ACADEMIC REGULATIONS COURSE STRUCTURE AND DETAILED SYLLABUS

ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

COMPUTER SCIENCE AND ENGINEERING (AI & ML)

for

B.TECH FOUR YEAR DEGREE PROGRAMME

(Applicable for the batches admitted from 2025-2026)

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ADITYA INSTITUTE OF TECHNOLOGY AND MANAGEMENT

(An Autonomous Institution)

Approved by AICTE,

Recognized Under 2(f) & 12(b) of UGC Permanently
Affiliated to JNTUGV, Vizianagaram K.Kotturu, Tekkali,
Srikakulam -532201, Andhra Pradesh.

www.adityatekkali.edu.in

Vision of the Institute

To evolve into a premier engineering institute in the country by continuously enhancing the range of our competencies, expanding the gamut of our activities and extending the frontiers of our operations.

Mission of the Institute

Synergizing knowledge, technology and human resource, we impart the best quality education in technology and management. In the process, we make education more objective so that the efficiency for employability increases on a continued basis.

Vision of the Department

To develop competent and socially responsible engineers in the domain of Artificial Intelligence & Machine Learning for noteworthy contributions to the society.

Mission of the Department

1. To educate the students in fundamental principles of computing and develop the skills needed to solve practical problems using contemporary computer-based technologies.

2. To provide State-of-the-art computing laboratory facilities to promote industry-institute interaction to enhance student‘s practical knowledge.

3. To inculcate self-learning abilities, team spirit, and professional ethics among the students to serve society.

The **Programme Educational Objectives (PEOs)** for our CSE (Artificial Intelligence and Machine Learning) program are to produce graduates who will:

PEO1: Graduates will have the ability to Analyse, Develop and Apply innovative ideas to solve real-world problems using Artificial Intelligence and Machine Learning techniques.
PEO 2: To pursue higher studies, graduates will have the ability to contribute novel and scientific research-oriented methods in the Artificial Intelligence and Machine Learning area.
PEO 3: Practice the profession with ethics and make them responsible professionals to promote industrial progress growth and societal transformation.

PROGRAM OUTCOMES (POs):

Engineering graduates will be able to:

1. **Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem Analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for

sustainable development.

8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-Long Learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs):

By the completion of CSE (Artificial Intelligence and Machine Learning) program the student will be able to:

PSO1: Applythe fundamental knowledge for problem analysis and conduct investigations in CSE (AIML) for sustainable development.
PSO 2: Design and development of solutions byusing modern software for the purpose of execution of the projects in specialized areas.
PSO 3: Inculcate effective communication and ethics for lifelong learning with social awareness.

Course Structure

I Year I Semester

Category	Course Code	Course Name	L	T	P	C
MC	25MCS101	Induction Program	3 Weeks			0
BH	25BHT101	Communicative English	3	0	0	3
BH	25BHT102	Linear Algebra & Calculus	2	1	0	3
BH	25BHT106	Chemistry	3	0	0	3
ES	25EST106	Computer Programming	3	0	0	3
ES	25ESL106	IT Workshop	1	0	4	3
BH	25BHL101	Communicative English Lab	0	0	3	1.5
BH	25BHL104	Chemistry Lab	0	0	3	1.5
ES	25ESL105	Computer Programming Lab	0	0	3	1.5
MC	25MCS103	Health and Wellness, Yoga and Sports	0	0	1	0.5
		Total	**12**	**1**	**14**	**20**

I Year II Semester

Category	Course Code	Course Name	L	T	P	C
BH	25BHT103	Differential Equations and Vector Calculus	2	1	0	3
BH	25BHT104	Engineering Physics	3	0	0	3
PC	25CST101	Data Structures	3	0	0	3
ES	25EST102	Basic Electrical and Electronics Engineering	3	0	0	3
ES	25ESL103	CAED Lab	0	0	3	1.5
PC	25CSL101	Data Structures Lab	0	0	3	1.5
BH	25BHL102	Engineering Physics Lab	0	0	3	1.5
PC	25CSL102	AI Tools Lab	0	0	3	1.5
ES	25ESL102	Basic Electrical and Electronics Engineering Lab	0	0	3	1.5
MC	25MCS102	NSS/NCC/Scouts &Guides/Community Service	0	0	1	0.5
BH	25BHS104	Design Thinking and Sustainable Development	1	0	2	2
		Total	**12**	**1**	**8**	**22**

Mandatory Socially Relevant Internship using Design Thinking and Sustainable Development of 02 weeks duration

Induction Programme

S. No.	Course Name	Category	L	T	P	C
1.	Physical Activities -- Sports, Yoga and Meditation, Plantation	MC	**0**	**0**	**6**	**0**
2.	Career Counselling	MC	**2**	**0**	**2**	**0**
3.	Orientation to all branches -- career options, tools, etc.	MC	**3**	**0**	**0**	**0**
4.	Orientation on admitted Branch -- corresponding labs, tools and platforms	EC	**2**	**0**	**3**	**0**
5.	Proficiency Modules & Productivity Tools	ES	**2**	**1**	**2**	**0**
6.	Assessment on basic aptitude and mathematical skills	MC	**2**	**0**	**3**	**0**
7.	Remedial Training in Foundation Courses	MC	**2**	**1**	**2**	**0**
8.	Human Values & Professional Ethics	MC	**3**	**0**	**0**	**0**
9.	Communication Skills -- focus on Listening, Speaking, Reading, Writing skills	BS	**2**	**1**	**2**	**0**
10.	Concepts of Programming	ES	**2**	**0**	**2**	**0**

Communicative English

Subject Code: 25BHT101 (Common to all Branches)

L	T	P	C
3	0	0	3

Course Objectives

- The main objective of introducing this course, communicative English, is to facilitate effective listening, Reading, Speaking and Writing skills among the students. It enhances the same in their comprehending abilities, oral presentations, reporting useful information and providing knowledge of grammatical structures and vocabulary. This course helps the students to make them effective in speaking and writing skills and as to make them industry-ready.

Course Outcomes

Upon successful completion of this course, students will be able to:

1. Identify and comprehend the main ideas, supporting details, and context from literary texts and audio materials. *(Remembering, Understanding)*
2. Demonstrate the ability to participate in conversations and discussions by expressing ideas clearly on familiar and academic topics. *(Applying, Analyzing)*
3. Compose grammatically accurate sentences, paragraphs, and emails using appropriate structure and punctuation. *(Applying, Creating)*
4. Apply reading strategies such as skimming, scanning, and inference to analyze written texts effectively. *(Applying, Analyzing)*
5. *Use* a range of vocabulary, including synonyms, antonyms, and technical terms, to enhance both spoken and written communication. *(Understanding, Applying)*

Unit – I

Lesson: HUMAN VALUES: Luck by Mark Twain (Short story)

Listening: Identifying the topic, the context and specific pieces of information by Listening to short audio texts and answering a series of questions.

Speaking: Asking and answering general questions on familiar topics such as home, family, work, studies and interests; introducing oneself and others.

Reading: Skimming to get the main idea of a text; scanning to look for specific pieces of Information.

Writing: Capital Letters and Punctuation; Commonly Misspell Words
(That has to be part of the bridge course- 2 weeks before the actual academic Programme starts)

Grammar: Verbs; Tenses; Types of Sentences

Vocabulary: Synonyms, Antonyms, Affixes (Prefixes/Suffixes), Root-words, One word Substitutes

Unit – II

Lesson: NATURE: Ode to the West wind by P B Shelly (Poem)

Listening: Answering a series of questions about main ideas and supporting ideas after Listening to audio texts.

Speaking: Discussion in pairs/small groups on specific topics followed by short structure talks.

Reading: Identifying sequence of ideas; recognizing verbal techniques that help to link the ideas in a paragraph together.

Writing: Structure of a paragraph - Paragraph Writing (specific topics)

Grammar: Use of Articles; Prepositions; Active & Passive Voic

Vocabulary: Homonyms, Homophones, Homographs.

Unit – III

Lesson: BIOGRAPHY: The Knowledge Society – A P J Abdul Kalam)

Listening: Listening for global comprehension and summarizing what is listened to.

Speaking: Discussing specific topics in pairs or small groups and reporting what is discussed.

Reading: Reading a text in detail by making basic inferences-recognizing and interpreting, Specific Context clues; strategies to use text clues for comprehension

Writing: Writing structured essays on specific topics.

Grammar: Adjectives; Degrees of Comparison; Clauses and Phrases

Vocabulary: Compound words, Collocations.

Unit – IV

Lesson: INSPIRATION: Like a Tree, Unbowed by Wangari Maathai

Listening: Making predictions while listening to conversations/transactional dialogues Without video; listening with video.

Speaking: Role plays for practice of conversational English in academic contexts (formal and informal) - asking for and giving information/directions.

Reading: Studying the use of graphic elements in texts to convey information, reveal trends/ Patterns/ relationships, communicate processes or display complicated data.

Writing: Letter Writing: Official Letters; E-Mail

Grammar: Direct & Indirect speech; Cohesive devices-linkers; Formation of Simple, Compound and Complex Sentences.

Vocabulary: Words often confused and Jargons.

