



**Bansilal Ramnath Agarwal Charitable Trust's
Vishwakarma Institute of Technology
(An Autonomous Institute affiliated to Savitribai Phule Pune University)
NEP Compliant Structure & Syllabus
of
Department of Engineering, Sciences & Humanities (DESH)
Pattern '2026-27'
F. Y. B. Tech.**

Effective from Academic Year 2026-27

Prepared by: - Board of Studies in Engineering, Sciences & Humanities

Approved by: - Academic Board, Vishwakarma Institute of Technology, Pune

Chairman - BoS

Dean - Academics

Chairman - Academic Board

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Program Outcomes:

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)

PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)

PO4: Conduct 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.

Structure of First Year for Academic Year 2026-27

Course Code	Course Name	Type	Teaching Learning Scheme				
			Th	Tut	Lab	Hrs./ Week	Credits
Module 1							
ES26101	Linear Algebra		3	1	0	4	4
ES26105	Basics of Engineering		2	0	2	4	3
ES26106	Universal Human Values		2	0	0	2	2
ES26107	Indian Knowledge System		1	0	0	1	1
ES26108A	Language-English		2	0	0	2	2
ES26108B	Language-German		2	0	0	2	2
ES26108C	Language-Japanese		2	0	0	2	2
ES26108D	Language-Chinees		2	0	0	2	2
ES26109	Student Activity		2	0	0	2	2
ES26110	Induction Training		0	0	0	0	0
Module 2							
ES26201	Calculus		3	1	0	4	4
ES26205	Engineering Robotics		2	0	2	4	3
ES26206	Environment Studies		3	0	0	3	3
ES26208A	Language-FCTC		2	0	0	2	2
ES26208B	Language-German		2	0	0	2	2
ES26208C	Language-Japanese		2	0	0	2	2
ES26208D	Language-Chinees		2	0	0	2	2
ES26207	Design Thinking & Ideation		2	0	0	2	2
Courses in Semester 1 Irrespective of Module							
ES26102	Engineering Design and Innovation 1	ESE	0	0	2	2	1
ES26103	Logic and Quantitative Aptitude 1		2	0	0	2	2
ES26104	Programming for Engineers		2	0	4	6	4
ES26108	Eng/Ger/Jap/Chi		2	0	0	2	2
ES26110	Induction Training	AU	0	0	0	0	0
Semester 1 Total Credits (Module 1 / Module 2)			16	1	8	25	21
Courses in Semester 2 Irrespective of Module							
ES26202	Engineering Design and Innovation 2		0	0	2	2	1
ES26203	Logic and Quantitative Aptitude 2		2	0	0	2	2
ES26204	Engineering Problem Solving		2	0	4	6	4
ES26209	Indian Democracy and Constitution	AU	0	0	0	0	0
Semester 2 Total Credits (Module 1 / Module 2)			16	1	8	25	21

Institute Vision

"To be globally acclaimed Institute in Technical Education and Research for holistic Socio- economic development".

Institute Mission

- To ensure that 100% students are employable and employed in Industry, Higher Studies, become Entrepreneurs, Civil/ Defence Services/ Govt. Jobs and other areas like Sports and Theatre.
- To strengthen Academic Practices in terms of Curriculum, Pedagogy, Assessment and Faculty Competence.
- Promote Research Culture among Students and Faculty through Projects and Consultancy.
- To make students Socially Responsible Citizen.

Department Vision

"To integrate aspects of Engineering, Applied Sciences, and Humanities for grooming students to become competent in diverse areas of engineering and humanities."

Department Mission

- **Impart** fundamental knowledge in engineering, applied science & develop basic skills to achieve **Professional excellence**.
- **Inculcate** ethical, spiritual values and sense of social responsibility for overall personality development.
- **Develop** technical skills, communication and soft skills for professional career through global exposure.
- **Develop** team behaviour & project planning abilities amongst students through hands on experience.

ES26101: Linear Algebra

Teaching Scheme	Examination Scheme
Credits: 4	CP: NA
Lectures: 3 Hrs/week	TW: 25 Marks
Practical: NA	MSE (W): 25 Marks
Tutorial: 1 Hrs/ week	ESE (W): 50 Marks

Prerequisites:	
•	Determinants and Matrices, Vector Geometry
Course Objectives:	
•	To provide a strong mathematical foundation in vectors, matrices, and linear systems required for engineering analysis.
•	To develop problem-solving skills through analytical and computational methods in linear algebra.
•	To enable students to model and solve engineering problems using vector spaces and linear transformations.
•	To introduce eigenvalue techniques and their applications in engineering, machine learning, structural analysis, signal processing, and data science.
Course Outcomes:	
	After completion of the course, student will be able to
1.	Solve systems of linear equations using Gaussian elimination and row echelon form, determine the rank of matrices, and apply these techniques to engineering problems.
2.	Understand the concepts of vector spaces, subspaces, spanning set, basis, linear dependence & independence
3.	Apply knowledge of inner product spaces to compute length of a vector, angle, distance between two vectors, to compute orthogonal basis using Gram-Schmidt process and solve least squares approximation
4.	Determine matrix representations of linear transformations and find kernel, range, rank, nullity, and demonstrate linear transformations geometrically.
5.	Compute eigenvalues & eigenvectors and apply it for diagonalization of matrices.

6.	Analyze quadratic forms through orthogonal diagonalization, determine their nature and canonical forms, and apply Singular Value Decomposition (SVD) and the Principal Axes Theorem to engineering problems.
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Section1:	Topics/ Contents
System of Linear Equations: Rank of matrix, Row Echelon Form, System of linear equations, Gaussian elimination method, Applications of System of Linear equations. (6 hrs) Vector Spaces: Introduction to vector spaces over reals (Euclidean Vector Space, Polynomial Space, Matrix Space, $C[a,b]$), Subspace, Linear combination, Spanning set, Linear dependence & independence, Basis & dimension of a vector space, Row space, Column space & Null space of a matrix. (8 hrs) Inner Product Spaces: Inner product spaces, Euclidean inner product spaces, Norm, Distance, Angle, Projection, Orthogonal and Orthonormal vectors, Orthogonal Complement, Gram-Schmidt process of orthogonalization, Applications to least square fitting to data. (7 hrs)	
Section2:	Topics/ Contents
Linear Transformation: Introduction to linear transformations, Matrix representation relative to Standard Basis, Kernel and Range of linear transformations, One-One-onto linear transformations, Rank-Nullity Theorem, Regular Transformation, Composite linear transformation, Orthogonal Transformation, Geometric Linear transformations in R^2. (8 hrs) Eigen Values and Eigen Vectors: Eigen Values and Eigen Vectors of a matrix, Algebraic and geometric multiplicity, Cayley-Hamilton Theorem, Diagonalization of a matrix. (7 hrs) Quadratic Forms: Orthogonal diagonalization, Introduction to Quadratic forms, Nature of quadratic forms, Canonical form, Applications of quadratic forms: Principal Axes Theorem, Singular Value Decomposition. (6 hrs)	
List of Tutorials:	
1. Row Echelon Form, Rank of matrix. 2. Solution of System of linear equations & Applications of System of Linear equations. 3. Subspaces of vector space. 4. Basis and dimension of a vector space; Row Space, Column Space and Null Space of a Matrix. 5. Norm, Distance, Angle between two vectors and Orthogonality. 6. Gram Schmidt Process, least square method. 7. Linear transformations, Matrix of Linear Transformation, Rank -Nullity Theorem, 8. Basis and dimensions of Kernel and Image of linear Transformation, Geometric Linear transformation 9. Eigen Values and Eigen Vectors of a matrix, Algebraic and geometric multiplicity. 10. Cayley Hamilton Theorem, Diagonalization of a matrix. 11. Matrix and nature of quadratic forms, Canonical forms. 12. Singular Value Decomposition.	

Text Books:	
1	Howard Anton, Chris Rorres, Anton Kaul; Elementary Linear Algebra: Applications Version; 12th Edition; John Wiley & Sons
2	David C. Lay; Linear Algebra and its Applications; 2003; Pearson Education
3	Gilbert Strang; Linear Algebra and its applications; 4th edition; Cengage Learning.
4	Erwin Kreyszig; Advanced Engineering Mathematics; John Wiley & Sons.
Reference Books:	
1	Seymour Lipschutz, Marc Lipson; Schaum's outlines of Linear Algebra (6 th edition), McGraw-Hill Education (India) Private Limited, New Delhi.
2	David Poole Linear Algebra: A Modern Introduction (4th Edition), Linear Cengage Learning
3	Ron Larson and David C. Falvo Linear Algebra: An Introduction, Cengage Learning
4	B. V. Ramana; Higher Engineering Mathematics; Tata McGraw Hill Publisher

ES26102: Engineering Design and Innovation 1

Teaching Scheme	Examination Scheme
Credits: 1	MSE: 30 Marks
Lectures: NA	ESE: 70 Marks
Practical: 2 Hrs/ week	
Tutorial: NA	

Prerequisites:	
•	Strong basic knowledge of Science, Physics, Chemistry, Math's
•	Basic computer awareness
•	Communication and teamwork skill
•	Curiosity for problem solving
Course Objectives:	
•	To develop critical thinking and a sight to identify real life societal problems
•	To evolve problem-solving ability by exploring and proposing solutions to real life societal problems
•	To build sound scientific and technical understanding for the usage of appropriate method, technology and tool
•	To engage students in enriching and genuine hands-on experiences.
•	To emphasize long-term, interdisciplinary and self-directed activities for lifelong learning
•	To provide every student a chance to contribute individually as well as a group member to develop teamwork and professional skills.
Course Outcomes:	(Difficulty Level is mentioned in round bracket)
	After completion of the course, student will be able to
1.	Identify project topic relevant to societal needs from diverse domain areas based on literature review (4)
2.	Map technologies and tools to define the define the Project Title and prepare Project Synopsis (4)
3.	Analyze appropriate tools and learn them; also acquire knowledge as per the project need (5)

4.	Apply the acquired technological knowledge and skills to design feasible solution. (5)
5.	Develop/fabricate a working model/prototype of the proposed solution (5)
6.	Test and validate product/ Project Model performance, write the project report and present the project work appropriately (4)

Section1:	Topics/Contents
	Project Centric Learning: Project Centric Learning (PCL) vs Project Based Learning (PBL), Philosophy and importance of PCL, implementation of PCL through Engineering Design and Innovation Project (EDI), Project Group formation, Role of student and Project guide EDI Terminology: Three pillars of EDI Project: Domain, Tools, Technology Domain areas: Awareness and identification of project areas like Agriculture, Defense, Healthcare, Smart city, Smart energy, Security Systems, Automobile, Space, Green Earth, Automobiles, Water Management, Swachh Bharat or any other socially relevant area. Tools: Learn and use latest scientific/ engineering tools such as Circuit Simulation (PSpice, Simulink, Workbench), Wired/ Wireless and Ad-hoc Networking (NS-2, Packet Tracer), Signal Processing (Code Composer Studio along with Integrated circuits) or any other scientific/ engineering/ AI tools as per the project need. Technology: Map the appropriate technology as per the selected project such as Artificial Intelligence, Block Chain, Robots, Cloud Computing, Energy Technology, Nanotechnology, Advanced Material, Clean Technology, Edge/ Computing, New Screens along with Electronics, Energy harvesting, Energy storage, automobile, remote smart grid, biomedical, waste management, food processing or map any other relevant technology as per the project. Literature Review & Self Learning: Brain Storming and Discussion on project topic, Literature Review, defining project statement/ Title, Preparation of project Synopsis Map the appropriate technology and learn appropriate tools, also gather/ procure components, things as per the project need, do the project planning
Section2:	Topics/ Contents
	Project Designing: Apply appropriate method, technological knowledge and skills to design a feasible solution of the project. Prototype Development and Testing: Development/ fabrication of a final working model/ Prototype of the proposed project solution. Test, modify, refine and validate the prototype to have its optimal performance Project Report and Presentation: Write project report in IEEE research paper format, Preparation of a Poster and Presentation based on project work

Publish/ Present project paper in National/ International Journal/ Conference or file a Patent based on the novelty, innovation and future commercial aspects of the project work in the subsequent semester

Text Books:

1	K Nagrajan, "Project Management", 2nd Edition, New age International Ltd., 2004.
2	Pradeep Pai, "Project Management", 1st Edition, Pearson India, 2019.
3	Mahnaz Moallem, Woei Hung, and Nada Dabbagh, "The Wiley Handbook of Problem-Based Learning" Wiley-Blackwell Publisher 2019
4	Robert M. Capraro, Mary Margaret Capraro, James R. Morgan, "STEM Project-Based Learning: An Integrated Science, Technology, Engineering, and Mathematics (STEM) Approach", Sense Publishers Rotterdam, Netherlands, 2013

Reference Books:

1	H. S. Fogler and S. E. LeBlanc, "Strategies for Creative Problem Solving", 2nd Edition, Pearson, Upper Saddle River, NJ, 2008.
2	A. Whimbey and J. Lochhead, "Problem Solving & Comprehension", 6th Edition, Lawrence Erlbaum, Mahwah, NJ, 1999.
3	De Graaff E, Kolmos A., Red.: "Management of change: Implementation of problem based and project-based learning in engineering", Rotterdam Sense Publishers Rotterdam, Netherlands, 2007
4	Samuel Mantel, Jack Meredith, Scott Shafer, Sutton, and M.R. Gopalan, "Project Management Core Textbook", Second Indian Edition, Wiely Publisher, 2014
5	João M. Fernandes, Ricardo J. Machado, "Requirements in Engineering Projects", Springer Nature Switzerland AG, 2016

ES26103: Logic and Quantitative Aptitude I

Teaching Scheme	Examination Scheme
Credits: 2	CP: 30 Marks
Lectures: 2 Hrs/ week	GD/PPT/HA: 20 Marks
Practical: NA	MSE (W/O): 20 Marks
Tutorial: NA	ESE (W/O): 30 Marks

Prerequisites:	
	Nil. The course assumes no prior programming, technical or discipline-specific background and is common to all first-year branches of study.
Course Objectives:	
•	To familiarise the student with the structure of graduate recruitment, the principal role archetypes across engineering branches and the hiring timeline applicable to a four-year programme.
•	To develop competence in advanced quantitative aptitude at the level of difficulty encountered in current graduate selection examinations.
•	To develop speed and accuracy in the interpretation of tabular, graphical and caselet data.
•	To impart test-taking strategy appropriate to sectional, adaptive and negatively marked assessments.
•	To establish disciplined digital work practice, including version control, structured storage, collaboration and information security.
•	To develop verified and responsible use of artificial intelligence tools and to establish a professional digital presence linked to a public record of work.
Course Outcomes:	
	After completion of the course, student will be able to
1.	Describe the structure of graduate recruitment, identify role archetypes across engineering branches and relate first-year activity to the placement timeline.

