TRIBHUVAN UNIVERSITY

INSTITUTE OF SCIENCE AND TECHNOLOGY

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BACHELOR OF SCIENCE IN COMPUTER SCIENCE AND INFORMATION TECHNOLOGY

(COURSE OF STUDY)

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EFFECTIVE FROM ACADEMIC YEAR – 2079

Tribhuvan University

Institute of Science and Technology

Course of Study

Bachelor of Science in Computer Science and Information Technology

(B.Sc. CSIT)

2022

Prepared by

Computer Science and Information Technology

Subject Committee

Introduction:

The Bachelor of Science in Computer Science and Information Technology (B.Sc. CSIT) curriculum is designed by closely following the courses practiced in accredited international universities, subject to the condition that the intake students are twelve years of schooling in the science stream or equivalent from any university recognized by Tribhuvan University (TU). In addition to the foundation and core Computer Science and Information Technology courses, the program offers several elective courses to fulfill the demand of high technology applications development. The foundation and core courses are designed to meet the undergraduate academic program requirement, and the service courses are designed to meet the need of fast changing computer technology and application. Students enrolled in the four year B.Sc. CSIT program are required to take courses in design and implementation of computer software systems, foundation in the theoretical model of computer science, and a functional background of computer hardware. All undergraduate students are required to complete 126 credit hours of computer science course and allied courses.

Objective:

The main objective of B.Sc. CSIT program is to provide students intensive knowledge and skill on different areas of computer science and information technology including design, theory, programming and application of computer system. It is envisaged that graduate of this program will be equipped with necessary knowledge of computer software and hardware system.

Eligibility Condition for Admission:

A student who seeks admission to B.Sc. CSIT program:

a) For grading system:

- Should have successfully passed 11 and 12 class in Science stream with minimum full marks 100/100 in Physics and Mathematics respectively and should score final grade ‘C’ in all subjects.

b) For percentage system:

- Should have successfully passed 11 and 12 class in Science stream with minimum full marks 100/100 in Physics and Mathematics respectively and should score minimum of second division.

c) For PCL (I.Sc.) or equivalent:

- Should have successfully passed I.Sc. or equivalent examination with minimum full marks 100/100 in Physics and Mathematics respectively and should score minimum of second division.

d) For A level:

- Should have successfully passed A Level in science stream (with full marks 100/100 in Physics and Mathematics respectively) and should score minimum D Grade (With or without small letter).

e) For CTEVT:

- Should have successfully passes three years diploma in Engineering with full marks 100/100 in Physics and Mathematics respectively and should score minimum of second division.

f) For International Education Institute or International University:

- Should have to submit equivalence letter from Curriculum Development Centre, Sano Thimi, Bhaktapur.

g) Should have successfully passed the entrance examination conducted by Institute of Science and Technology (IoST), TU securing at least 35% marks.

h) Complied with all the application procedures.

Course Duration:

The entire course is of eight semesters (four academic years). There is a separate semester examination after the end of each semester.

Hours of Instruction:

a) Working days: 90 days in a semester

b) Class hours:

- 3 credit hours courses with theory and labs is equivalent to 3 lecture hours and 3 lab hours = 6 working hours per week.
- 3 credit hours theory-only course is equivalent 3 lecture hours and 2 tutorial hours = 5 working hours per week.

Evaluation:

All the courses except project work and internship should have internal weightage of 40% and external weightage of 60%. For the courses having laboratory work, the internal weightage is divided into 20% laboratory work and 20% internal assessment. A student should secure minimum of 40% in each category to pass a course. The final grade and grade

point in each course will be the sum of overall weightage of all categories. There will be a separate practical examination for the 20% weightage of laboratory work in the presence of an external examiner.

The Project work and Internship are evaluated by different evaluators. To pass Project Work and Internship, students should secure at least 40% marks in the evaluation of each evaluator and the final grade and grade point will be the sum of all the evaluations. For the evaluation of final presentation, an external examiner will be assigned.

Grading System:

The grade awarded to each student in each course is based on his/her overall performance through internal and external evaluations. Several evaluation criteria are used for the continuous internal evaluation. External evaluation is solely based on examination conducted by Institute of Science and Technology (IoST). The grade in each course is assigned using a letter grade that indicates the overall performance of each student in each course. The chart below represents letters with its corresponding grading scale, grade point, and performance remarks.

