



Aditya Institute of Technology and Management

ACADEMIC REGULATIONS (AR25)

For

Bachelor of Computer Applications (BCA) Programme

(Duration: 3/4 Years)

(Applicable for the batches admitted from the A.Y. 2025-26)

**ADITYA INSTITUTE OF TECHNOLOGY AND MANAGEMENT
(AUTONOMOUS)**

Approved by AICTE, Accredited by NBA & NAAC,

Recognized under 2(f) and 12(b) of UGC

Permanently Affiliated to JNTUGV, Vizianagaram

K. Kotturu, Tekkali, Srikakulam-532201, Andhra Pradesh, India

ACADEMIC REGULATIONS

Applicable for the students of Bachelor of Computer Applications (BCA)/Bachelor of Business Administration (BBA) UG Programme admitted from the Academic Year 2025-26 onwards. The BCA/BBA Degree of Aditya Institute of Technology and Management shall be conferred on candidates who are admitted to the program and who fulfill all the requirements for the award of the Degree.

1. ELIGIBILITY FOR ADMISSIONS:

Admission to the above program shall be made subject to eligibility, qualification and specialization as prescribed by the University from time to time. Admissions shall be made on the basis of merit rank obtained by the candidates at entrance examination concerned or the qualifying Entrance Test conducted by the University or on the basis of any other order of merit as approved by the University, subject to reservations as laid down by the Govt. from time to time.

2. AWARD OF BCA/BBA DEGREE:

A student shall be declared eligible for the award of the BCA/BBA, Degree, if he pursues a course of study and completes it successfully in not less than THREE academic years and not more than SIX academic years.

The student shall register for all 120 credits and secure all the 120 credits.

The minimum instruction days in each semester are 90.

A Student, who fails to fulfill all the academic requirements for the award of the degree within SIX academic years from the year of their admission, shall forfeit his seat in B.B.A. course.

Credit Definition

1 Hour Lecture (L) per week	1 Credit
1 Hour Tutorial (T) per week	1 Credit
1 Hour Practical (P) per week	0.5 Credit
2 Hours Practical (Lab) per week	1 Credit

3. ATTENDANCE:

A candidate shall be deemed to have eligibility to write end semester examinations if he has put in a **minimum of 75% of attendance** in aggregate of all the subjects.

Condonation of shortage of attendance up to 10% (65% and above, and below 75%) maybe given by the College academic committee.

Condonation of shortage of attendance shall be granted only on genuine and valid reasonson representations by the candidate with supporting evidence.

Shortage of attendance below 65% shall in NO case be condoned.

A candidate shall not be promoted to the next semester unless he/she fulfills the attendance requirements of the present semester.

A stipulated fee shall be payable towards Condonation of shortage of attendance.

4. PROMOTION RULES:

The following academic requirements must be satisfied in addition to the attendance requirements mentioned in the above.

A student shall be promoted from first year to second year if he/she fulfils the minimum attendance requirement as per university norms.

A student will be promoted from II to III year if he/she fulfils the academic requirement of securing 40% of the credits (any decimal fraction should be rounded off to higher digit) up to in the subjects that have been studied up to III semester.

And in case a student is detained for want of credits for a particular academic year, the student may make up the credits through supplementary examinations and only after securing the required credits he/she shall be permitted to join in the V semester.

When a student is detained due to lack of credits/shortage of attendance he/she may be re-admitted when the semester is offered after fulfillment of academic regulations.

5. EVALUATION:

The performance of a student in each semester shall be evaluated subject wise with a maximum of **100** marks for theory and **100** marks for practical subject

A student has to secure not less than **35%** of marks in the end examination (in fraction rounded to lower digit) and a minimum of **40%** of marks in the sum total of the mid semester and end examination marks taken together for the Theory, Labs, project etc. In case of a mandatory course, he/she should secure **40%** of the total marks.

Theory Course:

Assessment Method	Marks
Continuous internal assessment	30
Semester end examination	70
Total	100

Continuous internal assessment:

For theory subjects, during the semester, there shall be two midterm examinations. Each midterm examination shall be evaluated for **25** marks of which **5** marks for objective paper (10X0.5=5 marks) (10 minutes duration), **20** marks for subjective paper (90 minutes duration). Each subjective paper is to be held for **30** marks, and will be scaled down to **20** marks.

Subjective paper contains three descriptive type questions with internal choice.

Weightage of Marks					
	I MID	I OBJECTIVE		II MID	II OBJECTIVE
I Unit	12 Marks	2 Marks	III Unit	6 Marks	1 Mark
II Unit	12 Marks	2 Marks	IV Unit	12 Marks	2 Marks
III Unit	6 Marks	1 Mark	V Unit	12 Marks	2 Marks

The objective paper shall be conducted along with subjective paper test.

Sum of marks obtained in objective paper and subjective paper is taken as MID term exam marks.

Final midterm examination marks (**25** marks) shall be arrived by considering the marks secured by the student in both the mid examinations with 80% Weightage given to the better mid exam and 20% to the other.

The first midterm examination will be conducted usually after completion of 50% syllabus (i.e. first 2.5 Units), and the second midterm examination will be conducted usually at the end of instruction (i.e. remaining 2.5 Units).

Assignment marks awarded based on minimum of two assignments (5 marks for each assignment) or one case study (group-wise). It should be continuous assessment throughout the semester and the average marks shall be considered.

Continuous internal assessment (**30** marks) is a sum of final midterm examination (**25** marks) and Assignment (**5** marks).

Semester end examination:

The question paper shall have descriptive type questions held for **70** marks, with the duration of **180** minutes. There shall be one question from each unit with internal choice. Each question carries **14** marks (5X14M=70 marks).

Open Elective:

The student can choose any one open elective course offered in the respective semester. The pattern of Midterm examinations and End examinations of these courses is similar to regular theory courses and the valuation is purely internal.

Laboratory Course:

Assessment Method	Marks
Continuous internal assessment	30
Semester end examination	70
Total	100

Continuous internal assessment:

Day-to-day work in the laboratory shall be evaluated for **15** marks by the concerned laboratory teacher based on the regularity/record/viva and **15** marks for the internal test.

Semester end examination:

The end examination shall be conducted by the teacher concerned and external examiner from outside the college.

Procedure **20** marks, experimental work **10** marks, Results **20** marks and Viva voce **20** marks (or)

Description **10** marks, Programming Code **20** marks, Output **20** marks and Viva voce **20** marks.

Personality Development and Soft skills Lab (BBA):

The Personality Development and Soft Skills Lab will be evaluated for a total of **100** marks consisting of **30** marks for internal assessment and **70** marks for semester-end examination.

Day-to-day work in the laboratory shall be evaluated for **10** marks by the concerned laboratory teacher based on the regularity/viva, record for **5** marks and **15** marks for the internal test.

The end examination shall be conducted by the teacher concerned and external examiner from outside the college: Examination **50** marks, Activity **5** marks and Viva voce **15** marks.

Social Responsibility Project (Summer Internship – I) (BBA):

All the students shall undergo Social Responsibility Project for a minimum period of 2 weeks after I year II Semester.

Self study report for the Social Responsibility Project after I year II Semester shall be submitted and evaluated during the II year I Semester.

The Self study report will be evaluated for a total of **100** marks consisting of **30** marks for internal assessment and **70** marks for semester-end examination.

Internal assessment for **30** marks shall be done by internal supervisor based on day to day observation.

The semester-end examination (Viva-Voce) shall be conducted by an internal examiner (a senior faculty appointed by Principal) and internal supervisor of the Social Responsibility Project.

6. METHOD OF AWARDING LETTER GRADES AND GRADE POINTS FOR A COURSE:

A letter grade and grade points will be awarded to a student in each course based on his/her performance as per the grading system given below:

Grading System for BCA/BBA Programme

Marks Range	Level	Letter Grade	Grade Points
>= 90%	Superior	S	10
80 – 89%	Excellent	A	9
70 – 79%	Very Good	B	8
60 – 69%	Good	C	7
50 – 59%	Average	D	6
40 – 49%	Pass	E	5
< 40%	Fail	F	0
Absent	Absent	Ab	0

7. CALCULATION OF SEMESTER GRADE POINTS AVERAGE (SGPA) FOR SEMESTER:

The performance of each student at the end of the each semester is indicated in terms of SGPA.

The SGPA is calculated as below:

$$\text{SGPA} = \frac{\Sigma(\text{CR} \times \text{GP})}{\Sigma \text{CR}} \quad (\text{For all courses passed in a semester})$$

Where CR = Credits of a Course

GP = Grade points awarded for a course

8. CALCULATION OF CUMULATIVE GRADE POINTS AVERAGE (CGPA) AND AWARD OF DIVISION FOR ENTIRE PROGRAMME:

The CGPA is calculated as below:

$$\text{CGPA} = \frac{\Sigma(\text{CR} \times \text{GP})}{\Sigma \text{CR}} \quad (\text{For the entire programme})$$

Where CR = Credits of a course

GP = Grade points awarded for a course

Both SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

9. AWARD OF CLASS:

Class Awarded	CGPA to be secured	Remarks
First Class with Distinction	≥ 7.5	From the CGPA secured from 120 Credits
First Class	≥ 6.5 and < 7.5	
Second Class	≥ 5.5 and < 6.5	
Pass Class	≥ 5.0 and < 5.5	

CGPA to Percentage conversion Formula: $(\text{CGPA} - 0.5) \times 10$

10. SUPPLEMENTARY EXAMINATIONS:

Supplementary examinations will be conducted along with regular examinations and after the declaration of results of regular examinations of that semester.