2.	Apply advanced quantitative techniques in number properties, ratio, percentage, rates and counting to solve problems under time constraint.
3.	Interpret tabular, graphical and caselet data and assess the sufficiency of the information provided to answer a stated question.
4.	Formulate an attempt strategy appropriate to a sectional, adaptive or negatively marked assessment.
5.	Manage academic and project work using version control and apply sound practice in storage, collaboration and information security.
6.	Evaluate the output of artificial intelligence tools through verification, and construct a professional digital profile linked to a public record of work.

Section 1:	Topics/ Contents
Unit 1 (04 Hrs)	Career Foundation and Assessment Strategy: Role archetypes across core, circuit and computing branches, comprising design, operations, quality, analytics, consulting, research and public sector functions. Recruitment practice in service, product, core-sector and start-up organisations. Hiring timeline from the first year to placement. Structure of graduate aptitude examinations, comprising sectional composition, cut-offs and adaptive scoring. Negative marking and the economics of attempting a question. Allocation of time per question. Conduct of proctored and remote examinations. Baseline diagnostic assessment.
Unit 2 (04 Hrs)	Quantitative Aptitude I: Number properties, comprising remainders, cyclicity and last-digit determination; factors and multiples; highest common factor and lowest common multiple in applied settings; divisibility. Ratio and proportion, comprising multi-stage ratio chains, mixtures and alligation, repeated replacement, partnership and proportional distribution.
Unit 3 (04 Hrs)	Quantitative Aptitude II: Percentage and growth, comprising successive and reverse percentage change; profit, loss, discount and margin chains; simple, compound and annualised growth. Rates and work, comprising time, speed and distance; relative motion; problems on trains, boats and streams; circular tracks and repeated meeting; time and work; efficiency chains; pipes and cisterns; work-rate substitution.
Section 2:	Topics/ Contents
Unit 4 (02 Hrs)	Counting and Chance: Permutations and combinations with restrictions and repetition. Circular and grouped arrangements. Selection under stated conditions. Probability, comprising conditional, independent and compound events, and expected value of a simple process.

Unit 5 (04 Hrs)	Data Interpretation: Reading of tabular, bar, line, pie and combination representations. Caselet interpretation and extraction of the question from prose. Approximation, estimation and elimination under time constraint. Data sufficiency. Missing-data and multi-set interpretation. Misleading scales, truncated axes and other errors of representation.
Unit 6 (10 Hrs)	Digital Practice and Professional Identity: Version control, comprising the repository, working tree and staging area; commits and change descriptions; history and recovery of earlier versions; remote repositories and synchronisation; structuring of a repository containing reports, drawings, datasets and project files. Digital and software literacy, comprising file formats and storage, local and cloud storage, synchronisation conflicts, collaboration platforms, access permissions, account security and data hygiene. Artificial intelligence literacy, comprising the capability and failure modes of large language models, framing of a request, verification of claims, sources and figures, academic integrity and disclosure. Professional identity, comprising the construction of a professional profile and its linkage to a public record of work.
Text Books:	
1	R. S. Aggarwal; Quantitative Aptitude for Competitive Examinations; Revised Edition, S. Chand Publishing, New Delhi.
2	Arun Sharma; How to Prepare for Quantitative Aptitude for the CAT; 9th Edition, McGraw Hill Education, Chennai.
3	S. Chacon and B. Straub; Pro Git; 2nd Edition, Apress, New York.
Reference Books:	
1	Nishit K. Sinha; Data Interpretation and Logical Reasoning; 4th Edition, Pearson Education, Noida.
2	Abhijit Guha; Quantitative Aptitude for Competitive Examinations; 7th Edition, McGraw Hill Education, Chennai.
3	D. Huff; How to Lie with Statistics; 1st Edition, W. W. Norton and Company, New York.
4	E. R. Tufte; The Visual Display of Quantitative Information; 2nd Edition, Graphics Press, Cheshire.

List of Practical's:

1. Timed problem set on remainders, cyclicity, factors, multiples and divisibility.
2. Timed problem set on ratio chains, allegation, repeated replacement and proportional distribution.

3. Timed problem set on successive percentage change, profit, loss, discount and compound growth.
4. Timed problem set on relative motion, circular tracks, efficiency chains and work-rate substitution.
5. Timed problem set on restricted arrangements, selection under conditions and compound probability.
6. Timed interpretation set on tabular, bar, line, pie and combination representations.
7. Timed interpretation set on data sufficiency, missing data and multi-set caselets.
8. Preparation of an attempt plan for a supplied sectional paper carrying negative marking.
9. Creation of a repository, recording of a sequence of commits and recovery of an earlier version.
10. Structuring and publication of a work repository containing reports, datasets and project files.
11. Diagnosis of a synchronisation, access permission or account security fault in a supplied scenario.
12. Verification of an artificial-intelligence-generated passage containing a fabricated figure or source.
13. Construction of a complete professional profile linked to the work repository.

List of Project areas:

1. Compilation of a personal quantitative aptitude practice record with sectional error analysis.
2. Comparative study of graduate recruitment practice across service, product, core-sector and start-up organisations.
3. Interpretation and written analysis of a publicly available dataset presented in graphical form.
4. Design of a structured four-year academic and project work repository for a stated branch of study.
5. Preparation of a departmental guide to the verified and responsible use of artificial intelligence tools.
6. Development and publication of a professional digital profile and record of work.

ES26104: Programming for Engineers

Teaching Scheme	Examination Scheme
Credits: 4	LAB: 20Marks
Lectures: 2 Hrs/ week	MSE: 20 Marks
Practical: 4 Hrs/ week	ESE: 50 Marks
Tutorial: NA	CP: 10 Marks

Prerequisites:	
•	Basic programming
•	Mathematics
Course Objectives:	
•	Understand basics of Python Programming
•	Describe Python operators, functions, and string manipulation techniques.
•	Discuss decision-making and looping constructs in Python Programming.
•	Apply Python's built-in data structures, type conversion, built-in methods, and comprehensions to organize and manipulate data efficiently.
•	Develop modular Python programs using user-defined functions, function arguments, recursion, and parameter-passing techniques.
•	Create data visualizations and perform numerical computations using NumPy arrays and Matplotlib.
Course Outcomes:	
	After completion of the course, student will be able to
1.	Demonstrate Python programming fundamentals by writing and executing simple programs.
2.	Develop Python programs using operators, mathematical functions, and string manipulation techniques.
3.	Construct Python programs using decision-making and looping constructs.
4.	Implement Python programs using appropriate data structures, mutability concepts, built-in methods, and comprehensions to solve computational problems effectively.

5.	Construct Python programs using user-defined functions, lambda expressions, recursion, and appropriate parameter-passing techniques to solve computational problems.
6.	Demonstrate Python programs using NumPy for numerical computation and Matplotlib for effective data visualization.

Section1:	
Unit I: Fundamentals of Python Programming (4 Hours) Introduction of Program, different types of Programming language: low level language, assembly level language, high level programming language, scripting language. Features of Python, How to Run Python code, Identifiers, Reserved Keywords, Variables, Comments in Python, Indentation in Python, Input, Output statement. <i>Self-Study: Python Installation and Environment Setup Debugging Basics.</i> Unit II: Operators (5 Hours) Operators: Arithmetic Operators, relational Operators, Logical Operators, bitwise operators, other stray operators, Operator Precedence, Mathematical Functions, Trigonometric Functions, Random Number Functions, Strings in python: subscript operator, indexing, slicing a string, string methods. <i>Self-Study: Regular Expressions (Regex), String Encoding and Unicode.</i> Unit III: Flow Control and Loops (5 Hours) Decision Making: if statement, if...else statement, if...elif...else statement, nested if statement; Loops: while loop, for loop, range () function, continue and break statement, while and for loop with else statement, pass statement. <i>Self-Study: Time Complexity of Loops, Enumerate and Zip Functions.</i>	
Section2:	
Unit IV: In-built Data Structures in Python (4 Hours) List, Tuple, Set, Dictionary; Mutable and Immutable Objects, Data Type Conversion, Built-in methods and comprehensions. <i>Self-Study: Searching and Sorting Techniques using Python Data Structures.</i> Unit V: Functions (5 Hours) Function Definition, Function Calling, Function Arguments, Anonymous Functions (Lambda Functions), recursive function, Function with more than one return value, default value to parameter, keyword parameter. <i>Self-Study: Nested Functions, Doc strings and documentation of Python Functions.</i> Unit VI: File Handling, NumPy and Matplotlib (5 Hours)	

Opening a File, Modes for Opening a File, Attributes of file object, closing a File, reading from a File, writing to a File, File Methods. Introduction to NumPy, Arrays, Array indexing, comparison of Array and List data types, Array math, Broadcasting. Matplotlib -Plot, subplots and images.

Self-Study: *Exception Handling in File Operations, Basic Image Processing, Advanced Plotting Techniques using Seaborn.*

Text Books:

1	"Programming And Problem Solving with Python", Ashok Kamthane and Amit Ashok Kamthane, ISBN 9789387067578
2	"Beginning Programming with Python for Dummies", John Paul Mueller, Wiley Publishing, ISBN 9788126553488

Reference Books:

1	DiveintoPython3: MarkPilgrim, Jesse Noller, Wiley Publishing, ISBN9788184899115.
2	Python in Easy Steps, Tata McGraw Hill Education, ISBN 9789351343080
3	Learning Python, 5th Edition, Mark Lutz, O'Reilly, ISBN 978-1449355739

List of Practical's:

1. Program to Calculate the Area of a circle and triangle.
2. Program to Swap Two Variables.
3. Program to Generate a Random Number.
4. Program to Convert Kilometres to Miles.
5. Program to find maximum of two numbers.
6. Program to check if a number is even or odd.
7. Program to check if a number is positive, negative or 0.
8. A school decided to replace the desks in three classrooms. Each desk sits two students. Given the number of students in each class, print the smallest possible number of desks that can be purchased. The program should read three integers: the number of students in each of the three classes, a, b and c respectively. In the first test there are three groups. The first group has 20 students and thus needs 10 desks. The second group has 21 students, so they can get by with no fewer than 11 desks. 11 desks is also enough for the third group of 22 students. So, we need 32 desks in total.
9. H hours, M minutes and S seconds are passed since the midnight ($0 \leq H < 12$, $0 \leq M < 60$, $0 \leq S < 60$). Determine the angle (in degrees) of the hour hand on the clock face right now.
10. Given integer coordinates of three vertices of a rectangle whose sides are parallel to the coordinate axes, find the coordinates of the fourth vertex of the rectangle. In the first test the three given vertices are (1, 4), (1, 6), (7, 4). The fourth vertex is thus (7, 6).
11. There was a set of cards with numbers from 1 to N. One of the cards is now lost. Determine the number on that lost card given the numbers for the remaining cards. Given a number N, followed by N - 1 integers - representing the numbers on the remaining cards (distinct integers in the range from 1 to N). Find and print the number on the lost card.

Assignments on Operators

12. Program to find maximum of three numbers.
13. Program to check if a year is leap.
14. Program to check if a date is valid.
15. Program to find the roots of a quadratic equation.

16. Given a string. Delete from it all the characters whose indices are divisible by 3.
17. Given a sequence of integer numbers ending with the number 0. Determine the length of the widest fragment where all the elements are equal to each other.
18. In bowling, the player starts with 10 pins at the far end of a lane. The object is to knock all the pins down. For this exercise, the number of pins and balls will vary. Given the number of pins N and then the number of balls K to be rolled, followed by K pairs of numbers (one for each ball rolled), determine which pins remain standing after all the balls have been rolled. The balls are numbered from 1 to N (inclusive) for this situation. The subsequent number pairs, one for each K represent the start to stop (inclusive) positions of the pins that were knocked down with each role. Print a sequence of N characters, where "I" represents a pin left standing and "." represents a pin knocked down.
19. A timestamp is three numbers: a number of hours, minutes and seconds. Given two timestamps, calculate how many seconds is between them. The moment of the first timestamp occurred before the moment of the second timestamp.

