

NATIONAL ENGINEERING COLLEGE

(An Autonomous Institution Affiliated to Anna University Chennai & Accredited by NAAC)

K.R. NAGAR, KOVILPATTI – 628 503

www.nec.edu.in

REGULATIONS – 2019

CURRICULUM & SYLLABUS

B.Tech. - ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

B.Tech. - ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

REGULATIONS – 2019

CURRICULUM STRUCTURE AND SYLLABUS FOR FIRST YEAR

SEMESTER I

S. No	Course Code	Course Title	Category	L	T	P	E	C
THEORY								
1.	19AD11C	English – I	HSMC	2	0	0	0	2
2.	19AD12C	Mathematical Foundations for Data Science	BSC	3	1	0	0	4
3.	19AD13C	Semiconductor Physics and Optoelectronics	BSC	2	0	0	0	2
4.	19AD14C	Chemistry for Artificial Intelligence and Data Science	BSC	2	0	0	0	2
5.	19AD15C	Engineering Graphics	ESC	2	0	4	0	4
6.	19AD16C	C Programming	ESC	3	0	0	0	3
PRACTICAL								
7.	19AD17C	Semiconductor Physics and Chemistry Laboratory	BSC	0	0	3	0	1.5
8.	19AD18C	C Programming Laboratory	ESC	0	0	3	0	1.5
TOTAL				14	1	10	0	20

SEMESTER II

S. No	Course Code	Course Title	Category	L	T	P	E	C
THEORY								
1.	19AD21C	English – II	HSMC	2	0	0	0	2
2.	19AD22C	Probability and Statistics	BSC	3	1	0	0	4
3.	19AD23C	Principles of Digital Electronics	BSC	3	0	0	0	3
4.	19AD24C	Environmental Science	MAC	3	0	0	0	3
INTEGRATED COURSE (Theory + Lab + Experiential Learning Practices)								
5.	19AD25C	Innovation through Design Thinking	EEC	1	0	2	0	2
6.	19AD26C	Data Structures	PCC	2	0	3	2	4.5
PRACTICAL								
7.	19AD27C	Communication and Soft Skills Laboratory	HSMC	0	0	2	0	1
TOTAL				14	1	7	2	19.5

SEMESTER III

S. No	Course Code	Course Title	Category	L	T	P	E	C
THEORY								
1.	19AD31C	Discrete Mathematics for AI	BSC	3	1	0	0	4
2.	19AD32C	Fundamentals of Data Science	PCC	3	1	0	0	4
3.	19AD33C	Operating Systems	PCC	3	0	0	0	3
4.	19AD34C	Design and Analysis of Algorithms	PCC	3	1	0	0	4
5.	19AD35C	Professional Ethics and Human Values	PCC	3	0	0	0	3
6.	19AD36C	Object Oriented Programming	ESC	3	0	0	0	3
PRACTICAL								
7.	19AD37C	Data Science Laboratory	PCC	0	0	3	0	1.5
8.	19AD38C	Operating Systems Laboratory	PCC	0	0	3	0	1.5
9.	19AD39C	Object Oriented Programming Laboratory	ESC	0	0	3	0	1.5
TOTAL				17	3	9	2	25.5

SEMESTER IV

S. No	Course Code	Course Title	Category	L	T	P	E	C
THEORY								
1.	19AD41C	Mathematics for Machine Learning	ESC	3	1	0	0	4
2.	19AD42C	Database Management Systems	PCC	3	0	0	0	3
3.	19AD43C	Problem solving in Artificial Intelligence	PCC	3	0	0	0	3
4.	19AD44C	Data Visualization Techniques	PCC	3	0	2	0	4
5.		Elective – I	PEC	3	0	0	0	3
PRACTICAL								
6.	19AD45C	Database Management Systems Laboratory	PCC	0	0	3	0	1.5
7.	19AD46C	Problem solving in Artificial Intelligence Laboratory	PCC	0	0	4	0	2
INTEGRATED COURSE (Theory + Lab +Experiential Learning Practices)								
8.	19AD47C	Java Programming	PCC	2	0	3	2	4.5
TOTAL				17	1	11	2	25