Letter Grade	Grading Scale	Grade Point	Performance Remarks
A+	90 – 100	4	Outstanding
A	80 – less than 90	3.7	Excellent
B+	70 – less than 80	3.3	Very Good
B	60 – less than 70	3	Good
C+	50 – less than 60	2.7	Satisfactory
C	40 – less than 50	2.3	Pass*
F	0 – less than 40	0	Fail

*Pass refers to acceptable

The performance of each student in each semester shall be evaluated in terms of Semester Grade Point Average (SGPA) which is the grade point average for the semester. SGPA is calculated as

$$SGPA = \frac{Total\ Grade\ Points\ earned\ in\ a\ semester}{Total\ number\ of\ credits\ earned\ in\ the\ semester}$$

The cumulative grade point average (CGPA) is the grade point average for all completed semesters. CGPA is calculated as

$$CGPA = \frac{Total\ Grade\ Points\ earned}{Total\ number\ of\ credits\ completed}$$

Final Examination:

Institute of science and technology, Tribhuvan University, will conduct the final examination at the end of each semester for each course except Project Work and Internship. The weightage of this final examination is 60% of the overall weightage.

Course Structure:

Semester I

Course Code	Course Title	Credit Hours	Full Marks
CSC114	Introduction to Information Technology	3	100
CSC115	C Programming	3	100
CSC116	Digital Logic	3	100
MTH117	Mathematics I	3	100
PHY118	Physics	3	100
Total		**15**	**500**

Semester II

Course Code	Course Title	Credit Hours	Full Marks
CSC165	Discrete Structure	3	100
CSC166	Object Oriented Programming	3	100
CSC167	Microprocessor	3	100
MTH168	Mathematics II	3	100
STA169	Statistics I	3	100
Total		**15**	**500**

Semester III

Course Code	Course Title	Credit Hours	Full Marks
CSC211	Data Structure and Algorithms	3	100
CSC212	Numerical Method	3	100
CSC213	Computer Architecture	3	100
CSC214	Computer Graphics	3	100
STA215	Statistics II	3	100
Total		**15**	**500**

Semester IV

Course Code	Course Title	Credit Hours	Full Marks
CSC262	Theory of Computation	3	100
CSC263	Computer Networks	3	100
CSC264	Operating Systems	3	100
CSC265	Database Management System	3	100
CSC266	Artificial Intelligence	3	100
Total		**15**	**500**

Semester V

Course Code	Course Title	Credit Hours	Full Marks
CSC325	Design and Analysis of Algorithms	3	100
CSC326	System Analysis and Design	3	100
CSC327	Cryptography	3	100
CSC328	Simulation and Modeling	3	100
CSC329	Web Technology	3	100
	Elective I	3	100
Total		**18**	**600**

List of Electives:

1. Multimedia Computing (CSC330)
2. Wireless Networking (CSC331)
3. Image Processing (CSC332)
4. Knowledge Management (CSC333)
5. Society and Ethics in Information Technology (CSC334)
6. Microprocessor Based Design (CSC335)

Semester VI

Course Code	Course Title	Credit Hours	Full Marks
CSC375	Software Engineering	3	100
CSC376	Complier Design and Construction	3	100
CSC377	E-Governance	3	100
CSC378	NET Centric Computing	3	100
CSC379	Technical Writing	3	100
	Elective II	3	100
Total		**18**	**600**

List of Electives:

1. Applied Logic (CSC380)
2. E-commerce (CSC381)
3. Automation and Robotics (CSC382)
4. Neural Networks (CSC383)
5. Computer Hardware Design (CSC384)
6. Cognitive Science (CSC385)

Semester VII

Course Code	Course Title	Credit Hours	Full Marks
CSC419	Advanced Java Programming	3	100
CSC420	Data Warehousing and Data Mining	3	100
MGT421	Principles of Management	3	100
CSC422	Project Work	3	100
	Elective III	3	100
Total		**15**	**500**

List of Electives:

1. Information Retrieval (CSC423)
2. Database Administration (CSC424)
3. Software Project Management (CSC425)
4. Network Security (CSC426)
5. Digital System Design (CSC427)
6. International Marketing (MGT428)

Semester VIII

Course Code	Course Title	Credit Hours	Full Marks
CSC475	Advanced Database	3	100
CSC476	Internship	6	200
	Elective IV	3	100
	Elective V	3	100
Total		**15**	**500**

List of Electives:

1. Advanced Networking with IPV6 (CSC477)
2. Distributed Networking (CSC478)
3. Game Technology (CSC479)
4. Distributed and Object-Oriented Database (CSC480)
5. Introduction to Cloud Computing (CSC481)
6. Geographical Information System (CSC482)
7. Decision Support System and Expert System (CSC483)
8. Mobile Application Development (CSC484)
9. Real Time Systems (CSC485)
10. Network and System Administration (CSC486)
11. Embedded Systems Programming (CSC487)
12. International Business Management (MGT488)

Introduction to Information Technology

Course Title: Introduction to Information Technology
Course No: CSC114
Nature of the Course: Theory + Lab
Semester: I

Full Marks: 60 + 20 + 20
Pass Marks: 24 + 8 + 8
Credit Hrs: 3

Course Description: This course covers the basic concepts of computers and information technology including introduction, hardware, software, memory, input/output, data representation, database, networks and data communication, Internet, multimedia, and computer security.

