: Shark Tank Success Stories.

Course Code: 172406	Course Name: Business Economics	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Tutorial : 2 Hours/Week	**2**	**TW :** 50 Marks

Prerequisite Courses:

- Professional Communication Skills.

Course Objectives:

- To equip students to recognize the importance of economics and business decision-making.
- To assist students in applying demand, supply principles, and pricing strategies.
- To inculcate the understanding of cost–structure, profitability, and break–even points from the business perspective.
- To facilitate the students to understand the real-life business eco-system.

Course Outcomes:

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

CO1: Understand the role of economics in business decision-making and analyze real-world economic scenarios.

CO2: Apply demand and supply principles to determine market equilibrium and pricing strategies.

CO3: Analyze cost structures, profitability and break-even points in business operations.

CO4: Evaluate the impact of business cycles, inflation, and government economic policies on industries.

CO5: Develop pricing strategies based on competitive analysis and consumer demand**.**

Course Content:

Unit-I: Basics of Business Economics **04 Hours**

Introduction to micro and macro-economics, concept of scarcity, choice and opportunity cost, role of economics in business decision making, real-world applications in Indian industries.

Unit-II: Demand, Supply and Market Equilibrium **04 Hours**

Law of demand and supply, elasticity of demand and its business implications, market equilibrium and price determination, case studies on demand forecasting.

Unit-III: Cost, Revenue and Profitability **04 Hours**

Types of costs – fixed, variable, marginal costs, break-even analysis and profit maximization

strategies.

Unit-IV: Business Cycles and Economic Policies 04 Hours

Understanding inflation, recession, boom cycles, impact of govt. policies on business and economy.

Unit-V: Pricing Strategies and Competition 04 Hours

Pricing strategies – skimming, penetration, cost-based pricing, other pricing strategies, understanding market structures – monopoly, oligopoly and perfect competition.

Learning Resources:

Text Books:

1. Managerial Economics – D.N. Dwivedi, Vikas Publishing.
2. Business Economics – H.L. Ahuja, Publication by S. Chand.
3. Microeconomics for Business – Satya P. Das, Oxford University Press India.
4. Macroeconomics for Managers – Shankar Acharya, Sage Publications.

Reference Books:

1. Indian Economy – Ramesh Singh, McGraw Hill.
2. Economic Environment of Business – Veena Keshav Pailwar, PHI Learning.

Web link for MOOC / NPTEL Links:

1. Introduction to Business Economics – NPTEL Lecture by IIT Madras. https://nptel.ac.in/courses/130106118.
2. How Economic Principles Shape India's Startup Ecosystem" – Published in the Economic Times. https://economictimes.indiatimes.com/tech/startups/national-startup-day-2025-how-nine-years-of-policies-shaped-indias-startup-ecosystem/articleshow/117291674.cms?from=mdr
3. Law of Demand and Supply Explained with Real-Life Examples" – Dr. Vivek Bindra. https://www.youtube.com/playlist?list=PLOxBmXq4mdMOd3RQ3bAWxz8siZ4pnOtjI
4. How Patanjali Capitalized on Demand Elasticity to Dominate Indian FMCG Market" – Business Standard. https://www.business-standard.com/article/management/the-patanjali-effect-116020800204_1.html
5. Break-Even Analysis and Its Business Applications – Harvard Business Review. https://hbr.org/2014/07/a-quick-guide-to-breakeven-analysis
6. How Indian Airlines Manage Costs and Profit Margins – The Hindu Business Line. https://www.thehindubusinessline.com/economy/logistics/will-indian-aviation-market-turn-profitable-as-it-heads-towards-duopoly/article67453093.ece

7. Business Cycles Explained with Real-Life Examples – NPTEL Economics. https://www.investopedia.com/terms/b/businesscycle.asp
8. Indian Government's Response to Economic Slowdowns: A Policy Review – Economic Survey of India. https://www.indiabudget.gov.in/budget2024-25/economicsurvey/doc/echapter.pdf
9. Types of Market Structures and Their Business Implications – Investopedia. https://www.investopedia.com/terms/m/market.asp
10. Indian Government's Response to Economic Slowdowns: A Policy Review – Economic Survey of India. https://www.indiabudget.gov.in/budget2024-25/economicsurvey/doc/echapter.pdf.

List of Activities:

1. **Economic Detective – Identifying Economic Principles in Real Businesses:** Students analyze news reports to find economic applications. Expected Outcome: Understanding economic impact on business. Case Study: "How Amul Uses Economic Principles for Business Expansion" – Discusses pricing strategies, production decisions, and supply chain management.
2. **Local Market Analysis – Demand-Supply Survey:** Students visit local markets to analyse pricing and customer behavior. Expected Outcome: Real-world application of demand-supply principles. Case Study: "Why Uber Uses Surge Pricing: A Demand and Supply Analysis.
3. **Profit Calculator – Cost and Revenue Analysis:** Students analyze cost structures of local businesses. Expected Outcome: Practical understanding of business profitability. Case Study: How Swiggy and Zomato Optimize Costs and Pricing to Stay Profitable.
4. **Economic Trends Report – Analysing GDP and Policies:** Students analyse recent economic trends and policies. Expected Outcome: Awareness of macroeconomic factors affecting business. Case Study: "How the 2008 Global Financial Crisis Impacted Indian Startups.
5. **Competitive Pricing Challenge – Designing a Pricing Strategy:** Students set competitive prices for a product and justify pricing. Expected Outcome: Real-world pricing strategy application. Case Study: Why Jio's Pricing Strategy Disrupted the Indian Telecom Market.

Course Code: 173307	Course Name: Universal Human Values	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Practical : 2 Hours/Week **Tutorial** : 1 Hour/Week	**2**	**TW** : 50 Marks

Prerequisite Courses:

- UHV-I (Student Induction Program).

Course Objectives:

- To equip students to recognize the harmony between "VALUES" and "SKILLS" for success and long-term fulfillment.
- To assist students to initiate an internal dialogue process to determine their true goals for their lives and careers.
- To inculcate principles of harmonious living within the family and society and to apply effective strategies for fostering trust, respect, and ethical values in interpersonal relationships.
- To facilitate the students to understand harmony at all the levels of human existence.
- To prepare students for the natural acceptance of human values and transform towards value based life.

Course Outcomes:

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

CO1: Explore a holistic vision of life, including the self and surroundings.

CO2: Recognize the co-existence of self, realize harmony, and comprehend the true happiness.

CO3: Apply strategies that foster harmony in family and society through effective communication and relationship-building to cultivate social well-being.

CO4: Execute self-regulations to mutually fulfilling human behavior and enriching interaction with nature to realize harmony.

CO5: Emphasize the implications of a holistic approach in terms of ethical human conduct, and transit towards value based life**.**

Course Contents:

Unit-I: Introduction to Value Education 06 Hours

Overview of UHV-I (SIP) to highlight basic Universal human values truth (satya), peace (shanti), love (prem), nonviolence (ahimsa), scientific temper, citizenship values, and also life-skills; character, seva/service (social), education to be ethical, rational, compassionate, and caring, gainful and fulfilling employment.

Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education) Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Happiness and Prosperity – Current Scenario, Method to Fulfil the Basic Human Aspirations.

Practice Sessions (Any Two):

1. **Self-Reflection** – Writing daily reflections on happiness, prosperity, and relationships.
2. **Natural acceptance** – Exploring natural acceptance.
3. **Human consciousness** – Exploring human consciousness
4. **Case Study Analysis** – Analyzing real-life scenarios related to materialism, relationships, and inner happiness.

Unit-II: Harmony in the Human Being 06 Hours

Human beings are more than just the body, harmony of the self with the body, understanding myself as co-existence of the self and the body, understanding needs of the self and the needs of the body, understanding the activities in the self and the activities in the body.