SEMESTER V

S. No	Course Code	Course Title	Category	L	T	P	E	C
THEORY								
1.	19AD51C	Finance and Accounting	HSMC	3	0	0	0	3
2.	19AD52C	Data Engineering	PCC	3	0	0	0	3
3.	19AD53C	Cloud Computing and Management	PCC	3	0	0	0	3
4.	19AD54C	Computer Networks	PCC	3	0	0	0	3
5.		Open Elective – I	OEC	3	0	0	0	3
6.		Elective – II	PEC	3	0	0	0	3
PRACTICAL								
7.	19AD55C	Cloud Computing Laboratory	PCC	0	0	3	0	1.5
8.	19AD56C	Networking Laboratory	PCC	0	0	3	0	1.5
INTEGRATED COURSE (Theory + Lab +Experiential Learning Practices)								
9.	19AD57C	Machine Learning	PCC	2	0	3	2	4.5
TOTAL				20	0	9	2	25.5

SEMESTER VI

S. No	Course Code	Course Title	Category	L	T	P	C
THEORY							
1.	19AD61C	Big Data Analytics	PCC	3	0	0	3
2.	19AD62C	Deep Learning	PCC	2	0	2	3
3.	19AD63C	Business Process Management	HSMC	2	0	0	2
4.	19AD64C	Professional readiness for Innovation, Employability, Entrepreneurship (Elective – III)	EEC	3	0	0	3
5.		Elective – IV	PEC	3	0	0	3
6.		Open Elective – II	OEC	3	0	0	3
7.	19MC01C	Constitution of India	MAC	3	0	0	0
PRACTICAL							
8.	19AD65C	Product Development Laboratory	PCC	0	0	6	3
9.	19AD66C	Big Data Analytics Laboratory	PCC	0	0	3	1.5
10.	19AD67C	Comprehension	SDC	0	0	2	1
TOTAL				16	1	13	22.5

SEMESTER VII

S. No	Course Code	Course Title	Category	L	T	P	C
THEORY							
1.		Elective – V	PEC	3	0	0	3
2.		Elective – VI	PEC	3	0	0	3
3.		Elective – VII	PEC	3	0	0	3
PRACTICAL							
4.	19AD71C	Project Work – I	SDC	0	0	6	3
5.	19AD72C	Research Paper and Patent Review – Seminar	SDC	0	0	2	1
TOTAL				9	0	8	13

SEMESTER VIII

S. No	Course Code	Course Title	Category	L	T	P	C
THEORY							
1.		Elective – VIII	PEC	3	0	0	3
PRACTICAL							
2.	19AD81C	Project Work – II	SDC	0	0	12	6
3.	19AD82C	Internship	SDC	0	0	4	2
TOTAL				3	0	16	11

Total Number of Credits: 162

LIST OF ELECTIVES

S. No	Course Code	Course Title	Category	L	T	P	C
INTELLIGENT SYSTEMS							
1.	19AD01E	Human and intelligent systems	PEC	3	0	0	3
2.	19AD02E	Intelligent Agents	PEC	3	0	0	3
3.	19AD03E	Business Intelligence	PEC	3	0	0	3
4.	19AD04E	Computational Intelligence	PEC	3	0	0	3
5.	19AD05E	Augmented Intelligence	PEC	3	0	0	3
6.	19AD06E	Swarm Intelligence	PEC	3	0	0	3
SOFTWARE							
7.	19AD07E	Software Testing and Quality Assurance	PEC	3	0	0	3
8.	19AD08E	Software Development Processes	PEC	3	0	0	3
9.	19AD09E	Software Architecture	PEC	3	0	0	3
10.	19AD10E	Agile Methodologies	PEC	3	0	0	3
ARTIFICIAL INTELLIGENCE							
11.	19AD11E	Cognitive Science and Decision Making	PEC	3	0	0	3
12.	19AD12E	Computer Vision	PEC	3	0	0	3
13.	19AD13E	Reinforcement Learning	PEC	3	0	0	3