Assignments on Flow Control and Loops

20. Program to display first 'n' numbers.
21. Program to calculate factorial of a numbers.
22. Program to display numbers in the reverse order.
23. Program to check if a number is prime.
24. Program to calculate sum and average of first 'n' numbers.
25. Program to display first 'n' multiples of a number.
26. Program to display first 'n' Fibonacci numbers.
27. Program to find the sum of digits of a number.

Assignments on In-built Data Structures

28. Program to Create and view elements of a list.
29. Program to Create and view elements of a tuple.
30. Program to access List Index and Values
31. Program to add two Lists.
32. Program to check if a List is Empty or Not.
33. Program to Find the Largest Number in a List.
34. Program to Find the Second Largest Number in a List.
35. Program to Put Even and Odd elements in a List into Two Different Lists.
36. Program to Find all Numbers in a Range which are Perfect Squares and Sum of all Digits in the Number is Less than 10.
37. Program to Generate Random Numbers from 1 to 20 and Append Them to the List.
38. Program to Remove the Duplicate Items from a List.
39. Program to create and view a dictionary.
40. Program to create and view elements of a set.
41. Program to Print values of dictionary.
42. Program to print all keys of dictionary.
43. Program to insert and delete from dictionary.
44. Program to sort (ascending and descending) a dictionary by value.
45. Program to concatenate dictionaries to create a new one.
46. Program to check whether a given key already exists in a dictionary.
47. Program to merge two Python dictionaries.
48. Program to get the maximum and minimum value in a dictionary.
49. Program to Add a list of elements to a set.
50. Program to Update the first set with items that don't exist in the second set.
51. Program to Return a set of elements present in Set A or B, but not both.
52. Program to check if two sets have any elements in common.
53. Program to Remove items from set1 that are not common to both set1 and set2.

Assignments on Functions

54. Function to check if a number is even or odd.
55. Function to find the maximum of two numbers.
56. Function with keyword arguments
57. Function with default arguments.
58. Function to Find the Factorial of a Number Using Recursion.
59. Function to Find the Sum of the Digits of the Number Recursively.
60. Create a function named count vowels that accepts a string and returns the number of vowels in the string.
61. Write a function greet user that takes a user's name as a parameter and prints a personalized greeting message.
62. Given a sequence of integers that end with a 00. Print the sequence in reverse order. Don't use lists or other data structures. Use the force of recursion instead.

Assignments on File Handling

63. To keep record of students' data, manipulate files to store, update, and delete students' information.
64. Write a Python program that reads the content of a text file and prints it to the console.
65. Create a Python program that takes user input (a string) and writes it to a new text file.
66. Write a Python program that reads a text file, counts the number of words in it, and writes the word count to a new file.
67. Write a Python program that reads the content of one text file and writes it to another file.
68. Develop a Python program that counts the number of lines in a text file and displays the count.
69. Write a Python program that appends a user-provided string to the end of an existing text file.
70. To keep record of patients' medical data, manipulate files to store, update, and delete such information.
71. Write a python program to create two 3X3 random matrixes and perform following operation: (a) Addition (b) subtraction (c) multiplication and display shape, dimensions, dtype, Rank and flatten output of every o/p matrix.
72. Write a Python program to plot Line Chart, Bar Chart, Pie Chart, Scatter Chart, Histogram for taking two different arrays as input.

Assignments on Matplotlib

73. A coaching centre recorded the number of hours studied and marks scored by 7 students. Visualize this data in a way that clearly reveals the relationship between study hours and marks, ensuring the graph is easy to interpret at a glance.
74. The performance of three students (A, B, C) across 5 tests needs to be compared on a single visual. Design a chart that allows a viewer to immediately identify who is performing best and how each student's trend differs, without any confusion between the three data series.
75. You are given a student's marks in 5 subjects. Determine the most suitable chart type(s) to (a) compare performance across subjects, (b) show each subject's proportion of the total marks, and (c) illustrate how the values are distributed. Create the corresponding visualizations.
76. Your report must present four different perspectives of data (a trend, a comparison, a relationship, and a distribution) on a single page without any overlap or visual clutter. Design a layout that accommodates all four clearly and legibly.
77. Among your three charts, one is more significant than the others and requires more visual emphasis, while the remaining two serve as supporting visuals. Design a single figure layout that makes this hierarchy visually evident.
78. You are provided with an image file. Load it into Python, display it visually, and determine the underlying numerical structure of the image data - including what each dimension of that data represents.
79. A colleague claims that a colour image and its black-and-white counterpart "contain the same information, just displayed differently." Design a visual comparison that could support or challenge this claim, including a way to interpret the intensity values shown in the grayscale version.

80. Given a photograph, demonstrate three different ways the underlying image data can be transformed using array-based operations alone (without any built-in image-editing function). Present the original image alongside your results so that each transformation is clearly visible.
81. Your visualization needs to be submitted in a report that accepts only image files, and a separate copy is required for a printable document. Determine the appropriate file formats to save your chart in for each use case.
82. Select a real-world dataset relevant to your field of study (e.g., sensor readings, academic marks, weather data) and design a single dashboard-style figure using at least three different chart types that best represents the story the data tells.
83. Demonstrate how the same dataset's graph appears under three different visual themes, presented side-by-side, so that a viewer could select the most suitable style for a presentation.
84. In a dataset with fluctuating values, a viewer should be able to identify the highest and lowest points immediately, without scanning the entire graph. Devise a way to highlight these specific points directly on the chart.
85. You are given a grid of numeric values (e.g., a 5×5 matrix). Create a visualization that allows someone to quickly identify which cells contain high versus low values, without reading each number individually.
86. A specific region of your chart or image must be visually flagged as "important" or "noteworthy" for a reviewer, without altering the underlying data. Determine a way to highlight that region directly on the visualization.
87. Design a report figure in which one primary chart dominates the layout while two supporting charts accompany it ensuring the viewer immediately understands that all three belong to the same analysis, through consistent labelling.

Assignments on NumPy and Matplotlib

88. A college wants to analyze the marks of 100 students in five subjects using NumPy. Develop a Python program to store the marks in a NumPy array and generate useful academic insights.
89. An IT company wants to analyze employee salary data using NumPy to support HR decisions.
90. A hospital has collected patient health information and wants to identify patients requiring immediate medical attention.
91. A weather department records daily temperatures for one month. Analyze the temperature data using NumPy.
92. A smart city project records hourly vehicle counts at a traffic signal. Analyze the traffic pattern using NumPy.
93. An online shopping company wants to analyze monthly sales of five products.
94. A manufacturing company measures the dimensions of produced components. Components outside the acceptable range are considered defective.
95. Images are represented as NumPy arrays. Develop a program to perform basic image enhancement operations.
96. A fitness application records daily step counts for users. Analyze their activity using NumPy.
97. A cricket coach wants to analyze a player's performance over 20 matches using NumPy.
98. Stress-Strain Analysis: Calculate stress and strain from experimental data using NumPy and plot the stress-strain curve using Matplotlib
99. Temperature Distribution in a Metal Rod: Analyze temperature measurements at different positions along a rod and visualize the temperature profile.
100. Spring-Mass System Simulation: Simulate the displacement of a spring-mass system using NumPy and visualize the motion over time.
101. Manufacturing Quality Control: Analyze dimensions of manufactured components and plot histograms to study dimensional variation.
102. Fuel Consumption Analysis: Compare fuel consumption of vehicles at different speeds and plot the results.
103. Traffic Volume Analysis: Analyze hourly traffic count data and plot traffic flow patterns.

104. Rainfall Data Analysis: Process monthly or annual rainfall data and visualize rainfall trends using line and bar charts.
105. Load-Deflection Analysis of a Beam: Calculate beam deflection under different loads and plot load versus deflection.
106. Concrete Compressive Strength Analysis: Analyze compressive strength test results and visualize the variation among samples.
107. Bridge Vibration Monitoring: Process vibration sensor data from a bridge and plot vibration trends over time.
108. Water Consumption Analysis: Analyze daily water consumption data for a residential area and visualize usage patterns.
109. Construction Project Cost Analysis: Compare planned and actual project costs and display the results using charts.
110. Soil Property Analysis: Analyze soil moisture or density data collected from different locations and visualize the distribution.

List of Project areas:

1. Web Application
2. Data analysis
3. Computer vision
4. Machine learning
5. Artificial intelligence
6. Web technologies
7. Numerical analysis
8. Robotics & Automation
9. Manufacturing
10. Simulation & Modelling
11. Graph Plotting & Visualization
12. Quality Control
13. Construction Management
14. Building Information Modelling (BIM)
15. Geotechnical Engineering
16. Hydrology & Water Resources
17. Surveying & GIS
18. Structural Analysis
19. IoT
20. Smart Infrastructure

ES26105: Basics of Engineering

Teaching Scheme	Examination Scheme
Credits: 3	LAB: 20 Marks
Lectures: 2 Hrs./ week	MSE: 20 Marks
Practical: 2 Hrs./ week	ESE: 50 Marks
Tutorial: NA	CVV: 10 Marks

Course Objectives:	
•	To develop a fundamental understanding of computer networks, Internet technologies, wireless and mobile communication.
•	To develop understanding of fundamentals of electrical circuits, power systems, energy sources for power generation and semiconductor devices.
•	To introduce engineering materials, manufacturing processes, quality, automation and emerging industrial technologies.
•	To introduce concepts of structural systems, seismic design, smart infrastructure, and sustainable civil engineering practices.
•	To introduce emerging technologies such as AI, ML, Blockchain, Nanotechnology, and Space Technology and their engineering applications.
•	To develop engineering design thinking, systems thinking, ethical practices, and sustainable design skills.
Course Outcomes:	
	After completion of the course, student will be able to
CO1	Explain the fundamental principles of networking and Internet communication along with comparison of wired/wireless and mobile technologies.
CO2	Understand the fundamentals of electrical circuits, power systems, energy sources for power generation, and semiconductor devices.
CO3	Select suitable materials and explain basic manufacturing, joining, quality, additive manufacturing, robotics, and AI applications in industry.
CO4	Understand fundamental concepts of structural behaviour, seismic resistance, smart infrastructure and sustainable practices in civil engineering applications.

CO5	Explain the fundamentals, applications, benefits, and challenges of emerging technologies in modern engineering systems.
CO6	Design simple products and systems for functionality, manufacturability, sustainability with ethical practices.

Unit 1: The Connected World: Computing, Networks and Communication (5 hrs)

- 1.1.** Computer Networks & the Internet: Data communication, Internetworking & Internet, Protocols & layered architecture - OSI & TCP/IP models, Packet vs circuit switching, IP addressing, TCP & UDP, HTTP/HTTPS, DNS & Email.
- 1.2.** Wired & Wireless Networking: Host-to-network communication, IEEE 802 standards, Ethernet, WLAN & Wi-Fi, WPAN, Bluetooth & ZigBee, Radio waves & electromagnetic spectrum.
- 1.3.** Mobile Communication: 1G → 5G & Beyond: 1G, 2G, 3G, 4G, 5G - Advantages & applications of 5G, Connected/autonomous vehicles, Remote healthcare & smart systems, Introduction to 6G.
- 1.4.** IoT, Edge/Fog & Cloud Computing: IoT communication & architecture, Device → Edge/Fog → Cloud evolution, Cloud & data centers, Storage vs computation, Sequential vs parallel processing, CPU vs GPU, GPUs in modern AI.
- 1.5.** Cybersecurity in the Connected World: Cybersecurity fundamentals, Encryption, Authentication & secure passwords, Phishing & social engineering, Malware & ransomware, Practical cybersecurity hygiene.

Unit 2: Power, Circuits & the Electrical World (5 hrs)

- 2.1.** Concept of EMF & Voltage, Current, Power and Energy. Overview of basic circuit elements: Resistance, Inductance, Capacitance.
- 2.2.** Classification of Electrical Networks, Introduction to AC and DC Circuits and their comparison, Energy storage elements: Battery and Capacitor.
- 2.3.** Advantages of AC transmission. Types of Energy sources: Non-Renewable sources. Renewable sources: Solar, Wind and Biomass.
- 2.4.** Overview of typical electrical power system, Introduction to Power grid.
- 2.5.** Introduction to Semiconductors: Conductors, Insulators and Semiconductor Materials, Introduction to ICs, Moore's Law, Semiconductor devices (Diode, Transistor, FET, MOSFET).

Unit 3: Materials, Machines & Manufacturing (5 hrs)

- 3.1.** Selection of Engineering Materials: Classification of materials - Ferrous & Nonferrous Metals, Ceramics, Polymer and Composites, Material properties, applications and selection criteria.
- 3.2.** Introduction to Manufacturing Technology: Classification of manufacturing processes, significance and applications of each process, Metal Casting - Sand Casting and Die Casting.
- 3.3.** Forming Techniques: Forging, Extrusion, Rolling, Sheet Metal Forming.

- 3.4.** Subtractive Manufacturing Processes: Turning, milling, drilling, shaping, grinding. Assembly and Joining Techniques: Arc welding, Resistance welding, Gas welding, soldering and brazing.
- 3.5.** Concept of Quality Control, Additive manufacturing, Robotics and Automation applications in Industries. Scope of AI in industrial processing.

Unit 4: Structures, Infrastructures & the Built Environment (5 hrs)

- 4.1.** Component of Structure (Substructure and Superstructure), Types of Loads, Load transfer path, Truss action and Arch Action, Basic structural Actions (Axial Force, Bending, Shear, Torsion).
- 4.2.** Essentials of Earthquake Resistant Design - Intensity and magnitude of earthquake, Recording of an earthquake, Symmetry and Unsymmetric, Modes of vibration, Flexibility vs Rigidity in seismic design, Base Isolation technique.
- 4.3.** Urban Planning and Infrastructure: Dimensions of smart cities (Smart Water Supply, Smart Sanitation, Smart Transportation, Power Grids, Affordable and Sustainable Buildings), Electronic Measuring Devices (Distance measuring, Angle Measuring and Area measuring devices), IoT and AI in Civil Engineering.
- 4.4.** Role of Building Bylaws in regulating environment, Concept of Built-up area, Carpet area, Plinth area, Plot area, FSI, Concept of Smart City.

