SCHEME OF INSTRUCTION
BE (COMPUTER SCIENCE & ENGINEERING)
CSE: IV - SEMESTER

S.No	Course Code	Course Title	Scheme of Instruction			Contact Hrs/Wk	Scheme of Examination		Credits
			L	T	P		CIE	SEE	
Theory									
1	HS 401 MC	Management – I (organizational Behavior / Finance & Accounting)	3	0	0	3	30	70	3
2	MC 101 HS	Mandatory Course Environment Sciences	3	0	0	3	30	70	0
3	PC 401 CS	Discrete Mathematics	3	1	0	4	30	70	4
4	PC 402 CS	Computer Organization and Microprocessors	3	0	0	3	30	70	3
5	PC 403 CS	Object Oriented Programming using Java	3	0	0	3	30	70	3
6	PC 404 CS	Design and Analysis of Algorithms	3	1	0	4	30	70	4
Practicals									
7	PC 451 CS	Computer Organization and Microprocessor Lab	0	0	3	3	25	50	1.5
8	PC 452 CS	Object Oriented Programming using Java Lab	0	0	2x2	4	25	50	2
9	PC 453 CS	Design and Analysis of Algorithms lab	0	0	2	2	25	50	1
Total			**18**	**2**	**9**	**29**	**255**	**570**	**21.5**

L : Lectures

T : Tutorials

P : Practicals

CIE : Continuous Internal Evaluation

SEE : Semester End Examination

HS 401 MC ORGANIZATION BEHAVIOUR

Instruction	3 Periods per week
Duration of University Examination	3 Hours
University Examination	70 Marks
Sessional	30 Marks
Credits	3

Course Objective:

The objective of the course is to give an overview of management behavior,process of a organization. It highlights the organizational structure and also about leadership style which will be useful for problem solving and decision making.

Course Outcome:

i) Students can able to understand the levels of management and its role and process
ii) It creates awareness about the significance of planning which is a pre-requisite for decision making.
iii) It helps to understand the phenomena of organization structure and importance of leadership styles to solve various managerial problems.
iv) It enriches the knowledge of communication and role of control system in an organizational structure

Unit – I:
Management – meaning, nature, and significance – Combination of art and science Management as a profession, Management Vs Administration - Levels of Management -

Elements of managerial process – Styles and Roles of managers in organizations. Contributions of Taylor and Fayol. Human Relations and Behavioral School – Hawthorne studies.

Unit – II:
Planning – Nature and process of planning: Planning and Environmental uncertainties - Types of planning – Advantages and limitations of planning – Decision making – Stages in decision making.

Unit – III:
Nature and significance of organization – Authority and Responsibility relationships - Span of control, Process of delegation – Barriers to delegation – Centralization and Decentralization, Concept of Line and Staff – Overcoming Line – staff conflict, Committees, Coordination. Organization structure, types, advantages and disadvantages

Unit – IV:
Staffing, motivation and leadership. Scope of staffing function. Theories of motivation – theory X, theory Y and theory Z. Maslows need hierarchy. Leadership's styles.

Unit – V:
Communication and control – Process of communication – Verbal and Nonverbal. Barriers to communication. Types, process, and tools of Control. Characteristics of effective Control system – Human Reaction to control system.

References:

1. Harold Koontz & Heinz Weihrich, "Essentials of Management", Tata McGraw Hill, 7th Edition.

2.Curtis W. Cook and Phillip L. Hunsaker, *Management and OrganisationalBehaviour,* 3rd Edition, McGraw-Hill,2010.

3.Hellriegel, Jackson & Slocum, "Management", Thomson, 9th Edition.

4. Tripathi and Reddy, "Management".

5. Parag Divan "Management – Principles and Practices", Excel – 2008.

6. Stoner, "Management", PHI, 2008.

7. Robbins, "Management", PHI, 2008.

8. T. Ramaswamy, "Principles of Management", Himalaya Publishing House, 2008.

MC 302CE **ENVIRONMENTAL SCIENCES**

Instruction	3 Periods per week
Duration of University Examination	3 Hours
University Examination	70 Marks
Sessional	30 Marks
Credits	0

Course Objectives:

- Comprehend the need of environmental science, ethics and issues
- Illustrate the characteristics and functions of ecosystem
- Understand the concepts of Biodiversity and its conservation needs
- Study various environmental pollution effects, prevention and control acts

Course Outcomes:

- Application of awareness on environmental Issues for sustainable society
- Acquaintance with utilization of various natural resources and ecosystems
- Ability in conserving and protecting the biodiversity
- Knowledge of social and environment related issues and their preventive measures

Unit – 1

Multidisciplinary nature of Environmental studies: Definition, scope and importance, Need for public awareness. Environmental ethics: issues and possible solutions. Population growth. Sustainable development and SDGs.