14.	19AD14E	Natural Language Processing	PEC	3	0	0	3
OPTIMIZATION							
15.	19AD15E	Nonlinear Optimization	PEC	3	0	0	3
16.	19AD16E	Bio-inspired Optimization Techniques	PEC	3	0	0	3
DATA ANALYTICS							
17.	19AD17E	Speech Processing and Analytics	PEC	3	0	0	3
18.	19AD18E	Social Network Analysis	PEC	3	0	0	3
19.	19AD19E	Health care Analytics	PEC	3	0	0	3
20.	19AD20E	Engineering Predictive Analytics	PEC	3	0	0	3
21.	19AD21E	Data Analytics in Bioinformatics	PEC	3	0	0	3
COMPUTING							
22.	19AD22E	Parallel Computing	PEC	3	0	0	3
23.	19AD23E	Soft computing Techniques	PEC	3	0	0	3
24.	19AD24E	Distributed Systems	PEC	3	0	0	3
25.	19AD25E	Nature and Bio inspired computing	PEC	3	0	0	3
26.	19AD26E	Information Retrieval	PEC	3	0	0	3
27.	19AD27E	Information Extraction and Retrieval	PEC	3	0	0	3
SECURITY							
28.	19AD28E	Secure Cloud Computing	PEC	3	0	0	3
29.	19AD29E	Cyber Security	PEC	3	0	0	3
30.	19AD30E	Data and Information Security	PEC	3	0	0	3
31.	19AD31E	Security risk assessment and management	PEC	3	0	0	3
32.	19AD32E	Pattern and Anomaly Detection	PEC	3	0	0	3
DESIGNING/PROGRAMMING							
33.	19AD33E	Advanced Python Programming	PEC	3	0	0	3
34.	19AD34E	Web Services and API Design	PEC	3	0	0	3
35.	19AD35E	Mobile Applications Development	PEC	3	0	0	3
36.	19AD36E	Programming Paradigms	PEC	3	0	0	3
37.	19AD37E	Web design and development	PEC	3	0	0	3
MANDATORY ELECTIVE							
38.	19AD38E	Professional readiness for Innovation, Employability, Entrepreneurship	PEC	0	0	6	3
ROBOTICS							
39.	19AD39E	AI and Robotics	PEC	3	0	0	3
40.	19AD40E	Internet of Things	PEC	3	0	0	3
41.	19AD41E	Robotics and Intelligent systems	PEC	3	0	0	3
42.	19AD42E	Robotic Process Automation	PEC	3	0	0	3
Others							
43.	19AD43E	Ethics Of Artificial Intelligence	PEC	3	0	0	3
44.	19AD44E	Engineering Economics	PEC	3	0	0	3

OPEN ELECTIVE

S. No	Course Code	Course Title	Category	L	T	P	C
THEORY							
1.	19AD01N	Fundamentals of Machine Learning	OEC	3	0	0	3
2.	19AD02N	Fundamentals of Artificial intelligence	OEC	3	0	0	3
3.	19AD03N	Mobile application development	OEC	3	0	0	3
4.	19AD04N	Introduction to Virtual and Augmented Reality	OEC	3	0	0	3
5.	19AD05N	Programming for robotics	OEC	3	0	0	3

COURSE OUTCOMES

Upon completion of this course, the student will be able to

- CO1: enhance their basic language skills to understand various aspects of communication skills (K3)
- CO2: express their thoughts with correct usage of language in formal writings (K3)
- CO3: understand various language components and develop pronunciation skills. (K2)
- CO4: prepare effective technical documents and interpret any pictorial representation. (K3)
- CO5: frame sentences and write effective reports. (K3)

UNIT I **6**

Parts of Speech – Newspaper article presentation – Greetings and self-Introduction– Instruction writing–Technical vocabulary– Purpose of listening– Listening for general information.

UNIT II **6**

Transformation of words into different grammatical forms – Letter to friends/ parents/ siblings – Process description –Letter writing (for Industrial visits and training) – Talks on technology– Listening to scientific talks.

UNIT III **6**

Personality adjectives – Phonetics - (Vowels - Consonants – Diphthongs – Transcriptions) – Kinds of sentences (Statement, Interrogative, Imperative & Exclamatory) – Situational conversation.

UNIT IV **6**

Technical terms and extended definitions – Active and Passive Voices – Note-making – E-mail writing – Picture description – Checklists.

UNIT V **6**

Homophones – Concord – Foreign words and phrases – Verbal analogies – Report writing (Types–Structure – Stages in report writing – Model report).

L:30; TOTAL:30 PERIODS

TEXT BOOKS

1. Anderson and Paul. V, "Technical Communication: A Reader Centered Approach,"9th Edition, New Delhi: Cengage, 2018.
2. Murphy. R, "Basic Grammar Practice on Tense," New Delhi: Cambridge University Press, 2018.

