BSc. CS 3RD SEMESTER (NEP 2020)

SUBJECT CODE	SUBJECT NAME
MAJOR-P-5	Discrete Mathematical Structures
MAJOR-P-6	Computer Organization
MAJOR-P-7	Operating Systems
MINOR-2-P-2	Introduction to Algebra & Number Theory
MDC-3	Professional Writing
VAC-2	Ethics & Values

Semester III

Core V Discrete Mathematical Structures

Course Outcomes:

- To learn the mathematical foundations required for computer science.
- This course will help in understanding other courses in computer science.

Learning Outcomes:

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

1. Learn propositional logic and set theory
2. Learn concept of functions and recurrence relations
3. Learn counting techniques, and relations
4. Learn concepts of graphs and its applications

Unit-I:

Logic and Proofs: Propositional logic, Propositional Equivalences, Predicates and Quantifiers, Nested Quantifiers, Rules of Inference, Introduction to Proofs.

Sets: Venn Diagrams, Subsets, The size of a set, Power Sets, Cartesian Products, Set Operations

Unit-II:

Functions: One-to-One and Onto Functions, Inverse Functions and Compositions of Functions Partial Functions. Sequences, Recurrence Relations, Summations.

Unit-III:

Counting: The Basics of Counting, The Pigeonhole Principle, Permutations and Combinations, Binomial Coefficients and Identities.

Relations: Relations and their Properties, n-ary Relations and their Applications, Representing Relations, Closure of Relations, Equivalence Relations, partial Orderings.

Unit-IV:

Graph Terminology and Special Types of Graphs, Bipartite Graphs, Representing Graphs: Isomorphism of Graphs, Euler and Hamilton Paths, Shortest Path Problems: Dijkstra's Algorithm, Traveling Salesperson Problem, Planar Graphs, Graph Coloring. Tree Traversal, Minimum Spanning Trees

Text Books:

- ✓ *Kenneth H. Rosen, Discrete Mathematics and its Applications, Mc Graw Hills International Seventh Edition.*
- ✓ *C. L. Liu, "Elements of Discrete Mathematics", McGraw Hills International Second Edition.*

Reference Books:

- ✓ *Elements of Discrete Mathematics by C. L. Liu and D.P. Mohapatra, TMH, 2012*
- ✓ *J. P Tremblay, R. Manohar, "Discrete Mathematical Structures with Applications to Computer Science", TMH, 1997.*

Core VI Computer Organization

Course Objectives:

- To understand data representation techniques and used of various logic gates
- To understand the basic components of a digital computer and their working
- To know about various memory devices

Learning Outcomes:

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

- Use different number systems and know the function of basic logic gates
- Design various combinational circuits
- Understand the functioning of a digital computer
- Understand the use of various memory devices and their management

Unit-I:

Character Codes, Decimal System, Binary System, Decimal to Binary Conversion, Hexadecimal Notation, Boolean Algebra, Basic Logic Functions: Electronic Logic Gates, Synthesis of Logic Functions, Minimization of Logic Expressions, Minimization using Karnaugh Maps, Synthesis with NAND and NOR Gates, Tri-State Buffers.

Unit-II:

Designing of combinational circuits- Half Adder, Full Adder, Carry-Lookahead Addition, Decoders, Encoders, Multiplexers, Flip-Flops, Gated Latches, Master-Slave Flip-Flops, Edge-Triggering, T Flip-Flops, JK Flip-Flops. Registers and Shift Registers, Counters.

Unit-III:

Basic Structure of Computers - Computer Types, Functional Modules, Basic operational Concepts, Bus Structures, Performance, Multiprocessors and Multi-computers, Input/Output Organization - Accessing I/O devices, Interrupts, Processor examples, Direct memory access, Buses, Interface circuits, Standard I/O interfaces.

Unit-IV:

Memory System - Basic concepts, Semi-conductor RAM memories, Read-only memories, Speed, Size and Cost, Cache Memory: Computer Memory System, Cache Memory Principles, Performance considerations, Virtual Memories, memory management requirements, Secondary Storage.

Text Books:

- ✓ *M. Morris Mano, Michael D. Ciletti (2008), Digital Design, 4th edition, Pearson Education Inc, India.*
- ✓ *Carl Hamacher, Zvonks Vranesic, SafeaZaky (2002), Computer Organization, 5th edition, McGraw Hill, New Delhi, India*

Reference Books:

- ✓ *Computer Architecture and Organization: William Stallings, Pearson Education.*
- ✓ *Computer Architecture and Organization: John P. Hayes McGraw Hill.*

Core VII **Operating Systems**

Course Objectives:

- To understand Operating system structure and services.
- To understand the concepts of Process, memory, storage, and I/O management.
- To explore different applications of data structures.