Unit 5: Emerging and Frontier Technologies (4 hrs)

- 5.1. AI, Machine Learning and Deep Learning:** Introduction of AI, AI, ML and DL relationship, Machine and Deep Learning, Working of AI/ML/DL, Engineering Applications, Generative AI and future limitations.
- 5.2. Blockchain Technology:** Introduction to Blockchain Technology: Basic concept, structure, working, Types of Blockchain, advantages, limitations and applications.
- 5.3. Nanotechnology Technology:** Introduction to Nanotechnology, Nanoscale and Types of Nanomaterials, Nanomaterial Manufacturing, Characterizations and applications, Future and Engineering Challenges.
- 5.4 Space Technology** Introduction to Space Technology, satellites and orbit, Launch Vehicle & Rocket Technology, Spacecraft system, applications of Space Technology.

Unit 6: Engineering Thinking: Design Ethics and Practices (5 hrs)

- 6.1.** Introduction to Engineering design, Types of Designs, Design process and Problem definition, Design Constraints - Cost, time and processing.
- 6.2.** Systems Thinking for Engineers: Need of Design, identification, concept generation.
- 6.3.** Design standards: Conventions, Dimensioning and tolerances.
- 6.4.** Engineering Design Case Studies: Functional and Mechanical design, Design for Manufacturing and Assembly, Criteria for Material selection, Product life cycle.
- 6.5.** Ethics in Engineering Design: Sustainability & Green Design and its Characteristics, Intellectual Property and Copyrights.

List of Practical's:

Any 8 experiments from the list below (At least 1 experiment per unit + any 2)

1. Implementation of DHCP, SMTP, DNS and Web Server using Cisco Packet Tracer **(Unit1)**.
2. Design and Implementation of an IoT Application using Cisco Packet Tracer **(Unit 1)**.
3. Virtual Simulation on Verification of Ohm's Law **(Unit2)**.
4. Connection and Measurement of Power Consumption of a Fluorescent /Tube Light **(Unit 2)**.
5. Virtual Simulation of Various Stages of Casting through Demonstration of Sand-Casting Process **(Unit 3)**.
6. 3D Printing Virtual Simulation Lab **a)** Simulation of Fused Deposition Modelling (FDM) Process. **(b)** Simulation of Selective Laser Sintering (SLS) Process for Metals. **(Unit 3)**
7. Virtual Simulation of Metal Forming Processes (any one process: Upsetting, Extrusion, Forging, or Sheet Metal Forming). **(Unit 3)**
8. Compression Test on Concrete Cube using Virtual Laboratory. **(Unit 4)**
9. Virtual Simulation of Tensile Testing **(Unit 4)**
10. Advanced Imaging Modes of SEM (BSE (Compositional & Topography) , TLD, Multiple Elemental mapping) **(Unit 5)**
11. Case Study of Design and Development of a Simple Product using Functional and Mechanical Design Considerations. **(Unit 6)**
12. Case Study of Root Cause Analysis of Catastrophic Failure of any product/Infrastructure/Transportation/Defence/Automotive System **(Unit 6)**

Text Books:

1. Behrouz A. Forouzan, *Data Communications and Networking*, 5th Edition, McGraw-Hill Education.
2. James F. Kurose and Keith W. Ross, *Computer Networking: A Top-Down Approach*, 8th Edition, Pearson.
3. W. A. J. Chapman, *Workshop Technology*, Volume I, II, III, ELBS.
4. P. C. Sharma, *Production Technology*, S. Chand Publication.
5. V. K. Mehta, *Basic Electrical Engineering*, S. Chand Publications.
6. R. K. Rajput, *A Textbook of Power System Engineering*, Laxmi Publications.
7. B. C. Punmia, A. K. Jain, and A. K. Jain, *Theory of Structures*, Laxmi Publications, New Delhi, India.
8. M. Ali Khan, *Earthquake-Resistant Structures: Design, Build and Retrofit*, Butterworth-Heinemann, Oxford, U.K.
9. C. J. Kibert, *Sustainable Construction: Green Building Design and Delivery*, 4th Edition, Wiley, Hoboken, NJ, USA, 2016.
10. Arshdeep Bahga and Vijay Madisetti, *Internet of Things*, University Press.
11. Alfred Basta, Nadine Basta, Mary Brown, and Ravinder Kumar, *Cyber Security & Cyber Laws*, Cengage.
12. Naveen Chilamkurti, T. Poongodi, and Balamurugan Balusamy, *Blockchain, Internet of Things, and Artificial Intelligence*, CRC Press.

13. Risal Singh and Shipra Mittal Gupta, *Introduction to Nanotechnology*, Oxford.
14. George E. Dieter and Linda C. Schmidt, *Engineering Design*, McGraw-Hill Education (Indian Edition).

Reference Books:

1. Theodore S. Rappaport, *Wireless Communications: Principles and Practice*, 2nd Edition, Prentice Hall.
2. Andrew S. Tanenbaum, Nick Feamster, and David J. Wetherall, *Computer Networks*, 6th Edition, Pearson.
3. Edward Hughes, *Electrical and Electronic Technology*, Pearson Publications.
4. Serope Kalpakjian, *Manufacturing Engineering and Technology*, Prentice Hall.
5. Mikell P. Groover, *Fundamentals of Modern Manufacturing*, John Wiley & Sons.
6. Smith W. F., *Principles of Material Science and Engineering*, McGraw-Hill Book Co.
7. B. Chahar and R. K. Jain, *Sustainable Development in Civil Engineering*, New Age International, New Delhi, India, 2019.
8. Chowdhury, Niaz, Chandra Deka, and Ganesh, *Multidisciplinary Functions of Blockchain Technology in AI and IoT Applications*, IGI Global.

ES26106: Universal Human Values

Teaching Scheme	Examination Scheme
Credits: 2	GD/PPT/HA: 50 Marks
Lectures: 2 Hrs/ week	CT2 (W/O): 50 Marks
Practical: NA	
Tutorial: NA	

Prerequisites:	NA
Course Objectives:	
•	To understand the principles of Universal Human Values, develop a holistic perspective of life
•	To understand and gain clarity about personal aspirations and the means to fulfil them responsibly and harmoniously.
•	To understand the human being as the harmonious coexistence of the self and body, recognize relationships as the foundation of family harmony.
•	Understand and live with Universal Human Values such as trust, respect, affection, care, guidance, glory, gratitude and love.
•	To understand harmony in nature, coexistence of human with nature, and society and to practice it in day-to-day life.
•	To understand and develop professional ethics by inculcating Universal Human Values to be responsible and ethical member of society.
Course Outcomes:	
	After completion of the course, student will be able to
1.	The students will be able to understand concept of Universal value Education and realize the need for developing a holistic perspective of life.
2.	The students will be able to realize as Co-existence of Self and Body, and will develop the clarity on the real aspirations and means of fulfilment.
3.	The students will be able to learn and practice the feeling of relationship as the basis for harmony in the Family
4.	The students will be to implement of Universal Human Values, such as, Trust, Respect, Affection and Care, Guidance, Glory. Gratitude, Love in their daily life.

5.	The students will be able to maintain harmony in the nature and harmony in society at large.
6.	The students will be able to follow professional ethics, implement values and ethics as a professional and responsible member of society

Unit 1:	Universal Human Values (4 hrs)
Need for value education, Value Based Education, Skill Based Education, Universal Human values, Self-Regulation. physical health and mental health, correlation of physical and mental health, significance of human values for physical and mental health. Assignment: Topic presentation and discussion on skill and value-based education	
Unit 2:	Human Aspirations and Self-Exploration (5 hrs)
Understanding Human Aspirations, Self-Exploration, Right Understanding, Difference between physical facility wealth and feeling of prosperity, understanding of needs and wants, Understanding needs of Body and I, Harmony in myself. Assignment: Topic presentation and question answers on self-exploration	
Unit 3:	Concept of Human Values (5 hrs)
Concept of Human Values such as - Trust, Respect, Affection and Care, Guidance, Glory. Gratitude, Love, understanding ultimate goal of humanity as harmony in society at large, Understanding family as a unit of society. Assignment: Topic presentation and question answers on concept of human values	
Unit 4:	Harmony in family (5 hrs)
Feeling of relationships as the basis of harmony in family, Understanding values for Human-to-Human Relationships, significance of human values in harmonious family life, responsibilities as a member of family Assignment: Case study discussion on harmony in family	
Unit 5:	Harmony in society and Nature (5 hrs)
Harmony in Nature – Human existence as coexistence with nature, Interconnectedness and mutual fulfilment amongst the four orders of nature, Nature as a collection of units – Physical order, Bio order, Animal order and Human order, inter dependence of all these orders of nature, use of human values to achieve the co-existence. Assignment: Topic presentation and question answers	
Unit 6:	Human Values and Ethics in professional life (4 hrs)

Acceptance of Human Values at levels – Individual Human Being, as a responsible member of society, Ethical professional, correlation of basic human values and professional values, significance of human values for successful professional life

Assignment: Case study discussion based on professional ethics

Text Books:

1	R S Naagarazan, "A text book on Professional Ethics and Human values", New age International, 2nd Edition, Excel Book, 2009.
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Reference Books:

1	R R Gaur, R Sangal, G.P. Bagaria, "A Foundation Course in Human Values and Professional Ethics", 1st Edition, Excel Book, 2009.
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ES26107: Indian Knowledge System

Teaching Scheme	Examination Scheme
Credits: 1	MSE (O): 50 Marks
Lectures: 1 Hrs/ week	ESE (O): 50 Marks
Practical: NA	
Tutorial: NA	

Prerequisites:	
Basic understanding of Indian history, culture, and heritage, Fundamental awareness of science, society, and environmental issues, Interest in exploring India's traditional knowledge systems and philosophical foundations.	
Course Objectives:	
To understand the foundational concepts of the Indian Knowledge System, including the Vedas, Vedangas, Sanskrit, ancient Indian metrics, and the contributions of major ancient Indian universities to knowledge.	
To explore the rich contributions of Bharatiya art, literature, music, dance, philosophy, and mathematics through the works and achievements of eminent Indian scholars, thinkers, and cultural figures.	
To understand the significant contributions of the Bharatiya Knowledge System to mathematics, astronomy, time measurement, physics, and scientific concepts through historical evidence and indigenous knowledge traditions.	
To understand the rich heritage of Bharatiya engineering, science, and technology through ancient innovations in metallurgy, materials, construction, marine technology, and urban civilization.	
To understand the evolution of Bharatiya civilization, its major dynasties, and its indigenous concepts of economy, management, architecture, Vastu Shastra, temple design, and iconography.	
To understand Bharatiya perspectives on nature, environment, life sciences, agriculture, ecology, and health through concepts such as Panchabhutas, Rta, Ayurveda, and the contributions of ancient scholars.	
Course Outcomes:	
	After completion of the course, student will be able to

1.	Understand the foundational concepts of the Indian Knowledge System, including the Vedas, Vedangas, Sanskrit language and metrics, and the major ancient Indian universities and their contributions to knowledge.
2.	Appreciate and demonstrate an understanding of the rich contributions of Bharatiya art, literature, music, dance, philosophy, and mathematics through the works of eminent Indian scholars and thinkers.
3.	Explain and appreciate key Bharatiya contributions such as zero, decimal and binary systems, arithmetic, algebra, geometry, trigonometry, time measurement, gravity, and concepts of matter, life, and the universe.
4.	Identify and appreciate the technological achievements of ancient India, including metallurgy, pottery, glass, dyes, cements, marine technology, and engineering structures such as the Iron Pillar of Delhi.
5.	Explain the major features and contributions of Bharatiya civilization and apply their understanding of traditional economic, management, architectural, and cultural principles.
6.	Explain and appreciate traditional Indian approaches to environmental sustainability, plant and life sciences, agriculture, anatomy, physiology, and healthcare through the principles of Ayurveda and related knowledge systems.

Section 1:	Introduction to Indian Knowledge System: (3 hrs)
Introduction to Vedas, A synopsis of the four Vedas, Sub-classification of Vedas, Messages in Vedas, Introduction to Vedangas, Sanskrit Language – Origins, Structure and Unique Characteristics of the Sanskrit Language, Ancient Indian Universities -Nalanda, Takshashila Vallabhi, Vikramshila, Jagaddala University, Nagarjuna Vidyapeeth, Kanthalloor University etc. Self-Study: Jagaddala University, Nagarjuna Vidyapeeth, Kanthalloor University, if some more.	
Section 2:	Arts, Literature, Culture and Scholars: (2 hrs)
Sixty-four art forms (64 Kalas), Art, Music, and Dance, Naṭaraja - A Masterpiece of Bharatiya Art, Literature, Life and works of Agastya, Lopamudra, Ghoṣa, Valmiki, Patanjali, Vedavyasa, Yajnavalkya, Gargi, Maitreyi, Bodhayana, Kauṭilya, Paṇini, Thiruvalluvar. Salient aspects of Indian Mathematics - Aryabhata, Varahamihira, Adi Shankaracharya, Bhaskaracharya, Madhavacharya, Self-Study - Life and work of scholars, Lopamudra, Ghoṣa, Yajnavalkya, Gargi, Maitreyi, Bodhayana, Kauṭilya, Paṇini, Thiruvalluvar	
Section 3:	Science and Mathematics: (3 hrs)
Number systems in India– Historical evidence, Concepts of Zero and Pi, decimal system, binary system, contributions in the area of arithmetic, algebra, geometry, trigonometry, combinatorial problems in Chandaḥshastra of Pingala, and Magic squares in India, Time – Concept of Kala, Cycles of Time, Measurement of Time, Knowledge of Time – the Science of Light, Concept of Matter, Life and Universe, Gravity, Sage Agastya’s Model of Battery, Velocity of Light.	