Current Environmental Issues: global warming and Climate change, acid rain, ozone layer depletion. Environment protection Acts. Environment and human health

Unit – 2

Natural Resources: Renewable and nonrenewable resources: Natural resources and associated problems Forest resources, Water resources, Mineral Resources, Water conservation, Food Resources Energy Resources.

Land Resources: Land as a resource, land degradation, soil erosion, and desertification Role of individual in conservation of natural resources, Equitable use of resources for sustainable life styles.

Unit – 3

Ecosystems: Concept of an ecosystem Structure and function of an ecosystem, Producers, consumers, decomposers. Energy flow in the eco systems. Ecological succession, Food chains, food webs and ecological pyramids,

Introduction, types, characteristic features, structure and functions: Terrestrial ecosystem, Forest ecosystem, Grass land ecosystem, Desert ecosystem. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit – 4

Biodiversity and its Conservation: Introduction-Definition: genetics, species and ecosystem diversity. Biogeographically classification of India, Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values, Biodiversity at global, national and local level. India as a mega diversity nation.

Hot-spots of biodiversity, Threats to biodiversity: habitats loss, poaching of wild life, man wildlife conflicts. Endangered and endemic spaces of India, Conservation of biodiversity: in-situ and ex-situ conservation of biodiversity, Wildlife conservation and protection act, Forest conservation and protection act

Unit – 5

Environmental Pollution: Definition, Causes, effects and control measures - Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards,

Air (prevention and control of pollution) Act, Water (prevention and control of pollution) Act Solid waste Management: Causes, effects and control measures of urban and industrial wastes Role of an individual's, communities and NGOs in prevention of pollution

Suggested Reading:

1. Gilbert, M. Masters Introduction to Environmental Engineering and Science, Prentice-Hall of India Pvt. Ltd., New Delhi, 1995.
2. Textbook of Environmental studies, Erach Bharucha, UGC.
3. Hammer. M J. and Hammer. MJ. Jr., Water and Wastewater Technology.
4. Prentice-Hall of India Pvt. Ltd., New Delhi. 1998
5. Fundamental concepts in Environmental Studies, D D Mishra, S Chand & Co Ltd.
6. Sasi Kumar, K. and Sanoop Gopi Krishna., Solid waste Management, Prentice-Hall of India Pvt. Ltd., New Delhi, 2009

PC 401 CS **DISCRETE MATHEMATICS**

Instruction	4 Periods per week
Duration of University Examination	3 Hours
University Examination	70 Marks
Sessional	30 Marks
Credits	4

Course Objectives:

1. Use mathematically correct terminology and notation.
2. Construct correct direct and indirect proofs.
3. Use division into cases in a proof.
4. Use counterexamples.
5. Apply logical reasoning to solve a variety of problems

Course Outcomes:

1. For a given logic sentence express it in terms of predicates, quantifiers, and logical connectives
2. For a given a problem, derive the solution using deductive logic and prove the solution based on logical inference
3. For a given a mathematical problem, classify its algebraic structure
4. Evaluate Boolean functions and simplify expressions using the properties of Boolean algebra
5. Develop the given problem as graph networks and solve with techniques of graph theory.

UNIT -I

Sets, Relation and Function: Operations and Laws of Sets, Cartesian Products, Binary Relation, Partial Ordering Relation, Equivalence Relation, Image of a Set, Sum and Product of Functions, Bijective functions, Inverse and Composite Function, Size of a Set, Finite and infinite Sets, Countable and uncountable Sets, Cantor's diagonal argument and The Power Set theorem, Schroeder-Bernstein theorem. **Principles of Mathematical Induction**: The Well-Ordering Principle, Recursive definition, The Division algorithm: Prime Numbers, The Greatest Common Divisor: Euclidean Algorithm, The Fundamental Theorem of Arithmetic.