Unit – V

Lesson: MOTIVATION: The Secret of Work – Swami Vivekananda

Listening: Identifying key terms, understanding concepts and answering a series of relevant

Speaking: Formal oral presentations on topics from academic contexts

Reading: Reading comprehension.

Writing: Summarizing, Product Description Paraphrasing

Grammar: Editing short texts–identifying and correcting common errors in grammar and usage (articles, prepositions, tenses, subject verb agreement)

Vocabulary: Technical Jargons

Text Books

1. Pathfinder: Communicative English for Undergraduate Students, 1st Edition,OrientBlackSwan, 2023 (Units 1,2 & 3)

Reference Books

1. Professional Communicative English, Maruti Publications,2019
2. Epitome of Wisdom, Maruti Publications, 2013
3. Infotech English, Maruti Publications, 2021
4. English Essentials, Maruti Publications, 2014
5. Bailey, Stephen .Academic writing: A Hand book for International Students.Routledge,2014.
6. Murphy, Raymond. English Grammar in Use, Fourth Edition, Cambridge UniversityPress,2019.
7. Lewis, Norman. Word Power Made Easy-The Complete Handbook for Building a Superior Vocabulary. Anchor, 2014.

Resource Links

Grammar

- www.bbc.co.uk/learningenglish
- https://dictionary.cambridge.org/grammar/british-grammar/
- www.eslpod.com/index.html
- https://www.learngrammar.net/
- https://english4today.com/english-grammar-online-with-quizzes/
- https://www.talkenglish.com/grammar/grammar.aspx

Vocabulary

- https://www.youtube.com/c/DailyVideoVocabulary/videos
- https://www.youtube.com/channel/UC4cmBAit8i_NJZE8qK8sfpA

Linear Algebra & Calculus

Subject Code: 25BHT102 (Common to all Branches)

L	T	P	C
2	1	0	3

Course Objectives

- Understand and apply fundamental concepts of matrices, including rank, inverse, and solutions of linear systems using direct and iterative methods.
- Explore linear and orthogonal transformations, eigenvalues, eigenvectors, and apply the Cayley-Hamilton theorem and canonical forms.
- Gain proficiency in calculus through the application of Mean Value Theorems and function approximations using Taylor's and Maclaurin's series.
- Analyze and apply techniques in multi variable calculus including partial differentiation, Jacobian and optimization using Lagrange multipliers.
- Apply double and triple integration techniques for calculating areas, volumes and other applications in engineering contexts.

Course Outcomes

Upon successful completion of this course, students will be able to:

1. solve systems of linear equations and analyze matrices using rank, inverse, and elimination methods.
2. analyze and simplify matrices using eigenvalues, eigenvectors and the Cayley-Hamilton theorem.
3. apply mean value theorems and function expansions to approximate and interpret real-valued functions.
4. use multi-variable calculus to find partial derivatives and solve optimization problems.
5. compute and apply double and triple integrals to evaluate areas and volumes in engineering contexts.

Unit – I

Matrices: Rank of a matrix by echelon form and normal form; inverse of non-singular matrices using Gauss-Jordan method. System of linear equations: Solving homogeneous and non-homogeneous systems using Gauss elimination method and Gauss-Seidel iteration method.

UNIT – II

Linear Transformation and Orthogonal Transformation: Eigenvalues and eigenvectors and their properties (without proof); diagonalization of a matrix; Cayley-Hamilton Theorem (without proof); finding the inverse and powers of a matrix using the Cayley-Hamilton Theorem.

Quadratic forms: Nature of quadratic forms; reduction of quadratic forms to canonical form using orthogonal transformation.

UNIT–III: Calculus:

Mean Value Theorems: Rolle‘s Theorem, Lagrange‘s Mean Value Theorem and Cauchy‘s Mean Value Theorem with geometrical interpretations.

Taylor‘s and Maclaurin‘s Theorems with remainders (without proof); problems and applications based on the above theorems.

UNIT – IV

Partial Differentiation and Applications (Multivariable Calculus): Partial derivatives, total derivatives, chain rule, change of variables; Taylor's and Maclaurin's series expansion for functions of two variables; Jacobians; maxima and minima of functions of two variables; method of Lagrange multipliers.

UNIT– V

Multiple Integrals (Multivariable Calculus): Double integrals – change of variables (Cartesian and Polar coordinates); change of order of integration. Triple integrals – cylindrical and spherical coordinates.

Applications of double integrals (Area) and triple integrals (Volumes).

Text Books

1. B.S. Grewal, Higher Engineering Mathematics, 44/e, Khanna Publishers, 2017.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 10/e, JohnWiley & Sons, 2018.
3. B.V. Ramana, Higher Engineering Mathematics, McGraw Hill Education, 2018.

Reference Books

1. T. K. V. Iyengar, B. Krishna Gandhi, S. Ranganatham & M.V.S.S.N.Prasad, Engineering Mathematics-I, S.Chand Publisher, 2020.
2. R.K. Jain and S.R.K. Iyengar, Advanced Engineering Mathematics, 5/Ed, Alpha Science International Ltd., 2021 (9^{th} reprint).
3. Michael Greenberg, Advanced Engineering Mathematics, 9^{th} edition, Pearson edn.

Chemistry

Subject Code: 25BHT106 (Common to CSE, CSM, CSD, IT, CSC, ECE, and EEE)

L	T	P	C
3	0	0	3

Course Objectives

- To familiarize engineering chemistry and its applications
- To train the students on the principles and applications of electrochemistry and polymers
- To introduce instrumental methods and spectroscopic techniques.

Course Outcomes

Upon successful completion of this course, students will be able to:

1. Demonstrate the importance of water for society and industrial needs.
2. Summarize the concepts of Instrumental methods and distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques
3. Compare the materials of construction for battery and electrochemical sensors.
4. Demonstrate the preparation, properties, and applications of thermoplastics, thermosetting, elastomers, conducting polymers and bio-degradable polymers.
5. Apply the principle of Band diagrams in the application of conductors and semiconductors.

Unit – I

Water Technology Soft and hard water, Estimation of hardness of water by EDTA Method, Numerical Problems on Temporary and Permanent Hardness - Disadvantages of Hard Water, Boiler troubles – Priming, foaming, scale and sludge, Caustic embrittlement, Industrial water treatment –Ion-exchange processes, Desalination of brackish water- Reverse osmosis (RO) and electrodialysis. Wastewater treatment-Block diagram (primary, secondary, tertiary).

Unit – II

Instrumental Methods and Applications Electromagnetic spectrum. Absorption of radiation: Beer-Lambert‘s law-Statements. UV-Visible Spectroscopy, Instrumentation, electronic transition, Definition of Chromophore – Definition of Auxochrome – Absorption and Intensity Shifts, IR spectroscopy-Instrumentation fundamental modes and Fingerprint Region. NMR – Principle - Equivalent and Non-Equivalent Protons - Chemical Shift- Splitting – Coupling Constant.

Unit – III

Electrochemistry and Applications: Electrodes - Electrochemical cell, Nernst equation, cell potential (EMF) calculations and numerical problems (EMF), potentiometry- potentiometric titrations (redox titrations), conductometric titrations (acid-base titrations). Electrochemical sensors (definition and working principle), reference electrodes – calomel electrode – NHE (or) SHE.

Primary cells – Zinc-air battery, Secondary cells –lithium-ion batteries - working of the batteries including cell reactions; Fuel cells, hydrogen-oxygen fuel cell, Polymer Electrolyte Membrane Fuel cells (PEMFC)- working of the cells.

Unit – IV

Polymer Chemistry: Introduction to polymers, functionality of monomers, chain growth and step growth polymerization, Tacticity in polymers, Coordination polymerization.

Plastics –Thermoplastics and Thermosetting plastics, Preparation, properties and applications of – PVC, Teflon, Bakelite, Nylon-6,6, Polyester resin(PET).

Elastomers–Buna-S, Buna-N–preparation, properties and applications.

Conducting polymers – Polyacetylene, polyaniline – mechanism of conduction and applications.

Biodegradable polymers - Introduction- Polyl Lactic Acid (PLA)-Applications.

Unit – V

Modern Engineering materials:

Semiconductors –Introduction, Basic concepts (Salient features of band theory-Definition semiconductor-Elemental semiconductors -intrinsic semiconductor and extrinsic semiconductors), applications.

Superconductors – Introduction- Basic Concept (Preparation of YBa2Cu3O7-y by ceramic method), Properties- applications.

Supercapacitors: Introduction, Principle & Mechanism of Supercapacitors - Applications.

Nanomaterials: Introduction, classification, properties and applications of Fullerenes, carbon nano tubes and Graphines nanoparticles.

Text Books

1. Jain and Jain, Engineering Chemistry, 16/e, DhanpatRai, 2013.
2. Peter Atkins, Julio de Paula and James Keeler, Atkins‘ Physical Chemistry, 10/e, Oxford University Press, 2010.

Reference Books

3. 1. Skoog and West, Principles of Instrumental Analysis, 6/e, Thomson, 2007.
4. 2. J.D. Lee, Concise Inorganic Chemistry, 5th Edition, Wiley Publications, Feb.2008
5. 3. Textbook of Polymer Science, Fred W. Billmayer Jr, 3rd Edition

Computer Programming

Subject Code: 25EST106 (Common to all Branches)

L	T	P	C
3	0	0	3

Course Objectives

- To provide a strong foundation in problem solving and programming is using the C language.
- This course introduces number systems, core programming concepts, control structures, arrays, functions, pointers, structures, and file handling.
- Emphasis is on writing efficient, modular, and error-free programs suitable for real-world applications.