REFERENCES

1. Lucantoni and Peter, "English as a Second Language," Cambridge University Press, 2022.
2. McCarthy. M, "English Grammar, The Basics," 1st Edition, New York: Routledge, 2021.
3. Raman. M, and Sharma. S, "Technical Communication: Principles and Practice", 3rd Edition New Delhi: Oxford University Press, 2015.

4. Richard Bronson, "Theory and Problems of Matrix Operations", 2nd Edition, McGraw Hill, New York, 2011

19AD13C	SEMICONDUCTOR PHYSICS AND OPTOELECTRONICS	L	T	P	C
		2	0	0	2

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: recognize the different types of semiconductors and their properties (K2)
- CO2: select the suitable semiconductor diode for a simple electronic circuit application (K2)
- CO3: explain the constructional features and working of different types of transistors (K2)
- CO4: discuss the basic principle, types, and applications of laser and display devices (K2)
- CO5: describe the types, fabrication, losses, and applications of optical fibers (K2)

UNIT I SEMICONDUCTING MATERIALS 6

Energy band formation – Direct and indirect bandgap semiconductors - Intrinsic semiconductors; carrier concentration in intrinsic semiconductors, variation of Fermi level with temperature – Extrinsic semiconductors; carrier concentration in n-type & p-type semiconductors, variation of Fermi level with temperature and impurity concentration – Hall effect

UNIT II DIODES 6

Theory of PN junction diode - Energy Band Structure - Biasing of PN Junction – Forward bias and Reverse bias - Current equation – Zener diode; characteristics, voltage regulator – Half wave and full wave rectifiers

UNIT III TRANSISTORS 6

BJT: Construction and Operation of NPN and PNP Transistors - Study of CE, CB, and CC configurations and comparison of their characteristics
 FET: Construction and Operation of N-Channel JFET – Expression for Drain Current, Comparison of JFET and BJT- MOSFET; enhancement and depletion mode, comparison with JFET

UNIT IV OPTICAL DEVICES 6

Principle of spontaneous emission and stimulated emission - Population inversion – Pumping - Einstein’s A and B coefficients – Different types of lasers: gas lasers (CO₂), solid-state lasers (Nd-YAG), semiconductor laser - Applications of lasers in science, engineering, and medicine - LED-OLED.

UNIT V FIBRE OPTICS 6

Principle – Total internal reflection - Acceptance angle and Numerical aperture - Types of optical fibers - Double crucible technique – Splicing - Losses in optical fibers - Fiber optic communication system - Applications – Fiber optic sensors – Medical Endoscope

L:30; TOTAL:30 PERIODS

TEXT BOOKS

1. David A. Bell, “Fundamentals of Electronic Devices and Circuits”, 5th Edition, Oxford University Press, 2009.
2. John Wilson, John Hawkes, “Optoelectronics”, 3rd Edition, Pearson Education, 2018.

REFERENCE BOOKS

1. Mathur. K.S, "Fiber Optic fundamentals and Advances in communications", 1st Edition, Zorbabooks, 2021.
2. Renk, Karl. F "Basics of laser physics", 2nd Edition, Springer international publishing, 2018.
3. Salivahanan. S, Suresh Kumar. N and Vallavaraj. A, "Electronic Devices and Circuits", 2nd Edition, Tata McGraw Hill, 2018.

REFERENCE BOOKS

1. Clayden. J, Greeves. N and Warren. S, "Organic Chemistry", 2nd Edition, Oxford University Press, 2014.
2. Engel. T and Gasteiger. J, "Chemoinformatics: Basic Concepts and Methods", 1st Edition, Wiley-VCH, 2018.
3. Skoog. D, Holler. F and Crouch. S, "Principles of Instrumental Analysis" 7th Edition, Brooks / Cole, 2017.

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: familiarize with the fundamentals of Engineering graphics and construct the engineering curves. (K2)
- CO2: construct the orthographic projections of points, straight lines and lamina (K2)
- CO3: draw the projections of simple solids in different positions. (K3)
- CO4: visualize the sectional views and surface areas of various solids. (K3)
- CO5:** perform freehand sketching and prepare elementary 2-D and 3D sketches of simple solids. (K3)

INTRODUCTION**5**

Principles of Engineering Graphics – significance. Usage of Drawing Instruments. Lettering and dimensioning exercise. First angle projection should be followed for all the topics except projection of points.