Practice Sessions (Any Two):

1. **Self-Introductory** – Introduce yourself in detail, your goals and plans to achieve goals in life.
2. **Group Discussion –** How do you differentiate right and wrong? What have been your achievements and shortcomings in your life? Observe and analyze them?
3. **Need of Self and Body** – Explore the difference in need of self and body.
4. **Harmony in Self and Body** – Exploring harmony of self with the body.

Unit-III: Harmony in the Family and in Society 06 Hours

Family Harmony and Well-Being, Trust – The Core Foundation of Relationships, Respect – Proper Acknowledgment and Appreciation, Ethical Values in Interpersonal Relationships, Comprehending Social Harmony, Aspirations for a Universal Human Order, Key Aspects of the Human Order, The Five Pillars of Human Organization.

Practice Sessions (Any Two):

1. **Role-Playing** – Exercise on Family Communication & Conflict Resolution,
2. **Group Discussion** – Exploring the feeling of trust and respect, trust-building activities

in personal and professional relationships.

3. **Debate** – Debate on social harmony and universal human order.
4. **Human Goal** – Exploring Systems to fulfil Human Goal.

Unit-IV: Harmony in Nature/Existence 06 Hours

Understanding harmony in nature, self-regulation, and mutual fulfillment among the four orders of nature, realizing existence as coexistence, and holistic perception of harmony in existence.

Practice Sessions (Any Two):

1. **Orders of Nature** – Exploring the four orders of nature.
2. **Harmony in Nature** – Discussion on harmony in nature.
3. **Self-expression** – On Exploring co-existence in existence.
4. **Discussion** – Self-regulation and mutual fulfillment among the four orders of nature.

Unit-V: Implications of Holistic Understanding: A Look at Professional Ethics 06 Hours

Natural acceptance of human values, definitiveness of ethical human conduct, a basis for humanistic education, humanistic constitution and universal human order, competence in professional ethics, holistic technologies, production systems and management models-typical case studies, strategies for transition towards value-based life and profession.

Practice Sessions (Any Two):

1. **Discussion** – Exploring ethical human conduct.
2. **Humanistic Models** – in education.
3. **Case Studies** – Holistic technologies, production systems and management models.
4. **Transformation** – Steps of transition towards universal human order.

Learning Resources:

Text Books:

1. An Introduction to Indian Philosophy, Chatterjee, S.G. and Datta, D.M., University of Calcutta Press, 1960.
2. Manav Vyavahar Darshan, Nagraj A., Jeevan Vidya Prakashan, 3rd edition,2003.
3. A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2019 (2nd Revised Edition),. ISBN 978-93-87034-47-1, Excel Books, New Delhi
4. Professional ethics and Human Values, R. S. Naagarazan, New age International publishers
5. The Textbook A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034- 47-1.

6. The Teacher‟s Manual for A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G.
7. Harmony in the House: A Family Values Model by David A. Stallman. ECHOES Press -David A. Stallman; 1st edition (7 June 2013)
8. Professional Ethics and Human Values, Premvir Kapoor, ISBN: 978-93-86173-652, Khanna Book Publishing Company, New Delhi, 2022.

Reference Books:

1. Human Values and Professional Ethics – R. R. Gaur, Rajeev Sangal, G.P. Bagaria, Excel Books, New Delhi
2. Vyavaharvadi Samajshastra, Nagraj,A., Jeevan Vidya Prakashan, 2nd edition, 2009.
3. Sociology & Economics for Engineers, Premvir Kapoor, Khanna Publishing House, New Delhi, 2018
4. Human Values, 2003, A. N. Tripathy, New age International Publishers
5. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amar kantak, 1999.
6. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
7. The Story of Stuff by Annie Leonard, Publisher Simon and Schuster
8. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi Public Affairs Press of Washington, D.C.
9. Small is Beautiful - E. F Schumacher. Publisher Harper Collins
10. Slow is Beautiful - Cecile Andrews, New Society Publishers
11. Economy of Permanence - J C Kumarappa, Sarva Seva Sangh Prakashan
12. Bharat Mein Angreji Raj – Pandit Sunderla, Prabhat Prakashan, New Delhi
13. Rediscovering India - by Dharampal, SIDH, Mussoorie, 2003.
14. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi, Navajivan Publishing House, Ahemadabad 380014, Gujarat, India
15. India Wins Freedom - Maulana Abdul Kalam Azad, published in 1988 by Orient BlackSwan
16. Vivekananda - Romain Rolland (English) Advaita Ashram, Calcutta
17. Gandhi - Romain Rolland (English) Shiva lal Agarwala & company, Agra.

Web link for MOOC / NPTEL Links:

1. https://nptel.ac.in/courses/109104068
2. https://onlinecourses.nptel.ac.in/noc24_hs169/preview
3. https://archive.nptel.ac.in/content/syllabus_pdf/109104068
4. https://www.skillindiadigital.gov.in/courses/detail/d7db86f0-d2d8-42aa-a8c0-502467563b5a
5. https://uhv.org.in/

Tutorial and Term Work:

Term work shall be consists of following 08 activities from PART-A and 10 short reports from PART-B.

PART-A

1. **Digital Detox Experiment:** Avoiding social media and unnecessary digital distractions for a day and reflecting on mental clarity and happiness.
2. **Community Interaction Task:** Engaging with different social groups to understand diverse perspectives on happiness and prosperity.
3. **Health Awareness Program:** List down all your important desires. Observe whether the desire is related to Self (I) or the Body
4. **Role playing activity:** Make a chart to show the whole existence as co-existence. With the help of this chart try to identify the role and the scope of some of the courses of your study
5. **Family Dialogue Circle:** Participants engage in a structured conversation where they assume different family roles and practice active listening, empathy, and resolution strategies.
6. **Blindfold Trust Walk:** Participants pair up, with one guiding a blindfolded partner through obstacles to build trust and reliance.
7. **Reduce Waste:** Plastic / E-Waste / Medical/Hospital Waste/Pharmaceutical/Industrial Waste and its Management
8. **Value-based Life:** Strategies for Transition towards Value-based Life and Profession.

PART-B

Total 10 reports in brief, of practice session (02 from each unit).

Course Code: 173407	Course Name: Environmental Studies	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Practical : 2 Hours/Week **Tutorial** : 1 Hour/Week	**2**	**TW** : 50 Marks

Prerequisite Courses:

- Basic Science.

Course Objectives:

- To describe the scope, importance and need for public awareness of environmental studies and natural resources.
- To explain the structure, function, and diversity of ecosystems and biodiversity, along with related case studies.
- To identify the causes, effects, and control measures of various types of environmental pollution.
- To discuss major environmental and social issues, policies, and acts related to sustainable development.
- To observe and document environmental features, pollution sites, and ecosystems through field visits.

Course Outcomes:

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

CO1: Describe the importance of environmental studies and the sustainable use of natural resources.

CO2: Explain the structure and function of ecosystems and the significance of biodiversity.

CO3: Identify various types of environmental pollution and their control measures.

CO4: Discuss key environmental issues, policies and their impact on society.

CO5: Observe and report environmental conditions and features through field activities**.**

Course Content:

Unit-I: Introduction to Environmental Studies **06 Hours**

Definition, scope and importance, components of environment, Need for Public awareness, Natural Resources: Renewable and non- renewable resources: Natural resources and associated problems a) Forest b) Water c) Mineral d) Food e) Land f) Energy. Role of an individual in conservation of natural resources, use of resources for sustainable lifestyle.

Unit-II: Ecosystems and Biodiversity **06 Hours**

Ecosystems: Concept of an ecosystem, structure and function of an ecosystem, producers,

consumers and decomposer, energy flow in the ecosystem, ecological succession, food chains, food webs and ecological pyramids, characteristic features, case study on forest ecosystem, aquatic ecosystem.

Biodiversity: Introduction – definition: genetic, species and ecosystem diversity, biogeographical classification of India, value of biodiversity: consumptive use, productive use, social, ethical, aesthetic values, biodiversity at global, national and local levels, India as a mega-diversity nation, hotspots of biodiversity, threats to biodiversity, conservation of biodiversity, case study on any one hotspot of biodiversity.