Course Objectives: The main objective of this course is to provide students knowledge of fundamental concepts of computers and information technology.

Course Contents:

Unit 1: Introduction to Computer (3 Hrs.)
Introduction; Digital and Analog Computers; Characteristics of Computer; History of Computer; Generations of Computer; Classification of Computer; The Computer System; Application of Computers

Unit 2: The Computer System Hardware (3 Hrs.)
Introduction; Central Processing Unit; Memory Unit; Instruction Format; Instruction Set; Instruction Cycle; Microprocessor; Interconnecting the Units of a Computer; Inside a Computer Cabinet

Unit 3: Computer Memory (4 Hrs.)
Introduction; Memory Representation; Memory Hierarchy; CPU Registers; Cache Memory; Primary Memory; Secondary Memory; Access Types of Storage Devices; Magnetic Tape; Magnetic Disk; Optical Disk; Magneto-Optical Disk; How the Computer uses its memory

Unit 4: Input and Output Devices (4 Hrs.)
Introduction; Input-Output Unit; Input Devices; Human Data Entry Devices; Source Data Entry Devices; Output Devices; I/O Port; Working of I/O System

Unit 5: Data Representation (6 Hrs.)
Introduction; Number System; Conversion from Decimal to Binary, Octal, Hexadecimal; Conversion of Binary, Octal, Hexadecimal to Decimal; Conversion of Binary to Octal, Hexadecimal; Conversion of Octal, Hexadecimal to Binary; Binary Arithmetic; Signed and Unsigned Numbers; Binary Data Representation; Binary Coding Schemes; Logic Gates

Unit 6: Computer Software (6 Hrs.)
Introduction; Types of Software; System Software; Application Software; Software Acquisition; Operating System (Introduction, Objectives of Operating System, Types of OS, Functions of OS, Process Management, Memory Management, File Management, Device Management, Protection and Security, User Interface, Examples of Operating Systems)

Unit 7: Data Communication and Computer Network (5 Hrs.)
Introduction; Importance of Networking; Data Transmission Media; Data Transmission across Media; Data Transmission and Data Networking; Computer Network; Network Types; Network Topology; Communication Protocol; Network Devices; Wireless Networking

Unit 8: The Internet and Internet Services (4 Hrs.)
Introduction; History of Internet; Internetworking Protocol; The Internet Architecture; Managing the Internet; Connecting to Internet; Internet Connections; Internet Address; Internet Services; Uses of Internet; Introduction to Internet of Things (IoT), Wearable Computing, and Cloud Computing, Introduction to E-commerce, E-governance, and Smart City, GIS and its Applications

Unit 9: Fundamentals of Database (4 Hrs.)
Introduction; Database; Database System; Database Management System; Database System Architectures; Database Applications; Introduction to Data Warehousing, Data mining, and BigData

Unit 10: Multimedia (3 Hrs.)
Introduction; Multimedia - Definition; Characteristics of Multimedia; Elements of Multimedia; Multimedia Applications

Unit 11: Computer Security (3 Hrs.)
Introduction; Security Threat and Security Attack; Malicious Software; Security Services; Security Mechanisms (Cryptography, Digital Signature, Firewall, Users Identification and Authentication, Intrusion Detection Systems); Security Awareness; Security Policy

Laboratory Works:
After completing this course, students should have practical knowledge of different hardware components of computer, operating systems, Word Processors, Spreadsheets, Presentation Graphics, Database Management Systems, and Internet and its services.

Text Books:
1. Computer Fundamentals, Anita Goel, Pearson Education India

Reference Books:
1. Introduction to Computers, Peter Norton, 7th Edition, McGraw Hill Education
2. Computer Fundamental, Pradeep K. Sinha and Priti Sinha
3. Data Mining Concepts and Techniques, Third Edition, Jiawei Han, Micheline Kamber and Jian Pei
4. Cloud Computing Bible, Barrie Sosinsky, Wiley

C Programming

Course Title: C Programming
Course No: CSC115
Nature of the course: Theory + Lab
Semester: I

Full Marks: 60 + 20 + 20
Pass Marks: 24 + 8 + 8
Credit Hrs.: 3

Course Description: This course covers the concepts of structured programming using C programming language.