Course Outcomes

Upon successful completion of this course, students will be able to:

1. Explore number systems and develop basic C programs using algorithms, flowcharts, and simple I/O operations.
2. Apply decision-making, looping, and branching statements to solve conditional and repetitive problems.
3. Use arrays and strings for data storage and manipulation.
4. Design modular programs using functions and apply pointer concepts for dynamic and memory optimized programs.
5. Devise programs to manage and store complex data using structures and files.

Unit – I

Introduction to Number System: Number Systems - Binary, Decimal, Octal, and Hexadecimal Systems, and Conversions

Introduction to Programming: Introduction to components of the Computer system, Algorithm, Flow chart, Program development steps, C Tokens, Data Types, Operator precedence and associativity, Expression Evaluation, Structure of C program, simple programs using formatted and unformatted I/O statements, preprocessor directives.

Unit – II

Control Structures:

Decision statements: if, if-else, nested if, if-else-if ladder, and switch case.

Iterative statements: while, do-while, for, nested loops.

Branching Statements: Break and continue.

Unit – III

Arrays: Definition, Types of Arrays, declaration, initialization, Operations on arrays.

Strings: Fundamentals, declaration, initialization, accessing string, String manipulation.

Unit – IV

Functions: Definition and use, Declaration, Types of Functions, Parameter passing (Call by value and call by reference), Passing Arrays, Recursion, Recursion vs Iteration, function Vs Macro, Storage classes. **Pointers:** Definition, Declaration, Initialization, Pointer arithmetic, functions and pointers, Pointer to pointer, arrays and pointers, Pointers as Function Arguments, DMA

Unit – V

Structures, Unions and File Handling

Structures: Definition, Declaration, Accessing the structure elements, Array of structures, Arrays within structures, pointer to structure, passing structure to function, nested structures, self-referential structures, bit fields.

File Handling: Purpose, Types of files, file opening modes, closing a file, file I/O, Error Handling, Random Access to Files, Command line arguments.

Text Books

1. B. W. Kernighan and D. M. Ritchie, The C Programming Language, 2nd ed., Englewood Cliffs, NJ, USA: Prentice-Hall, 1988.
2. Y. Kanetkar, Let Us C, 20th ed., New Delhi, India: BPB Publications, 2024.
3. N. Kamthane, Programming in C, 3rd ed., New Delhi, India: Pearson Education, 2015.

Reference Books

1. E. Balagurusamy, Programming in ANSI C, 9th ed., New Delhi, India: McGraw-Hill Education, 2024.
2. B. S. Gottfried, Programming with C, 2nd ed., New York, NY, USA: McGraw-Hill Education, 2006.

Resource Links

- https://www.programiz.com/c-programming
- https://www.geeksforgeeks.org/c/c-programming-language/
- https://www.tutorialspoint.com/cprogramming/index.htm

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IT Workshop

Subject Code: 25ESL106 (Common to CSE, CSM, CSD, CSC, and IT)

L	T	P	C
1	0	4	3

Course Objectives

- Explain the internal parts of a computer, peripherals, I/O ports, connecting cables.
- Demonstrate basic command line interface commands on Linux.
- Teach the usage of Internet for productivity and self-paced lifelong learning.
- Demonstrate Office Tools such as Word processors, Spread sheets and Presentation tools.

Course Outcomes

Upon successful completion of this course, students will be able to:

1. Exemplify Hardware components and their functionalities.
2. Demonstrate installation of OS.
3. Configure a PC securely into network.
4. Prepare documents with various text editing features.
5. Create spreadsheets for data processing and visualize using power point presentation.

Computer Hardware

Experiment 1: Identification of peripherals of a PC

Task 1: Identify the peripherals of a computer, components in a CPU and their functions. Draw the block diagram of the CPU along with the configuration of each peripheral.

Task 2: Demonstrate disassemble and assemble a PC.

Operating Systems

Experiment 2: Operating System installation MS Window

Task 1: Illustrate the installation process of MS- Windows

Experiment 3: Operating System installation Linux

Task 1: Install Linux on a Windows based system and facilitate dual booting.

Experiment 4: Linux Operating System commands

Task 1: Implement basic Linux commands like mkdir, rmdir, cat, touch, mv, cp, rm, cd, pwd, echo, date, cal, bc, ls, find, stat, grep, head, tail, ps, kill, ifconfig, ping.

Networking and Internet

Experiment 5:

Task 1: Create awareness on networking components and functionalities. Demonstrate the network connectivity and TCP/IP configuration

Task 2: Illustrate the customization of web browsers with the LAN proxy settings, bookmarks, search toolbars, pop up blockers, and plug-ins (Macromedia Flash and JRE).

Experiment 6:

Task 3: Create awareness on various threats on the internet and protection of the PC like blocking pop ups, blocking active x downloads, firewall configuration and installing anti-virus software.

MS–OFFICE

Experiment 7: MS–Word -Orientation

Task 1: Prepare a project certificate by applying the features:- Fonts Styles, Drop Cap, Text effects, . Borders and Colors, Header and Footer, Date and Time.

Task 2: Design index page of a project by using the features:- Formatting Styles, Inserting table, Bullets, and Numbering, Changing Text Direction, Cell alignment, Footnote, Hyperlink, Symbols, Spell Check, Images from files and clipart, Drawing toolbar and Word Art, Formatting Images, Textboxes, and Paragraphs.

Task 3: Create a News letter: Table of Content, Newspaper columns, Images from files and clipart, Drawing toolbar and Word Art, Formatting Images, Textboxes, and Paragraphs.

Task 4: Develop a Feedback form that includes forms, Text Fields, Radio buttons, check boxes and Mail Merge.

Experiment 8: MS-Excel

Task 1: Describe various basic components of excel namely quick access toolbar, file tab, title bar, ribbon/toolbar, formula bar, cells, rows and columns bars, and status bar.

Task 2: Develop a student performance analysis sheet by covering the features:- Split cells, freeze panes, group and outline, Sorting, Boolean and logical operators, Conditional formatting.

Task 3: Visualization of student performance using Cell Referencing, Formulae in excel – average, std. deviation, Charts, Renaming and Inserting worksheets, Hyper linking, Count function.

Task4: Create Cricket Score Card-Features to be covered:-Pivot Tables, Interactive Buttons, Importing Data, Data Protection, Data Validation.

Experiment 9: MS-Power Point

Task 1: Create a basic PowerPoint presentation covering, Slide Layouts, Inserting Text, Word Art, Formatting Text, Bullets and Numbering, Auto Shapes, Lines and Arrows, Hyperlinks, Inserting –Images, Clip Art, Tables, and Charts in PowerPoint.

Task 2: Create Power Point presentations includes:-Master Layouts (slide, template, and notes), Types of views (basic, presentation, Slideslotter, notes, etc), and Background textures, Design Templates, Hidden slides.

Text Books

1. Vikas Gupta, ―Comdex Information Technology course tool kit‖, 10th ed, WILEY Dream Tech, 2010.
2. Cheryl A Schmidt, ―The Complete Computer upgrade and repair book‖, 3rd edition, WILEY Dream tech, 2002
3. **Simy Joy, Payal Anand, Priya Nair Rajeev**, Introduction to Information Technology, ITL Education Solutions limited, 3rd ed Pearson Education, 2012.
4. Kate J .Chase, ―PC Hardware and A+ Handbook‖–PHI(Microsoft), 2004

Reference Books

1. Scott. Mueller, Upgrading and RepairingPCs,22/e, QUE, 2008.
2. Cheryl A Schmidt, The CompleteComputerupgradeandrepairbook,3/e, Dream tech, 2002
3. IT Essentials PC Hardware and Software Labs and Study Guide, Patrick Regan– CISCO Press, Pearson Education, 3rd edition, 2008.

Communicative English Lab

Subject Code: 25BHL101 (Common to All Branches)

L	T	P	C
0	0	3	1.5

Course Objectives

- Develop a strong foundation in phonetics and pronunciation for effective verbal communication.
- Enhance students' listening comprehension skills through exposure to varied audio materials.
- Improve speaking skills in formal and informal contexts through interactive exercises.
- Train students in presentation techniques to express ideas clearly and confidently.
- Equip students with interview skills; resume writing, and workplace communication essentials.

Course Outcomes

Upon successful completion of this course, students will be able to:

1. Recognize and produce English speech sounds accurately using the phonetic alphabet, and demonstrate correct stress, intonation, and rhythm in spoken communication. (Remembering, Applying)
2. Develop critical listening skills by interpreting gist, specific details, and speaker attitudes from a variety of authentic audio materials. (Understanding, Analyzing)
3. Engage in everyday conversations and demonstrate effective spoken interaction through structured activities such as role plays, JAM sessions, and telephone etiquette. (Applying, Creating)
4. Plan, design, and deliver effective oral presentations using visual aids, PowerPoint slides, and public speaking strategies. (Applying, Creating)
5. Prepare for professional interviews by writing resumes and cover letters, and demonstrating appropriate verbal and non-verbal communication skills in mock interviews. (Creating, Evaluating).