Unit-III: Environmental Pollution 06 Hours

Definition, cause, effects and control measures of different pollution: a) Air, b) Water, c) Soil, d) Noise, e) Thermal, f) Nuclear hazards, industrial pollution and control, solid waste management: control measures of urban and industrial waste, role of an individual in prevention of pollution. Case studies.

Unit-IV: Environment and Social Issues 06 Hours

Environment from unsustainable to sustainable development, urban problems related to energy water conservation, rainwater harvesting, watershed management, resettlement and rehabilitation of people: its problems and concerns, case studies, environmental ethics: issues and possible solutions, climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies, wasteland reclamation, consumerism and waste products. Environment (protection) act, air (prevention and control of pollution) act, water (prevention and control of pollution) act, wildlife (protection) act, forest (conservation) act, issues involved in enforcement of environmental legislation, public awareness.

Unit-V: Field Wok 06 Hours

Visit to water treatment plant/Municipal solid waste treatment plant and detail report on it.

Visit to an area to document environmental assets; river/forest/flora/fauna, etc.

Visit to a local polluted site – Urban/Rural/Industrial/Agricultural.

Study of common plants, insects, birds and basic principles of identification.

Learning Resources:

Text Books:

1. Environmental Studies, Erach Bharucha, University Grants Commission, New Delhi
2. Environmental Science, Y. K. Singh, New Age International Publishers, 2006, .
3. Environmental Studies: From Crisis to Cure, Rajagopalan R., Oxford University Press, USA, ISBN:9780199459759, 0199459754.
4. A text book of Environmental Science, Shashi Chawla, Tata Mc Graw-Hill New Delhi

5. A Text Book of Environmental science, Arvind Kumar, APH Publishing New Delhi.

Web link for MOOC / NPTEL Links:

1. Challenges to Sustainable Development: https://www.un.org/en/development/desa/financial-crisis/sustainable-development.html
2. NPTEL course on sustainable development: https://nptel.ac.in/courses/109105190
3. Swayam Course on Environmental studies (Natural Resources, Biodiversity and other topics): https://onlinecourses.swayam2.ac.in/cec19_bt03/preview
4. NPTEL course on environmental studies which encompasses SDGs, Pollution, Climate issues, Energy, Policies and legal framework: https://onlinecourses.nptel.ac.in/noc23_hs155/preview
5. SWOT analysis of Biodiversity: https://www.cbd.int/development
6. India's Strategies to progress across the SDGs.: https://sustainabledevelopment.un.org/memberstates/india
7. IGNOU's Initiative for online study material on Environmental studies: https://egyankosh.ac.in/handle/123456789/61136
8. IGNOU's Initiative for online study material on sustainability: https://egyankosh.ac.in/handle/123456789/50898
9. United Nation's website mentioning Sustainability goals: https://sdgs.un.org/goals
10. Green Belt Movement's work on tree plantation, soil conservation and watershed management techniques: http://www.greenbeltmovement.org/what-we-do/tree-planting-for-watersheds

List of Activities:

Part-A: Assignments

1. Study and report on the role of individuals in conserving natural resource or engineering material.
2. Research and write a case study on one biodiversity hotspot in India. Include location, species richness, threats, and conservation efforts.
3. Choose one type of pollution (e.g., air or water or soil) and illustrate/analyse its causes, effects, and possible control measures in your city or town.
4. Prepare a presentation on any one issue: global warming, climate change, acid rain, or ozone depletion. Include current data and case studies.

Part-B: Field Work

5. Visit a water treatment plant or municipal waste treatment plant. Submit a detailed report with process description and photos/diagrams.

6. Visit to an area to document environmental assets; river/forest/flora/fauna, etc.
7. Report on a local polluted site – Urban/Rural/Industrial/Agricultural.
8. Study of common plants, insects, birds and basic principles of identification.

Part-C: Project/Activity

9. Branch-specific environmental studies/sustainability related Project/Activity.

Part-D: Report

10. Document your active participation in an environmentally friendly or sustainability-related activity, highlighting your role, the engineering relevance, and the impact of the initiative on promoting sustainable practices.

Course Code: 161308	Course Name: Community Engagement / Field Projects	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Practical : 4 Hours/Week	**2**	**TW** : 50 Marks

Prerequisite Courses:

- Professional Communication Skills, Programming and Problem Solving.

Course Objectives:

- To enhance the quality of teaching learning by bridging the gap between theory and practice through community engagement.
- To promote strong interactions between educational institutions and local communities for detection and solution of real-life problems.
- To create awareness about social responsibility to develop empathy for complex global challenges.
- To recognize the need for research and innovations in collaboration with society through community-based research methods.
- To catalyze the acquisition of values of public service and inculcate citizenship among the students.
- To involve educational institutions with local communities in order to make the curriculum, courses, and pedagogies more appropriate to achieve the goals of national development.

Course Outcomes:

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

CO1: Explore relevance between theory and practice through community-based problem learning.

CO2: Identify real-life socio-technical problems and develop the solution.

CO3: Implement a wisdom of empathy and social responsibility to meet complex global challenges.

CO4: Develop innovative ideas in collaboration with society through community-based research methods.

CO5: Analyze the need of research projects and develop a plan for betterment of public service values through active citizenship**.**

Course Contents:

A community engagement / field project is essential for second-year engineering students as it

bridges the gap between theoretical knowledge and real-world application. At this stage, students have gained foundational technical skills, and engaging with the community allows them to apply these skills to address practical challenges faced by society. It fosters a sense of social responsibility, encouraging students to consider the human and environmental impact of engineering solutions. Moreover, such projects help develop vital soft skills like communication, teamwork, and problem-solving, as students interact with diverse groups and learn to explain complex ideas in simple terms. By working on real-life issues, students also enhance their creativity and innovation, preparing them for future professional roles while contributing positively to their communities.

Guidelines for Conduction:

1. Formation of groups: 4 to 5 students /group.
2. Identification of one student representative for each class (if required).
3. Identification of communities (sectors / villages / nearby vicinity) as per the students' skills under respective departments.
4. Collection of different ideas or real-world problem statements from students through any open platform (Google forms / spreadsheets / handwritten applications).
5. Allocation of groups to an identified community (sectors / villages / nearby vicinity).
6. Allocating a faculty / mentor to a group. It is expected that a mentor can get assigned to a maximum three groups.
7. Students will be allowed to visit communities (sectors / villages / nearby vicinity) once in a week with prior permission.
8. Mentors can monitor field work and progress of projects through worksheets circulated by the coordinator.
9. Coordinator will keep a record of spreadsheets / reports / evaluation sheets.
10. Mentors are expected to approve the real-world problem and to encourage students to provide some solution / representation of a problem / volunteer-ship to any activity conducted by government / responsible authorities.
11. Mentors will collect all the project reports submitted by each group.

Guidelines for Evaluations:

1. Evaluation to be done based on the active participation of the student and marks could be awarded. For the community engagement project each student must get engaged and the coordinator / mentor must evaluate the projects / groups as well as the individual student twice in a semester. Mid-term evaluation must be done internally while end semester evaluation will be done by domain experts in specific domains or any other expert in the field. The average of these two evaluations will be considered as final

evaluation.

2. Students must represent a problem through power point presentations / posters / reels / short movies or any other effective media.
3. Project report shall be submitted by each group. Other than these, any required innovative process to make CEP effective and easy learning for students should be incorporated.

Guidelines for Students:

1. Community Engagement / Field Project is an opportunity for students to step out of their comfort zone, use knowledge, energy and creativity to contribute meaningfully to society.
2. It is an opportunity to discover the human side of engineering. Project reports shall be submitted by each student/group of students. All the students are expected to follow the phase wise instructions given by their CEP Coordinator / mentor.