UNIT I ENGINEERING CURVES**17**

Construction of ellipse, parabola and hyperbola using eccentricity method– Construction of cycloids, Epi and Hypo-cycloids - construction of involutes for square and circle –Tangent and Normal to the above curves.

UNIT II ORTHOGRAPHIC PROJECTIONS**17**

Principle of orthographic projections – Conventions - First angle and third angle projections. Projections of points placed in all quadrants – projections of straight lines – inclined to both reference planes - determination of true length and inclinations. Projections of regular polygonal surfaces and circular lamina inclined to both reference planes.

UNIT III PROJECTIONS OF SOLIDS**17**

Projections of simple solids like prisms, pyramids, cylinder and cone - axis inclined to one reference plane - change of position method.

UNIT IV SECTIONS OF SOLIDS AND DEVELOPMENT OF SURFACES**17**

Sectioning of simple solids – Axis perpendicular to horizontal plane- Drawing sectional views with true shape of the section.

Development of lateral surfaces of truncated solids – Prisms, pyramids, cylinder and cone.

UNIT V ISOMETRIC PROJECTIONS AND FREE HAND SKETCHING**17**

Principles of isometric projection – isometric scale – isometric projections of simple solids like prism, pyramid, cone and cylinder – Combination of solids.Orthographic views of simple components by Free hand drawing - Transferring measurement from the given object to the free hand sketches.

L: 30; P:60; TOTAL: 90 PERIODS

TEXT BOOKS

1. Bhatt N.D, “Engineering Drawing”, 53rdEdition, Charotar Publishing House, 2014.
2. Shah M.B and Rana B.C, “Engineering Drawing”, Pearson Education, 2ndEdition, 2009.

REFERENCES

1. Agrawal B. & Agrawal C.M., Engineering Graphics, TMH Publication, 2ndEdition, 2013

2. Narayana K.L. & Kannaiah P, Text book on Engineering Drawing, Scitech Publishers, 2010.
3. Gopalakrishna K.R, "Engineering Drawing", Subhas Publications, 32nd Edition, 2017.

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO 1: practice the fundamental programming concepts and terminologies. (K3)
- CO 2: use different control structures and understand how function calls are carried out. (K3)
- CO 3: solve problems using arrays and strings. (K3)
- CO 4: develop applications in C using structures and file handling. (K3)
- CO 5: structure how to store and manage the addresses of dynamically allocated blocks of memory (K3)

UNIT I FUNDAMENTALS OF C PROGRAMMING 9

Introduction to programming paradigms - Features of C language - Structure of C program - Compilation process - I/O statements - Tokens: Variables, Data Types, Identifiers, Keywords, Constants, Operators - Type Casting - Storage classes - Pre-processor directives.

UNIT II CONTROL STATEMENTS AND FUNCTIONS 9

Decision making statements: if, if-else, if-elseif-else, switch.
 Looping statements: while, for, do-while, Nested loops, Infinite Loops, break, continue, goto
 Functions: Introduction - Function prototype, Function definition, Function call, Built-in functions - Recursion - Math function - Example Programs in functions

UNIT III ARRAYS AND STRINGS 9

Array: Introduction, Declaration, Initialization - Types of array: One dimensional, Two Dimensional, Multi-Dimensional – Sorting and Searching in Array

String: Introduction, Ways to declare a string in C - String Functions

UNIT IV STRUCTURES AND FILE HANDLING 9

Structure: Introduction - typedef in C - Array of Structures - Nested Structure - Structure Padding – Union – Files: Introduction, Types of file processing: Sequential access, Random access - File Handling – Programs using File

UNIT IV POINTERS AND MEMORY ALLOCATION 9

Pointers: Introduction, Declaration - Pointer to array, Pointer to a function, Pointer to structure - Pointer operators and Pointer arithmetic - Arrays and pointers - Array of pointers - Structure pointer - Memory Allocation in C - Command line arguments

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Harsha Priya, R. Ranjeet, "Programming and Problem Solving Through C Language", Firewall/Laxmi Publications (P) Ltd., New Delhi, 2015.