Course Objective: This course is designed to familiarize students to the techniques of programming in C.

Course Contents:

Unit 1: Problem Solving with Computer (2 Hrs.)
Problem analysis, Algorithms and Flowchart, Coding, Compilation and Execution, History of C, Structure of C program, Debugging, Testing and Documentation

Unit 2: Elements of C (4 Hrs.)
C Standards(ANSI C and C99), C Character Set, C Tokens, Escape sequence, Delimiters, Variables, Data types (Basic, Derived, and User Defined), Structure of a C program, Executing a C program, Constants/ Literals, Expressions, Statements and Comments.

Unit 3: Input and Output (2 Hrs.)
Conversion specification, Reading a character, Writing a character, I/O operations, Formatted I/O

Unit 4: Operators and Expression (4 Hrs.)
Arithmetic operator, Relational operator, Logical or Boolean operator, Assignment Operator, Ternary operator, Bitwise operator, Increment or Decrement operator, Conditional operator, Special Operators(sizeof and comma), Evaluation of Expression, Operator Precedence and Associativity.

Unit 5: Control Statement (4 Hrs.)
Conditional Statements, Decision Making and Branching, Decision Making and Looping, Exit function, Break and Continue.

Unit 6: Arrays (6 Hrs.)
Introduction to Array, Types of Array (Single Dimensional and Multidimensional), Declaration and Memory Representation of Array, Initialization of array, Character Array and Strings, Reading and Writing Strings, Null Character, String Library Functions(string length, string copy, string concatenation, string compare)

Unit 7: Functions (5 Hrs.)
Library Functions, User defined functions, Funciton prototype, Function call, and Function Definition, Nested and Recursive Function, Function Arguments and Return Types, Passing

Arrays to Function, Passing Strings to Function, Passing Arguments by Value, Passing Arguments by Address, Scope visibility and lifetime of a variable, Local and Global Variable,

Unit 8: Structure and Union (5 Hrs.)
Introduction, Array of structure, Passing structure to function, Passing array of structure to function, Structure within structure (Nested Structure), Union, Pointer to structure

Unit 9: Pointers (6 Hrs.)
Introduction, The & and * operator, Declaration of pointer, Chain of Pointers, Pointer Arithmetic, Pointers and Arrays, Pointers and Character Strings, Array of Pointers, Pointers as Function Arguments, Function Returning pointers, Pointers and Structures, Dynamic Memory Allocation

Unit 10: File Handling in C (4 Hrs.)
Concept of File, Opening and closing of File, Input Output Operations in File, Random access in File, Error Handling in Files

Unit 11: Introduction to Graphics (3 Hrs.)
Concepts of Graphics, Graphics Initialization and Modes, Graphics Function

Laboratory Works:
This course requires a lot of programming practices. Each topic must be followed by a practical session. Some practical sessions include programming to:

- Create, compile and run simple C programs, handle different data types available in C, perform arithmetic operations in C, perform formatted input and output operations, perform character input and output operations.
- Perform logical operations, create decision making programs, create loops to repeat task.
- Create user-defined functions, create recursive functions, work with automatic, global and static variables, create, manipulate arrays and matrices (single and multi-dimensional), work with pointes, dynamically allocate de-allocate storage space during runtime, manipulate strings (character arrays) using various string handling functions.
- Create and use structures and files to keep record of students, employees etc.

Text Books:

1. Byron Gottfried: "Programming with C," , Second Edition, McGraw Hill Education.
2. Herbert Schildt, C The Complete Reference, Fourth Edition, Osborne/McGraw-Hill Publication.

Reference Books:

1. Paul Deitel, Harvey Deitel, C: How to Program, Eighth Edition, Pearson Publication.
2. Al Kelley, Ira Pohl: "A Book on C", Fourth Edition, Pearson Education.
3. Brian W. Keringhan, Dennis M. Ritchiem, The C programming Language, Second Edition, PHI Publication.
4. Ajay Mittal, Programming in C: A Practical Approach, Pearson Publication

5. Stephen G. Kochan, Programming in C, CBS publishers & distributors.
6. E. Balagurusamy, Programming in ANSI C, Third Edition, TMH publishing

Digital Logic

Course Title: Digital Logic
Course No: CSC116
Nature of the Course: Theory + Lab
Semester: I

Full Marks: 60 + 20 + 20
Pass Marks: 24 + 8 + 8
Credit Hrs: 3

Course Description: This course covers the concepts of digital logic and switching networks. The course includes the fundamental concepts of boolean algebra and its application for circuit analysis, multilevel gates networks, flip-lops, counters logic devices and synchronous and asynchronous sequential logic and digital integrated circuits.