Learning Resources:

Reference Books:

1. James Jacob W., Stewart E. Sutin, John C. Weidman, John L. Yeager, 2015, A Community Engagement in Higher Education: Policy Reforms and Practice, Sense publisher.
2. Jane Krauss, Suzanne K. Boss, Thinking Through Project-Based Learning: Guiding Deeper Inquiry.
3. John Larmer and Suzie Boss, Project Based Teaching: How to Create Rigorous and Engaging Learning Experiences.
4. John Larmer, John R. Mergendoller, and Suzie Boss, 2013, Setting the Standard for Project Based Learning, Corwin Press.
5. Suzie Boss, Jane Krauss, Leslie Conery, Reinventing Project-Based Learning: Your Field Guide to Real-World Projects in the Digital Age, 2007, Int'l Society for Tech. in Education.
6. Judyth Sachs, Lindie Clark, 2017, Learning Through Community Engagement Vision and Practice in Higher Education, Springer Singapore.

Web link for MOOC / NPTEL Links:

1. https://onlinecourses.swayam2.ac.in/ugc25_ge01/preview.
2. https://www.uvm.edu/sites/default/files/community_engagement_handout.pdf

Semester - IV

Course Code: 161401	Course Name: Operating Systems	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 2 Hours/Week **Practical :** 2 Hours/Week	**2** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 25 Marks** **PR + OR : 25 Marks**

Prerequisite Courses:

- Computer Organization and Architecture.
- Fundamentals of Data Structures.

Course Objectives:

- Understand operating system objectives, design, and architectures with Linux shell scripting.
- Learn process and thread management, scheduling, and thread programming.
- Explore synchronization, deadlock handling, and concurrency solutions.
- Study memory management techniques like paging and virtual memory.
- Understand I/O management, disk scheduling, and file systems.

Course Outcomes:

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

CO1: Analyze the role and functions of an Operating System in resource management.

CO2: Apply process/thread scheduling algorithms in operating systems.

CO3: Implement process synchronization techniques.

CO4: Evaluate memory management techniques for optimization.

CO5: Compare I/O management, disk scheduling, and file system techniques.

Course Contents

Unit-I: Foundations of Operating Systems **05 Hours**

Operating System Objectives, The Evolution of Operating System, OS Design Considerations for Multiprocessor and Multicore OS, Architectures of Operating System: Monolithic, Microkernel, Exokernel, Linux OS: Basic Shell Commands, Shell Scripting using BASH.

Unit-II: Process and Thread Management **08 Hours**

Process: Process Concept, Process States, Process Control Block, Process Description

Threads: Process and Threads, Basic types of threads, Multithreading, Thread Programming using thread library APIs.

Process Scheduling: Types of Scheduling, Scheduling Criteria, Scheduling Algorithms: First-Come First- Served, Shortest-Job-First, Priority, Round Robin.

Case Study: Scheduling Mechanisms in Linux.

Unit-III: Synchronization and Deadlock Management 08 Hours

Concurrency and Synchronization: Critical - Section Problem, Mutual Exclusion: Requirements, Operating System support - Semaphore and Mutex.

Classical Synchronization Problems: Reader-Writer Problem, Producer - Consumer Problem, Real Life Problems.

Inter-Process Communication: Pipes and Shared Memory

Deadlock: Principles of Deadlock, Deadlock Characterization: Necessary Conditions, Resource - Allocation Graph, Methods for Handling Deadlock: Deadlock Prevention, Deadlock Avoidance, Deadlock Detection and Recovery.

Unit-IV: Memory Management 06 Hours

Memory Management Fundamentals: Goals, Requirements, and Challenges.

Memory Partitioning: Fixed Partitioning, Dynamic Partitioning, Buddy System, Paging, Segmentation.

Virtual Memory: Demand Paging, Page Replacement, Thrashing,

Case Study: Linux Operating System.

Unit-V: Input / Output and File Management 05 Hours

I/O Management: I/O Devices, Organization of the I/O Function, I/O Buffering,

Secondary Storage Management: Disk Structure.

Disk Scheduling File Management: Overview-Files and File Systems, File structure. File Organization and Access, File Directories, File Sharing,

Case Study: Linux File System, Android File System.

Learning Resources:

Text Books:

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, Operating System Concepts, John Wiley & Sons ,Inc., 9th Edition,2012, ISBN 978-1-118-06333-03.
2. William Stallings, Operating System: Internals and Design Principles, Prentice Hall, 8th Edition, 2014, ISBN-10: 0133805913.
3. Arnold Robbins, Nelson H. F. Beebe, Classic Shell Scripting, O'Reilly Media, Inc., 2005, ISBN 9780596005955.

Reference Books:

1. Tom Adelstein and Bill Lubanovic, Linux System Administration, O'Reilly Media, ISBN-10: 0596009526, ISBN-13: 978-0596009526.
2. Harvey M. Deitel, Operating Systems, Prentice Hall, ISBN-10: 0131828274, ISBN-13: 978- 0131828278.
3. Thomas W. Doeppner, Operating System in depth: Design and Programming, WILEY, ISBN: 978- 0-471-68723-8.

4. Mendel Cooper, Advanced Shell Scripting, Linux Documentation Project. 5. Andrew S. Tanenbaum & Herbert Bos, Modern Operating System, Pearson, ISBN-13: 9780133592221, 4th Edition.
5. Achyut S Godbole, Operating Systems, 3rd Edition, Tata McGraw-Hill Education, 2005.

Web link for MOOC / NPTEL Links:

1. https://archive.nptel.ac.in/courses/106/105/106105214/
2. https://nptel.ac.in/courses/106106144

Guidelines for Laboratory /Term Work Assessment:

Guidelines for Laboratory /Term Work Assessment Continuous assessment of laboratory work should be based on overall performance of Laboratory assignments by a student. Assessment of each Laboratory assignment will assign grade/marks based on parameters, such as timely completion, performance, innovation, efficient codes, punctuality, documentation and neatness.

List of Practicals:

1. Study basic Linux commands such as echo, ls, read, cat, touch, tac, test, diff, grep, sed, find, and explore loops, conditional statements, arithmetic comparisons, and Bash scripting for automation.
2. Write a program where the main function accepts integers to be sorted, uses the FORK system call to create a child process, with the parent process sorting the integers using a sorting algorithm and waiting for the child process using the WAIT system call, while the child process sorts the integers using any sorting algorithm, and demonstrate the zombie and orphan process states during execution.
3. Write a program to simulate two CPU scheduling algorithms
4. Write a program to solve the Producer-Consumer problem utilizing counting semaphores along with mutex or binary semaphores for synchronization.
5. Write a program to solve the Reader-Writer problem with a focus on giving priority to readers for synchronization.
6. Write a program for Deadlock Avoidance Algorithm..
7. Write a program for Page Replacement Algorithms.
8. Full duplex communication between two independent processes. First process accepts sentences and writes on one pipe to be read by second process and second process counts number of characters, number of words and number of lines in accepted sentences, writes this output in a text file and writes the contents of the file on second pipe to be read by first process and displays on standard output.

Course Code: 161402		Course Name: Database Management System
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 2 Hours/Week **Practical:** 2 Hours/Week	**2** **1**	**CCE** : 40 Marks **ESE** : 60 Marks **TW** : 25 Marks **PR + OR** : 25 Marks

Prerequisite Courses:

- Data structure, Discrete Mathematics.

Course Objectives:

- Understand the fundamental concepts of database management.
- Understand the fundamental concepts of Relational Database management system.
- Present SQL & NOSQL procedural interfaces to SQL comprehensively.
- Understand the basic concepts of transaction processing and concurrency control.
- Understand different NOSQL and Mongo DB concepts.

Course Outcomes:

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

CO1: Design E-R Model for given requirements and convert the same into database tables.

CO2: Use SQL to write queries for given requirements.

CO3: Implement normalization techniques, to construct optimized relational database designs.

CO4: Analyze and implement transaction management strategies.

CO5: Apply principles of NoSQL and MongoDB databases to perform the operations on databases.

Course Contents

Unit-I: Introduction to DBMS **06 Hours**

Basic concepts, Advantages of DBMS over file processing systems, Database System Architecture, Components of a DBMS, Overall structure of DBMS, Data abstraction, Database languages, Data independence. Data models, ER diagrams: Components of E-R Model, Conventions, Keys, EER diagram Components, converting ER diagrams into tables, Relational models.