REFERENCES

1. Pradip Dey, Manas Ghosh, "Fundamentals of Computing and Programming in C", Second Edition, Oxford University Press, 2013.
2. M.G.Venkateshmurthy, "Programming Techniques through C": A Beginner's Companion, Pearson Education, Canada, 2009.
3. Ashok.N.Kamthane, "Computer Programming", Pearson Education, India, 2011.

PART A – SEMICONDUCTOR PHYSICS LABORATORY**COURSE OUTCOMES**

Upon completion of this course, the students will be able to

CO1: interpret the properties of the laser and verify the parameters of optical fiber (K3)

CO2: demonstrate the voltage-current characteristics of different diodes (K3)

CO3: analyze the characteristics of transistors (K3)

LIST OF EXPERIMENTS

1. Determination of angle of divergence of the laser beam and acceptance angle, the numerical aperture of optical fiber
2. Determination of wavelength of laser using grating and particle size of lycopodium powder
3. Determination of V-I characteristics of PN junction diode
4. Determination of V-I characteristics of Zener junction diode
5. Determination of V-I characteristics of light emitting diode
6. Determination of characteristics of BJT
7. Determination of characteristics of FET
8. Study of logic gates using transistors

- A minimum of FIVE experiments shall be offered.

TEXTBOOK

1. Sessa Sai Kumar Vemula, "Engineering Physics lab manual" 1st Edition, LAP LAMBERT Academic Publishing, 2017

REFERENCE BOOK

1. David Loyd, "Physics laboratory" 4th Edition, Cengage Learning, 2013

PART-B CHEMISTRY LABORATORY

L T P C
0 0 3 1.5

Course outcome

Upon completion of this course, the students will be able to

CO1: determine the chemical parameters of the water sample (K3)

CO2: quantify the amount of acid by pH metric methods (K3)

CO3: identify the biomolecules (K3)

CO4: estimate the amount of biomolecules present in the given samples (K3)

LIST OF EXPERIMENTS

1. Estimation of Total hardness of water sample
2. Estimation of Alkalinity of water sample
3. Estimation of HCl by pH method
4. Qualitative analysis of biomolecules
5. Estimation of glycine
6. Estimation of Vitamin – C
7. Separation of amino acids by TLC method
8. Determination of DNA binding constant by UV-Visible spectroscopy (Demo)

P: 45; TOTAL: 45 PERIODS

- A minimum of FIVE experiments shall be offered.
- Laboratory classes on alternate weeks for Physics and Biology

TEXTBOOKS

1. Bhujbal. N, Kolat. S and Kand. R, "Practical Organic Chemistry: A Laboratory experiments for Graduates and Post Graduates", 1st Edition, Prashant Publications, 2020
2. Svehla and Sivasankar, "Vogel's Qualitative Inorganic Analysis", 8th Edition, Pearson Education Limited, 2015.

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO 1: solve simple syntactical structures of C Language (K3)
- CO 2: enhance the programming skills in C using arrays and functions (K3)
- CO 3: develop programs using pointers, structures and file concepts (K3)

List of Experiments:

1. I/O statements, operators, expressions
2. Decision-making constructs: if-else, goto, switch-case, break-continue
3. Loops: for, while, do-while
4. Arrays: 1D and 2D, Multi-dimensional arrays, traversal
5. Strings: operations
6. Functions: call, return, passing parameters by (value, reference), passing arrays to function.
7. Recursion
8. Pointers: Pointers to functions, Arrays, Strings, Pointers to Pointers, Array of Pointers
9. Structures: Nested Structures, Pointers to Structures, Arrays of Structures and Unions.
10. Files: reading and writing, File pointers, file operations, random access, processor directives.

P: 60; TOTAL: 60 PERIODS

Software Requirement: Turbo C

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO 1: frame effective conditional and interrogative sentences. (K3)
- CO 2: write effective letters and reports in any professional context. (K3)
- CO 3: enhance the vital sub-functions of communication in any formal situation. (K3)
- CO 4: participate actively in both informal and formal discussions. (K3)
- CO 5: recall the acquired skills and apply them in the workplace. (K2)

UNIT I **6**

Standard abbreviations – Tenses (Present, Past, and Future) – Question framing – Asking and answering Yes/No and Wh questions - If conditionals.

UNIT II **6**

Single-Word substitution – Business letters for quotations and clarification – Chart description – Review of recent technologies – Listening to TED talks.

UNIT III **6**

Idioms and Phrases – Direct & Indirect Speech– Business letters for placing orders and making complaints – Product description.