11. WITHHOLDING OF RESULTS:

If the student is involved in indiscipline/malpractices/court cases, the result of the student will be withheld.

12. TRANSITORY REGULATIONS:

Discontinued or detained candidates are eligible for readmission (within the duration as mentioned in item 2 and when next offered.

The readmitted students will be governed by the regulations under which the candidate has been admitted.

13. GENERAL:

Wherever the words he/him/his occurs in the regulations, they include she/her/hers.

The academic regulation should be read as a whole for the purpose of any interpretation.

In the case of any doubt or ambiguity in the interpretation of the above rules/regulations, the decision of the Principal is final.

The College may change or amend the academic regulations or syllabi at any time and the changes or amendments made shall be applicable to all the students with effect from the dates notified by the College.

DISCIPLINARY ACTION FOR MALPRACTICES/IMPROPER CONDUCT IN EXAMINATIONS

	Nature of Malpractices/Improper conduct	Punishment
1	If the student possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, cell phones, pager, palm computers or any other form of material concerned with or related to the subject of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the student which can be used as an aid in the subject of the examination)	Expulsion from the examination hall and cancellation of the performance in that subject only.
	If the student gives assistance or guidance or receives it from any other student orally or by any other body language methods or communicates through cell phone with any student or students in or outside the exam hall with respect to any matter	Expulsion from the examination hall and cancellation of the performance in that subject only. In case of an outsider, he will be handed over to the police and a case is registered against him.
2	If the student has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the subject of the examination (theory or practical) in which the student is appearing	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the student has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year.
3	If the student impersonates any other student in connection with the examination	The student who has impersonated shall be expelled from examination hall. The student is also debarred and forfeits the seat. The performance of the original student, who has been impersonated, shall be cancelled in all the subjects of the examination (including practical's and project work) already appeared and shall not be allowed to appear for examinations of the remaining subjects of that semester/year. The student is also debarred for two consecutive semesters from class work and all semester-end examinations. The continuation of the course by the student is subject to the academic regulations in connection with forfeiture of the seat. If the imposter is an outsider, he will be handed over to the police and a case is registered against him.
4	If the student smuggles the answer book or additional sheet or takes out or arranges to send out the question paper or answer book or additional sheet during or after the examination	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the student has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The student is also debarred for two consecutive semesters from class work and all semester-end examinations. The continuation of the course by the student is subject to the academic regulations in connection with forfeiture of the seat.
5	If the student uses objectionable, abusive or offensive language in the answer script or in letters to the examiners or writes to the examiner requesting him to award pass marks	Cancellation of the performance in that subject.
6	If the student refuses to obey the orders of the Chief Superintendent/Assistant -Superintendent / any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a	In case of students of the college, they shall be expelled from examination hall and cancellation of their performance in that subject and all other subjects the candidate(s) has (have) already

	walkout or instigates others to walk out or threatens the officer-in charge or any person on duty in or outside the examination hall or causes any injury to any of his relatives either by words spoken or written or by signs or by visible representation, assaults the officer-in-charge or any person on duty in or outside the examination hall or any of his relatives, or indulges in any other act of misconduct or mischief which results in damage or destruction of property in the examination hall or any part of the college campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination	appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The students also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case is registered against them.
7	If the student leaves the exam hall taking away answer script or intentionally tears off the script or any part thereof inside or outside the examination hall	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the student has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The student is also debarred for two consecutive semesters from class work and all university examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of the seat.
8	If the student possesses any lethal weapon or firearm in the examination hall	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the student has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The student is also debarred and forfeits the seat.
9	If student of the college, who is not a candidate for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clauses 6, 7, 8	In case of student of the college, expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the student has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat. Person(s) who do not belong to the college will be handed over to police and. a police case will be registered against them.
10	If the student comes in a drunken condition to the examination hall	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the student has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year.
11	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny	Cancellation of the performance in that subject and all other subjects the student has already appeared including practical examinations and project work of that semester/year examinations.

Ragging

Ragging is prohibited under the following Acts

Supreme Court in SLP No. 24295 of 2006 dt. 16-05-2007
High Court Judgement dt. 11-09-1997 in W.P.No. 26132/96
Act 26 of A.P. Legislative Assembly dt. 19-08-1997
Indian Parliament Notice dt. 26-07-2008
as per AICTE Notice dt. 01-07-2009
as per UGC Notice dt. 22-10-2009

Ragging within or outside any educational institution is Prohibited.

Ragging means doing an act which causes or is likely to cause Insult
or Annoyance or Fear or Apprehension or Threat or Intimidation
or outrage of modesty or Injury to a student.

	Imprisonment upto		Fine upto
Teasing Embarrassing and Humiliation	6 Months	+	Rs.1000/-
Assaulting or using criminal force or criminal intimidation	1 Year	+	Rs.2000/-
Wrongfully restraining or confining or causing hurt	2 Years	+	Rs.5000/-
Causing grievous hurt, kidnaping or rape or committing unnatural offence	5 Years	+	Rs.10,000/-
Causing death or abetting suicide	10 Years	+	Rs.50,000/-

Aditya Institute of Technology and Management, Tekkali
AR25 COURSE STRUCTURE (1st UG)
(Proposed for BCA)

Year/Sem.	Code	Theory/Lab	L	T	P	C
I BCA (Ist Sem)	25BCA1001	Communicative English	3	0	0	3
	25BCA1002	Fundamentals of Computer Science	3	0	0	3
	25BCA1003	Fundamentals of Commerce	3	0	0	3
	25BCA1004	Programming in C	3	1	0	4
	25BCA1005	Matrix Algebra and Statistical Methods	3	1	0	4
	25BCA1101	Communication Skills Lab	0	0	3	1.5
	25BCA1102	IT Workshop	0	0	3	1.5
	25BCA1103	Programming in C Lab	0	0	3	1.5
	25BCA1104	Introduction to R Programming Lab	0	0	3	1.5
	Total		15	2	12	23

Year/Sem.	Code	Theory/Lab	L	T	P	C
I BCA (IInd Sem)	25BCA1006	Mathematical Foundation to Computer Science	3	0	0	3
	25BCA1007	Environmental Science and Sustainability	2	0	0	2
	25BCA1008	Business Organization	3	0	0	3
	25BCA1009	Digital Logic and Computer Organization	3	0	0	3
	25BCA1010	Data Structures using C	3	1	0	4
	25BCA1011	Object Oriented Programming through C++	3	1	0	4
	25BCA1105	Data Structures using C Lab	0	0	3	1.5
	25BCA1106	Object Oriented Programming through C++Lab	0	0	3	1.5
	Total		17	2	6	22

L	T	P	C
3	0	0	3

Subject Code: 25BCA1001

COMMUNICATIVE ENGLISH

Course Objectives:

1. Demonstrate proficiency in the four core language skills—listening, speaking, reading, and writing—by applying them effectively in both academic and real-life scenarios.
2. Utilize accurate grammar and a broad vocabulary suitable for academic writing, formal communication, and workplace interactions.
3. Engage confidently and effectively in oral communication tasks, including group discussions, presentations, and job interviews.
4. Analyze and interpret a range of texts, including literary works, descriptive passages, and technical documents, with improved comprehension and critical thinking.
5. Compose well-structured and grammatically correct written content, such as paragraphs, summaries, letters, résumés, and essays, tailored to specific purposes and audiences.

Course Outcomes (COs):

1. **Identify** and **comprehend** main ideas, specific details, and contextual meanings from various audio and textual materials including stories, poems, biographies, essays, and conversations. (Remembering, Understanding)
2. **Engage** in meaningful spoken interactions by **participating** in conversations, role plays, group discussions, and oral presentations on academic and personal topics. (Applying, Creating)
3. **Analyze** and **interpret** written texts by applying reading strategies such as skimming, scanning, and inferring through context clues, and understanding text structure and coherence. (Analyzing, Understanding)
4. **Compose** structured and grammatically accurate written content, including paragraphs, summaries, essays, resumes, and official letters, using correct punctuation and vocabulary. (Applying, Creating)
5. **Apply** grammar rules and an enriched vocabulary—including synonyms, antonyms, homophones, collocations, and technical terms—to **enhance** both written and spoken communication. (Applying, Evaluating)

Unit I: HUMAN VALUES

Lesson: *Gift of the Magi (Short Story)*

Listening: Identifying the topic, context, and specific information, listening to short audio texts, answering questions

Speaking: Asking and answering general questions, introducing oneself and others, speaking about home, family, studies

Reading: Skimming for main ideas, scanning for specific information

Writing: Capitalization, spellings, punctuation, sentence formation, basic sentence structures, forming questions