Unit-II: Data Modeling and Design **06 Hours**

Basic concepts, Entity, attributes, relationships, constraints, keys. Attributes and domains, CODD's rules, Relational Integrity: Domain, Referential Integrities, Enterprise Constraints, Relational Databases Design: Purpose of Normalization, The process of Normalization: 1NF, 2NF, 3NF, BCNF, Data Redundancy and Update Anomalies, Functional Dependencies.

Unit-III: SQL Databases **06 Hours**

SQL Data Types and Literals, DDL, DQL, DML, DCL, TCL, SQL Operators, Tables: Creating, Modifying, Deleting, Updating (CRUD), SQL DML Queries, SELECT Query and clauses.

Views: Creating, Dropping, Updating using Indexes, Joins, Nested Queries.

PL/SQL: Stored Procedures, Cursors, Triggers, Set Operations, Predicates and Joins, Set membership, Tuple Variables, Set comparison, Ordering of Tuples, Aggregate Functions, SQL Functions.

Unit-IV: Database Transactions **06 Hours**

Transaction concept, Transaction states, ACID properties, Concept of Schedule, Serial Schedule **Serializability:** Conflict and View, Cascaded Aborts, Recoverable and Non-recoverable Schedules Concurrency Control: Lock-based, Time-stamp based Deadlock handling.

Database Recovery methods: Shadow- Paging and Log-Based Recovery.

Unit-V: NoSQL Databases **06 Hours**

Introduction to Distributed Database System: Advantages, disadvantages, CAP Theorem.

Types of Data: Structured, Unstructured and Semi-Structured Data.

NoSQL Database: Introduction, need, Features, Types of NoSQL Databases: Key-value store, document store, graph, wide column stores; BASE Properties, Data Consistency model, ACID Vs BASE, Comparative study of RDBMS and NoSQL, MongoDB (with syntax and usage): CRUD Operations, Indexing, Aggregation, MapReduce, Replication, Sharding.

Introduction to Emerging Database Technologies: Cloud Databases, Mobile Databases, SQLite Database, XML Databases, DynamoDB.

Learning Resources:

Text Books:

1. Silberschatz A., Korth H., Sudarshan S., "Database System Concepts", McGraw Hill Publishers, ISBN 0-07-120413-X, 6th edition
2. S.K.Singh, “Database Systems: Concepts, Design and Application”, Pearson Education, ISBN 978-81-317-6092-5.

Reference Books:

1. Jiawei Han, Micheline Kamber, Jian Pei, ―Data Mining: Concepts and Techniques‖, Elsevier.
2. Shio Kumar Singh, Database Systems Concepts Design and Applications, Pearson.
3. Mario Piattini, Oscar Diaz ―Advanced Database Technology and Design‖- online book.
4. J. Han, M. Kamber, Data mining: concepts and techniques. Morgan Kaufmann.

5. Kevin Roebuck, "Storing and Managing Big Data - NoSQL, HADOOP and More", Emereo Pty Limited, 2011, ISBN 1743045743, 9781743045749.

Weblink for MOOC / NPTEL Links:

1. https://onlinecourses.nptel.ac.in/noc20_cs03/preview

List of Practicals:

1. ER Modeling and Normalization: a. Consider case studies and formulate a problem statement for any application to be developed. b. Propose a conceptual design using ER features (Identifying entities, relationships between entities, attributes, keys, cardinalities, generalization, specialization etc.). c. Convert the ER diagram into relational tables and normalize relational data model.
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. Implement SQL queries to provide students with hands-on experience in implementing various data constraints using SQL commands in MySQL. (NOT NULL, UNIQUE, PRIMARY KEY, FOREIGN KEY, and DEFAULT)
4. Write at least 10 SQL queries for suitable database applications using SQL DML statements by implementing all types of Joins, Sub query and View.
5. Write a PL/SQL block of code. Teacher can frame 3 problem statements for writing PL/SQL block
6. Write a PL/SQL block of code to implement all types of cursors.
7. Write a PL/SQL Stored Procedure and functions. Teacher can frame 3 problem statements.
8. Write a database trigger on the Employee table. Teacher can frame the problem statements for writing Database Triggers of all types.
9. NoSQL / Large Scale Databases:
    a. Design and Develop MongoDB Queries using CRUD operations.
    b. Implement aggregation and indexing with suitable examples using MongoDB.
    c. Implement Map reduce operations with suitable examples using MongoDB.
    d. Create simple objects and array objects using JSON. Encode and Decode JSON Objects using Java/Perl/PHP/Python/Ruby.
10. Mini project

    Students in the group are expected to design and develop a database application with following details:

    a. Design Entity Relationship Model, Relational Model, Database Normalization
    b. Front End: Java/Perl/PHP/Python/Ruby/.net
    c. Backend: MongoDB/MYSQL/Oracle
    d. Database Connectivity: ODBC/JDBC
    e. Project Report preparation.

Course Code: 161403	Course Name: Computer Graphics	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 2 Hours/Week	**2**	**CCE : 40 Marks** **ESE : 60 Marks**

Prerequisite Courses:

- Basic Mathematics, Data Structures.

Course Objectives:

- To understand the basic concepts of Computer Graphics.
- To learn the mathematics involved in graphical transformations.
- To learn various algorithms for generating and rendering graphical figures.
- To apply various methods and techniques related to clipping and hidden-surface determination.
- To understand various applications of computer graphics.

Course Outcomes:

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

CO1: Understand the fundamentals of graphics systems and apply mathematics to perform elementary computer graphics operations.

CO2: Apply the core concepts of transformation in two and three dimensions.

CO3: Understand basics of hidden surface detection and apply clipping algorithm to clip lines outside the window.

CO4: Describe methods and techniques for shading and apply mathematics to generate fractals.

CO5: Understand the fundamental concepts of computer vision and animation for real-world applications.

Course Contents

Unit-I: Introduction to Computer Graphics **07 Hours**

Graphics Primitives: Pixel, Resolution, Aspect Ratio, Persistence, Refresh Rate, Frame Buffer, Raster-Scan and Random-Scan Display Devices, Application of Computer Graphics.

Display File: Display File Structure, Display file Interpreter, Primitive operations on display file.

Scan conversion: Line, Line segments and Qualities of line drawing algorithms.

Line Drawing Algorithm: Digital Differential Analyzer (DDA) algorithm, Bresenhams' Line drawing algorithm.

Circle Drawing Algorithm: Bresenhams' method of Circle drawing, Problems of Aliasing.

Case Study: Modern Display Devices.

Unit-II: 2D and 3D Transformations 06 Hours

Two-Dimensional (2D) Transformations: Matrix Representation of 2D Transformations, Translation, Scaling, Rotation, Concept of Reflection and Shear, Combined Transformations, Rotation about an Arbitrary Point.

Three-dimensional (3D) Transformations: Translation, Scaling, Rotation, Multiple Transformations.

Projections: Perspective Projections and Parallel Projections.

Case Study: Image augmentation.

Unit-III: Polygon Filling and Clipping Operations 07 Hours

Polygons: Types: Convex, Concave, and Complex. Vertex inside-outside tests: Odd-even rule, Winding number rule.

Polygon Filling Algorithms: Seed Fill, Flood Fill (4-connected and 8-connected), Scan Line Polygon Fill.

2D Viewing: Viewing Pipeline, Window-to-Viewport Coordinate Transformation.

2-D Clipping: Line Clipping, Cohen-Sutherland Line Clipping Algorithm.

Polygon Clipping: Sutherland-Hodgeman Polygon Clipping Algorithm, Weiler-Atherton Polygon Clipping Algorithm, Interior and Exterior Clipping, Text clipping.

Case Study: Study any popular graphics designing software e.g. Maya / Blender.