Self-Study-Mathematicians -Bhaskaracharya, Madhavacharya, Magic squares in India, Concept of Matter, Life and Universe, Velocity of Light.	
Section 4:	Engineering and Technology Heritage: (2 hrs)
Engineering and Technology Heritage: Pre-Harappan and Sindhu Valley Civilization, Laboratory and Apparatus, Juices, Dyes, Paints and Cements, Glass and Pottery, Metallurgy, bronze and copper artefacts, Engineering Science and Technology in the Vedic Age and Post-Vedic Records, Iron Pillar of Delhi, Rakhigarhi, Mehrgarh, Marine Technology, and Bet–Dwarka. Self- Study- Iron Pillar of Delhi, Marine Technology, Bet Dwarka.	
Section 5:	Bharatiya Civilization: (2 hrs)
Bharatiya Civilization: Genesis of the land, Antiquity of civilization, On the Trail of the Lost River, Discovery of the Saraswati River, the Saraswati-Sindhu Civilization, Different dynasties, Mauryan age, Gupta age. Indian conception of Economy and Management, Insights from Arthashastra, Management by Consciousness, Vastushastra - The science of architecture, Eight limbs of Vastu, Temples in India: marvellous stone architecture for eternity, Temple architecture in India, Iconography. Self-Study -Gupta age, Temples in India.	
Section 6:	Life, Environment and Health: (2 hrs)
Life, Environment and Health: Concept of Nature in Indian Tradition, Panchbhutas - Elements of Nature, Concept of Rta, Sacred Environment, Panchvati, Ethnic Studies, Life Science in Plants, Anatomy, Physiology, Agriculture, Ecology and Environment, Ayurveda, Charaksamhita, Sushrutsamhita, Atrey, Nagarjuna, Kaṇada, Patanjali. Self-Study -Nagarjuna, Kaṇada, Patanjali	
Text Books:	
1	Introduction to Indian knowledge system: concepts and Application, B. Mahadevan, Vinayak Rajat Bhat, Nagendra Pavana R.N, Publisher: PHI learning, 2023, ISBN: 9789391818203.
2	Traditional Knowledge System in India, Amit Jha, Atlantic Publisher, 2022, ISBN: 9788126912230
3	Textbook on The Knowledge System of Bharata by Bhag Chand Chauhan.
4	History of Science in India Volume-1, Part-I, Part-II, Volume VIII, by Sibaji Raha, et al. National Academy of Sciences, India and The Ramkrishan Mission Institute of Culture, Kolkata (2014).
Reference Books:	
1	Pride of India- A Glimpse of India’s Scientific Heritage edited by Pradeep Kohle et al. Samskrit Bharati (2006
2	Vedic Physics by Keshav Dev Verma, Motilal Banarsidass Publishers (2012)
3	India’s Glorious Scientific Tradition by Suresh Soni, Ocean Books Pvt. Ltd. (2010)

ES26109: Student Activity

Teaching Scheme	Examination Scheme
Credits: 2	MSE: 50 Marks
Lectures: 2 Hrs/ week	ESE: 50 Marks
Practical: NA	
Tutorial: NA	

Prerequisites:	
•	No pre-requisites
Course Objectives:	
•	To create awareness among students about government welfare schemes and digital learning opportunities available for personal and professional development.
•	To develop self-awareness and career-planning skills through psychological assessment, goal setting and SWOT/SWOC analysis.
•	To develop students' listening, professional writing and communication skills required for academic and workplace environments
•	To understand time-management and planning techniques for effective utilization of their time and resources.
•	To develop student's employability and interview skills through systematic preparation, professional etiquette and mock interviews.
•	To foster social responsibility, teamwork, leadership and responsible citizenship through participation in community-oriented activities.
Course Outcomes:	
	After completion of the course, student will be able to
1.	Explain relevant government scheme and complete appropriate online learning course
2.	Identify a personal career plan based on self-assessment for career goal and recognize their personal strengths and areas for improvement
3.	Understand effective listening and a professional writing
4.	Schedule a personal weekly planner using time-management techniques /tools
5.	Demonstrate interview readiness through a resume-based mock interview, appropriate professional etiquette and responses

6.	Demonstrate teamwork, leadership and social responsibility via social/community activity
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Section1:	Topics/Contents
	1. Awareness of Various Govt. schemes for benefit of citizens, Senior citizen schemes, farmer schemes: Introduction to Government welfare schemes and their importance, Digital platforms and sources for accessing government schemes, Eligibility criteria, documentation and application procedures, Major schemes and welfare programmes for general citizens, senior citizens, farmers, Awareness of fraud prevention and safe access to government services, Case studies of beneficiaries and practical examples. Student activity: Identification and presentation of selected government schemes. (5 lectures) 2. Infosys spring board courses: Introduction to digital learning and lifelong learning, Overview of Infosys Springboard and its learning resources, Registration, profile creation and navigation of the platform, Identification and selection of courses relevant to engineering students, Online learning practices and completion of courses, Assessment, certification and documenting online learning achievements. Student activity: Selection of a suitable course and certification. (2 lectures) 3. Psychology for students: Introduction to psychology and its relevance to student life, Self-awareness and understanding individual behaviour, Personality, attitudes, motivation and emotional awareness, psychological tests and their purpose, Interpretation of basic self-assessment results, Stress, academic pressure and coping strategies. Student activity: Psychology/ self-assessment test (2 lectures) 4. Self-Evaluation for Career Planning: Meaning and importance of self-evaluation in career planning, Identification of interests, abilities, skills and values, Short-term and long-term career goals, Connecting short-term goals with long-term career objectives, SMART goal setting, SWOT/SWOC analysis for personal and career development, Developing a personal career action plan. Student activity: Preparation of a personal Career Goal Tree + SMART Goal + SWOT/ SWOC analysis. (5 lectures)
Section2:	Topics/ Contents
	5. Listening and writing skills: Listening Skills: Meaning, importance and process of listening, Hearing versus listening, Types of listening: active, passive, selective, critical and empathetic listening, Barriers to effective listening, Techniques for overcoming listening barriers, Tips for becoming an effective listener. Student activity: Listening activities and practice exercises Professional Writing Skills: Principles of effective professional writing, Resume/CV structure and essential components, Preparation of an effective resume for engineering students, Common resume mistakes and how to avoid them, Cover letter and email writing, Professional email etiquette and subject-line writing, Job application writing. Student activity: Professional writing exercises. (5 lectures) 6. Time Management: Meaning and importance of time management, Time as a personal and professional resource, Identification of time wasters and procrastination, Setting priorities and distinguishing urgent from important tasks, Goal-based planning and scheduling, Daily, weekly and monthly planning, Time management tools: calendars, planners, to-do lists and digital applications, Time-blocking and task prioritization techniques. Student activity: Preparation of a personal weekly time-management plan. (2 hrs)

- 7. Job Interviews:** Introduction to job interviews and their purpose, Types of interviews: face-to-face, telephonic, online, panel and technical interviews, Pre-interview preparation and company research, Understanding the job description and required competencies, Resume-based interview preparation, Frequently asked HR and personal interview questions, Technical interview preparation for engineering students, STAR technique for answering competency-based questions, Communication skills and professional etiquette during interviews, Body language, posture, eye contact and voice modulation, Dress code and professional appearance, Handling difficult and unexpected questions, Online interview etiquette and technical preparation.

Student activity: Mock interview. (5 hrs)

- 8. Social activity:** Meaning and importance of social responsibility, Role of students in community development, Identification of local social/community needs, Planning and organizing a social activity, Teamwork, leadership and communication during social activities, Environmental awareness and community participation, Volunteerism and responsible citizenship, Documentation of the completed activity.

Student activity: Completion and documentation of one social activity. (2 hrs)

Text Books:

1	Krishna Kant Singh, Ram Shankar Singh, "An Introduction to Social Work", 1st Edition, Penguin Books Ltd, 2010.
2	Barun K. Mitra, 'Personality Development and Soft Skills, Oxford, ISBN: 9780199459742
3	Gopaldaswamy Ramesh, 'The Ace of Soft Skills: Attitude, Communication and Etiquette for Success', Pearson, ISBN · 9789332515789
4	Soma Mahesh Kumar, 'Soft Skills', McGraw Hill, ISBN: 9789355325259
5	Uma Maheshwari, 'J/W ExamXpert Soft Skills for Campus Placements', Wiley, ISBN-10. 8126575379, ISBN-13. 978-8126575374

Reference Books:

1	Gopaldaswamy Ramesh, Mahadevan Ramesh, 'The ACE of Soft Skills: Attitude, Communication and Etiquette for Success', Pearson India, ISBN: 9789332515789.
2	Sharon Gerson, Steven Gerson, "Technical writing process and product", Pearson Education Asia, LPE 3rd edition.
3	Gajendra Singh Chauhan, Sangeeta Sharma, 'Soft Skills: An Integrated Approach to Maximise Personality', Wiley, ISBN: 9788126556397.
4	B.N. Ghosh, 'Managing Soft Skills for Personality Development', McGraw Hill, ISBN (13): 978- 0-07-107813-9. ISBN (10): 0-07-107813-4.

ES26201: Calculus

Teaching Scheme	Examination Scheme
Credits: 4	TW: 25 Marks
Lectures: 3 Hrs/ week	MSE(W): 25 Marks
Practical: NA	ESE(W): 50 Marks
Tutorial: 1 Hrs/ week	

Prerequisites:	
•	Differentiation, Integration, Maxima & Minima, Differential Equation, Vector Geometry.
Course Objectives:	
•	To provide a strong mathematical foundation in infinite series, function expansions, and multivariable calculus.
•	To develop analytical skills for solving problems involving partial differentiation, extrema, and Jacobians.
•	To introduce vector calculus concepts and their applications in modelling physical and engineering phenomena.
•	To develop problem-solving abilities using multiple integrals in engineering and scientific applications.
•	To equip students with appropriate mathematical techniques for solving higher-order linear differential equations arising in engineering.
Course Outcomes:	
	After completion of the course, student will be able to
1.	Test the convergence of an infinite series and find expansion of functions.
2.	find partial derivatives of functions of several variables.
3.	apply the knowledge of partial differentiation to find extreme values of the function of several variables and Jacobian.
4.	interpret physical phenomenon such as gradient, divergence, curl using the knowledge of vector differentiation.
5.	evaluate multiple integrals and apply the knowledge of multiple integrals in its various applications
6.	solve higher order linear differential equations by suitable mathematical techniques

Section I
Infinite Series and Expansion of functions: Infinite Series, Tests of Convergence (Comparison & Ratio Test), Alternating series, Power series, Region of Convergence, Taylor's and Maclaurin's Series. (7 hrs) Partial Differentiation: Partial derivatives of first and higher orders, Euler's Theorem on homogeneous functions, Partial derivative of composite functions, Total derivative and implicit differentiation. (7 hrs) Application of Partial Derivatives: Maxima and minima of function of two variables, Lagrange's method of undetermined multipliers, Jacobian-properties & applications. (7hrs)
Section II
Vector Differentiation: Introduction to scalar point function and vector point function, Del Operator, Gradient, Directional Derivative, Divergence and Curl, Scalar Potential. (6 hrs) Multiple Integration and Applications: Double integration, Double integration by polar coordinates, change of order of integration, Triple integration, Application of double integration to find area. (8 hrs) Linear Differential Equations and Applications: Linear differential equation of higher order, Solution of nth order LDE by General Method, Method of Undermined Coefficient & Method of Variation of Parameters, Applications of differential equations. (7 hrs)
List of Tutorials
1. Convergence of infinite series 2. Maclaurin's and Taylor's series expansions 3. Evaluation of partial derivatives 4. Euler's theorem on homogeneous functions, Partial derivative of Composite functions, Total Derivative 5. Maxima and minima of functions of two variables, Lagrange's methods of undetermined multipliers, 6. Jacobian 7. Gradient & Directional Derivative 8. Divergence and Curl, Scalar Potential 9. Double integration and change of order of integration 10. Double integration by polar coordinates and application to find area 11. Solution of linear differential equations by General Method & Method of Undermined Coefficient 12. Solution of linear differential equations by Method of Variation of Parameters Applications of differential equations
Textbooks:

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| <ol style="list-style-type: none">1. Higher Engineering Mathematics by B.S. Grewal, Khanna Publisher.2. Higher Engineering Mathematics by B.V. Ramana, Tata McGraw Hill Publisher3. Higher Engineering Mathematics by H.K. Dass, S. Chand Publication4. Advanced Engineering Mathematics by Erwin Kreyszig, John Wiley & Sons. |
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Reference Books:

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| <ol style="list-style-type: none">1. Calculus: Early Transcendental by James Stewart, Cengage Learning2. Advanced Engineering Mathematics by Peter O'Neil, Global Engineering, Publisher.3. Textbook of Applied Mathematics (Volume I & II), by P.N. Wartikar & J.N. Wartikar Pune Vidhyarthi Griha Publisher.4. Advanced Engineering Mathematics by M. Greenberg, Wiley Publications. |
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ES26202: Engineering Design and Innovation 2