Grammar: Parts of speech, sentence structures

Vocabulary: Synonyms, antonyms, prefixes, suffixes, root words

Unit II: NATURE

Lesson: *The Brook by Alfred Tennyson (Poem)*

Listening: Listening for main ideas, supporting details

Speaking: Pair and group discussions, short structured talks

Reading: Identifying sequence of ideas, linking techniques in paragraphs

Writing: Paragraph structure, paragraph writing on specific topics

Grammar: Linkers, articles, zero article, prepositions

Vocabulary: Homonyms, homophones, homographs

Unit III: BIOGRAPHY

Lesson: *Elon Musk (Biography)*

Listening: Listening for global comprehension, summarizing

Speaking: Pair and group discussions, reporting discussions

Reading: Reading for detail, using context clues for inference

Writing: Summarizing, note-making, paraphrasing

Grammar: Tenses, subject-verb agreement

Vocabulary: Compound words, collocations

Unit IV: INSPIRATION

Lesson: *The Toys of Peace by Saki*

Listening: Predicting from conversations, listening with/without video

Speaking: Role plays, formal and informal communication, asking/giving information

Reading: Interpreting graphic elements, understanding trends, relationships in data

Writing: Official letters, resumes

Grammar: Reporting verbs, direct and indirect speech, active and passive voice

Vocabulary: Words often confused, jargons

Unit V: MOTIVATION

Lesson: *The Power of Intrapersonal Communication (Essay)*

Listening: Identifying key terms, answering comprehension questions

Speaking: Oral presentations, academic topics

Reading: Reading comprehension

Writing: Structured essays, error identification, editing short texts

Grammar: Articles, prepositions, tenses, subject-verb agreement

Vocabulary: Technical jargons

Textbooks:

1. Pathfinder: Communicative English for Undergraduate Students, Orient Black Swan, 2023 (Units 1–3)
2. Empowering with Language, Cengage Publications, 2023 (Units 4–5)

References:

1. Sham Ji Dubey, English for Engineers, Vikas Publishers, 2020
2. Stephen Bailey, Academic Writing: A Handbook for International Students, Routledge, 2014
3. Raymond Murphy, English Grammar in Use, Cambridge University Press, 2019
4. Norman Lewis, Word Power Made Easy, Anchor, 2014

Subject Code: 25BCA1002

L	T	P	C
3	0	0	3

Fundamentals of Computer Science

Course Objectives:

1. Understand the evolution, classification, and applications of computer systems.
2. Learn the functionality and types of input, output, and memory devices used in computing systems.
3. Explore data communication principles and networking fundamentals including topologies, protocols, and network applications.
4. Gain insights into programming languages including their evolution, classification, and usage in software development.
5. Acquiring knowledge of modern and emerging technologies such as Artificial Intelligence, Blockchain, 5G, IoT, Quantum Computing, Cybersecurity

Course Outcomes:

1. Describe the evolution, components, and classification of computers and their applications.
2. Identify and explain various input/output devices and memory types used in computing systems.
3. Explain fundamental networking concepts including LAN, WAN, network protocols, and topologies.
4. Analyze and categorize programming languages and describe the process of program development.
5. Outline the principles of emerging technologies including AI, Blockchain, Quantum Computing, 5G, IoT, and Cybersecurity, and their real-world applications.

UNIT I: Understanding Computer

Introduction: Evolution of Computers, Generations of Computers, Classification of Computers, Computing Concepts, The Computer System and its components, Applications of Computers

Computer software and its types: Introduction, Types of Computer Software, System Management Programs, System Development Programs, Standard Application Programs, Unique Application Programs, Introduction to Operating System.

UNIT II: Input –Output devices and storage systems

Input devices: Pointing Devices, Scanning Devices, Optical Recognition Devices, Digital Camera, voice Recognition System, Data Acquisition Sensors, Media Input Devices

Output devices: Display Monitors, Printers, Impact Printers, Non-impact Printers, Plotters, Voice Output Systems, Projectors, Terminals

Memory: RAM, ROM, Storage Systems, Magnetic Storage Systems, Optical Storage Systems, Magneto Optical System, Solid-state Storage Devices, Storage Evolution Criteria.

UNIT III: Data Communications and Networks

Introduction, Data Communication Using Modem, Basics of Computer Network, Network Topologies, LAN, MAN, WAN, Network Protocols and Software, Applications of Network

UNIT IV: Programming languages

Introduction, History of Programming Languages, Generations of Programming Languages, Characteristics of a Good Programming Language, Categorization of High-level Languages, Popular High-level Languages, Factors Affecting the Choice of a Language, developing a Program, Running a Program.

UNIT V: Contemporary Computing Paradigms and Emerging Technologies

Software Engineering, Operating System, Data Base management System, Artificial Intelligence, Machine Learning, Deep Learning, Quantum Computing, Block Chain, 5G, IoT, Cloud Computing, Edge Computing, Extended Reality, Cyber Security

Textbooks:

1. Fundamentals Of Computers, 1Edition, E Balagurusamy, Mc Graw Hill India, 2009
2. Computer Fundamentals, A. Goel, 2010, Pearson Education
3. Fundamentals of Computers, P. K.Sinha& P. Sinha, 2007, BPB Publishers
4. Emerging Technologies in Computing: Theory, Practice, and Advances Edited by Pramod Kumar, Anuradha Tomar, and R. Sharmila CRC Press / Chapman & Hall (2024)

Reference Textbooks:

1. “Fundamentals of Computers” by V. Rajaraman, PHI Learning Pvt. Ltd, 2021 Edition.
2. “Introduction to Information Technology” by Satish Jain & M. Geeta, BPB Publications, 2022 Edition.

Web Resources:

- <https://edu.gcfglobal.org/en/computerbasics/>
- https://tutorialspoint.com/computer_fundamentals/index.htm
- <https://onlinecourses.swayam2.ac.in/>
- <https://nptel.ac.in/courses/106/103/106103068/>

L	T	P	C
3	0	0	3

Subject Code: 25BCA1003

FUNDAMENTALS OF COMMERCE

Course Objectives

1. To help students acquire conceptual knowledge of Commerce and Economy
2. To understand the role of Commerce in economic and societal development
3. To gain foundational understanding of accounting principles and practices
4. To introduce the taxation system and relevant authorities
5. To provide insights into digital commerce and basic web technologies

Course Outcomes (COs)

1. Define and explain the scope and role of commerce in economic and societal development
2. Apply basic concepts of macroeconomics and microeconomics in real-world scenarios
3. Understand the fundamental principles of accounting and GAAP standards
4. Describe the types and structure of taxation and recognize key tax authorities
5. Utilize basic web tools and digital marketing strategies for business promotion

Unit I: Introduction to Commerce

Definition of Commerce, Role of Commerce in Economic Development, Role of Commerce in Societal Development, Imports, Exports, Balance of Payments, World Trade Organization

Unit II: Economic Theory

Macro Economics, Meaning of Macro Economics, Definition of Macro Economics, Measurements of National Income, Concepts of National Income, Micro Economics, Demand, Supply, Elasticity of Demand, Classification of Markets, Perfect Competition, Characteristics of Perfect Competition, Equilibrium Price, Marginal Utility

Unit III: Accounting Principles

Meaning of Accounting, Objectives of Accounting, Accounting Cycle, Branches of Accounting, Financial Accounting, Cost Accounting, Management Accounting, Accounting Concepts, Accounting Conventions, GAAP (Generally Accepted Accounting Principles)

Unit IV: Taxation

Meaning of Tax, Meaning of Taxation, Types of Tax, Income Tax, Corporate Taxation, Goods and Services Tax (GST), Customs, Excise, Differences between Direct and Indirect Tax, Objectives of Tax, Central Board of Direct Taxes (CBDT), Central Board of Excise and Customs (CBIC)

Unit V: Computer Essentials and Digital Commerce

Web Design, WordPress Basics, Developing a Simple Website, Digital Marketing, Social Media Marketing, Content Marketing, Search Engine Optimization (SEO), Email Marketing, Data Analytics, Prediction of Customer Behavior, Customized Suggestions

Textbooks

1. S.P. Jain, K.L. Narang, Accountancy - I, Kalyani Publishers, 2022
2. R.L. Gupta, V.K. Gupta, Principles and Practice of Accounting, Sultan Chand & Sons, 2021
3. S. Sankaran, Business Economics, Margham Publications, Chennai, 2020
4. Kalyani Publications Editorial Board, Business Economics, Kalyani Publishers, 2021

Reference Books

1. Dr. Vinod K. Singhanian, Direct Taxes: Law and Practice, Taxmann Publications, 2023
2. Dr. Mehrotra, Dr. Goyal, Direct Taxes: Law and Practice, Sahitya Bhavan Publications, 2022

Web Reference:

1. https://swayam.gov.in/nd2_cec20_mg14/preview
2. <https://www.coursera.org/learn/global-strategy>
3. <https://www.wto.org/>
4. <https://nptel.ac.in/courses/110/104/110104068/>
5. <https://nptel.ac.in/courses/109/106/109106148/>
6. <https://www.coursera.org/learn/macroeconomics>
7. <https://www.investopedia.com/economics-basics-4689748>
8. https://swayam.gov.in/nd1_noc23_mg65/preview
9. <https://www.coursera.org/learn/wharton-accounting>
10. <https://www.edx.org/course/accounting-essentials>
11. <https://www.investopedia.com/terms/a/accounting.asp>
12. https://swayam.gov.in/nd1_noc24_hs04/preview
13. <https://www.coursera.org/learn/federal-taxation>
14. <https://incometaxindia.gov.in/Pages/tax-information-services.aspx>
15. <https://www.cbic.gov.in/>
16. <https://www.coursera.org/specializations/digital-marketing>
17. <https://www.edx.org/course/digital-marketing>
18. <https://www.futurelearn.com/courses/digital-skills-digital-marketing>
19. <https://www.coursera.org/projects/wordpress-for-beginners>
20. <https://learndigital.withgoogle.com/digitalgarage/course/digital-marketing>

L	T	P	C
3	1	0	4

Subject Code: 25BCA1004

PROGRAMMING IN C

Course Objectives

1. Introducing students to the fundamentals of computer programming,
2. Provide hands-on experience with coding and debugging,
3. Foster logical thinking and algorithmic problem solving,
4. Familiarize students with programming constructs like data types, control structures, arrays, and functions,
5. Encourage collaborative learning and teamwork in coding projects.