Unit – 1: Introduction to Phonetics

- Introduction to the Phonetic Alphabet
- The Sounds of English: Speech Sounds – Vowels and Consonants
- Word Stress and Sentence Stress
- Intonation Patterns and their role in communication
- Accent and Rhythm in Connected Speech

Focus: *Familiarizing students with correct pronunciation, phonetic transcription, and stress-timing features of spoken English.*

Unit – 2: Listening Skills

- Listening for Gist and Specific Information
- Listening for Note-Taking and Summarizing
- Interpreting Opinions and Attitudes through listening
- Exposure to Speeches and Talks by Eminent Personalities (TED Talks, etc.)

Focus: *Enhancing critical listening, comprehension, and note-making abilities through diverse audio inputs.*

Unit – 3: Speaking Skills

- Self-Introduction and Peer Introduction
- Everyday Conversation Skills (greetings, taking/ending leave, casual dialogue)

- Asking and Giving Information
- Role Plays based on real-life situations
- Just A Minute (JAM) Sessions for spontaneity and fluency
- Telephone Etiquette and formal phone conversations

Focus: *Developing interactive spoken English skills, fluency, and verbal etiquette through guided practice.*

Unit – 4: Presentation Skills

- Basics of Public Speaking and Presentation Techniques
- Planning and Delivering Poster Presentations
- Designing and Presenting using PowerPoint Slides
- Using Visual Aids effectively during presentations

Focus: *Equipping students with the skills to design, organize, and deliver structured oral presentations with confidence.*

Unit – 5: Interview & Career Skills

- Writing a Professional Resume and Cover Letter
- Preparation for Job Interviews: Frequently Asked Questions
- Participating in Mock Interviews with Feedback
- Body Language, Tone, and Confidence Building

Focus: *Preparing students for placement activities and professional communication contexts.*

Suggested Software: Walden Info tech,Young India Films

Reference Books

1. MeenakshiRaman,Sangeeta-Sharma.TechnicalCommunication.OxfordPress.2018.(This can be for theory and not for lab)
2. Samson T:Innovate with English, Foundations
3. Grant Taylor: English Conversation Practice, Tata McGraw-Hill Education India, 2016
4. Jayashree, M Let‘s Hear them Speak: Developing Listening –Speaking skills in English. Sage Publications
5. Hewing‘s, Martin. Cambridge Academic English (B2).CUP, 2012.(That is for reading and writing and can be used in theory classes
6. T. Balasubramanyam, A Text book of English Phonetics for Indian Students, (3rdEd) Trinity Press. (This is all theory and can be for MA English students but not for B. Tech students)

Resource Links

Spoken English:

1. **www.esl-lab.com**
2. **www.englishmedialab.com**
3. **www.englishinteractive.net**

4. **https://www.britishcouncil.in/english/online**
5. **http://www.letstalkpodcast.com/**
6. **https://www.youtube.com/c/mmmEnglish_Emma/featured**
7. **https://www.youtube.com/c/ArnelsEverydayEnglish/featured**
8. **https://www.youtube.com/c/engvidAdam/featured**
9. **https://www.youtube.com/c/EnglishClass101/featured**
10. **https://www.youtube.com/c/SpeakEnglishWithTiffani/playlists**
11. **https://www.youtube.com/channel/UCV1h_cBE0Drdx19qkTM0WNw**
12. **https://www.linguahouse.com/en-GB**
13. **https://www.ted.com/watch/ted-ed**

Voice &Accent:

- https://www.youtube.com/user/letstalkaccent/videos
- https://www.youtube.com/c/EngLanguageClub/featured
- https://www.youtube.com/channel/UC_OskgZBoS4dAnVUgJVexc
- https://www.youtube.com/channel/UCNfm92h83W2i2ijc5Xwp_IAquestionsthattestcomprehension

Chemistry Lab

Subject Code: 25BHL104 (Common to CSE, CSM, CSD, IT, CSC, ECE and EEE)

L	T	P	C
0	0	3	1.5

Course Objectives

- Verify the fundamental concepts with experiments.

Course Outcomes

Upon successful completion of this course, students will be able to:

1. Determine the cell constant and conductance of solutions.
2. Measure molecular/system properties such as surface tension and viscosity and prepare advanced polymer Bakelite material.
3. Measure the strength of an acid present in secondary batteries by pH metry and strength of solutions by potentiometry.
4. Analyse the sample using spectroscopic techniques and Measure molecular/system property such as chloride content of water.
5. Measure molecular/system properties such as hardness of water and dissolved oxygen.

List of Experiments

1. Measurement of 10Dq by spectrophotometric method.
2. Conductometric titration of strong acid vs. strong base.
3. Conductometric titration of weak acid vs. strong base.
4. Determination of cell constant and conductance of solutions.
5. Potentiometry - determination of redox potentials and emfs.
6. Determination of Strength of an acid in Pb-Acid battery. (pHmetry)
7. Preparation of a Bakelite
8. Verify Lambert-Beer‘s law.(Colurimetric estimation of iron)
9. Wavelength measurement of sample through UV-Visible Spectroscopy.
10. Identification of simple organic compounds by IR.
11. Preparation of nanomaterials by precipitation method.
12. Estimation of Ferrous Iron by Dichrometry.
13. Determination of surface tension and viscosity.
14. Determination of Hardness of water sample by EDTA Method
15. Determination of Dissolved Oxygen present in the given water sample by Modern Winkler‘s Method.
16. Determination of Chloride content present in given water sample

Reference Books

1. "Vogel's Quantitative Chemical Analysis 6th Edition 6th Edition" Pearson Publications by J. Mendham, R.C. Denney, J.D. Barnes and B. Sivasankar

Computer Programming Lab

Subject Code: 25ESL105 (Common to all Branches)

L	T	P	C
0	0	3	1.5

Course Objectives

- To equip students with hands-on programming skills using the C language by solving a variety of real-life and algorithmic problems.
- The course emphasizes the use of control structures, arrays, functions, pointers, structures, and file handling through practical implementation.
- It aims to develop logical thinking and modular coding practices aligned with foundational computing principles.

Course Outcomes

Upon successful completion of this course, students will be able to:

1. Apply basic C programming constructs such as variables, data types, operators, and input/output operations to solve simple problems.
2. Develop programs using control structures to implement decision making and iterative tasks.
3. Demonstrate the usage of arrays to solve problems related to lists of elements.
4. Implement modular and memory optimized programs using functions and pointers.
5. Design programs using structures and file handling techniques to manipulate stored data.

List of Experiments

1. Write the C programs to perform the following
   a) Simple and compound interest calculation
   b) Find the maximum of 3 values using the conditional operator.
   c) Interchanging values of two variables.
2. Write the C programs to perform the following
   a) Demonstrate the precedence and associativity among operators using single expression
   b) Demonstrate the type casting operations
   c) Demonstrate different format specifies on different data types
3. Write C programs for the following using decision making statements
   a) Find roots of quadratic equation.
   b) Find the max and min of three numbers using if-else.
   c) Determine type of character (vowel, consonant, digit, special character).
4. Write the C programs to perform the following
   a) Read a number and display in reverse.
   b) Check for Armstrong number property
   c) Convert a binary number (entered as an integer) into its decimal equivalent.
5. Write a menu-driven C program using switch-case and loops to display:
   a) Prime numbers in a given range
   b) Fibonacci series
   c) Different patterns like Pascal triangle
6. Implement the following using arrays
   a) Largest and smallest from a list of elements.
   b) Program for Linear Search.
   c) Program for arranging elements.

7. Implement the following using arrays
   a) To count the total number of duplicate elements in an array.
   b) Matrix addition
   c) Matrix multiplication
8. Write a program in C using functions
   a) Implementation of strong number property.
   b) Implementation of call by value and call by reference
   c) Demonstrate the string operations with and without library functions (length, reverse, copy, concatenation, compare)
9. Write the C programs to perform the following
   a) GCD using recursion and non-recursion.
   b) Demonstrate working of macros vs functions.
10. Write the C programs to perform the following
    a) Find the sum and average of the list of elements using DMA Functions
    b) Demonstrate pointer arithmetic.
11. Write the C programs to perform the following
    a) Passing structure as a parameter to a function
    b) Nested structures.
12. Write the C programs to perform the following
    a) Count the number of lines, words, and characters in a file using command line arguments.
    b) Merging the contents of two files into a new file.

Text Books

1. B. W. Kernighan and D. M. Ritchie, The C Programming Language, 2nd ed., Englewood Cliffs, NJ, USA: Prentice-Hall, 1988.
2. Y. Kanetkar, Let Us C, 20th ed., New Delhi, India: BPB Publications, 2024.
3. N. Kamthane, Programming in C, 3rd ed., New Delhi, India: Pearson Education, 2015.

Reference Books

1. E. Balagurusamy, Programming in ANSI C, 9th ed., New Delhi, India: McGraw-Hill Education, 2024.
2. B. S. Gottfried, Programming with C, 2nd ed., New York, NY, USA: McGraw-Hill Education, 2006.