UNIT IV **6**

Error spotting (Based on Concord, Pronouns, Articles & Adverb Placement) – Group Discussion (Uses – Structure – Strategies – Team Work – Positive & Negative Body Languages – Samples – Demo) – Proposal writing.

UNIT V **6**

Job application letter & Résumé preparation –Circular and minutes of the meeting – Reading (Skimming, Scanning, and Inferring) – Reading comprehension.

L:30; TOTAL:30 PERIODS

TEXTBOOKS

1. Bovee. C.L, and Thill. J.V, “Business Communication Today,” 15th Edition, New Delhi: Pearson Education, 2021.
2. Digiacomo. M, “The English Grammar Workbook for Adults,” Emeryville, CA: Rockridge Press, 2020.

REFERENCE BOOKS

1. Lester. M and Larry. B, “Handbook of English Grammar and Usage”, 3rd Edition, McGraw Hill Education, 2018.
2. Meenakshi. R, Sangeeta. S, “Professional English”, Oxford university press, 2019.
3. Ravindra Nath. T, “Technical English-II”, Shaswat publication, 2020.
4. Sudharshana. N. P, “English for Engineers”, Cambridge University Press, 2018.
5. Walter. S, “Oxford English Grammar Course”, 2019.

- Applications”, 6th Edition, Tata McGraw Hill, 2008
3. Godse. D.A. and Godse. A.P, “Digital Electronics”, Technical Publications, 4th Edition, 2017
 4. Rishabh Anand, “Digital Electronics”, Chand Publications, 2nd edition, 2021
 5. Thomas L. Floyd, “Digital Fundamentals”, 11th Edition, Pearson Education, 2017

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO1: express the structure and functions of different ecosystems (K2)

CO2: identify the causes, impacts, and management of e-waste, municipal waste, and hazardous waste (K2)

CO3: recognize the causes, impacts, and preventive measures of various global issues (K2)

UNIT I ENVIRONMENT AND ECOSYSTEMS 9

Scope and importance of the environment – Need for public awareness – Ecosystem – Structure and function of an ecosystem – Energy flow in the ecosystem – Forest and aquatic ecosystems – A field study of simple ecosystems – Pond and forest.

UNIT II INTEGRATED WASTE MANAGEMENT IN SMART CITIES 9

Introduction – Generation and types of solid waste - Swachh Bharat Mission - Solid waste: collection, transportation, segregation and processing – Disposal: landfill, biochemical processes, and energy recovery - Municipal solid waste management rules 2016.

UNIT III E-WASTE MANAGEMENT 9

Introduction – Composition - Types – Generation – Environmental and health hazards of e-waste – Recycling - Recovery of metals: pyrometallurgical, hydrometallurgical, and biometallurgical process – e-waste management and handling rules 2016 – e-waste management companies in India.

UNIT IV HAZARDOUS WASTE MANAGEMENT 9

Sources – Hazard identification – Dose - Response assessment – Risk characterization: Impact on plants, animals, and human beings – Hazardous waste management act 1986 - Physical treatment methods: sedimentation, adsorption, aeration - Chemical treatments: neutralization, precipitation, and redox method – Biological method.

UNIT V GLOBAL AND REGIONAL ENVIRONMENTAL ISSUES 9

Global effects of air pollution: Global warming and climate change - Acid rain - Ozone hole- Biodiversity: types, threats, and conservation - Population - Energy consumption and environmental degradation.

L: 45; TOTAL: 45 PERIODS

TEXTBOOKS

1. Miller. G.T and Spoolman. S, "Environmental Science", 16th Edition, Brooks/Cole Publishing Co., 2018.
2. Peavy. H.S, Rowe. D.R and Tchobanoglous. G, "Environmental Engineering", 2nd Edition, McGraw Hill Education, 2020.

REFERENCE BOOKS

1. Kaushik. A and Kaushik. C.P, "Environmental Science and Engineering", 6th Edition, New Age International Publishers, 2018.
2. Weller. K, "Environmental Science and Biological Engineering", 1st Edition, WIT Press, 2015.

COURSE OUTCOMES

Upon Successful completion of this course, the students will be able to

CO1: To discuss the design thinking process and innovation. (K2)

CO2: Practice design thinking process through a multidisciplinary task. (K3)

UNIT I BASICS OF DESIGN THINKING PROCESS**15**

Design thinking process basics-Ideation tools-case studies.