UNIT-II

Basic counting techniques-inclusion and exclusion, pigeon-hole principle, permutation and combination.

UNIT-III

Propositional Logic: Syntax, Semantics, Validity and Satisfiability, Basic Connectives and Truth Tables, Logical Equivalence: The Laws of Logic, Logical Implication, Rules of Inference, The use of Quantifiers. **Proof Techniques**: Some Terminology, Proof Methods and Strategies, Forward Proof, Proof by Contradiction, Proof by Contraposition, Proof of Necessity and Sufficiency.

UNIT-IV

Algebraic Structures and Morphism: Algebraic Structures with one Binary Operation, Semi Groups, Monoids, Groups, Congruence Relation and Quotient Structures, Free and Cyclic Monoids and Groups, Permutation Groups, Substructures, Normal Subgroups, Algebraic Structures with two Binary Operation, Rings, Integral Domain and Fields. Boolean Algebra and Boolean Ring, Identities of Boolean Algebra, Duality, Representation of Boolean Function, Disjunctive and Conjunctive Normal Form

UNIT–V

Graphs and Trees: Graphs and their properties, Degree, Connectivity, Path, Cycle, Sub Graph, Isomorphism, Eulerian and Hamiltonian Walks, Graph Colouring, Colouring maps and Planar Graphs, Colouring Vertices, Colouring Edges, List Colouring, Perfect Graph, definition properties and Example, rooted trees, trees and sorting, weighted trees and prefix codes, Bi-connected component and Articulation Points, Shortest distances.

Suggested books : 1. Kenneth H. Rosen, Discrete Mathematics and its Applications, Tata McGraw – Hill

2. Susanna S. Epp, Discrete Mathematics with Applications,4th edition, Wadsworth Publishing Co. Inc

3. C L Liu and D P Mohapatra, Elements of Discrete Mathematics A Computer Oriented Approach, 3rd Edition by, Tata McGraw – Hill.

Suggested reference books: 1. J.P. Tremblay and R. Manohar, Discrete Mathematical Structure and It's Application to Computer Science", TMG Edition, TataMcgraw-Hill

2. Norman L. Biggs, Discrete Mathematics, 2nd Edition, Oxford University Press. Schaum's Outlines Series, Seymour Lipschutz, Marc Lipson,

3. Discrete Mathematics, Tata McGraw - Hill

PC 402 CS COMPUTER ORGANIZATION AND MICRO PROCESSOR

Instruction	3 Periods per week
Duration of University Examination	3 Hours
University Examination	70 Marks
Sessional	30 Marks
Credits	3

Course Objectives:

- **To understand the** Instruction Set Architecture: Instruction format, types, various addressing modes
- To understand the basic components and design of the CPU: the ALU and control unit **.**
- **To understand** the parallelism both in terms of a single processor and multiple processors
- **To** understand the 8085 and 8051 architecture
- To learn the interfacing with I/O Organization, Interrupt-driven I/O, and DMA

Course Outcomes:

Student will be

- **Able to understand the** Instruction Set Architecture: Instruction format, types, various addressing modes
- Able to understand the basic components and design of the CPU: the ALU and control unit **write multi threaded programs with synchronization.**
- **Able to understand** the parallelism both in terms of a single processor and multiple processors
- **Able to** understand the 8085 anad 8051 architectures
- Able to apply interfacing with I/O Organization, Interrupt-driven I/O, DMA

UNIT -I

Data Representation: Fixed and Floating Point representations. **Overview of Computer Function and Interconnections**: Computer components, Interconnection structures, Bus interconnection, Bus structure, and Data transfer.

Register Transfer Microoperations: Register Transfer Language, Register Transfer, Bus and Memory Transfers, Arithmetic, Logic and Shift microperations, Arithmetic Logic Shift Unit.

UNIT-II

Basic Computer Organization and Design: Instruction Codes, Computer Registers, Computer Instructions, Timing and Control, Instruction Cycle, Memory reference instruction, Input-Output and Interrupt. **Microprogrammed Control: Control memory, Address Sequencing, Microprogram** example, Design of Control Unit.

UNIT-III

Central Processing Unit: General Register Organization, Stack Organization, Instruction formats, Addressing modes, Data Transfer and Manipulation, and Program control.

Floating Point Arithmetic Operations.

Pipeline Processing: Arithmetic, Instruction and RISC Pipelines.