Course Outcomes

1. Apply basic programming concepts and problem-solving techniques to develop simple C programs.
2. Construct and analyze C programs using control structures for decision making and iteration.
3. Implement array and string operations in C to solve structured data problems.
4. Demonstrate the use of pointers and user-defined data types for efficient memory and data handling.
5. Design modular programs using functions, recursion, and file I/O operations in C.

Syllabus

UNIT I: Introduction to Programming and Problem Solving

History of Computers, ALU, Input-Output Units, Memory, Program Counter, Programming Languages, Algorithms, Flowcharts (using Dia Tool), Pseudocode, Compilation and Execution, Primitive Data Types, Variables, Constants, Input and Output, Operations, Type Conversion, Casting, Algorithmic Approach, Top-down and Bottom-up Strategies, Time and Space Complexity.

UNIT II: Control Structures

Sequential Programs, Conditional Statements (if, if-else, switch), Loops (for, while, do-while), goto Statement, Break, Continue.

UNIT III: Arrays and Functions Strings

Array Indexing, Memory Model, One-Dimensional Arrays, Two-Dimensional Arrays, Function Declaration and Definition, Function Calls, Arguments and Return Types, Pointers as Parameters, Arrays as Parameters, Recursion, Scope and Lifetime of Variables.

UNIT IV: Pointers and Strings

Pointers, Dereferencing, Address Operators, Pointer Arithmetic, Arrays with Pointers, Structures, Unions. String Basics, String Operations.

UNIT V: Structures and File Handling

Definition, Declaration, Accessing the structure elements, Array of structures, Arrays with in structures, pointer to structure, DMA, Basics of File Handling.

Text Books

1. E. Balagurusamy, Programming in ANSI C, Tata McGraw Hill Education, 7th Edition, 2021
2. Yashavant Kanetkar, Let Us C, BPB Publications, 20th Edition, 2022

Reference Books

1. Herbert Schildt, C: The Complete Reference, McGraw Hill, 4th Edition, 2023
2. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall, 2nd Edition, 2022

Web Resources

1. https://onlinecourses.nptel.ac.in/noc22_cs40/preview
2. <https://ocw.mit.edu/courses/6-087-practical-programming-in-c-january-iap-2010/>
3. <https://cslibrary.stanford.edu/101/>

L	T	P	C
3	1	0	4

Subject Code: 25BCA1005

MATRIX ALGEBRA AND STATISTICAL METHODS

Course Objectives:

1. Develop a foundational understanding of matrix algebra, including determinants and solving systems of equations.
2. Introduce eigenvalues, eigenvectors and the Cayley-Hamilton theorem for analyzing matrices.
3. Teach fundamental statistical measures for analyzing data and measuring variation.
4. Learn techniques of correlation and regression for data interpretation and prediction.
5. Apply probability theory to solve problems involving uncertainty and real-life decision-making.

Course Outcomes (COs):

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

1. CO1: apply matrix operations and solve systems of linear equations using determinants, ranks, inverses and Cramer's rule.
2. CO2: determine eigenvalues and eigenvectors and use the Cayley-Hamilton theorem to compute powers of matrices.
3. CO3: use statistical measures to summarize, analyze and interpret data sets.
4. CO4: compute correlation and regression coefficients to analyze relationships and make data-based predictions.
5. CO5: apply probability theorems, including Baye's theorem to solve problems under uncertainty.

Unit I: Matrix Algebra

Matrices; matrix operations; determinants and their properties; transpose of a matrix; adjoint and inverse of a square matrix; rank of a matrix. Solution of linear systems of equations using Cramer's rule, matrix inversion method, and checking consistency of the system.

Unit-II: Eigenvalues and Eigenvectors

Eigenvalues and eigenvectors; Cayley-Hamilton Theorem (without proof); finding the power of a matrix using the Cayley-Hamilton Theorem.

Unit-III: Descriptive Statistics

Measures of central tendency – Mean, Median, and Mode, Types of mean, Measures of variation – range, quartile deviation, mean deviation and standard deviation, Measures of shaping - Coefficient of Variation, Skewness and Kurtosis.

Unit IV: Correlation and Regression

Introduction; concept of correlation – types of correlation; Karl Pearson's correlation coefficient and its properties; rank correlation coefficient; regression – linear regression and its properties.

Unit V: Probability Concepts:

Sample space and events – Probability – The axioms of probability - Some elementary theorems - Conditional probability – Baye's theorem.

Textbooks

1. Sunil S. Patil, Numerical and Statistical Methods, EBPB Publications, 2021.
2. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons, 2022.
3. G. Jay Kerns, Introduction to Probability and Statistics Using R, First Edition 49 ISBN: 978-0-557-24979-4. (Free e-book from R software website)

Reference Book:

1. T.K.V. Iyengar, Dr. B. Krishna Gandhi, S. Ranganatham and Dr. M.V.S.S.N. Prasad, Probability and Statistics, S .Chand Publications.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2018

Web Reference:

1. <https://archive.nptel.ac.in/courses/111/105/111105134/>
2. https://onlinecourses.swayam2.ac.in/cec23_ma05/preview
3. https://onlinecourses.nptel.ac.in/noc23_me135/preview
4. <https://oli.cmu.edu/courses/probability-statistics-open-free/>

L	T	P	C
0	0	3	1.5

Subject Code: 25BCA1101

COMMUNICATION SKILLS LAB

Course Objectives:

1. Recognize and articulate English vowel and consonant sounds with correct pronunciation.
2. Use appropriate accent neutralization and intonation in formal and professional communication.
3. Participate actively in oral communication tasks such as JAM sessions, debates, and group discussions.
4. Draft professional documents, including résumés, cover letters, and emails, with clarity and effectiveness.
5. Demonstrate confidence and fluency in delivering presentations and attending job interviews.

Course Outcomes (COs):

By the end of this course, students will be able to:

1. **Identify** and **produce** English vowel and consonant sounds accurately, and **demonstrate** correct pronunciation in spoken communication. (*Remembering, Applying*)
2. **Apply** appropriate stress, rhythm, and intonation patterns to **achieve** neutral and intelligible spoken English. (*Applying, Analyzing*)
3. **Participate** effectively in spontaneous and structured speaking activities such as JAM sessions, role plays, debates, and group discussions. (*Applying, Creating*)
4. **Compose** professional documents including resumes, cover letters, emails, and Statements of Purpose with clarity, coherence, and correct format. (*Creating, Applying*)
5. **Deliver** structured presentations and **demonstrate** confidence and clarity in mock interviews through effective verbal and non-verbal communication. (*Applying, Evaluating*)

Syllabus:

1. **English Sounds** – Vowels, consonants, pronunciation basics
2. **Accent & Intonation** – Neutralization, stress, rhythm
3. **Speaking Skills** – JAM, role plays, debates, and group discussions
4. **Professional Writing** – Resume, cover letter, email writing, Statement of Purpose (SOP)
5. **Presentation & Interview Skills** – PPT/poster presentations and mock interviews

Reference Books:

1. Raman Meenakshi, Sangeeta Sharma, Technical Communication, Oxford Press, 2018
2. Taylor Grant, English Conversation Practice, Tata McGraw-Hill Education, 2016
3. Hewings Martin, Cambridge Academic English (B2), Cambridge University Press, 2012
4. J. Sethi & P.V. Dhamija, A Course in Phonetics and Spoken English, 2nd Edition, Kindle, 2013

Web Resources:

1. <https://www.britishcouncil.in/english/online>
2. https://www.youtube.com/c/mmmEnglish_Emma
3. <https://www.youtube.com/c/EnglishClass101>
4. <https://www.youtube.com/c/SpakEnglishWithTiffani>

L	T	P	C
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Subject Code: 25BCA1102

IT WORK SHOP

Course Objectives

1. To introduce students to PC hardware, assembling, OS installation (Windows & Linux), and driver configuration
2. To cover basic DOS commands for OS maintenance
3. To understand internet access, web browsers, email, and online searches
4. To use productivity tools: MS Word, Excel, PowerPoint for document creation, data analysis, and presentations

Course Outcomes

Students will be able to:

1. Identify computer components and peripherals
2. Understand OS installation and DOS command usage
3. Use the Internet effectively: browsing, emails, search engines
4. Create and format professional documents in MS Word
5. Perform data analysis and calculations in MS Excel

List of Tasks

PC Hardware

Task 1: Identify components and prepare a report on CPU and peripherals

Task 2 (Optional): Practice assembling and disassembling a PC

Task 3: Install Windows OS

Task 4: Use internal and external DOS commands

Task 5: Install Linux OS

Internet & WWW

Task 6: Surf the Web, use email, bookmarks, search engines, and browsers

MS Word

Task 7: Create project certificates using formatting tools

Task 8: Create abstract documents with tables, hyperlinks, and images

Task 9: Design a newsletter with TOC, columns, and graphics

Task 10: Build feedback forms with forms, fields, and mail merge

MS Excel

Task 11: Create a scheduler with formatting and auto-fill

Task 12: Analyze performance using sorting, conditional formatting

Task 13: Calculate GPA using formulas and charts

Task 14: Create a cricket scorecard with pivot tables and data validation

MS PowerPoint

Task 15: Basics of PowerPoint – slides, text, shapes, hyperlinks

Task 16: Advanced PPT – master layouts, design templates, hidden slides

Text Books

1. Vikas Gupta – Comdex IT Course Toolkit, Wiley Dreamtech
2. Cheryl A. Schmidt – The Complete Computer Upgrade & Repair Book, 3rd Ed., Wiley Dreamtech
3. ITL Education Solutions – Introduction to Information Technology, Pearson
4. Kate J. Chase – PC Hardware and A+ Handbook, PHI

Reference Books

1. Scott Mueller – Upgrading and Repairing PCs, 22nd Ed., QUE
2. Cheryl A. Schmidt – The Complete Computer Upgrade & Repair Book, 3rd Ed., Dreamtech.