UNIT II PRACTICING DESIGN THINKING PROCESS**30**

Real world problem selection-Practicing the preliminary stages of Design Thinking Process - work presentation.

L: 15; P: 30; TOTAL: 45 PERIODS**REFERENCES**

1. Falk Uebernickel, Li Jiang, Walter Brenner, Britta Pukall, Therese Naef, "Design Thinking: The Handbook", WS Professional, 2020
2. Pavan Soni, "Design Your Thinking: The Mindsets, Toolsets and Skill Sets for Creative Problem solving", Penguin Random House, 2020
3. D.M. Arvind Mallik, "Design Thinking for Educators", Notion Press, 2019
4. Michael Lewrick, "The Design Thinking Playbook", Wiley, 2019
5. Kathryn Christopher, "Design Thinking in Engineering", Kendall Hunt Publishing Company, 2019
6. Robert Curedale, "Design Thinking Process & Methods" 5th Edition, Design Community College Inc, 2019
7. David Lee, "Design Thinking in the Classroom", Ulysses Press, 2018
8. Jimmy Jain, "Design Thinking for Startups", Notion Press, 2018
9. Monika Hestad Silvia Rigoni Anders Grnli, "The Little Booklet on Design Thinking: An Introduction", 2nd Edition, Zaccheus Entertainment, 2017
10. Scott Swan, Michael G. Luchs and Abbie Griffin, "Design Thinking: New Product Development Essentials", Wiley-Blackwell, 2016
11. Thomas Lockwood, "Design Thinking: Integrating Innovation, Customer Experience, and Brand Value", Allworth Press, 2009

MENTOR ACTIVITIES:

Educating the design thinking process: basics, Ideation tools and empathy map through case studies – presentation 10 Hours

Forming multidisciplinary batches among the students- Guide the batches to select a real-world task- Apply and practice the different stages of Design thinking process to bring out innovative solutions 20 Hours

Evaluating the students' activities through their presentations

End semester Assessments can be made through:

- Design Thinking presentation(PowerPoint format)
- Design Thinking poster preparation and presentation (PDF format, in color and monochrome, printable in A3 size)

Other points:

This course is for all department students

- A class/section should be with all department students
- A course instructor will be responsible for the academic process.
- In a project batch, maximum number of students should be four and no two students from same discipline possibly.
- The course has no pre-requisite and may be offered to second/fourth semester students.

L: 30; P: 45; E: 30 TOTAL: 105 PERIODS

TEXT BOOK

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", 2nd Edition, Pearson Education, 2016.

REFERENCES

1. Debasis Samanta, "Classic Data Structures", 2nd Edition, Prentice Hall, 2012.
2. Reema Thareja, "Data Structures Using C", 2nd Edition, Oxford University Press, 2019.
3. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, "Data Structures and Algorithms", Pearson Education, 2012.
4. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, "Fundamentals of Data Structures in C", 2nd Edition, Universities Press, 2008.
5. Richard Gilberg, Behrouz Forouzan, "Data Structures: A Pseudocode Approach with C", 2nd Edition, Cengage Learning, 2004

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COURSE OUTCOMES

Upon completion of this course, students will be able to

CO1: enable learners to develop their communicative competence (K2)

CO2: participate in group discussions confidently (K3)

CO3: make presentations on general and technical topics (K3)

CO4: collaborate and work in teams successfully (K4)

UNIT I **6**

Lab session: Listening and responding to audio files

Practice session: Mini Presentation related to Business English & Picture description.

UNIT II **6**

Lab session: Role Play – News Reader

Practice session: Resume and cover letter Preparation

UNIT III **6**

Practice session: Presentation, Group discussion

UNIT IV **6**

Project: Preparing a project report with a team of five members on recent topics about technology.

L:30; TOTAL:30 PERIODS

REFERENCE BOOKS

1. Dhanavel, S. P. "English and Soft Skills" Vol.1, Orient BlackSwan, Chennai 2010
2. Lewis. S and Weintraub. R, "InCredible Communication: Uncover the Invaluable Art of Selling Yourself." 1st Edition, London: Bloomsbury, 2022.
3. Sudha Rani, D. "Advanced Communication Skills Laboratory Manual." New Delhi: Pearson, 2010.