Memory Organization: Cache memory, Virtual memory, Memory Management hardware

UNIT-IV

8085 Architecture: Introduction to microprocessors and microcontrollers, 8085 Processor Architecture, Internal operations, Instructions and timings. Programming the 8085 - Introduction to 8085 instructions, Addressing modes and Programming techniques with Additional instructions.

Input-Output Organization: Modes of Transfer, Priority Interrupt, Direct Memory Access (DMA), I/O Processor. Basic Interfacing concepts with 8085, Programmable Interrupt Controller(8259A). Direct Memory Access(DMA) - DMA Controller (Intel 8257)

UNIT–V

Introduction to Microcontrollers, 8051 – Architecture, Instruction set, Addressing modes and Programming techniques. Comparison of various families of 8-bit micro controllers. System Design Techniques - Interfacing of LCD, ADC, Sensors, Stepper motor, Keyboard and DAC using microcontrollers. Communication Standards - Serial RS 232 and USB.

Features of Multi-Core Processors architectures and Graphics Processing Units.

Suggested Readings:

1. Morris Mano M "*Computer System Architecture*", 3rd Edition, Pearson Education India, 2007.
2. William Stallings "*Computer Organization and Architecture*", PHI, 7th Edition, 2008.
3. Ramesh S. Gaonkar "Microprocessor Architecture, Programming, and Applications with the 8085", 5/E, Prentice Hall, 2002.
4. Myke Predko "Programming and Customizing the 8051 Microcontroller", Tata McGraw Hill, 1994.

PC 403 CS OBJECT ORIENTED PROGRAMMING USING JAVA

Instruction	3 Periods per week
Duration of University Examination	3 Hours
University Examination	70 Marks
Sessional	30 Marks
Credits	3

Course Objectives:

- To introduce fundamental object oriented concepts of Java programming Language - such as classes, inheritance packages and interfaces.
- To introduce concepts of exception handling and multithreading.
- To use various classes and interfaces in java collection framework and utility classes.
- To understand the concepts of GUI programming using AWT and Swing controls.
- To introduce Java I/O streams and serialization.

Course Outcomes:

Student will be

- Able to understand the usage of abstract classes.
- Able to write multi threaded programs with synchronization.
- Able to implement real world applications using java collection frame work and I/O classes
- Able to write Event driven GUI programs using AWT/Swing

UNIT -I

Object Oriented System Development: understanding object oriented development, understanding object oriented concepts, benefits of object oriented development**.**

Java Programming Fundamentals: Introduction, overview of Java, data types, variables and arrays, operators, control statements, classes, methods, inheritance, packages and interfaces**.**

UNIT -II

Exceptional Handling, Multithreaded Programming, I/O Basics, Reading Console Input and Output, Reading and Writing Files, Print Writer Class, String Handling.

UNIT -III

Exploring Java.Lang, Collections Overview, Collection Interfaces, Collection Classes, Iterators, Random Access Interface, Maps, Comparators, Arrays, Legacy Classes and Interfaces, String Tokenizer, Bitset, Date, Calendar, Observable Timer.

UNIT –IV

GUI Programming & Event Handling: Event Handling Mechanisms, The Delegation Event Model, Event Classes, Source of Events, Event Listener Interfaces, Handling mouse and keyboard events, Adapter classes, Inner classes, Anonymous Inner classes, Introduction, AWT classes working with Graphics, Understanding Layout Managers, Flow Layout, Border Layout, Grid Layout, Card Layout, Grid Bag Layout.

Java Swing: Basics of Swing, Difference between AWT & Swing, MVC Architecture, Components and Container, Exploring Swing Controls- JLabel and Image Icon, JText Field, The Swing Buttons- JButton, JToggle Button, JCheck Box, JRadio Button, JTabbed Pane, JScroll Pane, JList, JCombo Box, Swing Menus, Dialogs.

UNIT –V

Java I/O Classes and Interfaces, Files, Stream and Byte Classes, Character Streams, Serialization.

Suggested Reading:

1. Herbert Schildt, *The Complete Reference JAVA*, Tata McGraw Hill, 7th Edition, 2005.
2. James M Slack, *Programming and Problem Solving with JAVA*, Thomson Learning, 2002.
3. C.Thomas Wu, *An Introduction to Object-Oriented Programming with Java*, Tata McGraw Hill, 5th Edition, 2005.