Web References:

1. <https://www.coursera.org/learn/computer-hardware-software>
2. <https://www.edx.org/learn/computer-hardware>
3. <https://www.coursera.org/learn/technical-support-fundamentals>
4. <https://www.coursera.org/courses?query=microsoft%20office>
5. <https://alison.com/tag/microsoft-office>
6. <https://www.classcentral.com/course/youtube-microsoft-office-2021-365-for-beginners-9-hours-of-excel-word-and-powerpoint-training-117776>

L	T	P	C
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Subject Code: 25BCA1103

PROGRAMMING IN C LAB

Course Objectives

The course aims to provide students with hands-on experience in:

- Familiarizing with the Linux environment and C development tools
- Writing and executing C programs
- Applying programming constructs to solve computational problems
- Understanding memory management, file operations, and modular programming

Course Outcomes

1. Understand and work in the C programming environment (Linux/Turbo C).
2. Write structured programs using basic C constructs like loops, conditionals, arrays, and functions.
3. Implement modular code using structures, pointers, and recursion.
4. Develop programs for file handling and memory allocation.
5. Apply debugging and problem-solving strategies for program development.

List of Experiments

Week 1: Introduction & Basic I/O

1. Explain the set-up process of Linux environment and work with editors like Vi, Vim, or Emacs?
2. Explain the process to compile and run programs using Turbo C or GCC compilers?
3. Explain basic input/output operations and arithmetic operations performed in a programming language?

Week 2: Algorithms & Flowcharts to Code

1. Write a c program to calculate simple statistics such as sum and average.
2. Write a c program to convert temperature values between Celsius and Fahrenheit.
3. Write a c program to compute simple and compound interest with appropriate formulas.

Week 3: Arithmetic Expressions

1. Write a c program to calculate square root of a number
2. Write a c program to calculate Area of triangle (use Heron's formula)

Week 4: Operator Precedence

1. Write a c program to Evaluate expressions

2. Write a c program to demonstrate use of conditional operators to find max of three numbers

Week 5: Conditional Statements (if/switch)

1. Write a c program to find maximum and minimum of four numbers.
2. Write a c program to find roots of a quadratic equation.
3. Write a c program to mimic calculator using switch-case.

Week 6: Loops

1. Write a c program to calculate factorial of a given number.
2. Write a c program to check if the given number is prime or not.
3. Write a c program to check if the given number is palindrome or not.

Week 7: 1D Arrays

1. Write a c program to find maximum and minimum elements of an array.
2. Write a c program to perform linear search.
3. Write a c program to reverse the elements of an array.

Week 8: 2D Arrays & Strings

1. Write a c program for matrix addition & multiplication.
2. Write a c program for String concatenation (without built-ins).
3. Write a c program for String reversal (with and without built-ins).

Week 9: Functions

1. Write a c program to demonstrate Call by value and Call by reference (swap two numbers)

Week 10: Recursion

1. Write a c program to display Fibonacci series.
2. Write a c program to calculate factorial of a given number.

Week 11: Pointers and Structures

1. Write a c program for Array sum using malloc().
2. Write a c program to read and display student records using structures.
3. Write a c program using calloc() and list failed students.

Week 12: Structures vs Unions

1. Write a c program to show the differences between structures and unions.
2. Write a c program to copy structure data.

Week 13: File Handling

1. Write a c program to demonstrate reading and writing text files.
2. Write a c program to count lines, words, characters

Textbooks

1. **Ajay Mittal**, Programming in C: A Practical Approach, Pearson Education, 1st Edition, 2010, ISBN: 9788131731920.
2. **Byron S. Gottfried**, Schaum's Outline of Programming with C, 3rd Edition, McGraw-Hill Education, 2010, ISBN: 9780071635093.
3. **Dr. N. B. Venkateswarlu**, C Programming, S. Chand Publishing, 1st Edition, 2012, ISBN: 9788121998166.

Reference Books

1. **Brian W. Kernighan and Dennis M. Ritchie**, The C Programming Language, 2nd Edition, Prentice Hall of India, 1988, ISBN: 9780131103627.
2. **Behrouz A. Forouzan and Richard F. Gilberg**, Computer Science: A Structured Programming Approach Using C, 3rd Edition, Cengage Learning, 2006, ISBN: 9780534491322

Web Resources

1. <https://www.learn-c.org/>
2. <https://ps-iiith.vlabs.ac.in/>
3. <https://ocw.mit.edu/>
4. <https://anu.edu.au>

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0	0	3	1.5

Subject Code: 25BCA1104

INTRODUCTION TO R PROGRAMMING LAB

Course Objectives (COs)

The main objectives of this course are to:

1. To introduce basic R operations and demonstrate the basic Arithmetic, Variable assignment, data types in R and creating and naming a vector, matrix and naming matrix in R.
2. To demonstrate the Add column and Add a Row in Matrix, selection of elements in Matrixes, Performing Arithmetic of Matrices, Factors, Implement the Factor and to illustrate Ordered Factors in R.
3. To perform an R program to take input from the user, check if a Number is Odd or Even and check if the given number is a Prime Number, to find the Factorial of a Number, Factors of a Number and Fibonacci sequence using Recursive Function.
4. To perform an R program to make a Simple Calculator, find L.C.M of two numbers and to create a Vector and to access elements in a Vector, to create a Matrix and access rows and columns using functions col names() ,row names(), c bind() and r bind() functions.
5. To perform an R program to create a Matrix from a Vector using the dim() function, a List and modify its components, Data Frame, Data Frame like a List and Data Frame like a Matrix.
6. To perform all types of charts, graphs and descriptive statistics for given data using R programming.

Course Outcomes (COs)

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

1. obtain basic operations using R programming.
2. calculate the matrix and factors using R - programming.
3. perform the numbers, factorial of number, Fibonacci sequence using R programming.
4. perform the LCM, access rows , columns using colnames() ,rownames(),cbind() and rbind() functions using R programming.
5. perform data frame using R programming.
6. determine all types of charts, graphs and descriptive statistics for given data using R programming.

Exercise 0: Introduction to R

- Install R and RStudio
- Basic functionality of R

Exercise 1: Basics of R Programming

- Write an R program to print "Hello World"
- Demonstrate basic arithmetic operations in R
- Demonstrate variable assignment in R

Exercise 2: Data Types and Vectors

- Demonstrate different data types in R
- Create and name a vector in R
- Create and name a matrix in R

Exercise 3: Working with Matrices

- Add a column and a row to a matrix in R
- Select elements from a matrix in R
- Perform arithmetic operations on matrices

Exercise 4: Factors in R

- Demonstrate factors in R
- Implement factors in R
- Illustrate ordered factors in R

Exercise 5: User Input and Control Structures

- Take input from the user in R
- Check if a number is odd or even
- Check if a given number is prime

Exercise 6: Loops and Recursion

- Find the factorial of a number
- Find the factors of a number
- Generate the Fibonacci sequence using a recursive function

Exercise 7: Basic Applications in R

- Create a simple calculator
- Find the L.C.M. of two numbers
- Create a vector and access its elements

Exercise 8: Matrix Operations

- Create a matrix and access rows and columns using `colnames ()` and `rownames ()`
- Create a matrix using `cbind ()` and `rbind ()` functions

Exercise 9: Lists and Data Frames

- Create a matrix from a vector using the `dim ()` function
- Create a list and modify its components
- Create a data frame

Exercise 10: Accessing Data Frames and Factors

- Access a data frame like a list
- Access a data frame like a matrix
- Create and use factors

Exercise 11: Data Visualization in R

- Create a scatter plot for data frame columns
- Create bar and box plots for data frame columns
- Add legends, and modify the width and height of the plot layout
- Create pie charts, bar charts, and histograms

Exercise 12: Statistical Analysis in R

- Calculate mean, median, variance, standard deviation, coefficient of dispersion, and coefficient of variation
- Perform correlation and regression analysis.