Reference Links

- https://www.programiz.com/c-programming
- https://www.geeksforgeeks.org/c/c-programming-language/
- https://www.tutorialspoint.com/cprogramming/index.htm

Health and Wellness, Yoga and Sports

Subject Code: 25MCS103 (Common to all Branches)

L	T	P	C
0	0	1	0.5

Course Objectives

- The main objective of introducing this course is to make the students maintain their mental and physical wellness by balancing emotions in their life. It mainly enhances the essential traits required for the development of the personality.

Course Outcomes

Upon successful completion of this course, students will be able to:

1. Understand the importance of yoga and sports for Physical fitness and sound health.
2. Demonstrate an understanding of health-related fitness components.
3. Compare and contrast various activities that help enhance their health.
4. Assess current personal fitness levels.
5. Develop Positive Personality

Unit – 1

Concept of health and fitness, Nutrition and Balanced diet, basic concept of immunity Relationship between diet and fitness, Globalization and its impact on health, Body Mass Index (BMI) of all age groups.

Activities:

i) Organizing health awareness programmes in community
ii) Preparation of health profile
iii) Preparation of chart for balance diet for all age groups

Unit – 2

Concept of yoga, need for and importance of yoga, origin and history of yoga in Indian context, classification of yoga, Physiological effects of Asanas- Pranayama and meditation, stress management and yoga, Mental health and yoga practice.

Activities:

Yoga practices – Asana, Kriya, Mudra, Bandha, Dhyana, Surya Namaskar

Unit – 3

Concept of Sports and fitness, importance, fitness components, history of sports, Ancient and Modern Olympics, Asian games and Commonwealth games.

Activities:

i) Participation in one major game and one individual sport viz., Athletics, Volleyball, Basketball, Handball, Football, Badminton, Kabaddi, Kho-kho, Table tennis, Cricket etc.
ii) Practicing general and specific warm up, aerobics
iii) Practicing cardiorespiratory fitness, treadmill, run test, 9 min walk, skipping and running.

Reference Books

1. Gordon Edlin, Eric Golanty. Health and Wellness, 14th Edn. Jones & Bartlett Learning, 2022
2. T.K.V.Desikachar. The Heart of Yoga: Developing a Personal Practice
3. Archie J.Bahm. Yoga Sutras of Patanjali, Jain Publishing Company, 1993
4. Wiseman, John Lofty, SAS Survival Handbook: The Ultimate Guide to Surviving Anywhere Third Edition, William Morrow Paperbacks, 2014
5. The Sports Rules Book/ Human Kinetics with Thomas Hanlon. -- 3rd ed. Human Kinetics, Inc.2014

Differential Equations and Vector Calculus

Subject Code: 25BHT103 (Common to all Branches)

L	T	P	C
2	1	0	3

Course Objectives

- Develop understanding of first-order and first-degree differential equations and their real-world applications.
- Introduce methods to solve higher-order linear differential equations with constant coefficients and apply them to engineering systems.
- Equip students with techniques for forming and solving partial differential equations relevant to physical processes.
- Provide knowledge of vector differentiation operators—gradient, divergence and curl—and their physical interpretations.
- Enable students to evaluate vector integrals and apply the fundamental vector theorems (Green's, Stoke's and Divergence) in practical scenarios.

Course Outcomes

Upon successful completion of this course, students will be able to:

1. Apply first-order differential equations to model and solve problems in growth and electric circuits.
2. Solve higher-order linear differential equations.
3. Use Lagrange's method to solve partial differential equations arising from physical and engineering problems.
4. Calculate and interpret the gradient, divergence and curl of vector fields and verify standard identities.
5. Evaluate line and surface integrals and apply vector calculus theorems to real-world applications

Unit – I

Differential Equations of First Order and First Degree: Exact differential equations and equations reducible to exact form; linear differential equations; Bernoulli's equations. **Applications**: Newton's Law of Cooling, Law of Natural Growth and Decay and Electrical Circuits.

Unit – II

Linear Differential Equations of Higher Order (with Constant Coefficients):
Definitions of homogeneous and non-homogeneous equations; complementary function; general and particular integrals; method of variation of parameters.
Application: L–C–R Circuit.

Unit – III

Partial Differential Equations: Introduction and formation of partial differential equations by eliminating arbitrary constants and arbitrary functions; solutions of first-order linear equations using Lagrange's method.

Unit – IV

Vector Differentiation: Scalar and vector point functions; vector operator Del; Del applied to scalar point functions – Gradient; Del applied to vector point functions – Divergence and Curl; vector identities.

Unit – V

Vector Integration: Line integral -Work done, surface integral- Flux. Integral theorems- Green's Theorem, Stoke's Theorem and Divergence Theorem (without proof).

Text Books

1. Erwin Kreyszig, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2018.
2. B.S. Grewal, Higher Engineering Mathematics, 44/e, Khanna publishers,2017.
3. B.V. Ramana, Higher Engineering Mathematics, McGraw Hill Education, 2017.

Reference Books

1. Dennis G.Zill and Warren S.Wright, Advanced Engineering Mathematics, Jones and Bartlett, 2018.
2. Micheael Greenberg, Advanced Engineering Mathematics, 9th edition, Pearson edn.
3. T. K. V. Iyengar, B. Krishna Gandhi, S. Ranganatham & M.V.S.S.N.Prasad, Engineering Mathematics-I, S.Chand Publisher, 2020.
4. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, 5/e, Alpha Science International Ltd., 2021 (9th reprint).

Engineering Physics

Subject Code: 25BHT104 (Common to all Branches)

L	T	P	C
3	0	0	3

Course Objectives

- To introduce the basic concepts of physical optics phenomena, such as interference and diffraction. Understanding of the concepts of quantum mechanics and semiconductor physics, as well as dielectric and magnetic materials, that lead to potential applications in emerging microdevices.

Course Outcomes

Upon successful completion of this course, students will be able to:

1. Understand the phenomenon of interference and diffraction of light, enabling precise analysis of optical instruments.
2. Acquire foundational insight into the quantum nature of the particles and electronic properties of the semiconductors.
3. Develop insight into the dielectric and magnetic properties of materials
4. Analyze the crystal structures by X-ray diffraction techniques.
5. Apply the basic knowledge of lasers and fiber optics to analyze their construction.

Unit – I WAVE OPTICS

Interference: Introduction - Principle of superposition and its Analytical treatment - Interference of light - Interference in thin films (Reflection Geometry) - Colors in thin films- Newton‘s Rings- Determination of wavelength and refractive index.

Diffraction: Introduction – difference between interference and diffraction – difference between Fresnel and Fraunhofer diffractions - Fraunhofer diffraction due to single slit, double slit & Diffraction Grating (N-slit) – Maximum number of orders possible – determination of wavelength of laser.

Unit – II

QUANTUM MECHANICS AND SEMICONDUCTORS: Quantum Mechanics: Dual nature of matter – Heisenberg‘s Uncertainty Principle – Significance and properties of wave function – Schrödinger‘s time- independent wave equations– Particle in a one-dimensional infinite potential well.

Semiconductors: Formation of energy bands – classification of crystalline solids - Intrinsic semiconductors and Extrinsic semiconductors - Drift and diffusion currents – Einstein‘s equation - Hall effect and its Applications.

Unit – III

DIELECTRICS AND MAGNETIC MATERIALS

Dielectric Materials: Introduction - Dielectric polarization - Dielectric polarizability, Susceptibility, Dielectric constant and Displacement Vector - Types of polarizations- Electronic (Quantitative), Ionic (Quantitative) and Orientation polarizations (Qualitative) - Lorentz internal field - Clausius-Mossotti equation.

Magnetic Materials: Introduction - Magnetic dipole moment – Magnetization - Magnetic susceptibility and permeability - Classification of magnetic materials: Dia, Para, Ferro, Antiferro & Ferri magnetic materials - Domain concept for Ferromagnetism (Qualitative) - Hysteresis - soft and hard magnetic materials.

Unit – IV

CRYSTALLOGRAPHY & X-RAY DIFFRACTION

Crystallography: Space lattice, Basis, Unit Cell and lattice parameters – Bravais Lattices – crystal systems (3D) – coordination number - packing fraction of SC, BCC & FCC

X-ray diffraction: Miller indices – separation between successive (h k l) planes - Bragg's law - X-ray Diffractometer – crystal structure determination by Laue method and Powder method.

Unit – V

LASERS & OPTICAL FIBER

LASERS: Introduction - Characteristics of Lasers - Principles of Laser: Absorption, Spontaneous emission, stimulated emission, principle of lasing action, population inversion, pumping, Types of Lasers: Helium-Neon Laser [Four Level System] – semiconductor laser - Applications of Lasers.

OPTICAL FIBER: Introduction - Construction of Optical Fiber - Principle of Optical Fiber: Total Internal Reflection - Numerical Aperture and Acceptance Angle - Classification of optical fibers based on refractive index profile - Applications of Optical Fibers in Communication.

Text Books

1. ―A Text book of Engineering Physics‖ - M. N. Avadhanulu, P.G.Kshirsagar & TVS
2. ArunMurthy, S.Chand Publications, 11th Edition 2019.
3. ―Engineering Physics‖ - D. K. Bhattacharya and Poonam Tandon, Oxford press (2015).
4. ―Engineering Physics‖ - P. K. Palanisamy SciTech publications.