PC 404 CS **DESIGN AND ANALYSIS OF ALGORITHMS**

Instruction	4 Periods per week
Duration of University Examination	3 Hours
University Examination	70 Marks
Sessional	30 Marks
Credits	4

Course Objectives

- Analyze the asymptotic performance of algorithms.
- Write rigorous correctness proofs for algorithms.
- Demonstrate a familiarity with major algorithms and data structures.
- Apply important algorithmic design paradigms and methods of analysis.
- Synthesize efficient algorithms in common engineering design situations.

Course Outcomes

1. For a given algorithms analyze worst-case running times of algorithms based on asymptotic analysis and justify the correctness of algorithms

2. Describe the greedy paradigm and explain when an algorithmic design situation calls for it. For a given problem develop the greedy algorithms.

3. Describe the divide-and-conquer paradigm and explain when an algorithmic design situation calls for it. Synthesize divide-and-conquer algorithms. Derive and solve recurrence relation.

4. Describe the dynamic-programming paradigm and explain when an algorithmic design situation calls for it. For a given problems of dynamic-programming and

5. develop the dynamic programming algorithms, and analyze it to determine its computational complexity.

6. For a given model engineering problem model it using graph and write the corresponding algorithm to solve the problems.

7. Explain the ways to analyze randomized algorithms (expected running time, probability of error).

8. Explain what an approximation algorithm is. Compute the approximation factor of an approximation algorithm (PTAS and FPTAS).

UNIT -I

Introduction: Characteristics of algorithm. Analysis of algorithm: Asymptotic analysis of complexity bounds – best, average and worst-case behavior; Performance measurements of Algorithm, Time and space trade-offs, Analysis of recursive algorithms through recurrence relations: Substitution method, Recursion tree method and Masters' theorem.

UNIT-II

Fundamental Algorithmic Strategies: Brute-Force, Greedy,Dynamic Programming, Branch and-Bound and Backtracking methodologies for the design of algorithms; Illustrations of these techniques for Problem-Solving , Bin Packing, Knap Sack TSP. Heuristics – characteristics and their application domains.

UNIT-III

Graph and Tree Algorithms: Traversal algorithms: Depth First Search (DFS) and Breadth First Search (BFS); Shortest path algorithms, Transitive closure, Minimum Spanning Tree, Topological sorting, Network Flow Algorithm**.**

UNIT-IV

Tractable and Intractable Problems: Computability of Algorithms, Computability classes – P, NP, NP-complete and NP-hard. Cook's theorem, Standard NP-complete problems and Reduction techniques

UNIT–V

Advanced Topics: Approximation algorithms, Randomized algorithms, Class of problems beyond NP – P SPACE

Suggested books:

1. Introduction to Algorithms, 4TH Edition, Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, MIT Press/McGraw-Hill.

2. Fundamentals of Algorithms – E. Horowitz et al.

Suggested reference books

1. Algorithm Design, 1ST Edition, Jon Kleinberg and ÉvaTardos, Pearson.

2. Algorithm Design: Foundations, Analysis, and Internet Examples, Second Edition, Michael T Goodrich and Roberto Tamassia, Wiley.

3. Algorithms -- A Creative Approach, 3RD Edition, UdiManber, Addison-Wesley, Reading, MA.

PC 451 CS COMPUTER ORGANIZATION AND MICRO PROCESSORS LAB

Instruction	3 Periods per week
Duration of University Examination	3 Hours
University Examination	50 Marks
Sessional	25 Marks
Credits	1.5

PART A: Programs using VERILOG

1. Review of the different logic design ckts., a) Gates b) Flip/Flop(RS, JK, D, T),
2. Familiarity with state of art IC-chips, e.g. a) Multiplexer , b) Decoder, c) Encoder, d) Counter, e)Shift-Register, f)adder Truth Table verification and clarification from Data-book.
3. Design a BCD adder.
4. Design an Adder/Subtracter composite unit
5. Design a carry-look ahead Adder
6. Design a ripple counter and carry-look ahead counter.
7. Design ALU and 4-bit processor

PART B: **8085 Programming using Microprocessor Trainer Kit**

8. Simple programming examples using 8085 instruction set. To understand the use of various instructions and addressing modes.
9. Interfacing and programming of 8255
10. Interfacing and programming of 8254.
11. Interfacing and programming of 8279.