Textbooks

1. DVLN Jogiraju, Agatamudi Lakshmana Rao, R. Visweswararao, Nagendra Kumar Bhupathi, Computational Statistics and R Programming, Kalyani Publishers, 1st Edition, New delhi, India.
2. Thomas Mailund, Beginning Data Science in R: Data Analysis, Visualization, and Modelling for the Data Scientist, Apress, Aarhus, Denmark.

Reference Books

1. Probability & Statistics with R- Programming, Dr. Agatamudi Lakshmana Ra, Dr. Ch. GanapathiSwamy, Sri N. Lakshmana Rao, Dr. Rajamahanthi Santhikumar, Infinite Research, Registered Under MSME Government of India, UDYAM AP-02-0028189, India.
2. R for Beginners, Emmanuel Paradis, Institut des Sciences de l' Evolution, Universite Montpellier II, F-34095 Montpellier cdex 05 France.

L	T	P	C
3	0	0	3

Subject Code: 25BCA1006

MATHEMATICAL FOUNDATION TO COMPUTER SCIENCE

Course Objectives:

1. To introduce the foundational principles of logic including propositional calculus, truth tables, tautologies, logical equivalence and quantifiers, enabling students to analyze and construct valid logical arguments and reason formally.
2. To introduce the foundational concepts of sets, relations and functions, along with closures, orderings, lattices and counting principles, enabling students to model and analyze mathematical structures and logic-based problems.
3. Learn to formulate and solve linear and non-linear recurrence relations using generating functions.
4. Apply numerical techniques such as Bisection, Newton-Raphson to solve transcendental equations and Interpolation (Newton's forward and backward) to estimate function values for evenly spaced intervals and Lagrangian for unevenly spaced intervals.
5. To introduce numerical techniques for approximating derivatives and evaluating definite integrals using finite difference methods, Newton's formulas and numerical integration rules such as Trapezoidal and Simpson's 1/3.

Course Outcomes:

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

1. CO1: apply propositional logic concepts such as truth tables, tautologies, logical equivalence and quantifiers to construct and evaluate logical arguments.
2. CO2: solve mathematical problems using the principles of sets, relations, functions and inclusion-exclusion.
3. CO3: analyze and solve linear and non-linear recurrence relations using generating functions.
4. CO4: solving algebraic and transcendental equations and to enable accurate estimation of function values through interpolation methods .
5. CO5: apply numerical differentiation and integration methods to approximate derivatives and definite integrals.

UNIT-I: Logic and Propositional Calculus:

Propositions and truth tables; tautologies; logical equivalence; algebra of propositions; arguments; logical implication; propositional functions; quantifiers

UNIT–II: Sets and Functions:

Sets; relations; functions; closures of equivalence relations; partial ordering; well-ordering; lattice; sum-of-products and product-of-sums; principle of inclusion and exclusion.

UNIT–III: Recurrence Relations:

Linear and non-linear recurrence relations; solving recurrence relations using generating functions

UNIT–IV: Solution of Algebraic and Transcendental Equations and Interpolation:

Algebraic and Transcendental Equations: Bisection method; Secant method; Method of False position; Iteration method; Newton-Raphson method.

Interpolation: Introduction; finite differences – forward and backward; Newton’s forward and backward interpolation formulae, Lagrangian method (Unevenly spaced intervals). Only formulae and problem-solving for all the topics mentioned above.

UNIT–V: Numerical Methods:

Numerical Differentiation: Differentiation using finite differences – Newton’s forward and backward methods.

Numerical Integration: Trapezoidal Rule and Simpson’s 1/3 Rule. Only formulae and problem-solving for all the topics mentioned above

Text Books

1. Kolman B., Busby R. and Ross S., Discrete Mathematical Structures, 6th Edition, Pearson Education, 2015.
2. Sastry S. S., Introductory Methods of Numerical Analysis, Fifth Edition, PHL, 2022.
3. Discrete Mathematics Structures with Applications to Computer Science, J.P. Tremblay, R. Manohar, TMH, 1997.

Reference Books

1. M.K. Jain, S.R.K. Iyengar, and R.K. Jain, Numerical Methods for Scientific and Engineering Computation, 6th Edition, New Age International Publishers, 2012.
2. S.B. Singh, Discrete Structures, Khanna Book Publishing, 2023 (AICTE Recommended Textbook)
3. A Text Book on Mathematical Methods, Ravindranath, V. and Vijayalaxmi, A., Himalaya Publishing House, Bombay, 2nd edition, 2012.

Web Resources

1. <https://nptel.ac.in/courses/111107127>

L	T	P	C
2	0	0	2

Subject Code: 25BCA1007

ENVIRONMENTAL SCIENCE AND SUSTAINABILITY

Course Objective(s):

- 1). This course aims to familiarize students with basic environmental concepts, their relevance to business operations, and forthcoming sustainability challenges.
- 2). This course will equip students to make decisions that consider environmental consequences, enable future business graduates to become environmentally sensitive and responsible managers.

Course Outcome(s):

- 1) Explore the basic environmental concepts, natural resources and issues relevant to the business and management field.
- 2) Recognize the interdependence between environmental processes, ecosystems and biodiversity.
- 3) Determine the role of business decisions, policies, and actions in minimizing environmental degradation.
- 4) Identify the possible solutions to curb environmental problems caused by socio-economic dynamics and managerial actions.
- 5) Develop skills to address immediate environmental concerns through changes in business operations, policies, and decisions.

Unit 1: Understanding Environment, Natural Resources, and Sustainability

Fundamental environmental concepts and their relevance to business operations; Components and segments of the environment, the man-environment relationship, and historical environmental movements. Concept of sustainability; Classification of natural resources, issues related to their overutilization, and strategies for their conservation. Sustainable practices in managing resources, including deforestation, water conservation, energy security, and food security issues. The conservation and equitable use of resources, considering both intergenerational and intergenerational equity, and the importance of public awareness and education.

Unit 2: Ecosystems, Biodiversity, and Sustainable Practices

Various natural ecosystems, learning about their structure, functions, and ecological characteristics. The importance of biodiversity, the threats it faces, and the methods used for its conservation. Ecosystem resilience, homeostasis, and carrying capacity, emphasizing the need for sustainable ecosystem management. Strategies for in situ and ex situ conservation, nature reserves, and the significance of India as a mega diverse nation.

Unit 3: Environmental Pollution, Waste Management, and Sustainable Development

Various types of environmental pollution, including air, water, noise, soil, and marine pollution, and their impacts on businesses and communities. Causes of pollution, such as global climate change, ozone layer depletion, the greenhouse effect, and acid rain, with a particular focus on pollution episodes in India. Importance of adopting cleaner technologies; Solid waste management; Natural and man-made disasters, their management, and the role of businesses in mitigating disaster impacts.

Unit 4: Social Issues, and Sustainable Development

Dynamic interactions between society and the environment, with a focus on sustainable development and environmental ethics. Role of businesses in achieving sustainable development goals and promoting responsible consumption. Ecological economics, human population growth, and demographic changes in India. Environmental refugees, and the resettlement and rehabilitation of affected populations.

Unit 5: Legislation, and Practical Applications

Overview of key environmental legislation and the judiciary's role in environmental protection, including the Water (Prevention and Control of Pollution) Act of 1974, the Environment (Protection) Act of 1986, and the Air (Prevention and Control of Pollution) Act of 1981. Environmental justice.

Text Books :

1. Poonia, M.P. Environmental Studies (3rd ed.), Khanna Book Publishing Co.
2. Bharucha, E. Textbook of Environmental Studies (3rd ed.) Orient Blackswan Private Ltd.
3. Dave, D., & Katewa, S. S. Text Book of Environmental Studies. Cengage Learning India Pvt Ltd
4. Rajagopalan, R. Environmental studies: from crisis to cure (4 ed.). Oxford University Press.

References Books:

1. Miller, G.T. & Spoolman S. Living in the Environment. (20th ed.). Cengage.
2. Basu, M., & Xavier Savarimuthu, S. J. Fundamentals of environmental studies. Cambridge University Press.
3. Roy, M. G. Sustainable Development: Environment, Energy and Water Resources. Ane Books.
4. Pritwani, K. Sustainability of business in the context of environmental management. CRC Press.
5. Wright, R.T. & Boorse, D.F. Environmental Science: Toward A Sustainable Future (13th ed.). Pearson.

Web links:

1. <https://www.ourplanet.com>
2. <https://www.undp.org/content/undp/en/home/sustainable-development-goals.html>
3. www.myfootprint.org
4. <https://www.globalchange.umich.edu/globalchange1/current/lectures/kling/ecosystem/ecosystem.html>

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3	0	0	3

Subject Code: 25BCA1008

BUSINESS ORGANIZATION

Course Objectives:

1. Introduce the basic concepts, features, and types of business and its organization.
2. Explain the process of business promotion and various forms of business ownership.
3. Familiarize students with the importance of plant location and layout planning.
4. Provide knowledge about business combinations and rationalization in industries.
5. Impart foundational understanding of computers, internet technologies, and cybersecurity concepts.

Course Outcomes (COs):

1. CO1: Understand the concept of business, stages of development, types of business activities, and distinguish between industry, commerce, and profession.
2. CO2: Identify the forms of business organizations and analyze their merits and demerits, including the concept of One Person Company.
3. CO3: Evaluate the factors affecting plant location and layout, and assess criteria for determining business size and its optimization.
4. CO4: Describe the types and objectives of business combinations, and differentiate between rationalization and nationalization.
5. CO5: Demonstrate knowledge of computer fundamentals, internet basics, network types, and cybersecurity essentials.