Unit-IV: Hidden-Surface Detection, Curves and Fractals 05 Hours

Hidden-Surface Detection: Techniques for efficient Hidden-Surface Detection, Categories of algorithms, Back face removal, z-buffer Algorithm, Painter's algorithm (depth sorting), Area sub-division method.

Curves: Concept of Spline and Bezier curves.

Fractals: Introduction, Classification, Fractal generation: Snowflake, Triadic curve, Hilbert curve, Applications.

Case study: Fractal Generator Software.

Unit-V: Introduction to Computer Vision 05 Hours

Definition and scope of computer vision, Overview of image processing, computer vision, and machine vision, Human vs. Computer Vision.

Color models: Properties of Light, CIE chromaticity Diagram, RGB, HSV, CMYK.

Applications: Face recognition, medical imaging, autonomous vehicles, surveillance, AR/VR, robotics, forensics.

Basics of Animation: Frame rate, keyframes, and in-betweening (tweening); Morphing techniques; Animation Principles: Timing, easing, and anticipation.

Case Study: Vision Pipeline for real world problems.

Learning Resources:

Text Books:

1. S. Harrington, Computer Graphics, 2nd Edition, McGraw-Hill Publications, 1987, ISBN: 0-07-100472-6.
2. D. Rogers, Procedural Elements for Computer Graphics, 2nd Edition, Tata McGraw-Hill Publication, 2001, ISBN: 0-07-047371-4.
3. R. C. Gonzalez and R. E. Woods, Digital Image Processing, 4th ed. Harlow, U.K.: Pearson, 2018.

Reference Books:

1. J. Foley, V. Dam, S. Feiner, J. Hughes, Computer Graphics Principles and Practice, 2nd Edition, Pearson Education, 2003, ISBN 81-7808-038 -9.
2. D. Rogers, J. Adams, Mathematical Elements for Computer Graphics, 2nd Edition, Tata McGraw Hill Publication, 2002, ISBN 0-07-048677-8.
3. Donald D. Hearn, Computer Graphics with OpenGL, 4th Edition, ISBN- 13:9780136053583.

MOOC / NPTEL/YouTube Links:

1. Computer Graphics By Prof. Samit Bhattacharya, IIT Guwahati https://onlinecourses.nptel.ac.in/noc20_cs90/preview
2. Introduction to Computer Graphics By Prof. Prem K. Kalra, IIT Delhi https://archive.nptel.ac.in/courses/106/102/106102065/

Activity Based Learning (Suggested Activities In-Class):

1. Flipped Classroom.
2. Gamification.
3. Online Interactive Tool.
4. Collaborative and Individual Problem based learning.
5. Quizzes/Assignment.
6. Vlab.

Course Code: 171405A		Course Name: Introduction to Cyber Security
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Practical :** 2 Hours/Week	**3** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 25 Marks** **PR + OR : 25 Marks**

Prerequisite Courses:

- Fundamentals of Computer & Programming, Operating System, Basic concept of Networks.

Course Objectives:

- To develop an understanding of the fundamental concepts, issues, and challenges in the field of cyber security.
- To create awareness about various types of cyber offenses, their legal remedies, and the procedures for reporting such crimes.
- To sensitize students to privacy and security concerns on social media and promote responsible usage through knowledge of legal aspects and best practices.
- To familiarize students with e-commerce and digital payment systems, including RBI guidelines and preventive measures against online frauds.
- To enable students to understand and apply basic security practices and tools for safeguarding computers and mobile devices.

Course Outcomes:

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

CO1: Explain the architecture, communication and governance of cyberspace and web technologies.

CO2: Identify and relate specific cybercrime incidents to relevant provisions of the IT Act 2000.

CO3: Apply basic practices to ensure privacy and security on social media platforms.

CO4: Apply security practices and legal guidelines to ensure safe E-Commerce and digital payment systems.

CO5: Demonstrate configuration and management of secure digital devices and tools**.**

Course Contents:

Unit-I: Introduction to Cyber Security **08 Hours**

Defining Cyberspace and Overview of Computer and Web-technology, Architecture of cyberspace, Communication and web technology, Internet, World wide web, Internet

infrastructure for data transfer and governance, Internet society, Regulation of cyberspace, Concept of cyber security, Issues and challenges of cyber security.

Unit-II: Cyber Crimes and Cyber Law 08 Hours

Cybercrime- Classification, Common Cybercrimes, Cybercriminals modus-operandi, reporting of cybercrimes, Remedial and mitigation measures, Legal perspective of Cybercrime, IT Act 2000 and its amendments, Cybercrime and offences, Organisations dealing with Cybercrime and Cyber security in India.

Case Study: WannaCry Ransomware Attack- A Global Wake-Up Call.

Unit-III: Social Media Overview and Security 08 Hours

Introduction to social networks, social media: Types, platforms, monitoring, hashtag, viral content, marketing, privacy, challenges, opportunities and pitfalls in online social networks, security issues related to social media, flagging and reporting of inappropriate content, laws regarding posting of inappropriate content, best practices for the use of social media.

Case Study: WhatsApp Spyware incident, Facebook–Cambridge Analytica Data Harvesting Scandal.

Unit-IV: E-Commerce and Digital Payments 08 Hours

Commerce Basics: Definition, components, security elements, and threats, E-commerce security best practices. **Digital payments**: Introduction, components and stake holders, modes of digital payments, digital payments related common frauds and prevention. RBI Guidelines on digital payments and customer protection. Relevant provisions of Payment Settlement Act, 2007. **Case Study:** Cosmos Bank Cyber Attack.

Unit-V: Digital Devices Security, Tools and Technologies 08 Hours

End Point device and mobile security, password policy, security patch management, data backup, management of third-party software, device security policy, cyber security best practices, host firewall and Antivirus - Significance & management, Wi-Fi security, configuration of basic security policy and permissions. **Case Study:** The Pegasus Airlines.

List of Practical / Assignments: (Guidelines for course teacher)

- The course instructor should design assignments that reflect essential cyber security principles and consider students' level of familiarity with digital tools and platforms.
- Assignments must reflect current cyber threats, technologies, laws and best practices followed in the industry.
- Assignments should be based on real-life cyber incidents, case studies and practical security problems.
- Practical demonstration tasks such as identifying vulnerabilities, analyzing cybercrime scenarios, or applying security controls in digital payment system. Study of social media platforms, should be included to improve readiness for future projects / professional roles.

Learning Resources:

Text Books:

1. Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives Sumit Belapure & Nina Godbole, Wiley India Pvt. Ltd.
2. Cyber Crime and Laws Dr. Santosh Kumar & Dr. Gagandeep Kaur, Whitesmann Publishing.
3. Cyber Crime Impact in the New Millennium R. C. Mishra, Authors Press.
4. Fundamentals of Network Security E. Maiwald, McGraw Hill.

Reference Books:

1. Network Security Bible (2nd Edition) Eric Cole, Ronald Krutz, James W. Conley, Wiley India Pvt. Ltd.
2. Security in the Digital Age: Social Media Security Threats and Vulnerabilities Henry A. Oliver- Pearson.
3. Electronic Commerce Elias M. Awasd, Prentice Hall of India Pvt Ltd.
4. Cyber Laws: Intellectual Property & E-Commerce Security by Kumar K, Dominant Pub.
5. Cryptography and Network security, Atul Kahate, The McGraw Hill, second Edition.

Web link for MOOC / NPTEL Links:

1. Cyber Security and Privacy by Prof. Saji K Mathew, IIT Madras
   https://onlinecourses.nptel.ac.in/noc23_cs127/preview
2. Practical Cyber Security for Practitioners by Prof. Sandeep K. Shukla, IIT Kanpur
   https://onlinecourses.nptel.ac.in/noc25_cs120/preview
3. Introduction To Cyber Security by Dr. Jeetendra Pande, Uttarakhand OU, Haldwani.
   https://onlinecourses.swayam2.ac.in/nou24_cs04/preview
4. Cyber Laws by Dr Vishal Goyal, Professor in Computer Science, Department of Computer Science, Punjabi University, Patiala.
   https://onlinecourses.swayam2.ac.in/cec24_cs14/preview

Important DOs and DON'Ts in Cyber Security:

DOs

- Use strong passwords and enable two-factor authentication on all accounts.
- Keep your devices, apps, and antivirus updated regularly.
- Verify sources before clicking links or downloading files; report phishing emails.
- Backup important data and secure your devices.
- Follow ethical and legal practices; understand IT Act and cyber laws.