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

1. Understand various services offered by an OS as a resource manager
2. Understand the concept of a process and various CPU scheduling techniques
3. Learn the concepts on effective memory management and virtual memory
4. Learn various approaches to disk scheduling & file management techniques

Unit-I:
Introduction to Operating System, Computer System Architecture, System Structures: Operating system services, User and Operating-System Interface, system calls, system programs, Operating system design and implementation, Operating system structure, Batch processing, multi-programming, time-sharing and real-time systems

Unit-II:
Process Management: Process Concept, Operations on processes, Process scheduling, Inter-process Communication, Threads, Multithreading Models. CPU Scheduling algorithms: Scheduling Criteria, FCFS, SJF, Priority, Round Robin, Multilevel Queue, Multilevel Feedback Queue. Deadlocks: Deadlock detection, deadlock prevention, and deadlock avoidance fundamentals.

Unit-III:
Memory Management Strategies: Swapping, Contiguous Memory Allocation, Segmentation, Paging, Virtual Memory Management: Concepts, Demand Paging, Page Replacement techniques: FIFO, LRU, Optimal, Thrashing.

Unit-IV:
Storage Management: Overview of Mass-Storage Structure, Disk Scheduling: FCFS, SSTF, SCAN, C-SCAN, LOOK, C-LOOK, RAID technology.
File System concept, Access Methods, Directory and Disk Structure, File System systems, File, Sharing and File Protection.

Text Books:

- ✓ *Operating System Concepts, Abraham Silberschatz, Peter B. Galvin, and Greg Gagne, Eighth Edition, Wiley Student Edition 2009*
- ✓ *Operating Systems, Rajiv Chopra, S. Chand Pubs.*

Reference Books:

- ✓ *Modern Operating System, Tanenbaum, Pearson, 4/ed. 2014*
- ✓ *Operating Systems 5th Edition, William Stallings, Pearson Education India*
- ✓ *Richard Blum, Linux Command Line and Shell Scripting Bible, O' Reilly*

Core VII- Lab: Operating Systems

1. Basic Linux Commands and Overview (date, cal, who, tty, echo, bc, pwd, mkdir, rmdir, cd, cat, cp, mv, rm, ls, wc)
2. Shell Programming
    i. Write a shell script to perform the tasks of basic calculator.
    ii. Write a shell script to find the greatest number among the three numbers.
3. Shell Programming
    i. Write a shell script to check if the number entered at the command line is prime or not.
    ii. Write a shell script to display the multiplication table of any number.
4. Shell Programming
    i. Write a shell script to compare two files and if found equal asks the user to delete the duplicate file.
    ii. Write a shell script to find the sum of digits of a given number.
    iii. Write a shell script to find the factorial of a given number.
5. Write a program (using fork() and/or exec() commands) where parent and child execute:
    i. Same program, same code.
    ii. Same program, different code.
    iii. Before terminating, the parent waits for the child to finish its task.
6. Write a program to copy files using system calls.
7. Write a program using C to implement FCFS scheduling algorithm.
8. Write a program using C to implement Round Robin scheduling algorithm.
9. Write a program using C to implement SJF scheduling algorithm.
10. Write a program using C to implement first-fit, best-fit, and worst-fit allocation strategies.

Introduction to Algebra & Number Theory

Course Objectives:

To present a systematic introduction to number theory and a basic course on algebra.

Learning Outcomes:

After completing the course the student will be able to

- Understand the equivalence relations and concept of group with different examples.
- Understand the properties of cyclic groups, rings, and integral domain.
- Know divisibility and division algorithm and find *gcd* using Euclidean Algorithm.
- Solve linear Diophantine equations, find least common multiples,solve linear congruence applying the Chinese remainder theorem.

Unit I

Integers and equivalence relations**,** properties of integers, modular arithmetic, mathematical inductions, equivalence relations, Introduction to groups**,** symmetries of a square, the dihedral groups, definitions and examples of groups, elementary properties of groups, subgroups, examples of subgroups.

Unit II

Cyclic groups, properties of cyclic groups, classification of subgroups of cyclic groups, definitions and examples of normal subgroups, Introduction to rings, definition and examples of rings, properties of rings, subrings, definition and examples of integral domain and fields.

Unit III

Divisibility**,** division algorithms, prime and composite numbers, Fibonacci and Lucas numbers, Fermat numbers, greatest common divisor, Euclidean algorithm.

Unit IV

Fundamental theorem of arithmetic, least common multiple, linear Diophantine equations, congruence, linear congruence, Chinese remainder theorem, Wilson's theorem, Fermat little theorem, Euler's theorem.