Unit I: Introduction to Business

Concept of business, Features of business, Stages of business development, Classification of business activities, Characteristics of business organization, Objectives of business organization, Difference between Industry and Commerce, Difference between Business and Profession, Features of modern business

Unit II: Business Promotion and Forms of Organization

Key considerations in establishing a business, Traits of a successful entrepreneur, Forms of business ownership – Sole Proprietorship, Forms of business ownership – Partnership, Forms of business ownership – Joint Stock Companies, Forms of business ownership – Co-operatives, Comparison of Private and Public Company, Concept of One Person Company (OPC)

Unit III: Plant Location, Layout, and Business Size

Importance of plant location, Factors affecting plant location, Objectives of plant layout, Types of plant layout, Measuring the size of a business, Determining the optimum size of a business

Unit IV: Business Combinations and Rationalization

Meaning of business combinations, Characteristics of business combinations, Types of business combinations, Objectives of business combinations, Forms of business combinations, Principles of rationalization, Benefits of rationalization, Limitations of rationalization, Difference between Rationalization and Nationalization

Unit V: Computer Fundamentals and Cybersecurity

Milestones in computer evolution, Generations of computers, Internet history, Internet Service Providers (ISPs), Internet Protocol (IP), Domain Name System (DNS), Types of networks, Applications of internet and networks, Information assurance fundamentals, Cryptography – Symmetric, Cryptography – Asymmetric, Malware, Firewalls, Data privacy, Data protection

Text Books

1. **R. K. Sharma & Shashi K. Gupta**, Business Organization and Management, Kalyani Publishers, 2022
2. **U.C. Mathur**, Business Organization, 3rd Edition, Random Publications, 2021

Reference Text Books:

1. **P.C. Tulsian & Vishal Pandey**, Business Organization and Management, Pearson Education, 2021
2. **V. Rajaraman**, Introduction to Information Technology, PHI Learning, 2023
3. **James Graham, Ryan Olson, Rick Howard**, Cybersecurity Essentials, 2nd Edition, Wiley India, 2022

Web Reference:

1. <https://www.coursera.org/specializations/business-introduction>
2. <https://www.classcentral.com/course/swayam-forms-of-business-organisation-45146>
3. https://onlinecourses.swayam2.ac.in/cec22_mg07/preview
4. <https://www.mooc-list.com/course/introduction-business-saylororg>
5. <https://www.my-mooc.com/en/mooc/industrial-organization-strategy-and-competition-in-business>
6. <https://www.my-mooc.com/en/mooc/introduction-to-business-analytics-communicating-with-data>
7. <https://pll.harvard.edu/subject/business/free>
8. <https://www.mooc.org/>

L	T	P	C
3	0	0	3

Subject Code: 25BCA1009

Digital Logic and Computer Organization

Course Objectives

Students will learn:

1. To understand the various number systems and conversions to perform arithmetic operations.
2. To analyze and design combinational and sequential circuits
3. How Computer Systems work & the basic principles
4. The concepts of RTL and arithmetic operations, instruction format, and instruction cycle.
5. The current state of art in memory system design
6. How I/O devices are accessed and their principles.
7. To provide knowledge on Instruction Level Parallelism and concept of advanced pipelining techniques.

Course Outcomes (COs)

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

1. Practice the various types of base number systems and conversions from one another by communicating with the computer.
2. Design various combinational and sequential circuits and analyze the design process.
3. Design a CPU and execute various operations on digital computers with the help of ISA and RTL.
4. Identify the characteristics of various memory systems and I/O communication
5. Explore the implications of pipeline, Multiprocessors designs techniques to boost up CPU organization and assess its performance.

Unit I:

Data Representation: Introduction, Number systems, Decimal, Binary, Octal, and Hexa-decimal number systems and their conversions, gray code, Complement representation of negative numbers: Signed Magnitude, One's complement method, Two's complement method.

Unit II:

Boolean algebra and Logic Gates: Logic Gates, Boolean functions and truth tables, Boolean theorems, Minimization of Boolean functions using Karnaugh map.

Combinational Circuits: Design of Half Adder, Full Adder, Subtractor, multiplier, comparator, decoders, encoders, multiplexers, demultiplexers.

Unit III:

Functional Units of a Computer: Central Processing Unit (CPU), Memory, Basic Operational Concepts, Control Unit, Bus Structures, Instruction set architecture (ISA), instruction execution cycle, RTL interpretation of instructions, Addressing modes.

Unit IV:

Memory organization: Concept of hierarchical memory, Basic Concepts, RAM, ROM Chips, Cache memory Organizations.

Input – Output Organization: Input-output interface, Isolated versus memory-mapped I/O, Asynchronous data transfer, modes of transfer, direct memory access (DMA).

Unit V: Pipelining and Multiprocessors

Pipelining and Multiprocessors: Basic pipelining concepts, pipeline hazards, overview of multiprocessors, interconnection networks, cache coherence.

Textbooks:

1. Digital Design and Computer Architecture, David Harris and Sarah Harris, Morgan Kaufmann Publishing Co., 2012
2. Switching and Finite Automata Theory- ZviKohavi& Niraj K. Jha, 3rd Edition, Cambridge.
3. Computer Architecture, A Quantitative Approach, Fifth or Sixth edition, J. L. Hennessy and A. Patterson (H and P), Morgan Kaufmann Publishing Co., 2019.
4. Computer Organization and Design, The Hardware/Software Interface, Fifth edition, D. A. Patterson and J. L. Hennessy (P and H), Morgan Kaufmann Publishing Co., 2013.
5. "Computer System Architecture", Revised 3rd Edition by M.Morris Mano and Rajiv Mall, Pearson Education.
6. Rajaraman, V., & Radhakrishnan, T. (2008). An introduction to digital computer design. PHI Learning Pvt. Ltd.

Reference Books

1. "Computer Architecture and Organization", 3rd Edition by John P. Hayes, WCB/McGraw-Hill
2. "Computer Organization and Architecture: Designing for Performance", 10th Edition by William Stallings, Pearson Education.
3. "Computer System Design and Architecture", 2nd Edition by Vincent P. Heuring and Harry F. Jordan, Pearson Education.
4. "Computer Organization and Embedded Systems", 6th Edition by Carl Hamacher, McGraw Hill Higher Education.
5. Introduction to Switching Theory and Logic Design – Fredriac J. Hill, Gerald R. Peterson, 3rd Ed, John Wiley & Sons Inc.

Web Reference:

1. <https://archive.nptel.ac.in/courses/106/105/106105163/>
2. <https://nptel.ac.in/courses/117/105/078>
3. <https://archive.nptel.ac.in/courses/106/104/106104073/>
4. <https://www.coursera.org/learn/comparch>
5. <https://www.mooc-list.com/tags/computer-organization>
6. <https://www.reddit.com/r/OMSCS/comments/i16zdk/>

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3	1	0	4

Subject Code: 25BCA1010

DATA STRUCTURES USING C

Course Objective:

The objective of this course is to provide students with a strong foundation in data structures and algorithmic problem-solving techniques. It aims to develop an understanding of how data is organized, managed, and processed efficiently. The course emphasizes the analysis of algorithm performance using time and space complexity and explores a wide range of fundamental data structures such as arrays, linked lists, stacks, queues, trees, and graphs. Through practical implementation and theoretical analysis, students will gain the skills required to design efficient algorithms and apply them to real-world computing problems.

Course Outcomes:

On completion of this course, the student will be able to:

1. CO1. Analyze and compute the time and space complexities of algorithms.
2. CO2. Compare searching and sorting algorithms based on performance.
3. CO3. Demonstrate dynamic memory management using linked lists.
4. CO4. Implement and apply stack and queue operations.
5. CO5. Perform operations and traversals on trees and graphs.

Unit I: Algorithm Analysis

Basic data structure concepts, time and space complexity, asymptotic notations, iterative and recursive algorithm performance.

Unit II: Searching and Sorting

Linear and binary search, hash functions and collision resolution, sorting algorithms: selection, insertion, bubble, quick, merge.

Unit III: Linked Lists

Singly, doubly, and circular linked lists – creation, insertion, deletion, and traversal.

Unit IV: Stacks and Queues

Stack operations and expression evaluation, queue types and operations, implementation using linked lists.

Unit V: Trees and Graphs

Binary tree traversal, BST operations (insert, delete), Graph representation, BFS and DFS, Dijkstra's algorithm for shortest path.

Textbooks:

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, 4th Edition, Pearson, 2021.
ISBN: 9780132847376
2. Ellis Horowitz & Sartaj Sahni, Fundamentals of Data Structures, Computer Science Press (Latest Reprint).