DON'Ts

- Never share passwords, OTPs, or sensitive banking information.
- Do not click on suspicious links or open unknown attachments.
- Never attempt hacking or bypass security without permission.
- Do not overshare personal information on social media or online platforms.
- Do not ignore suspicious activity - report it through official channels.

Course Code: 174408	Course Name: Foreign Languages	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Tutorial : 2 Hours/Week	**2**	**TW :** 50 Marks

Prerequisite Courses:

- Professional Communication Skills.

Course Objectives:

- To develop Foundational Language Skills, Enhance Communication Competence, Promote Multilingual Proficiency, Support Career and Academic Opportunities, Boost Confidence and Motivation in Language Learning.

Course Outcomes:

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

CO1: Learn the basic phonetics, alphabets and sounds of the selected foreign language.

CO2: Interpret and use everyday vocabulary to manage simple social interaction.

CO3: Form simple sentences using basic grammatical structures and sentence patterns.

CO4: Participate in simple conversations and everyday communication situations relevant to academic, social and professional contexts.

CO5: Demonstrate cultural awareness and appropriate language behaviour to facilitate global and cross-cultural interactions**.**

Course Guidelines:

1. **Course Selection**: Students will choose one foreign language course from the provided basket, based on their interest and career aspirations.
2. **Course Allocation**: Each student will be allotted their selected language course, ensuring dedicated participation and meaningful learning.
3. **Expert Instruction**: Courses will be taught by qualified language instructors using an engaging mix of activities, group discussions, cultural presentations, and lectures, either in-person or online.
4. **Activity Documentation**: Students must prepare and submit a hard copy report of the language-learning activities they participated in, along with a certificate of participation from the instructor or institution.
5. **Evaluation Criteria**: Assessment will focus on the completeness, quality, and reflection demonstrated in the submitted activity report.
6. **Mentorship**: Faculty mentors will be assigned to each student to guide them in the

learning process, assist with linguistic challenges, and support their overall progress in the selected language.

7. **Activity Framework**: Faculty members, in consultation with language experts, will design a set of language-related activities (e.g., vocabulary building, basic conversations, and cultural immersion tasks) that align with the objectives of each course.
8. **Personal Growth**: Emphasis is placed on selecting a language that aligns with the student's personal interests, academic goals, or global career opportunities, fostering long-term motivation and growth.
9. **Balance and Engagement**: Students are encouraged to choose a course that they are genuinely curious or passionate about, ensuring consistent engagement and maximum benefit from the learning experience.

Baskets for Language Courses:

1. 174408A: Basic English Language

Unit-I: Basic of Communication **06 Hours**

An introduction to phonetics and phonology.

Unit-II: Vocabulary for Communication **06 Hours**

Basic vocabulary and sentence construction, idioms and phrases, antonyms, synonyms.

Part of speech: Noun, pronoun, verb, adjective, adverb, preposition, conjunction, interjection.

Unit-III: Grammar for Communication **06 Hours**

Articles, tense, change the voice, direct- indirect speech, degree, punctuation.

Grammar usage in sentences, sentence structure error, grammar error.

Unit-IV: English for the Real World **06 Hours**

Everyday communication: Introduction, shopping, meeting friends, travelling, telephonic communication, negotiation, etc.

Unit-V: Language Skills for Functional Communication **06 Hours**

Reading skill, listening skills, speaking skills, writing skills. Email correspondence, dialogue writing. Spell check and writing presentation.

2. 174408B: Basic Sanskrit Language

Unit-I: Characteristics of Sanskrit **06 Hours**

Introduction: Some unique characteristics of Sanskrit. Basic introduction of oneself, simple

verbs daily vocabulary. Introducing different declensions and tenses - 1.

Unit-II: Sentence Structure and Vocabulary for Communication 06 Hours

Basic vocabulary and sentence construction.

Introducing different declensions and tenses – 2.

Practice with various verbs in different moods and tenses summary of the sentence structure with different questions.

Unit-III: Grammar for Communication 06 Hours

Revision of the main features of part 1 of introduction to basic spoken Sanskrit, different verb forms, daily vocabulary.

Introduction of different declensions in the plural and tenses – 1, daily vocabulary, poetic verses, conversations and stories.

Unit-IV: Daily Conversation 06 Hours

Practice with various verbs in different moods and tenses, summary of the sentence structures using the plural with different questions.

Introduction of a few more words ending with consonants and their declensions, an alternative conjugation of verbs, daily vocabulary, poetic verses, conversations and stories.

Introduction to their different declensions in singular, dual and plural, new verb forms, daily vocabulary, poetic verses, conversations and stories.

Unit-V: Comprehension and Conversations 06 Hours

Introduction to Sandhi, vowel with vowel / vowel with consonant / consonant with consonant / aspirant with vowel or consonant, poetic verse, reading and comprehension, conversations.

Practice with a variety of word endings, various verbs in different moods and tenses, summary of the sentence structures using the plural with different questions.

3. 174408C: Basic German Language

Unit-I: Introduction to the Alphabet Articulation 06 Hours

Introduction, greetings and alphabet articulation.

Introducing oneself and others; Grammar: W questions, personal pronouns, simple sentence, verb conjugation.

Themes: Hobbies, the week, numbers, the alphabet, months, seasons / **Grammar:** Articles, plural, the verbs to have and to be.

Unit-II: Word and Sentence Structure 06 Hours

Theme: In the city / naming places and buildings, means of transport, basic directions / **Grammar**: definite and indefinite articles; negation - kein and nicht; imperative.

Themes: food, drink, family / groceries and meals / **Grammar:** the accusative.

Unit-III: Daily Conversation 06 Hours

Theme: Everyday life, telling time, making appointments / **Grammar:** prepositions am, um, von.bis; modal verbs, possessive articles: leisure activity, celebrations.

Unit-IV: Writing Skills 06 Hours

My apartment, rooms, furniture, colours / Grammar: changing prepositions.

Professions / Grammar: perfect tense.

Clothes / Grammar: perfect tense and dative.

Grammar: separable verbs, the accusative, past tense of to have and to be.

Contacts, writing letters / Grammar: dative.

Unit-V: Basic of communication in German Language 06 Hours

Health and the body / Grammar: imperative and modal verbs.

Holiday and weather.

4. 174408D: Basic French Language

Unit-I: Introduction to Alphabets Articulation **06 Hours**

Introduction, greetings and alphabet articulation.

Unit-II: Grammar of French-I **06 Hours**

Indefinite articles and numbers, family vocabulary, colours and numbers.

Unit-III: Grammar of French-II **06 Hours**

Words of politeness, pronouns and conversation.

Unit-IV: Daily Conversation **06 Hours**

6 points to self-introduction, simple propositions and verbs.

Unit-V: Basic of Communication in French Language **06 Hours**

Pieces of communication.

5. 174408E: Basic Japanese Language

Unit-I: Japanese Scripts **06 Hours**

Japanese Scripts: Hiragana, Katakana, Kanji, Ideograms and Pictograms.

Unit-II: Language and Grammar **06 Hours**

Language and Grammar: Particles, sentence construction, demonstratives, interrogatives, conjunctions, vocabulary, nouns, verbs conjugations, adverbs, other parts of speech, verbs and tense, requests and commands, comparisons, expressions and phrases, idioms, etc.

Unit-III: Daily Conversation **06 Hours**

Introduction, time, daily conversation, usage of interrogatives, asking direction, conversation on phone, giving and receiving, making requests and commands, likes and dislikes, potential, permission, conditionals, direct in direct speech, learning to make speeches, writing mails, polite Japanese.