PART C: 8051 Programming

12. Simple programming examples using 8051 Microcontroller
13. A/D and D/A converter interface
14. Stepper motor interface
15. Display Interface

PC 452 CS **OBJECT ORIENTED PROGRAMMING USING JAVA LAB**

Instruction	4 Periods per week
Duration of University Examination	3 Hours
University Examination	50 Marks
Sessional	25 Marks
Credits	2

Course Objectives:

- Ability to learn the concept of classes, inheritance and abstract classes.
- Learn to demonstrate multithreaded programs with synchronization.
- Demonstrate real world applications using java collection frame work and I/O classes.
- Model Event driven GUI programs using AWT/Swing.

Course Outcomes:

Student will be

- Able to understand the OOPS features
- Able to understand the usage of abstract classes and interfaces.
- Able to write multi threaded programs with synchronization.
- Able to implement real world applications using java collection frame work and I/O classes
- Able to write Event driven GUI programs using AWT/Swing

1. A program to illustrate the concept of class with constructors, methods and overloading.

2. A program to illustrate the concept of Inheritance and Dynamic polymorphism.

3. A program to show the concept of packages.

4. A program to illustrate the usage of interfaces and Abstract class.

5. A program to illustrate exception handling keywords.

6. A program to illustrate user define exception using stack.

7. A program to illustrate user define exception for evaluating a post fix expression.

8. A program to illustrate to handle string in java using String and StringBuffer.

9. A program to illustrate manipulating array in java

10. A program to illustrate Multithreading.

11. A program to illustrate Thread synchronization.

12. A program to illustrate inter thread communication.

13. A program using String tokenizer.

14. A program using Linked list class.

15. A program using Tree set class.

16. A program using Hash set and Iterator classes.

17. A program using Map classes.

18. A program using Enumeration and Comparator interfaces.

19. A program to illustrate Buffered I/O streams and Buffered reader.

20. Write a Java program to read text from file from a specify index or skipping byte using file Input stream.

21. Write a Java program to determine number of byte return to file using data output stream.

22. A program to illustrate ByteArrayI/O Streams.

23. A program to illustrate the usage of Serialization.

24. An application involving GUI with different controls, menus and event handling.

25. A program to implement a simple calculator using grid layout manager.

26. A program to implement Recursive Fibonacci method using swing

27. A program to display digital clock using swing

28. A program to read from a file and write to a file using Applet

29. A program to display a calendar using JCombo box.

30. A program to illustrate event listener interfaces.

PC 453 CS DESIGN AND ANALYSIS OF ALGORITHMS LAB

Instruction	3 Periods per week
Duration of University Examination	3 Hours
University Examination	50 Marks
Sessional	25 Marks
Credits	1

1. Write a program to find Minimum Cost Spanning Tree of a given undirected graph using Prim's algorithm.

2. Write a program to find the shortest path in graph using Dijkstra's algorithm.

3. Write a program that implements N Queen's problem using backtracking algorithm.

4. Write a program to find all Hamiltonian Cycles in a connected undirected Graph G of n vertices using backtracking principle.

5. Write a program to implement dynamic programming algorithm to solve all pairs shortest path problem.

6. Write a program to solve 0/1 knapsack problem using Greedy algorithm.

7. Write a program to solve 0/1 knapsack problem using Dynamic programming algorithm.

8. Write a program to solve 0/1 knapsack problem using Backtracking algorithm.

9. Write a program to solve 0/1 knapsack problem using Branch and bound algorithm.

10. Write a program that uses dynamic programming algorithm to solve the optimal binary search tree

11. Write a program for solving traveling sales persons problem using Dynamic programming algorithm.

12. Write a program for solving traveling sales persons problem using The back tracking algorithm.

13. Write a program for solving traveling sales persons problem using Branch and Bound.

14. Write a program to obtain the Topological ordering of vertices in a given digraph using Warshall's algorithm.

15. Write a program to compute the transitive closure of a given directed graph using Warshall's algorithm.

16. Write a program to print all the nodes reachable from a given starting node in a digraph using BFS method.

17. Write a program to check whether a given graph is connected or not using DFS method.

18. Write a program to find Minimum Cost Spanning Tree of a given undirected graph using Prim's algorithm.