Reference Books

1. Michael T. Goodrich, Roberto Tamassia, David Mount, Data Structures and Algorithms in C++, 2nd Edition, Wiley, 2022.
ISBN: 9781118771334
2. Adam Drozdek, Data Structures and Algorithms in C++, 4th Edition, Cengage Learning, 2020.
ISBN: 9780357418238

Web Reference:

1. <https://nptel.ac.in/courses/106102064>
2. https://onlinecourses.nptel.ac.in/noc23_cs85
3. <https://nptel.ac.in/courses/106106127>
4. <https://www.coursera.org/specializations/data-structures->
5. <https://www.coursera.org/learn/data-structures>
6. <https://www.coursera.org/learn/algorithms-part1>
7. <https://www.coursera.org/specializations/algorithms>
8. <https://www.coursera.org/learn/algorithms-graphs-data>

L	T	P	C
3	1	0	4

Subject Code: 25BCA1011

Object Oriented Programming through C++

Course Objectives

This course aims to:

1. Introduce the fundamentals of Object-Oriented Programming (OOP) using C++.
2. Develop the ability to design efficient, maintainable, and portable object-oriented applications.
3. Help students understand OOP features like classes, objects, inheritance, polymorphism, and templates.
4. Equip learners with the skills to implement data structures using C++.
5. Enable students to manage exceptions and reuse code effectively.

Course Outcomes (COs)

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

1. Differentiate between procedural and object-oriented programming paradigms and understand the advantages of OOP.
2. Implement classes and constructors for encapsulating and initializing object data.
3. Demonstrate inheritance and operator overloading to enhance code reusability and readability.
4. Apply pointers and virtual functions to achieve dynamic binding and polymorphism.
5. Use function and class templates to build generic programs and handle exceptions effectively.

Unit I: Introduction to Object-Oriented Programming

Difference between C and C++, Evolution of C++, Limitations of procedural programming, Key concepts of Object-Oriented Programming, Advantages of OOP

Unit II: Classes and Constructors

Class definition, Object creation, Encapsulation, Member functions, Access specifiers, Nested classes, Constructors (default, parameterized, overloaded), Destructor and its usage

Unit III: Operator Overloading and Inheritance

Operator overloading (unary, binary, assignment =), Type conversion rules, Inheritance (single, multiple, multilevel, hierarchical), Virtual base classes, Object as class member

Unit IV: Pointers and Polymorphism

Pointer to objects, `this` pointer, Pointer to derived and base classes, Static and dynamic binding, Virtual functions, Virtual destructors

Unit V: Templates and Exception Handling

Function templates, Class templates, Bubble sort using templates, Difference between macros and templates, Exception handling (`try`, `throw`, `catch`, multiple catch blocks)

Textbooks

1. E. Balagurusamy, Object Oriented Programming with C++, 7th Edition, McGraw Hill, 2020.
2. Gary J. Bronson, A First Book of C++, 5th Edition, Cengage Learning, 2021.
3. Herbert Schildt, The Complete Reference C++, 4th Edition, McGraw Hill, 2021.

Reference Books

1. Reema Thareja, Object-Oriented Programming with C++, Oxford University Press, 2021.
2. Joyce Farrell, Object-Oriented Programming C++, 5th Edition, Cengage Learning, 2020.
3. D.S. Malik, C++ Programming: From Problem Analysis to Program Design, 8th Edition, Cengage, 2021.

Web Resources

1. https://onlinecourses.nptel.ac.in/noc22_cs103/preview
2. <https://ocw.mit.edu/courses/6-088-introduction-to-c-memory-management>
3. programming-january-iap-2010/pages/lecture-notes/
4. <https://see.stanford.edu/Course/CS106B>
5. <https://www.udemy.com/course/object-oriented-c-plus-plus-programming/>
6. <https://wiingy.com/learn/cpp/cpp-concepts/>

L	T	P	C
0	0	3	1.5

Subject Code: 25BCA1105

Data Structures using C Lab

Course Outcomes (COs)

On successful completion of this course, the student will be able to:

1. Apply recursion to solve classical programming problems.
2. Implement and analyze standard searching and sorting algorithms.
3. Utilize dynamic memory through linked list operations.
4. Demonstrate linear data structures like stacks and queues using arrays.
5. Construct and traverse Binary Search Trees and explore graph traversal algorithms.

Course Outcomes (COs):

1. Implement recursive algorithms to solve computational problems such as generating Fibonacci series, computing GCD, and solving the Towers of Hanoi.
2. Apply and analyze basic searching and sorting algorithms (linear search, binary search, selection sort, bubble sort) for efficient data processing.
3. Design and manipulate linear data structures such as arrays, stacks, queues, and linked lists to solve real-world problems.
4. Construct and traverse hierarchical data structures like binary trees and binary search trees using recursive and iterative techniques.
5. Represent and traverse graphs using adjacency matrices and apply DFS and BFS algorithms for pathfinding and network exploration.

Reduced List of Experiments

Recursion

1. Write a c program to generate Fibonacci series
2. Write a c program to find GCD of numbers
3. Write a c program to solve Towers of Hanoi

Searching Algorithms

1. Write a c program to find an element using Linear Search
2. Write a c program to find an element using Binary Search

Sorting Algorithms

1. Write a c program to sort elements using Selection Sort
2. Write a c program to sort elements using Bubble Sort

Hashing and Collision Resolution

1. Write a c program to Implement Hash Table using remainder method
2. Write a c program to Resolve collisions using linear probing

Linked Lists

1. Write a c program to Create a singly linked list (SLL) with student data using front insertion
2. Write a c program to Perform insertions and deletions at front and end

Stacks (Array Implementation)

1. Write a c program to demonstrate Push, Pop operations
2. Write a c program to check Palindrome or not
3. Write a c program to demonstrate Stack overflow and underflow

Infix to Postfix Expression Conversion

1. Write a c program for Infix to Postfix Expression Conversion, the Supported operators: +, -, *, /, %, ^ with parentheses

Queues (Array Implementation)

1. Write a c program to demonstrate Enqueue and Dequeue operations.
2. Write a c program to Handle overflow and underflow situations

Binary Trees and BSTs

1. Write a c program for tree Traversals (Inorder, Preorder, Postorder - Recursive & Iterative).
2. Write a c program for BST creation and search.

Graphs using Adjacency Matrix

1. Write a c program to Create a graph of cities
2. Write a c program to Perform DFS and BFS traversal

Textbooks

1. Weiss, Mark Allen. **Data Structures and Algorithm Analysis in C++**, 4th Edition, Pearson Education, 2014.
ISBN: 978-0132847377
2. Horowitz, Ellis, and Sartaj Sahni. **Fundamentals of Data Structures in C**, Computer Science Press, 1984.
ISBN: 978-0897910235

Reference Books

1. Goodrich, Michael T., Roberto Tamassia, and David M. Mount. **Data Structures and Algorithms in C++**, 2nd Edition, Wiley, 2004.
ISBN: 978-0471463399
2. Samanta, Debasis. **Classic Data Structures**, 2nd Edition, Prentice-Hall of India, 2012.
ISBN: 978-8120345012
3. Forouzan, B.A., and R.F. Gilberg. **Computer Science: A Structured Programming Approach Using C**, 3rd Edition, Thomson, 2011.
ISBN: 978-8131728117

Web Reference

1. <https://www.geeksforgeeks.org/data-structures/>
2. <https://www.programiz.com/dsa>
3. <https://cs50.harvard.edu/x/2024/weeks/5/>
4. https://www.tutorialspoint.com/data_structures_algorithms/
5. <https://www.javatpoint.com/data-structure-tutorial>

L	T	P	C
0	0	3	1.5

Subject Code: 25BCA1106

Object Oriented Programming Through C++ LAB

Course Outcomes:

1. Develop problem-solving skills using Object-Oriented Programming concepts.
2. Understand and implement the core principles of C++ programming.
3. Learn class design, encapsulation, inheritance, and polymorphism.
4. Gain practical experience in operator overloading, templates, and exception handling.
5. Familiarize with Standard Template Library (STL) basics and their usage.

Exercise 1: Basics and Introduction

1. Write simple programs to print "Hello World" and personalized greetings (input name).
2. Convert any one C program to C++.
3. Write a short description of using the g++ compiler (approx. 150 words).

Exercise 2: Control Structures and Expressions

1. Program to calculate simple and compound interest; compare benefits.
2. Program to calculate bus fare based on distance input.

Exercise 3: Functions and Overloading

1. Implement call by value and call by reference (using reference variables).
2. Write overloaded functions for power calculation (two versions).
3. Use default arguments in a simple interest calculation function.

Exercise 4: Classes and Objects

1. Create a `Distance` class with feet and inches data members and functions for input, output, and addition.
2. Demonstrate constructors and destructors in the above class.
3. Illustrate function overloading with `Distance` addition.

Exercise 5: Inheritance and Polymorphism

1. Write programs to demonstrate:
 - o Single and multilevel inheritance.
 - o Runtime polymorphism using virtual functions.
2. Illustrate the use of `this` pointer.

Exercise 6: Operator Overloading

1. Overload unary and binary operators (e.g., unary minus, binary +).
2. Implement assignment operator = overloading.

Exercise 7: Templates and Exception Handling

1. Write function templates for swapping and power calculation.
2. Write a program to illustrate class templates.
3. Implement exception handling for division by zero.

Exercise 8: Standard Template Library (STL)

1. Implement basic list and vector operations using STL containers.

Web Resources:

1. <https://eecs.wsu.edu/~nroy/courses/cpts122/labs/>
2. <https://www.coursera.org/learn/cplusplus>
3. <https://www.educative.io/courses/learn-cplusplus>
4. <https://www.udemy.com/course/fundamentals-of-c-plus-plus-programming/>