Reference Books

1. ―Fundamentals of Physics‖ - Halliday, Resnick and Walker, John Wiley &Sons.
2. ―Engineering Physics‖ - M.R. Srinivasan, New Age international publishers (2009).
3. ―Engineering Physics‖ - Shatendra Sharma, Jyotsna Sharma, Pearson Education, 2018.
4. ―Engineering Physics‖ - Sanjay D. Jain, D. Sahasrabudhe and Girish, University Press.
5. ―Semiconductor physics and devices:Basic principle‖ - A. Donald, Neamen, Mc GrawHill.
6. ―Engineering Physics‖ - B.K. Pandey and S. Chaturvedi, Cengage Learning
7. ―Solid state physics‖ – A.J.Dekker ,Pan Macmillan publishers
8. ―Introduction to Solid State Physics‖ - Charles Kittel ,Wiley

Data Structures

Subject Code: 25CST101 (Common to CSE/CSM/CSD/CSC/IT)

L	T	P	C
3	0	0	3

Course Objectives

- Be familiar with basic techniques of algorithm analysis and writing recursive methods
- Master the implementation of linked data structures such as linked lists and binary trees and balanced search trees.
- Be familiar with several sorting algorithms including selection-sort, bubble-sort.
- Be familiar with some graph algorithms such as shortest path and minimum spanning tree
- Master analyzing problems and writing program solutions to problems using the above techniques

Course Outcomes

Upon successful completion of this course, students will be able to:

1. Explain the role of data structures in organizing and accessing data efficiently.
2. Design linked lists for dynamic data storage and manipulation.
3. Develop novel solutions to applications using linear data structures.
4. Apply stack and queue based algorithms for efficient task scheduling and traversals in graphs.
5. Explore different tree data structures and design hash-based solutions.

Unit – I

Definition and importance of linear data structures, Abstract data types (ADTs) and their implementation, Types of data structures: Linear & Non-Linear. Searching Techniques: Linear & Binary Search, Sorting Techniques: Bubble sort, Selection sort, Insertion Sort.

Unit – II

Linked-Lists: Definition, Types, arrays Vs linked lists, Merits and Demerits; Operations: Creation, Insert, Delete, Traversals on Singly LL, doubly LL, circular LL.

Unit – III

STACKS: Definition, implementation of operations; QUEUES: Definition, types: Simple, Circular, Priority. Implementation of operations. Applications of Stacks & Queues: Conversion & Evaluation of expressions.

Unit – IV

GRAPHS: Basic Concepts, representation and storage of graphs: Adjacency Matrices and Adjacency Lists, graph traversals, DFS and BFS, Shortest-Path Algorithm: Dijkstra‘s Algorithm.

Unit – V

TREES: Basic concepts, Binary Tree traversals, Binary Search tree operations: insertion, deletion, traversals. HASHING: Introduction, hash functions, Collision resolution techniques: chaining and open addressing, Hash tables: basic implementation and operations.

Text Books

1. Fundamentals of Data Structures, Illustrated Edition by Ellis Horowitz, Sartaj Sahni, 3rd Ed, Computer Science Press.
2. Computer science, A structured programming approach using C, B.A. Forouzan and R.F. Gilberg, Fourth edition, Thomson, 2023
3. Data Structures Using C - A.S.Tanenbaum, Y. Langsam, and M.J. Augenstein, 2nd Ed, PHI/Pearson education, 2015

Reference Books

1. C & Data structures – P. Padmanabham, 3rd Ed, B.S. Publications, 2016
2. The C Programming Language, B.W. Kernighan, Dennis M.Ritchie, PHI/Pearson Education, 1998.

Basic Electrical and Electronics Engineering

Subject Code: 25EST102 (Common to CSE/IT/CSM/CSD/CSC/ME/CE)

L	T	P	C
3	0	0	3

Course Objectives

- To introduce the basic knowledge of electric circuits
- To analyze AC circuits.
- To provide knowledge on DC Machines.
- To understand the working, characteristics of PN Junction diode, Zener diode
- To explain the working of Rectifiers, Characteristics of transistor in Common base Configuration.

Course Outcomes

Upon successful completion of this course, students will be able to:

1. Able to summarize different electrical circuits.
2. Able to Summarize the behavior of AC circuits.
3. Able to examine the operation of DC Machines.
4. Able to Describe the working of PN Junction diode, Zener diode
5. Able to describe the working of Rectifiers and behavior of transistor (BJT) in Common base Configuration.

Unit – I

Introduction to Electric Circuits Basic definitions, Electrical circuit elements (R, L and C), Voltage and current sources Independent and dependent sources, Ohm‘s Law, Series & Parallel circuits, Voltage and current division Rules, Source transformation, Kirchhoff‘s Laws, Faraday‘s laws of electromagnetic induction and simple problems.

Unit – II

AC Circuits Basic definitions, Representation of sinusoidal waveforms, peak and RMS values, phasor representation, Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series only), real power, reactive power, apparent power, power factor, simple problems

Unit – III

DC Machines

DC Generator: Generator- Principle of Operation, Construction, EMF equation, Classification,

DC Motor: Motor- principle of operation, Torque equation, Classification, Speed Control Methods, Operation of three point starter

Unit – IV

Diode Characteristics Formation of PN junction diode, V-I Characteristics of Diode, Diode as a switch, Zener Diode Characteristics, Zener Diode as Voltage Regulator.

Rectifiers: Hale wave Rectifier, Full Wave rectifier (Mid point Center tapped Connection Diode only)

Unit – V

Transistor Characteristics Bipolar Junction Transistors (BJT) - input & output Characteristics of transistor in CB configuration, Relationship between α, β and γ.

Text Books

1. D.P. Kothari and I.J. Nagrath, ―Basic Electrical Engineering‖, Tata McGraw Hill, 2010. 2. Integrated Electronics – Jacob Millman, Chritos C. Halkies, Tata Mc-Graw Hill 2009.

Reference Books

1. Electronic Devices and Circuits–R.L. Boylestad and Louis Nashelsky, Pearson/Prentice Hall, 9th Edition, 2006.
2. Principles of Electrical and Electronics Engineering by V.K. Mehta, S. Chand & Co.

CAED Lab

Subject Code: 25ESL103 (Common to ECE, EEE, CSE, CSM, CSD, IT, and CSC)

L	T	P	C
0	0	3	1.5

Course Objectives

- To introduce students to AutoCAD tools for creating precise 2D and 3D drawings applicable across multiple engineering disciplines.
- To develop skills in editing, organizing, and annotating technical drawings as per standard drafting practices.
- To enable students to represent objects through projections, orthographic, and isometric techniques.

Course Outcomes

Upon successful completion of this course, students will be able to:

1. the AutoCAD environment by setting drawing units, limits, and scales, and develop precise 2D geometries using appropriate drawing and basic modify commands for accurate technical representation.
2. Apply advanced modify commands along with hatching techniques to create complex 2D layouts and incorporate dimensioning and annotations as per industry drafting standards
3. Organize technical drawings using multi-layer management and generate accurate projections of points and lines in simple positions to enhance clarity and readability
4. Produce orthographic projections of planes and 3D objects by applying correct projection methods to achieve precise multi-view drawings suitable for engineering documentation
5. Design simple 3D models and convert them into fully annotated 2D views, developing complete, domain specific technical drawings suitable for real-world engineering applications.

Introduction to AutoCAD Environment: Overview of CAD software, Configuring drawing units, limits, scales, and setting up templates for standardized work. Introduction to layers, line types, colors, and object properties.

Basic Drawing Commands: Creating fundamental 2D geometries using commands such as Line, Polyline, Circle, Arc etc. Methods of coordinate entry including absolute, relative, and polar coordinates.

Modify Commands – Basic & Advanced: Using modify tools such as Move, Copy, Rotate, Mirror, Trim, Extend, Fillet, Chamfer, Scale, and Offset to refine drawings. Advanced editing using Array (rectangular and polar), Break, Stretch, and other productivity-enhancing commands.

Hatching, Dimensioning, and Annotation: Applying hatch patterns and gradients for sectional views. Dimensioning techniques including linear, aligned, angular, radial, and ordinate dimensions. Adding text annotations using standard drafting conventions as per BIS/ISO standards.

Layer Management & Drawing Organization: Creating and managing multiple layers with appropriate line types, line weights, and colors for organizing complex technical drawings.

Projection of Points, Lines, and Planes: Representing points and lines in simple positions. Creating projections of planes in simple orientations.

Orthographic Projections of Solids: Creating front, top, and side views from given 3D objects. Converting pictorial representations into multi-view orthographic drawings with correct dimensions and annotations.

Basic 3D Modelling: Introduction to creating simple 3D objects such as blocks, cylinders, cubes, and cones. Viewing and visualizing 3D models from multiple perspectives. Generating orthographic views from 3D solids for engineering documentation.

Final Integrated CAD Design Project: Designing and developing a real-world object relevant to the specific engineering domain including complete annotations and dimensions.