Unit-IV: Japanese Culture, Festivals and Lifestyle **06 Hours**

Japanese culture, festivals and lifestyle: Japanese lifestyle, learning about culture, customs and festivals, idioms and phrases.

Unit-V: Basic of Communication in Japanese Language **06 Hours**

Audio and pictures: Association and meaning.

Guidelines for Evaluation:

1. Self-Introduction on different occasions (Formal and informal).
2. Public speaking exercises.
3. Common grammar errors/ Sentence structure errors.
4. Writing articles.
5. Vocabulary level test.

Learning Resources:

Text / Reference Books / Web Links:

Basic English Language Course

1. Raymond Murphy's English Grammar in Use Cambridge University Press. 2019
2. A Practical English Grammar, Thomson and Martinet. New Delhi: Oxford University Press, 1986.
3. Study Skills in English: A Course in Reading Skills for Academic Purposes, Michael J. Wallace, Cambridge University Press, 2004.
4. Cambridge English Pronouncing Dictionary (17thEdn.), Cambridge University Press, 2006

Basic Sanskrit Language Course

1. Kumari, S. (1993) Sanskrita Chitrapadakoshah, Mysuru: Bharatiya Bhasha Sansthanam.
2. Samkrita-vyavahaara-saahasree(Samskrit-English, New Delhi: Sanskrita Bharati.
3. Sampad, & Vijay. (2005). The Wonder that is Sanskrit. Pondicherry: Sri Aurobindo Society.
4. Satvlekar, S. D. (2013). Sanskrit Swayam Shikshak. Delhi: Rajpal & Sons (Rajpal Publishing).
5. Shastri, V K. (2012). Teach Yourself Samskrit, Prathama Diksha. Delhi: Rashtryia Sanskrita Samsthana.
6. Vishwasa (2014). Abhyāsa-pustakam, New Delhi: Samskrita Bharati

Basic German Language Course

1. NETZWERK Deutsch alsFremdspracheA1(Goyal, New Delhi, 2015).
2. Schulz-Griesbach: Deutsch alsFremdsprache. Grundstufe in einem Band (for Grammar).

Web Resources:

1. Facts about Germany: https://www.tatsachen-ueber-deutschland.de/en
2. Online German-English dictionary www.leo.org.

Practice materials:

1. https://www.goethe.de/en/spr/kup/prf/prf/sd1/ueb.html
2. https://www.deutschkurse-passau.de/JM/images/stories/SKRIPTEN/a1_skript_gr.pdf
3. https://www.schubert-verlag.de/aufgaben/arbeitsblaetter_a1_z/a1_arbeitsblaetter_index_z.htm

Basic French Language Course

1. Saisons 1 Méthode de français
   https://www.frenchcircles.ca/
2. https://blog.rosettastone.com/french-accent-marks/

Basic Japanese Language Course

1. Minna no Nihongo Textbook 1 & II (3 A Network).
2. Japanese for Busy people. (Association for Japanese Language Teaching).
3. Nihongo Dekimasu (Japan Foundation).
4. Shin Nihongo no Kiso (Association for Overseas Technical scholarship).
5. First steps in Japanese (3 A Corporation).
6. Kanji and Kana by Wolfgang Hadamitzky and Mark Spahn.
7. 250 Essential Kanji for everyday use Vol. I & 2 by Kanji Research group University of Tokyo.

Course Code: 161409	Course Name: Java Programming	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Practical : 4 Hours/Week	**2**	**TW** : 50 Marks

Prerequisite Courses:

- Basic of Programming Languages like Loop Structures, Arrays, Functions.

Course Objectives:

- To understand the basic concepts of Java.
- To learn object-oriented programming using Java.
- To learn and understand exception handling and wrapper classes.
- To learn and understand I/O packages and threading in Java.
- To learn front-end design.

Course Outcomes:

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

CO1: Use various data types, conditional and looping constructs in Java.

CO2: Demonstrate Java classes, various overloading and overriding methods in Java.

CO3: Design and implement Java programs using OOP principles.

CO4: Apply knowledge in handling files and implementing multithreading in Java applications.

CO5: Justify real-time applications on the Java Platform**.**

Guidelines for Assessment:

Guidelines for Laboratory /Term Work Assessment: Continuous assessment of laboratory work should be based on the overall performance of Laboratory assignments by a student. Assessment of each Laboratory assignment will assign grades/marks based on parameters, such as timely completion, performance, innovation, efficient codes, punctuality, documentation, and neatness. A set of suggested assignment lists is provided each student must perform at least 10 assignments. In addition to these, instructors must assign one real-life application in the form of a mini-project based on the concepts learned. Instructor must also set one assignment or mini-project that is suitable to the respective branch.

Learning Resources:

Text Books:

1. JAVA: Complete Reference, Herbet Schildt, TMH, India.

Reference Books:

1. D.T. Editorial Services, Java 8 Programming Black Book, Dreamtech Press India Pvt. Ltd., Paperback, 2015, 9789351197584.
2. Ken Arnold, James Gosling and David Holmes, The Java Programming Language, Addison-Wesley, 4th Edition, 2005, 0321349806.
3. Advanced Java 2 Platform HOW TO PROGRAM, H. M.Deitel, P. J. Deitel, S. E. Santry Prentice Hall.

Web link for MOOC / NPTEL Links:

Programming in Java IIT Kharagpur

1. https://nptel.ac.in/courses/108/105/108105113/
2. https://onlinecourses.nptel.ac.in/noc25_cs110/course

List of Practicals:

1. Study of the Installation of Java software, Eclipse IDE, compile, debug, and execute a Java program.
2. Write a program called Income Tax Calculator that reads the taxable income (in int). The program shall calculate the income tax payable (in double); and print the result rounded to 2 decimal places. The progressive income tax rate is mandated as follows:

Taxable Income	Rate (%)
First $20,000	**0**
Next $20,000	**10**
Next $20,000	**20**
The remaining	**30**

3. Write a package for string operations that has two classes, Con and Comp. Con has to concatenate two strings, and the comp class compares two strings, also displays a proper message on execution.
4. Create a class Book with fields: title, author, and price. Include a constructor to initialize these fields. Implement a method displayInfo() that prints all book details. Use method overloading to provide a second displayInfo() that includes a discount price parameter.
5. Create a Vector<String> to store student names that allows
   a. Removing a student by name.
   b. Displaying all enrolled students.
   c. Demonstrate the resizing ability of Vector by adding/removing elements.
   d. Use methods like .add (), .remove (), .size (), .get ().

6. Write a program that creates an interface named Animal with methods eat(), sleep (), and make Sound().
   a. Create classes Dog, Cat, and Bird that implement the Animal interface.
   b. Implement unique behaviours for each animal in the makeSound() method.
   c. Create a Zoo class that stores an array of Animal objects and demonstrates polymorphism by calling eat(), sleep(), and makeSound() for each animal.
7. Write a Java program that uses a combination of classes, objects, and static methods to simulate a Student Library Utility System. The system should allow issuing books to a student and returning them, while using static methods to validate actions and provide shared functionality.
8. Write a java program to manage employee information with attributes such as name, date of birth (DOB), and mobile number. Implement exception handling to validate input data, ensuring that day values range from 1 to 31 and month values range from 1 to 12 for DOB.
9. Write a java program to Read from a File, Count Words, Lines, and Characters, Write to a File. Copy Content from One File to Another.
10. Develop a Java program that demonstrates the use of multithreading to perform
    Task 1: Print numbers from 1 to 100 with a delay between each print (simulating a slow process).
    Task 2: Print letters from 'A' to 'Z' concurrently with Task 1.
11. Develop an Applet that receives an integer in one text field & compute its factorial value & returns it in another text field when the button “Compute” is clicked
12. Java Database Connectivity (JDBC): Merging data from multiple tables: joining, manipulating databases with JDBC, prepared statements, transaction processing, stored procedures C
13. Mini project: Design a mini project in java using different data structures.

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