Teaching Scheme	Examination Scheme
Credits: 1	MSE: 30 Marks
Lectures: NA	ESE: 70 Marks
Practical: 2 Hrs./ week	
Tutorial: NA	

Prerequisites:	
•	Strong basic knowledge of Science, Physics, Chemistry, Math's
•	Basic computer awareness
•	Communication and teamwork skill
•	Curiosity for problem solving
Course Objectives:	
•	To develop critical thinking and a sight to identify real life societal problems
•	To evolve problem-solving ability by exploring and proposing solutions to real life societal problems
•	To build sound scientific and technical understanding for the usage of appropriate method, technology and tool
•	To engage students in enriching and genuine hands-on experiences.
•	To emphasize long-term, interdisciplinary and self-directed activities for lifelong learning
•	To provide every student a chance to contribute individually as well as a group member to develop teamwork and professional skills.
Course Outcomes:	Difficulty Level is mentioned in round bracket
	After completion of the course, student will be able to
1.	Identify project topic relevant to societal needs from diverse domain areas based on literature review (4)
2.	Map technologies and tools to Define the Project Title and prepare Project Synopsis (4)
3.	Analyze appropriate tools and learn them; also acquire knowledge as per the project need (5)

4.	Apply the acquired technological knowledge and skills to design feasible solution. (5)
5.	Develop/fabricate a working model/prototype of the proposed solution (5)
6.	Test and validate product/ Project Model performance, write the project report and present the project work appropriately (4)

Section1:	Topics/ Contents
	Project Centric Learning: Project Centric Learning (PCL) vs Project Based Learning (PBL), Philosophy and importance of PCL, implementation of PCL through Engineering Design and Innovation Project (EDI), Project Group formation, Role of student and Project guide EDI Terminology: Three pillars of EDI Project: Domain, Tools, Technology Domain areas: Awareness and identification of project areas like Agriculture, Defense, Healthcare, Smart city, Smart energy, Security Systems, Automobile, Space, Green Earth, Automobiles, Water Management, Swachh Bharat or any other socially relevant area. Tools: Learn and use latest scientific/ engineering tools such as Circuit Simulation (PSpice, Simulink, Workbench), Wired/ Wireless and Ad-hoc Networking (NS-2, Packet Tracer), Signal Processing (Code Composer Studio along with Integrated circuits) or any other scientific/ engineering/ AI tools as per the project need. Technology: Map the appropriate technology as per the selected project such as Artificial Intelligence, Block Chain, Robots, Cloud Computing, Energy Technology, Nanotechnology, Advanced Material, Clean Technology, Edge/Computing, New Screens along with Electronics, Energy harvesting, Energy storage, automobile, remote smart grid, biomedical, waste management, food processing or map any other relevant technology as per the project. Literature Review & Self Learning: Brain Storming and Discussion on project topic, Literature Review, defining project statement/ Title, Preparation of project Synopsis Map the appropriate technology and learn appropriate tools, also gather/ procure components, things as per the project need, do the project planning
Section2:	Topics/ Contents
	Project Designing: Apply appropriate method, technological knowledge and skills to design a feasible solution of the project. Prototype Development and Testing: Development /fabrication of a final working model/ Prototype of the proposed project solution. Test, modify, refine and validate the prototype to have its optimal performance Project Report and Presentation: Write project report in IEEE research paper format, Preparation of a Poster and Presentation based on project work

Publish / Present project paper in National/International Journal / Conference or file a Patent based on the novelty, innovation and future commercial aspects of the project work in the subsequent semester

Text Books:

1	K Nagrajan, "Project Management", 2nd Edition, New age International Ltd., 2004.
2	Pradeep Pai, "Project Management", 1st Edition, Pearson India, 2019.
3	Mahnaz Moallem, Woei Hung, and Nada Dabbagh, "The Wiley Handbook of Problem-Based Learning" Wiley-Blackwell Publisher 2019
4	Robert M. Capraro, Mary Margaret Capraro, James R. Morgan, "STEM Project-Based Learning: An Integrated Science, Technology, Engineering, and Mathematics (STEM) Approach", Sense Publishers Rotterdam, Netherlands, 2013

Reference Books:

1	H. S. Fogler and S. E. LeBlanc, "Strategies for Creative Problem Solving", 2nd Edition, Pearson, Upper Saddle River, NJ, 2008.
2	A. Whimbey and J. Lochhead, "Problem Solving & Comprehension", 6th Edition, Lawrence Erlbaum, Mahwah, NJ, 1999.
3	De Graaff E, Kolmos A., Red.: "Management of change: Implementation of problem based and project-based learning in engineering", Rotterdam Sense Publishers Rotterdam, Netherlands, 2007
4	Samuel Mantel, Jack Meredith, Scott Shafer, Sutton, and M.R. Gopalan, "Project Management Core Textbook", Second Indian Edition, Wiely Publisher, 2014
5	João M. Fernandes, Ricardo J. Machado, "Requirements in Engineering Projects", Springer Nature Switzerland AG, 2016

ES26203: Logic and Quantitative Aptitude 2

Teaching Scheme	Examination Scheme
Credits: 2	CP: 30 Marks
Lectures: 2 Hrs/week	GD/PPT/HA: 20 Marks
Practical: NA	MSE (W/O): 20 Marks
Tutorial: NA	ESE (W/O): 30 Marks

Prerequisites:	
	Quantitative Reasoning and Professional Practice, or equivalent exposure to the assessment formats and digital work practice covered therein.
Course Objectives:	
•	To develop competence in logical, analytical and deductive reasoning at the level of difficulty encountered in current graduate selection examinations.
•	To develop spatial and abstract reasoning ability of the kind assessed in aptitude batteries and core-sector selection examinations.
•	To familiarize the student with gamified cognitive assessment and the behavioural attributes it measures.
•	To familiarize the student with situational judgement tests and work-style inventories employed in pre-interview screening.
•	To develop competence in workplace correspondence, technical writing and documentation.
•	To impart an understanding of professional conduct, employment systems and the construction of a published professional portfolio.
Course Outcomes:	
	After completion of the course, student will be able to
1.	Solve problems of arrangement, distribution and scheduling by systematic deduction and elimination.

2.	Evaluate arguments through syllogistic, conditional and critical reasoning, and identify assumptions, inferences and logical flaws.
3.	Solve spatial and abstract reasoning problems involving pattern completion, transformation and three-dimensional visualisation.
4.	Interpret the attributes measured by gamified cognitive assessments, situational judgement tests and work-style inventories, and respond to them appropriately.
5.	Compose professional correspondence, technical documents and procedural instructions suited to a stated reader and purpose.
6.	Apply established norms of professional conduct, interpret the principal elements of employment agreements, and construct a published professional portfolio.

Section 1:	Topics/ Contents
Unit 1 (04 Hrs)	Consolidation and Logical Reasoning I: Full-length timed retrieval across quantitative and interpretation material of the preceding semester, with sectional analysis, classification of errors and preparation of an individual correction plan. Arrangements and puzzles, comprising linear, circular and matrix arrangements, multi-constraint distribution, scheduling under stated conditions, grid deduction and elimination technique.
Unit 2 (04 Hrs)	Logical Reasoning II: Syllogisms and conditional statements. Statement and assumption, statement and inference, statement and conclusion. Identification of logical flaws in an argument, and statements that strengthen or weaken a conclusion. Number, letter and mixed series. Coding, decoding and symbol substitution. Analogies and classification. Blood relations, direction sense and ranking.
Unit 3 (02 Hrs)	Spatial and Abstract Reasoning: Figure series, matrices and abstract pattern completion. Mirror images and water images. Paper folding and cutting. Cubes, dice and three-dimensional visualisation. Embedded figures, rotation and mental transformation.
Unit 4 (06 Hrs)	Behavioural and Gamified Assessment: Purpose and inference of gamified cognitive assessment. Tasks measuring attention, working memory and processing speed. Learning rate and adaptation across repeated rounds. Decision-making under uncertainty and incomplete information. Risk-balancing, effort allocation and reward-timing tasks. Interpretation of task feedback and adjustment of strategy. Situational judgement tests, comprising format, scoring and response selection. Personality and work-style inventories, consistency checks and the requirement of honest and consistent response.

Section 2:	Topics/ Contents
Unit 5 (04 Hrs)	Professional Communication and Documentation: Structure of electronic mail, comprising subject line, opening, request and close. Tone and register appropriate to faculty, peers, recruiters and external organizations. Follow-up, reminder and escalation. Conventions of copy, threading and attachment. Technical writing for a reader without prior context. Structure of a report, with summary preceding detail. Preparation of instructions and procedures capable of independent execution. Documentation of a project for subsequent use.
Unit 6 (08 Hrs)	Workplace Conduct, Employment Systems and Professional Portfolio: Conduct of meetings, comprising preparation, participation, minutes and recorded actions. Norms of virtual meetings. Digital etiquette and response expectation across channels. Punctuality, commitment and cross-cultural considerations. Employment systems, comprising offer structure and components of compensation, contracts, bonds, probation and notice, internship routes and conversion to full-time appointment, and the respective functions of human resources, the reporting manager and the placement cell. Construction of a professional portfolio, comprising structure, selection and description of work, publication on a no-code platform, linkage to the work repository and professional profile, and preparation of the second-year roadmap.
Text Books:	
1	R. S. Aggarwal; A Modern Approach to Verbal and Non-Verbal Reasoning; Revised Edition, S. Chand Publishing, New Delhi.
2	Arun Sharma and Meenakshi Upadhyay; How to Prepare for Logical Reasoning for the CAT; 6th Edition, McGraw Hill Education, Chennai.
3	M. Raman and S. Sharma; Technical Communication: Principles and Practice; 3rd Edition, Oxford University Press, New Delhi.
Reference Books:	
1	Nishit K. Sinha; Data Interpretation and Logical Reasoning; 4th Edition, Pearson Education, Noida.
2	S. Kumar and P. Lata; Communication Skills; 2nd Edition, Oxford University Press, New Delhi.
3	M. Cook; Personnel Selection: Adding Value Through People; 6th Edition, Wiley-Blackwell, Chichester.

4	A. J. Rutherford; Basic Communication Skills for Technology; 2nd Edition, Pearson Education, Noida.
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List of Practical's:

1. Timed problem set on linear, circular and matrix arrangements.
2. Timed problem set on multi-constraint distribution and scheduling puzzles.
3. Timed problem set on syllogisms, assumptions, inferences and conclusions.
4. Timed problem set on series, coding and decoding, analogies and classification.
5. Timed problem set on figure series, paper folding, dice and mental rotation.
6. Supervised gamified assessment battery on attention, working memory and processing speed, followed by interpretation of the result.
7. Supervised gamified assessment battery on decision-making under uncertainty and risk balancing, followed by debriefing.
8. Supervised situational judgement test and interpretation of a work-style profile.
9. Composition of professional correspondence for a stated recipient and purpose.
10. Revision of a supplied poorly drafted electronic mail communication.
11. Preparation of a procedural document sufficient for independent execution by a reader.
12. Preparation of a stand-alone summary of a supplied extended document.
13. Interpretation of a supplied compensation structure and extract of an employment agreement.
14. Construction and publication of a professional portfolio, with project descriptions prepared for a non-specialist reader.

List of Project areas:

1. Compilation of a logical and spatial reasoning practice record with error analysis.
2. Preparation of a departmental manual of correspondence and documentation practice.
3. Documentation of a first-year academic or co-curricular project for use by a subsequent cohort.
4. Comparative study of behavioural and gamified assessment methods employed in graduate recruitment.
5. Preparation of a guide to employment terms, compensation structures and internship processes.
6. Development and publication of a professional portfolio consolidating academic and co-curricular work.

ES26204: Engineering Problem Solving

Teaching Scheme	Examination Scheme
Credits: 4	MSE (W/O): 20 Marks
Lectures: 2 Hrs/ week	ESE (W/O): 50 Marks
Practical: 4 Hrs/ week	LAB: 20 Marks
Tutorial: NA	CP: 10 Marks

Prerequisites:	
•	Computer Programming
Course Objectives:	
•	Understand fundamental problem-solving techniques and approaches used in computer programming.
•	Describe methods to verify, debug, and test the correctness of programs.
•	Discuss techniques to analyze and improve the time and space efficiency of programs.
•	Apply fundamental integer algorithms such as GCD, LCM, prime number generation, and number base conversion.
•	Develop modular and recursive C programs using modular arithmetic and recursive problem-solving techniques.
•	Apply array-based techniques and basic numerical methods to solve computational and engineering problems.
Course Outcomes:	
	After completion of the course, student will be able to
1.	CO1. Analyze a problem and apply logic to build an algorithm, flowchart, and pseudocode; translate it into a C program and debug basic syntax/logical errors in it.
2.	CO2. Apply C operators and control structures - conditional branching and loops - to convert a problem statement into a working program.
3.	CO3. Implement fundamental number-based algorithms such as GCD, Fibonacci, prime generation, and base conversion.
4.	CO4. Design modular C programs using functions, recursion, structures, and basic file handling.

5.	CO5. Develop C programs using array-based and string-handling techniques to solve computational and engineering problems.
6.	CO6. Apply problem-solving strategies such as divide-and-conquer, analogy, and working backwards to analyze and decompose engineering problems into algorithms.