List of Experiments

1. Setting drawing units, limits, and scales and creating basic 2D geometries (lines, circles, polygons, arcs) using drawing commands.
2. Creation of complex 2D geometries using modified commands (move, copy, rotate, mirror, trim, extend, fillet, chamfer, scale, offset).
3. Creation of complex 2D geometries using advanced modified commands (array, break, stretch etc.)
4. Creating hatch patterns and gradients for sectional views and apply dimensioning and annotating to a given drawing.
5. Creating multi-layered drawings with assigned properties.
6. Creating projection of points and lines in simple positions.
7. Creating projection of planes in simple positions.
8. Creating orthographic projection of given 3D objects (front, top, and side views).
9. Creating a simple 3D object (e.g., block, cylinder, cube, cone) and generating its orthographic views.
10. Drawing and dimensioning a real-world object relevant to the specific engineering domain (e.g., Basic device casing for ECE, Simple circuit layout for EEE, Network rack layout for CSE, etc.)

Text Books

1. Tickoo, S. (2024). AutoCAD 2025 for engineers & designers. CADCIM Technologies.
2. Shih, R. H. (2024). AutoCAD 2025 tutorial: First level 2D fundamentals. SDC Publications.

Data Structures Lab

Subject Code: 25CSL101 (Common to CSE/CSM/CSD/CSC/IT)

L	T	P	C
0	0	3	1.5

Course Objectives

- Be familiar with basic techniques of algorithm analysis and writing recursive methods
- Master the implementation of linked data structures such as linked lists and binary trees and balanced search trees.
- Be familiar with several sorting algorithms including selection-sort, bubble-sort.
- Be familiar with some graph algorithms such as shortest path and minimum spanning tree
- Master analyzing problems and writing program solutions to problems using the above techniques

Course Outcomes

Upon successful completion of this course, students will be able to:

1. Demonstrate the role of linear data structures in organizing and accessing data efficiently in algorithms.
2. Implement dynamic data storage for demonstrating memory allocation in linked lists..
3. Develop programs for novel solutions by involving linear data structures Stacks and Queues to handle recursive algorithms, manage program states, and solve related problems.
4. Apply stack and queue based algorithms for efficient task scheduling and traversals in graphs.
5. Demonstrate scenarios where hashing is advantageous, and design hash-based solutions for specific problems.

List of Experiments

1. a) Write a C program to reverse the digits of a number using recursive function.
   b) Write a C program to solve the Towers of Hanoi problem using recursive function.
   c) Design & Develop a C program to perform linear search for a key value in a given list.
2. a) Design & Develop a C program to perform Binary search for a key value in a given list.
   b) Develop a C program that implements Selection Sort to sort a given list of integers.
   c) Develop a C program that implements Bubble Sort to sort a given list of integers.
3. a) Implement a singly linked list and perform insertion and deletion operations.
   b) Develop a program to reverse a linked list iteratively and recursively.
   c) Solve problems involving linked list traversal and manipulation.
4. a) Create a program to detect and remove duplicates from a linked list.
   b) Implement a linked list to represent polynomials and perform addition.
5. Design, Develop and Implement a menu driven Program in C for the following operations on STACK of Integers (Array Implementation of Stack with maximum size MAX)
   a. Push an Element onto Stack.
   b. Pop an Element from Stack.
   c. Display the status (No. of elements, Empty/Full/not) of Stack.
   d. Exit

   Support the program with appropriate functions for each of the above operations
6. Design, Develop and Implement a menu driven Program in C for the following operations on QUEUE of Characters (Array Implementation of Queue with maximum size MAX)

a. Insert an Element into QUEUE b. Delete an Element from QUEUE
c. Display the status (No. of elements, Empty/Full/not) of QUEUE d . Exit
Support the program with appropriate functions for each of the above operations

7. Design, Develop and Implement a Program in C for converting an Infix Expression to Postfix Expression. Program should support for both parenthesized and free parenthesized expressions with the operators: +, -, *, /, %(Remainder), ^(Power) and alphanumeric operands.
8. a) Design, Develop and Implement a C program to implement Binary tree traversals using iterative functions.
   b) Design, Develop and Implement a C program to implement Binary tree traversals using recursive functions.
9. Design, Develop and Implement a menu driven Program in C for the following operations on Binary Search Tree (BST) of Integers
   a. Create a BST of ‗n' Integers: b. Traverse the BST in In-order, Pre-order and Post-Order
   c. Search the BST for a given element (Key) and report the appropriate message
   e. Exit
10. Design & Develop a Program in C for the following operations on Graph (G) of Cities
    a. Create a Graph of ‗n' cities using Adjacency Matrix.
    b. Print all the nodes reachable from a given starting node in a digraph using DFS or BFS method.
11. Design & Develop a Program in C to find the shortest paths to all Cities from a given City using . Dijkstra's Algorithm.
12. Given a File of N employee records with a set K of Keys(6-digit) which uniquely determine the records in file F. Assume that file F is maintained in memory by a Hash Table(HT) of m memory locations with L as the set of memory addresses (2-digit) of locations in HT. Let the keys in K and addresses in L are Integers.
13. Design and develop a Program in C that uses Hash function H: K L as H(K)=K mod m (remainder method), and implement hashing technique to map a given key K to the address space L.
    Resolve the collision (if any) using (a) linear probing.(b) Quadratic Probing

Text Books

1. Data Structures and Algorithm Analysis, Mark Allen Weiss , Fourth Edition , Pearson, 2013
2. Fundamentals of Data Structures, Illustrated Edition by Ellis Horowitz, Sartaj Sahni, Computer Science Press.

Reference Books

3. Data Structures and Algorithm Analysis, Michel T. Goodrich, Roberto Tamassia, David Mount, 2nd Edition, John Wiley & Sons, Inc, 2011
4. Classic Data Structures, Second Edition, Debasis Samanta, PHI, 2012, New Delhi, India.
5. Computer science, A structured programming approach using C, Third edition, B.A. Forouzan and R.F. Gilberg, 2011, Thomson, New Delhi, India.

Reference Links

1. https://www.geeksforgeeks.org/data-structures/

Engineering Physics Lab

Subject Code: 25BHL102 (Common to all Branches)

L	T	P	C
0	0	3	1.5

Course Objectives

- Applying the basic concepts of optical phenomena like interference and diffraction for verifying dimensions of thin objects, recognizing the importance of the energy gap in the study of electrical properties of semiconductors, and investigating the parameters and applications of lasers and optical fibers through experiments.

Course Outcomes

Upon successful completion of this course, students will be able to:

1. Verify the microscopic dimensions of the objects by applying principles of interference and diffraction.
2. Acquire a practical understanding of semiconductor physics by analyzing electronic properties of the semiconductors.
3. Analyze the induced magnetic field in a current-carrying circular coil.
4. Corroborate the mechanical properties of the materials
5. Evaluate the characteristics of the lasers and fiber optics

List of Experiments

1. Determination of the radius of curvature of a given Plano-convex lens by Newton‘s rings.
2. Determination of the thickness of a thin object using wedge shaped film.
3. Determination of wavelengths of different spectral lines in the mercury spectrum using a diffraction grating in normal incidence configuration.
4. Determination of the width of a slit using the diffraction phenomenon.
5. Determination of the temperature coefficient of a thermistor.
6. Determination of the energy bandgap of a given semiconductor
7. To study the V-I characteristics of a pn junction diode in forward and reverse biasing Conditions.
8. Magnetic field along the axis of a current-carrying circular coil by Stewart Gee‘s Method.
9. Determination of acceleration due to gravity and radius of Gyration by using a compound pendulum.
10. Determination of the rigidity modulus of the material of the given wire using the Torsional pendulum
11. Determination of the wavelength of Laser light using a diffraction grating.
12. Determination of Numerical Aperture and Bending Loss of an Optical Fiber
13. Determination of Hall voltage and Hall coefficient of a given semiconductor using the Hall effect.
14. Sonometer: Verification of laws of stretched string.
15. Determination of the Frequency of the electrically maintained tuning fork by Melde‘s experiment.
16. Determination of crystal structure and lattice parameter of a given crystal using powder diffraction data.
17. Determination of Young‘s modulus of the given beam by non-uniform bending.
18. Determination of dielectric constant using the resonance method.

Note: *Any TEN of the listed experiments are to be conducted. Out of which any TWO experiments may be conducted in virtual mode.*

Reference Books

1. A Textbook of Practical Physics - S. Balasubramanian, M.N. Srinivasan, S. Chand Publishers, 2017.

Reference links

- www.vlab.co.in
- https://phet.colorado.edu/en/simulations/filter?subjects=physics&type=html,prototype

AI Tools Lab

Subject Code: 25CSL102 (Common to CSE/CSM/CSD/CSC/IT)

L	T	P	C
0	0	3	1.5

Course Objectives

- To introduce foundational AI tools and techniques in a hands-on environment.
- To develop basic proficiency in using no-code/low-code AI platforms.
- To enable students to apply AI concepts in real-world mini-projects.
- To foster understanding of AI applications in NLP, vision, and automation.
- To encourage creativity and innovation through simple AI-driven experiments.

Course Outcomes

Upon successful completion of this course, students will be able to:

1. Identify and apply basic AI tools across various domains.
2. Demonstrate use of no-code and visual AI platforms like Teachable Machine and Dialogflow.
3. Develop simple AI applications such as chatbots and text/image generators.
4. Analyze the role of AI in real-life tasks like speech recognition and content creation.
5. Collaborate and innovate using AI-powered platforms to solve basic problems.