Books Recommended:

- ✓ *Joseph A. Gallian, Contemporary Abstract Algebra (4th Edition), Narosa Publishing House, New Delhi, 1999.(IX Edition 2010).*
- ✓ *Thomas Koshy, Elementary Number Theory with Applications (2nd Edition), Academic Press, 2007.*

Books for Reference:

- ✓ *I. N. Herstein: Topics in Algebra, Wiley Eastern Limited, India, 1975.*
- ✓ *David M. Burton: Elementary Number Theory (6th Edition), Tata McGraw-Hill Edition, Indian Reprint, 2007.*
- ✓ *Suggested digital platform: NPTEL/SWAYAM/MOOCs.*
- ✓ *e-Learning Source http://ndl.iitkgp.ac.in ; http://ocw.mit.edu ; http://mathforum.org.*

Professional Writing

Course Objectives

- The course aims at teaching students to write grammatically correct, clear, effective prose and applies it to writing for the workplace.
- Its objective is to help students develop writing skills and acquire the knowledge to apply these skills in standard workplace document formats.
- It includes a study of writing in a variety of professional contexts with an emphasis on assessing rhetorical situations and crafting messages to inform and persuade diverse audiences in a variety of forms and formats.

Unit-1

Writing: Definition and Requirement

Writing Process: Prewriting, Writing and Post writing

Basic Writing Skills

Plain English

Unit-2

Genres of Writing: Persuasive, Expository, Narrative, Descriptive and Argumentative

Unit-3

Basic forms: Letters, Application, Memo, Notices and Minutes

Raising the Bar: Presentations, Proposal, and Report

Unit-4

The Elements of Style: Grammar, Usage, and Mechanics

Prescribed Texts

- ✓ *The Craft of Professional Writing*, Second Edition by Michael S. Malone
- ✓ *Literature and Art of Communication*. Parhi, Pati, Mohol et al. Cambridge University Press, 2019.
- ✓ *Professional Writing Skills: A Write It Well Guide* by Natasha Terk

Suggested Readings

- ✓ *Huddleston R., and Geoffrey K. Pulia, eds. A Student's Introduction to English Grammar. CUP.2005*
- ✓ *MLA Handbook for Writers of Research Papers. Eighth edition. Modern Language Association of America. 2021*
- ✓ Excellence In Business Communication by John V. Thill and Courtland L. Bovee

  On Writing Well by William Zinsser

  https://communicationprogram.wharton.upenn.edu/library/

  https://www.osou.ac.in/eresources.php

ETHICS & VALUES

Credit point: 3 **Full mark -100** **Total Hours: 45**

COURSE OUTCOME

- Development of a good human being and a responsible citizen
- Developing a sense of right and wrong leading to ethically correct behavior
- Inculcating a positive attitude and healthy work culture
- To equip the students to prepare themselves national and state level civil service and other competitive examination.

COURSE CONTENTS

UNIT-I- ETHICS AND HUMAN INTERFACE [5 Hours]

Learning Outcome-

- ✓ *Understand the basic concept of ethics and its relevance in life*

- Ethics and Human Interface: Essence, Determinants and consequence of ethics and human action.
- Dimensions of Ethics in private and public relationship
- Human Values: Tolerance, Compassion, Rationality, Objectivity, Scientific Attitude Integrity, Respecting conscience and Empathy etc.
- Mahatma Gandhi and Ethical Practices: Non-Violence, Truth, Non-hatred and love for all, concern for the poorest, objective Nationalism and Education for man making. Relation between Ends and Means.

Subject Teacher: Philosophy/Political Science or Any other Teacher.

UNIT-II- ETHICS AND MAJOR RELIGIONS AND CIVILIZATIONS [7 hours]

Learning Outcome-

- ✓ *Be familiar with ethical principles and values promoted by major religious traditions and civilization*

- Hinduism- Dharma and Mokhya (out of 4 goals of life Dharma, Artha, Kama and Mokhya), Concept of Purusartha, Nisakama Karma(work without attachment to results), Concept of Basudev Kutumba and Peace (Whole world including all animals, plants, inanimate beings and human form one world)
- Ten Commandments: (Christianity and Judaism Tradition)
- Islamic Ethics: Justice, Goodness, Kindness, Forgiveness, Honesty, Purity and Piety
- Egyptian- Justice, Honesty, Fairness, Mercy, Kindness and Generosity
- Mesopotian-Non-indulgence in lying, stealing, defrauding, maliciousness, adultery, coveting possession of others, unworthy ambition, misdemeanors and injurious teaching.
- Buddhism-Arya Astangika Marg: Right View, Thought, Speed, Action, Livelihood, Efforts, Attention and Concentration.
- Jainism-Right faith, knowledge and conduct(Triralna)

- Chinese-Confucianism- Respect for Autonomy, Beneficence, non-maleficence and justice. Taoism: No killing, No stealing, No sexual misconduct, No false Speech and No taking of intoxicants.