Section1:	Topics/ Contents
Unit 1: Problem Solving & C Programming Fundamentals (4 hrs) Problem-Solving: the problem-solving life cycle, and why logic matters in solving a problem. Algorithms: definition and properties of a good algorithm. Flowcharts and Pseudocode: tools to plan a program before writing code. Programming Fundamentals: structure of a C program, and the role of a Compiler and Interpreter. First C Program & Debugging: writing and executing the first C program, understanding syntax and logical errors, and tracing a program's logic step by step using print statements or a simple IDE debugger to locate and fix errors.	
Unit 2: C Language Elements, Operators & Control Structures (5 hrs) Tokens in C: Identifiers, Keywords, Constants, Variables. Data Types: int, float, char, double. Operators and Expressions: Arithmetic, Relational, Logical, Assignment and Conditional (Ternary) operators; basic operator precedence. Conditional Branching: if, if-else, nested if-else, else-if ladder, switch-case, break and continue. Iterative Loops: for, while and do-while loop, nested loop.	
Unit 3: Fundamentals of Algorithms (5 hrs) Fundamental Algorithms: exchanging (swapping) the values of two variables, generating the Fibonacci sequence, reversing the digits of an integer, and converting a number between decimal, binary, octal and hexadecimal. Factoring Methods: finding the GCD of two numbers, generating prime numbers, and finding the prime factors of an integer.	
Section2:	Topics/ Contents
Unit 4: Functions, Recursion & Basic Structures (5 hrs) Functions in C: declaration, definition, function call; user-defined and library functions; parameter passing — call by value and call by reference. Recursion: solving problems such as factorial using a recursive function. Structures: declaration, initialization, and accessing members. File Handling: introduction to files (FILE pointer) and basic file operations - opening, reading and writing data using fopen(), fscanf() and fprintf().	
Unit 5: Array & String Techniques (5 hrs) Arrays: introduction to arrays, declaration and initialization, and traversal using loops. One-Dimensional Arrays: finding the sum and average, and the maximum and minimum, of array elements; array reversal. Introduction to Two-Dimensional Arrays. Strings: representing a string as a character array, string input/output, and basic string-handling functions (strlen, strcpy, strcat, strcmp).	
Unit 6: Algorithmic Strategies (4 hrs)	

Examples of problems solved using different approaches: asking questions, looking for things that are familiar, solving by analogy, means-ends analysis, divide and conquer (top-down approach or stepwise refinement), building block approach and merging solutions, working backwards from a solution, iterative vs recursive solutions.

Text Books:

1	R. G. Dromey, "How to Solve It by Computer", Prentice Hall of India.
2	Maureen Sprankle and Jim Hubbard, "Problem Solving and Programming Concepts", Prentice Hall.
3	Yashwant Kanetkar, "Let Us C", BPB Publication.
4	E. Balaguruswamy, "Programming in ANSI C", Tata McGraw-Hill.
5	Tony Gaddis, "Starting Out with Programming Logic and Design", 3rd edition, Pearson.
6	Joyce Farrell, "Programming Logic and Design – Introductory", 6th edition, Course Technology, CENGAGE Learning.

Reference Books:

1	Brian W. Kernighan and Dennis M. Ritchie, "The C Programming Language", Prentice Hall of India.
2	Ranade Abhiram G., "An Introduction to Programming Through C++", McGraw Hill Education India.
3	Jon Bentley, "Programming Pearls", 2nd edition, Pearson Education Asia.

List of Practical's:**Unit 1**

1. List the steps of the problem-solving life cycle for a simple everyday task.
2. Draw a flowchart and write pseudocode to find the largest of three numbers.
3. Write a C program to input two numbers and print their sum, difference, and product.
4. Write a C program containing an intentional syntax or logical error, execute it, identify the error from the output/compiler message, and correct it to get the correct result.
5. Compare compiler-based and interpreter-based execution of the same C program and justify which is more suitable for classroom learning.

Unit 2

6. State the data type and range of values for int, float, and char in C.
7. Explain the difference between an if-else ladder and switch-case with an example.
8. Write a C program to check whether a given number is positive, negative, or zero, and even or odd.
9. Write a C program using nested loops to print a number or star pattern (e.g., a right-angled triangle), and execute it to verify the output.
10. Design a menu-driven C program using switch-case to perform basic arithmetic operations.

Unit 3

11. Write a C program to find the GCD of two numbers using a loop.

12. Write a C program to generate the first N terms of the Fibonacci series.
13. Write a C program to check whether a given number is prime, and print all primes up to N.
14. Write a C program to reverse the digits of a given integer, and execute it for a sample input such as 4521.
15. Design a C program that converts a decimal number into its binary, octal, and hexadecimal equivalents.

Unit 4

16. Define call by value and call by reference with a suitable example.
17. Write a C program to compute the factorial of a number using a recursive function.
18. Write a C program using structures to store and display the records of 5 students.
19. Analyze the difference in output when a variable is passed by value versus by reference in a function.
20. Design a C program that reads data from a text file, processes it, and writes the result to another file.

Unit 5

21. Write a C program to find the average, maximum, and minimum of N numbers stored in an array.
22. Write a C program to reverse the elements of an array and check whether it is a palindrome.
23. Write a C program to count vowels, consonants, and digits in a given string.
24. Write a C program to traverse a 2D array (matrix) and display all its elements row-wise and column-wise, and execute it to verify the output.
25. Design a C program to read a 2D array (matrix) and display its row-wise sum and column-wise sum.

Unit 6

26. Write a C program using the divide-and-conquer approach to find the biggest number in an array, and run it to check the output.
27. Solve this puzzle using the working-backwards strategy: "A number is doubled, then 6 is added to get 20. Find the number." Write down each step.
28. Write two C programs to find the sum of the first N natural numbers—one using a loop and one using recursion. Run both and compare which one is faster.
29. A simple student grade calculator needs to be built. Break this problem into smaller parts using the building-block approach, and list the parts.
30. You need to arrange a list of exam scores in ascending order. Suggest a suitable problem-solving strategy from the ones studied, and explain why you chose it.

List of Project Areas:

1. **Simple Calculator:** A menu-driven C application using functions and switch-case to perform arithmetic and basic scientific operations.
2. **Student Record Management System:** A C program using structures, arrays, and file handling to store, search, and update student records.
3. **Number & Pattern Utility Toolkit:** A C program combining loops, recursion, and arrays to generate number patterns, check primes, and convert number bases.
4. **Library Management Mini-System:** A C program using structures, arrays, and file handling to add, search, issue, and return books.
5. **Text Analyzer Tool:** A C program using string-handling functions and arrays to count words, vowels/consonants, and check for palindromes in user-entered text.

6. **Puzzle & Strategy Solver:** A C program applying recursion and problem-solving strategies (e.g., Tower of Hanoi via divide-and-conquer and a number-guessing game via working-backwards) to solve classic puzzles.

ES26205: Engineering Robotics

Teaching Scheme	Examination Scheme
Credits: 3	LAB: 20 Marks
Lectures: 2 Hrs./ week	MSE(W): 20 Marks
Practical: 2 Hrs./ week	ESE (W): 50 Marks
Tutorial: NA	CP: 10 Marks

Prerequisites:	
•	12 th standard physics and mathematics concepts
Course Objectives:	
•	To introduce the fundamental concepts, terminologies, and components of electromechanical systems with emphasis on robotic systems.
•	To familiarize students with the construction, working principles, and applications of various actuators, end effectors, and control systems used in robotics.
•	To develop an understanding of the architecture, features, and programming environment of the microcontroller for embedded robotic applications
•	To provide knowledge of communication protocols commonly used in embedded and robotic systems for reliable data exchange.
•	To enable students to interface and program sensors with microcontroller-based systems for data acquisition and control.
•	To equip students with the practical skills required to design, implement, and analyze basic embedded robotic systems by integrating actuators, sensors, controllers, and communication interfaces.
Course Outcomes:	
	After completion of the course, student will be able to-
1.	Interpret various terminologies with reference to electromechanical systems such as robots
2.	Illustrate the internal architecture and terminologies of Renesas: ARM CORTEX - M4
3.	Interface different sensors with microcontroller-based systems
4.	Distinguish between various communication protocols
5.	Analyze working mechanisms of different actuators in electromechanical systems.

6.	Identify various types of end effectors and application of transformation matrix to calculate position of end effector.
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Section1:	Topics/ Contents
1. Electromechanical systems: Block diagram representation (Introduction to open loop and closed loop control system with examples), Robot, classification, configurations, terminology. Analogy with human body, degrees of freedom. (5 Hrs) <i>Self-Study: Introduction to the concepts like accuracy, precision, resolution, repeatability etc.</i>	
2. Microcontroller: Renesas: ARM CORTEX - M4, architecture, peripherals, ports, registers, memory types, timer/counter, PWM, interrupts. (5 Hrs) <i>Self-Study: Introduction to computational devices</i>	
3. Sensors: Proximity sensors (Range sensor), Tactile sensors (Contact sensor), light sensors (Photo diode, IR, Photo transistor), Hall-effect sensors, Temperature sensors (Thermo-couple, PT100, NTC), Ultrasonic Sensors. (4 hrs) <i>Self-Study: Study of data sheets of the above sensors.</i>	
Section2:	Topics/ Contents
4. Communication: Serial I/O, I2C, SPI, CAN. (5) <i>Self-Study: Blue-tooth and Wi-Fi communication</i>	
5. Actuators: Construction and working principle of pneumatic actuators, hydraulic actuators, DC, BLDC, Stepper and Servo motors. (5) <i>Self-Study: Solenoid coil, Relays</i>	
6. End effectors and robot controls: End effectors, classification, mechanical, magnetic, vacuum and adhesive gripper. Forward and Inverse kinematics. Introduction to transformation matrix. (4) <i>Self-Study: Gripper force analysis.</i>	
Text Books:	
1	R. K. Rajput, Robotics and Industrial Automation. New Delhi, India: S. Chand Publishing.
2	D. P. Kothari and I. J. Nagrath, Electrical Machines. New Delhi, India: Tata McGraw-Hill Education.
3	S. R. Mujumdar, Oil Hydraulic Systems: Principles and Maintenance. New Delhi, India: McGraw-Hill Education
4	J. J. Craig, Introduction to Robotics: Mechanics and Control, 3rd ed. Upper Saddle River, NJ, USA: Prentice Hall, 2004.
Reference Books:	
1	R. K. Mittal and I. J. Nagrath, Robotics and Control. New Delhi, India: Tata McGraw-Hill Education. 2003

2	T. Kenjo and S. Nagamori, Permanent Magnet and Brushless DC Motors. Oxford, U.K.: Clarendon Press, 1988.
3	R. D. Klafter, T. A. Chmielewski, and M. Negin, Robotic Engineering: An Integrated Approach. Englewood Cliffs, NJ, USA: Prentice Hall.
4	D. G. Alciatore and M. B. Histan, Introduction to Mechatronics and Measurement Systems, 3rd ed. New Delhi, India: Tata McGraw-Hill Education.

List of Practical's: Any 10 from the list

1. Robotic system introduction (Virtual Lab)
2. Introduction to Arduino UNO EK R4 Minima-- LED blinking.
3. LED array / Traffic Signals.
4. Interfacing LDR with Arduino UNO.
5. Ultrasonic Sensor.
6. IR sensor module.
7. Temperature sensor.
8. 16x2 LCD (With I2C)
9. 7 segment display, 4-digit module
10. PMDC Motor
11. Servo Motor
12. MATLAB/Simulink Assignment1
13. MATLAB/Simulink Assignment1
14. MATLAB/Simulink Assignment1

List of Project areas (Not limited to):

1. Mobile robotic systems (line-following, obstacle avoidance, and autonomous navigation)
2. Industrial automation using pneumatic and hydraulic actuation
3. Smart traffic management and intelligent signaling systems
4. Intelligent lighting and energy management systems
5. Smart parking assistance and vehicle guidance systems
6. Environmental and weather monitoring systems
7. Smart home automation and security systems
8. Motor control and speed regulation for robotic applications
9. Servo motor-based robotic arm and pick-and-place systems
10. Sensor-based industrial monitoring and control systems
11. Human-machine interface (HMI) using LCD and display modules
12. Embedded systems for process automation
13. Sensor fusion and intelligent decision-making for autonomous robots
14. Embedded robotics using Arduino kits
15. Automated material handling and conveyor control systems
16. Smart agriculture using sensor-based automation
17. IOT-enabled robotic and monitoring systems (optional, if communication modules are introduced)
18. Prototype development of autonomous electromechanical systems integrating sensors, actuators, displays, and embedded controllers

ES26206: Environmental Studies

Teaching Scheme	Examination Scheme
Credits: 03	ESE: 50 Marks
Lectures: 3 Hrs./ week	T.W. Presentation: 20M
Practical: NA	T.W. Assignment: 30M
Tutorial: NA	

Prerequisites:	
•	12 th Chemistry, Physic and Math's
Course Objectives:	
•	Understand the physical and chemical characteristics of water and their significance in water quality assessment
•	Understand the physical and chemical characteristics of wastewater and their importance in pollution assessment and treatment
•	Understand the sources, characteristics, atmospheric chemistry, meteorological factors, and Air Quality Index (AQI) related to air pollution
•	Understand the principles, working, applications, and selection of various air pollution control equipment for particulate and gaseous pollutants
•	Understand the principles of noise measurement, monitoring, assessment, and control using appropriate techniques and instruments.
•	Understand the generation, characteristics, collection, segregation, transportation, treatment, recycling, resource recovery, and disposal of municipal solid waste.
Course Outcomes:	
	After completion of the course, student will be able to
1.	Explain the physical, chemical, and biological characteristics of water and wastewater and their significance in environmental assessment.
2.	Introduction water and wastewater quality parameters and interpret their implications for environmental and public health
3.	Identify and assess particulate and gaseous air pollutants and calculate AQI using appropriate air quality data.