List of Experiments

1. Understand Introduction to AI Tools
2. Apply Text Generation with ChatGPT
3. Analyze Image Recognition using Teachable Machine.
4. Create Text to Image Generation.
5. Understand Voice Recognition with Google Speech-to-Text.
6. Create AI-Based Presentation with Canva AI.
7. Create a Chatbot using Dialogflow
8. Analyze NLP Tool Exploration using MonkeyLearn.
9. Evaluate Automated Data Insights with Google Sheets + AI
10. Create AI-Powered Videos using Lumen5.

Text Books

1. "Artificial Intelligence: A Guide for Thinking Humans" by Melanie Mitchell, 2020 2. "Hands-On Artificial Intelligence for Beginners" by Patrick D. Smith, 2018
3. "Artificial Intelligence Basics: A Non-Technical Introduction" by Tom Taulli, 2019

Reference Books

1. "Artificial Intelligence: A New Synthesis" by Nils J. Nilsson, 2011
2. "The Hundred-Page Machine Learning Book" by AndriyBurkov, 2019
3. "Designing Bots: Creating Conversational Experiences" by Amir Shevat (for chatbot-related experiments), 2017.

Basic Electrical and Electronics Engineering Lab

L	T	P	C
0	0	3	1.5

Subject Code: 25ESL102 (Common CSE/IT/CSM/CSD/CSC/ME/CE)

Course Objectives

- To introduce the basic laws related to electrical and electronics Circuits.
- To provide knowledge on Speed control Methods on DC motors.
- To analyze V-I characteristics of P-N diode and Zener diode.
- To provide knowledge on transistor Common base Configuration.
- To provide knowledge on Half and Full Wave Rectifiers.

Course Outcomes

Upon successful completion of this course, students will be able to:

1. Demonstrate various basic electrical Circuits.
2. Demonstrate Speed control Methods of DC motors.
3. Analyze the V-I characteristics of P-N diode and zener diode.
4. Analyze the Transistor Common base Configuration characteristics.
5. Demonstrate the performance of on Half and Full Wave Rectifiers..

List of Experiments

1. Verification of Ohm‘slaw.
2. Verification of Kirchhoff‘s current law
3. Verification of Kirchhoff‘s voltage law.
4. Verification of total resistance of the series and parallel connected circuits.
5. Verification on Measurement of power factor of series RL circuit.
6. Verification on Speed control Methods of DC motor.
7. Verification of PN Junction diode forward and reverse bias characteristics.
8. Verification of Zener diode characteristics.
9. Verification of Transistor CB characteristics (Input and Output).
10. Verification of Half wave rectifier (With and without Capacitor).

Additional Experiments

1. Verification of Full wave rectifier (With and without Capacitor).
2. Verification of operation and working of three point starter.

NSS/NCC/Scouts &Guides/Community Service

Subject Code: 25MCS102 (Common to all Branches)

L	T	P	C
0	0	1	0.5

Course Objectives

- The objective of introducing this course is to impart discipline, character, fraternity, teamwork, social consciousness among the students and engaging them in selfless service.

Course Outcomes

Upon successful completion of this course, students will be able to:

1. Understand the importance of discipline, character and service motto.
2. Solve some societal issues by applying acquired knowledge, facts, and techniques.
3. Explore human relationships by analyzing social problems.
4. Determine to extend their help for the fellow beings and downtrodden people.
5. Develop leadership skills and civic responsibilities.

Unit–I Orientation

General Orientation on NSS/NCC/ Scouts & Guides/Community Service activities, career guidance.

Activities:

i). Conducting –ice breaking sessions-expectations from the course-knowing personal talents and skills
ii). Conducting orientations programs for the students –future plans-activities-releasing road map etc.
iii). Displaying success stories-motivational biopics- award winning movies on societal issues etc.
iv). Conducting talent show in singing patriotic songs-paintings- any other contribution.

Unit–II

Nature & Care

Activities:

i). Best out of waste competition.
ii). Poster and signs making competition to spread environmental awareness.
iii). Recycling and environmental pollution article writing competition.
iv). Organising Zero-waste day.
v). Digital Environmental awareness activity via various social media platforms.
vi). Virtual demonstration of different eco-friendly approaches for sustainable living.
vii). Write a summary on any book related to environmental issues.

Unit–III Community

Service Activities:

i). Conducting One Day Special Camp in a village contacting village-area leaders- Survey in the village, identification of problems- helping them to solve via media- authorities- experts-etc.
ii). Conducting awareness programs on Health-related issues such as General Health, Mental health, Spiritual Health, HIV/AIDS,
iii). Conducting consumer Awareness. Explaining various legal provisions etc.

iv). Women Empowerment Programmes- Sexual Abuse, Adolescent Health and Population Education.

v). Any other programmes in collaboration with local charities, NGOs etc.

Reference Books

1. Nirmalya Kumar Sinha & Surajit Majumder, A Text Book of National Service Scheme
2. Vol;.I, Vidya Kutir Publication, 2021 (ISBN 978-81-952368-8-6)
3. Red Book - National Cadet Corps – Standing Instructions Vol I & II, Directorate General of NCC, Ministry of Defence, New Delhi
4. Davis M. L. and Cornwell D. A., ―Introduction to Environmental Engineering‖, McGraw Hill, New York 4/e 2008
5. Masters G. M., Joseph K. and Nagendran R. ―Introduction to Environmental Engineering and Science‖, Pearson Education, New Delhi. 2/e 2007
6. Ram Ahuja. Social Problems in India, Rawat

Publications, New Delhi.

Design Thinking and Sustainable Development

Subject Code: 25BHS104 (Common to all Branches)

L	T	P	C
1	0	2	2

Course Objectives

- Understand the principles of creativity, innovation, and entrepreneurship in an engineering context.
- Apply the process of design thinking to real-life problems
- Recognize and evaluate the importance of sustainable development and responsible engineering.
- Explore user pain points and identify real-world problems through empathy and market analysis.
- Apply ideation techniques to validate feasible and viable solutions for the identified problems.

Course Outcomes

Upon successful completion of this course, students will be able to:

1. Describe innovation ecosystems, and entrepreneurial processes
2. Analyze the global sustainable development goals (SDGs) and connect them to engineering practices
3. Understand and explore design thinking methodology to identify and solve real-world problems
4. Develop understanding to identify and validate user problem statement
5. Develop approach towards generation and feasibility assessment of ideas

Unit – I

Introduction to Innovation and Entrepreneurship: Innovation and its types – Incremental, Disruptive, Frugal, Social, Real-world examples of innovation – Indian and global, Introduction to entrepreneurial mindset, Journey of a startup – Idea to Market, Role of engineers in entrepreneurship

Activity: Conducting case studies on selected startups (e.g., Airbnb, Uber, etc.) and performing an in- depth sectoral analysis.

Unit – II

Sustainable Development Goals: Introduction to UN Sustainable Development Goals (SDGs), Link between engineering, sustainability, and society, Circular economy, Green technologies, Lifecycle thinking, Frugal innovation, Resource optimization

Activity: Conduct an analysis of a minimum of five Sustainable Development Goals (SDGs), including a comprehensive review of their objectives, targets, and key performance indicators.

Unit – III

Design Thinking – A Human-Centred Approach: Introduction to Design Thinking, Practical case studies of Design Thinking, The 5 stages of Design Thinking – Empathize, Define, Ideate, Prototype, Test.

Unit – IV

Problem Statement Identification and Validation: Empathize towards understanding user pain points, Tools and approaches for empathizing with users, Define – Confirm the problem the user is facing, Market analysis – Market size, Competitor analysis

Activity:

- For the identified problem, build empathy maps and create detailed user personas based on insights gathered from surveys and interviews.

- Determine the total market size, perform an in-depth market analysis, and analyze competitors to identify opportunities and gaps.
- Define the Problem statement and write HMW Statements.

Unit – V

Ideation to solve user problems: Tools and approaches to identify ideas for solving identified problems, Feasibility and viability of ideas for prototype development

Activity: Apply brainstorming techniques to generate solutions for the identified problem and organize them visually through mind mapping.

Text Books

1. Eric Ries. (2011). The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses. Crown Business.
2. Anuja Agarwal. (2023). Design Thinking: A Framework for Applying Design Thinking in Problem Solving. Cengage Learning India
3. Akhilesh A. Waoo. (2024). Sustainable Development Goals. Forever Shinings Publication

Reference Books

1. Rob Fitzpatrick. (2013). The Mom Test: How to Talk to Customers and Learn If Your Business is a Good Idea When Everyone is Lying to You.
2. Tim Brown. (2009). Change by Design: How Design Thinking Creates New Alternatives for Business and Society
3. Bill Aulet. (2013). Disciplined Entrepreneurship: 24 Steps to a Successful Startup. Wiley
4. Peter Thiel with Blake Masters. (2014). Zero to One: Notes on Startups, or How to Build the Future. Crown Business.
5. Don Norman. (2013). The Design of Everyday Things: Revised and Expanded Edition. Basic Books.
6. Lewrick, Michael, Patrick Link & Larry Leifer. (2018). The Design Thinking Playbook: Mindful Digital Transformation of Teams, Products, Services, Businesses and Ecosystems. Wiley