Subject Teacher: History/Philosophy/Political Science or Any other Teacher.

UNIT-III- CONSTITUTIONAL VALUES, GOOD CITIZENSHIP, PATRIOTISM AND VOLUNTEERISM [10 Hours]

Learning Outcome-

- ✓ *Students Learns about constitutional values of India, Civic Sense and good Citizenship (both National and International) Patriotism and need for Volunteerism*

- Salient Values of Indian Constitution: Sovereign, Socialist, Secular, Democratic, Republic, Justice, Liberty, Equality and Fraternity
- Patriotic values and ingredients of National Building, Examples of great Patriots, Rani Laxmi Bai, Bhagat Singh, Mangal Pandey, Birsa Munda, Laxman Naik, Subhas Chandra Bose and Khudiram Bose.
- Law abiding citizenship
- Concept of Global citizenship in contemporary world
- Volunteerism- concept and facts of Volunteerism, building a better society through Volunteerism, Blood Donation, Social work, Helping the Aged, Promotion of Green Practices and Environment protection.

Subject Teacher: Philosophy/Political Science /History/ or Any other Teacher.

UNIT-IV- WORK ETHICS [6 hours]

Learning Outcome-

- ✓ *Understand the concept of work ethics, ethics in work place and ethical practices to be adopted by various professionals*

- The concept of professionalism.
- Professional ethics at work place
- Core values needed for all professionals. Reliability, Dedication, Discipline, Productivity, Co-operation , Integrity, Responsibility, Efficiency, Professionalism, Honesty, Purity and Time Management, Accountability, Respect Diversity, Gender Sensitivity, Respect for others, Cleanliness, Rational Thinking, Scientific Attitude, Clarity in Thinking . Diligence, cleanliness and Environment Consciousness.
- Codes of conduct for Students(both in College and Hostels),Teachers, Business professional, Doctors, Lawyers, Scientist, Accountants, IT professionals and Journalist.
- Practical ethics in day to day life.

Subject Teacher: Commerce/Philosophy/Education/History/ or Any other Teacher.

UNIT-V-ETHICS AND SCIENCE AND TECHNOLOGY [7 Hours]

Learning Outcome-

- ✓ *Understand how Science is related to ethics and values has ethical implications.*

- Ethics of Science and Technology. Are science and Technology ethically neutral? Are Science and Technology Value Free?
- Ethics of scientific Research ,Innovation and Technology
- Ethics of Social Media, Modern Gadgets

- AI and Ethics

Subject Teacher: Philosophy or Any Science Teacher

UNIT-VI- ETHICS AND VULNERABLE SECTIONS OF SOCIETY [10 hours]

Learning Outcome-

- ✓ *Understand how various vulnerable sections of our society are treated unequally and what needs to be done to address their inequality*
- ✓ *Understand dimensions of substance abuse*

1. **Women and family-**Gendered practices in the family, marriages (dowry, child marriage, women's consent).
   Women and work- women's work at home and at work place, pay gap, gendered roles, harassment at work place and working women and role conflict.
   Women and Society- Gender sensitive language, property right, marriage-divorce/Separation and women's right; violence against women
2. **Issues Relating to Children:** Nutrition and health , Child Exploitation: Child labour ,trafficking, sexual exploitation
3. **Issues Relating to Elderly Persons :** Abuse of Elders, Financial insecurity, Loneliness and Social insecurity, Health Care Issues, Needs for a happy and Dignified Ageing
4. **Issues Relating to persons with disability:** Rights of PWD, affirmative action, prevention of discrimination, providing equal opportunity, various scheme for empowering PWD and social justice for PWD.
5. **Issues Relating to Third Gender:** Understanding LGBTQ, Social justice for them, Removal of discrimination, Affirmative action and Acceptance of diversity of gender.

Subject Teacher: Sociology/political Science /Anthropology or Any Science Teacher

Sample Questions-

1. Birsa Munda belongs to which state of India?[1 mark]
2. Recall at least 4 constitutional values from the preamble to India constitution.[2 marks]
3. Explain utility of being Punctual.[5 marks]
4. Explain the ethical principles a scientist should follow.[8 marks]

Course material: To be developed by OSHEC and DDCE, Utkal University. Video Lectures will be also prepared by OSHEC and VTP, Utkal University. There shall be no internal examination for this course. The Term End Examination shall be conducted by the respective Universities. Student would engage in self-study and colleges shall conduct at least 4 doubt clearing session for each unit by engaging subject teachers as indicated above. The Principal may assign responsibility to any teacher.