4.	Select and evaluate suitable air pollution control equipment for controlling particulate and gaseous pollutants.
5.	Measure, analyze, and control environmental noise using appropriate monitoring techniques and engineering control measures
6.	Develop appropriate municipal solid waste management strategies involving collection, segregation, transportation, treatment, recycling, resource recovery, and disposal.

Unit 1:	Introduction to Environmental Sustainability, SDG, ESG
Concept of Sustainability: Sustainability, Sustainable Development and 17 Sustainable Development Goals (SDGs), Global protocols: Montreal Protocol, Kyoto Protocol, National Climate Action Plan (NCAP). Environmental Social Governance (ESG) Concept. <i>Self-Study: BRSR report of one Indian company. Scope I, II and III emissions</i>	
Unit 2:	Water Quality Characteristic
Introduction to water quality and its significance in environmental engineering. Physical, and chemical characteristics of water Water quality parameters including temperature, colour, taste, odour, turbidity, total solids, suspended solids, dissolved solids, pH, acidity, alkalinity, hardness <i>Self-Study: Analyzing water quality parameter of Govt. organization MPCB, CPCB, Local bodies etc.</i>	
Unit 3:	Wastewater Quality Characteristics
Introduction to wastewater and its sources. Physical and chemical characteristics of wastewater. Parameters for wastewater quality assessment including inorganic matter and organic constituents, dissolved oxygen (DO), biochemical oxygen demand (BOD), chemical oxygen demand (COD), oil and grease, heavy metals <i>Self-Study: Analyzing waste water quality parameter of Govt. organization MPCB, CPCB, Local bodies etc.</i>	
Unit 4:	Basics of Air Pollution and Meteorology
Introduction to air pollution, sources and classification of pollutants. Meteorological parameters influencing air pollution, including temperature, wind speed, wind direction, atmospheric stability etc. Introduction to Air Quality Index (AQI), AQI parameters, calculation procedure, interpretation, and classification of air quality. <i>Self-Study: Analyzing AQI of your own city based on CPCB data</i>	
Unit 5:	Noise Pollution Monitoring and Control

Noise measurement units, decibel scale, sound pressure level (SPL), sound intensity, and noise level calculations. Noise control techniques at **the source, along the transmission path, and at the receiver.**

Self-Study: Noise control measures including **acoustic barriers, sound insulation, sound-absorbing materials, enclosures, vibration isolation, and silencers.**

Unit 6:	Municipal Solid Waste Generation and Characteristics
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Introduction to municipal solid waste (MSW), sources, generation, composition, and characteristics and disposal methods.

Self-Study: Report on local governing body on solid waste management.

Text Books:

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| 1 | Environmental Engineering: Water Supply Engineering
S. K. Garg, <i>Environmental Engineering - Vol. I: Water Supply Engineering</i> , Khanna Publishers. |
| 2 | Environmental Engineering
Peavy, H.S., Rowe, D R., and Tchobanoglous, G., <i>Environmental Engineering</i> , McGraw-Hill. |
| 3 | Wastewater Engineering: Treatment and Resource Recovery
Metcalf & Eddy, <i>Wastewater Engineering: Treatment and Resource Recovery</i> , McGraw-Hill. |

Reference Books:

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|---|---|
| 1 | Environmental Pollution Control Engineering
C.S. Rao, <i>Environmental Pollution Control Engineering</i> , New Age International. |
| 2 | Environmental Engineering
Davis, M.L. and Masten, S.J., <i>Principles of Environmental Engineering and Science</i> |
| 3 | Municipal Solid Waste Management
Vesilind, P.A., Worrell, W., and Reinhart, D., <i>Solid Waste Engineering</i> , Cengage Learning |

List of Activities:

1. **Assignment:** Analyze a given water quality dataset containing pH, turbidity, TDS, hardness, alkalinity, DO, BOD, and COD and comment on the quality of water.
2. **PPT/Virtual Lab:** Perform a virtual water quality analysis experiment for selected parameters such as pH, turbidity, hardness, alkalinity, and dissolved oxygen.
3. **PPT/Video/Virtual Lab:** Watch a laboratory demonstration or perform a virtual experiment on **BOD and COD determination** and prepare an observation/report sheet.
4. **Assignment:** Calculate and interpret **AQI** for a selected city using available air quality data and classify the level of air pollution.
5. **Assignment:** Prepare a comparative study of **settling chamber, cyclone separator, bag filter, ESP, and scrubber** based on working principle, removal efficiency, advantages, limitations, and applications.

6. **Assignment:** Conduct a noise survey of a selected location such as a road junction, educational campus, or residential area and prepare a noise-level assessment report.
7. **PPT/Assignment:** Prepare an **integrated municipal solid waste management plan** for a residential/institutional area covering segregation, collection, transportation, treatment, recycling, resource recovery, and disposal.
8. **PPT/Video/Virtual Activity:** Study a virtual/3D demonstration of **sanitary landfill, composting, incineration, or waste-to-energy** and prepare a flow diagram showing the complete process.
9. **United Nations Sustainable Development Goals (SDGs)**
 - **SDG 6:** Clean Water and Sanitation activity of Govt. Programme
 - **SDG 11:** Sustainable Cities and Communities (Target 11.6: Reduce environmental impact of cities, focusing on air quality) Govt. Activities
10. Study a **Field-Validated Case History of “Community Driven Decentralized Plastic Waste Management”** and implement at the VIT at Individual and Institutional Level. (Suggested Resource Case-Study: Sagarmitra-Pavanmitra Abhiyaan).

List of Project areas:

1. Comparative Evaluation of Water Quality Using Physico-Chemical Parameters
2. Comparative Study of BOD and COD for Wastewater Quality Assessment
3. Air Quality Assessment and AQI Calculation for a Selected Urban Area
4. Study of Particulate Matter Removal Using Cyclone, Bag Filter and Electrostatic Precipitator
5. Traffic Noise Assessment and Development of Noise Control Measures
6. Characterization and Quantification of Municipal Solid Waste in a Selected Area
7. Implement Sagarmitra Abhiyaan at VIT - Individual and Institutional Level.

ES26207: Design Thinking and Ideation

Teaching Scheme	Examination Scheme
Credits: 02	MSR: 50 Marks
Lectures: 02 Hrs./ week	ESR: 50 Marks
Practical: NA	
Tutorial: NA	

Prerequisites:	No prerequisites
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Course Objectives:	
•	To understand fundamental concept, principles and importance of design thinking and its relevance in engineering.
•	To understand design thinking theories and phases for developing a problem statement to cater user issues.
•	To understand different design thinking tools and techniques to resolve user issues.
•	To understand different ideation techniques for developing innovative ideas to resolve users' issues.
•	To demonstrate final innovative idea to the users by story-telling
•	To pitch (develop) an innovative idea which will cater a need of user
Course Outcomes:	
	After completion of the course, student will be able to
1.	Explain concept, principles and importance of design thinking and its relevance in engineering.
2.	Apply different design thinking theories, phases, tools and techniques for generation of innovative ideas to cater user problems.
3.	Apply design thinking theories and phases to develop a problem statement for an innovative idea to cater user problems.
4.	Apply different design thinking tools and techniques to finalize problem statement to resolve issues of user groups.
5.	Demonstrate story telling ability to present the innovative idea.

6.	Pitch the finalized idea.
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Section1:	Topics/ Contents
Introduction to design thinking Concept of innovation and invention. Design thinking: Concept, definition, Principles, examples. Importance of design thinking. Discussion of problems from engineering sectors Self-Study: Study development of previous innovations in line with design thinking concept.	
Theories and phases of design thinking Theories of design thinking: Thinking modes, problem solving, creative blocks, creative process. Phases of design thinking: Empathy, define, ideate, prototype, test. Product understanding and process challenges. Defining problem statement. Exploring design thinking in product/process innovation. Self-Study: Study innovation examples for how design thinking theories and phases are used in development of it.	
Design thinking tools & techniques Design thinking core mind sets: Mindful of process, culture of prototyping, human centered, biased towards action. Design tools/techniques: 5 W method, point of view, crazy 8, user journey map, user persona mapping. Self-Study: Study innovation examples for how design thinking tools and techniques are used in the development of it.	
Section2:	Topics/ Contents
Ideation in design thinking Ideation: Concept, purpose, mindset. Need and importance of ideation in design thinking. Role of empathy in ideation. Divergent and convergent thinking in ideation. Preparation for ideation session. Ideation techniques: Brainstorming, brainwriting, mind mapping, worst idea, questioning assumptions, sketching, analogies, SCAMPER, body storm, storyboarding. Self-Study: Study innovation examples for how design thinking tools and techniques are used in the development it.	
Story telling in design thinking Importance of storytelling in communicating ideas. Elements of effective design story: character, conflict, journey, solution, impact, emotion. Story telling structures: Pixar framework, Hero's journey. Self-Study: Develop story for their innovative idea for effective communication to the users.	
Pitching in design thinking Importance of pitching in design thinking. Steps to be followed for effecting pitching for an innovation. Self-Study: Prepare ppt of the innovative idea developed covering all the stages of its development up to its finalization.	
Text Books:	
1	Pavan Soni; Design Your Thinking: The mindsets, Toolsets and Skillsets for creative problem solving. Penguin Random House India Pvt. Ltd. (2020)

2	Pavan Soni; Design Your Thinking: The mindsets, Toolsets and Skillsets for creative problem solving. Penguin Random House India Pvt. Ltd. (2020)
3	S. Balara; Thinking Design; SAGE Publications, 2011
4	Gavin Ambrose, Paul Harris; Design Thinking; AVP Publishing, 2010
5	Ali Jamnia, Introduction to product design and development for Engineers, CRC Press publications, 2018.
Reference Books:	
1	Walter Brenner, Falk Ubernickel; Design Thinking for Innovation - Research and Practice, Springer series, 2016.
2	Michael Lewrick, Patrick Link; Larry Leifer; The Design Thinking Playbook; John Wiley and Sons's, 2018
3	Walter Brenner, Falk Ubernickel; Design Thinking for Innovation - Research and Practice, Springer series, 2016.

List of Practical's/Assignments: (All the exercises shall be executed in a group of 4/6 students)

1. **Assignment:** Explain the concept, principles and importance of design thinking in different sectors of engineering.
2. **PPT:** Present 3-4 innovative ideas to cater problems of any user group.
3. **PPT:** Present finalized problem statement by applying any one design thinking tools and techniques.
4. **PPT:** Present an ideation session for the finalized problem statement by applying any suitable ideation technique.
5. **PPT/Story telling:** Present the finalized problem statement by using story telling method.
6. **PPT/Report:** Pitching of the innovative idea and report submission of the same.

List of Project areas:

1. Development of an innovative idea to cater problems of user groups.
2. Patent publication based on the developed innovative idea.

ES26209: Indian Democracy and Constitution

Teaching Scheme	Examination Scheme
Credits: 0 (Audit Course)	CP: NA
Lectures: NA	GD/PPT/HA: NA
Practical: NA	MSE (W/O): NA
Tutorial: NA	ESE (W/O): As applicable

Prerequisites:	NA
Course Objectives:	
•	Understand the structure and functioning of Indian parliamentary democracy and its institutions.
•	Develop awareness of Fundamental Rights, Fundamental Duties and constitutional values.
•	Understand the principles and practices of good governance and the Directive Principles of State Policy.
•	Understand the meaning, importance, salient features and historical development of the Indian Constitution.
•	Develop the ability to critically examine democratic institutions, constitutional provisions and governance.
•	Foster responsible citizenship, national integrity and respect for constitutionalism and the rule of law.
Course Outcomes:	
	After completion of the course, student will be able to
1.	Analyze the democratic framework with the help of its standards of governance.
2.	Critically examine election process in the country.
3.	Enhance their understanding of good governance.
4.	Analyze the Indian political system, the powers and functions of the Union, State and local governments in detail.

Section1:	Topics/ Contents
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Democracy in India: a) Indian parliamentary democracy b) Lok Sabha c) Rajya Sabha.

Important concepts of Indian Democracy: a) Fundamental Rights in the Indian Constitution b) Fundamental Duties in the Indian Constitution c) Challenges of national integrity.

Good Governance: a) Meaning and concepts b) Government and governance c) Good governance from Directive Principles of State Policy.

Section2:	Topics/ Contents
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	Introduction to Constitution: Meaning and importance of the Constitution, salient features of Indian Constitution. Fundamental Duties Content. History of the Indian Constitution. Constitution and Constitutionalism
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	Preamble to the Indian Constitution: Philosophy of Fundamental Rights. Different important Articles from the Indian Constitutions.
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	Directive Principles of State Policy: An Introduction to Directive Principles of State Policy. Fundamental Duties in the Indian Constitution.
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Text Books:	
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1	M. V. Pylee, Introduction to the Constitution of India, 4th ed., Vikas Publication, 2005.
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2	M. P. Jain, Indian Constitutional Law, 8th ed., Justice Jasti Chelameswar.
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Reference Books:	
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1	Durga Das Basu, Introduction to the Constitution of India, 23rd ed., LexisNexis, 2018.
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2	Merunandan, Multiple Choice Questions on Constitution of India, 2nd ed., Meraga Publication, 2007.
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