Course Objectives: The main objective of this course is to introduce the basic tools for the design of digital circuits and introducing methods and procedures suitable for a variety of digital design applications.

Course Contents:

Unit 1: Binary Systems (6 Hrs.)
Digital Systems, Binary numbers, Number base conversion, Octal and hexadecimal numbers, compliments, Signed Binary numbers, Decimal codes (BCD, 2 4 2 1,8 4 -2 -1,Excess 3, Gray Code), Binary Storage and Registers, Binary logic

Unit 2: Boolean algebra and Logic Gates (5 Hrs.)
Basic and Axiomatic definitions of Boolean algebra, Basic Theorems and properties of Boolean Algebra, Boolean Functions, Logic Operations, Logic Gates, Integrated Circuits

Unit 3: Simplification of Boolean Functions (5 Hrs.)
K-map, Two and Three variable maps, Four variable maps, product of sum simplification, NAND and NOR implementation, Don't Care conditions, Determinant and selection of Prime Implicants

Unit 4: Combinational Logic (5 Hrs.)
Design Procedure, Adders, Subtractors, Code Conversions, Analysis Procedure, Multilevel NAND and NOR Circuits, Exclusive-OR Circuits

Unit 5: Combinational Logic with MSI and LSI (8 Hrs.)
Binary Parallel Adder and Subtractor, Decimal Adder, Magnitude Comparator, Decoders and Encoders, Multiplexers, Read-only-Memory (ROM), Programmable Logic Array (PLA), Programmable Array Logic (PAL)

Unit 6: Synchronous and Asynchronous Sequential Logic (10 Hrs.)
Flip-Flops, Triggering of flip-flops, Analysis of clocked sequential circuits, Design with state equations and state reduction table, Introduction to Asynchronous circuits, Circuits with latches.

Unit 7: Registers and Counters (6 Hrs.)
Registers, Shift registers, Ripple Counters, Synchronous Counters, Timing Sequences, The memory

Laboratory Works:
Students should be able to realize following digital logic circuits as a part of laboratory work.

- Familiarizations with logic gates
- Combinatorial Circuits
- Code Converters
- Design with Multiplexers
- Adders and Subtractors
- Flip-Flops
- Sequential Circuits
- Counters
- Clock Pulse Generator

Text Books:
1. M. Morris Mano, "Digital Logic & Computer Design"

Reference Books:

1. Brain Holdsworth, "Digital Logic Design", Elsevier Science.
2. John Patrick Hayes, "Introduction to Digital Logic Design", Addison-Wesley.
3. M. Morris Mano and Charles Kime, "Logic and Computer Design Fundamentals", Pearson New International.

Mathematics I

Course Title: Mathematics I
Course No: MTH117
Nature of the Course: Theory
Semester: I

Full Marks: 60 + 40
Pass Marks: 24+16
Credit Hrs: 3

Course Description: The course covers the concepts of functions, limits, continuity, differentiation, integration of function of one variable; logarithmic, exponential, applications of derivative and antiderivatives, differential equations, vectors and applications, partial derivatives and Multiple Integrals.

Course Objectives: The objective of this course is to make students able to

- understand and formulate real world problems into mathematical statements.
- develop solutions to mathematical problems at the level appropriate to the course.
- describe or demonstrate mathematical solutions either numerically or graphically.

Course Contents:

Unit 1: Function of One Variable (5 Hrs.)
Four ways of representing a function, Linear mathematical model**,** Polynomial, Rational, Trigonometric, Exponential and Logarithmic functions, Combination of functions, Range and domain of functions and their Graphs

Unit 2: Limits and Continuity (4 Hrs.)
Precise definition of Limit, Limits at infinity, Continuity, Horizontal asymptotes, Vertical and Slant asymptotes

Unit 3: Derivatives (4 Hrs.)
Tangents and velocity, Rate of change, Review of derivative, Differentiability of a function, Mean value theorem, Indeterminate forms and L'Hospital rule

Unit 4: Applications of Derivatives (4 Hrs.)
Curve sketching, Review of maxima and minima of one variable, Optimization problems, Newton's method

Unit 5: Antiderivatives (5 Hrs.)
Review of antiderivatives, Rectilinear motion, Indefinite integrals and Net change, Definite integral, The Fundamental theorem of calculus, Improper integrals

Unit 6: Applications of Antiderivatives (5 Hrs.)
Areas between the curves, Volumes of cylindrical cells, Approximate Integrations, Arc length, Area of surface of revolution

Unit 7: Ordinary Differential Equations (6 Hrs.)
Introduction, Introduction to first order equations Separable equations, Linear equations, Second order linear differential equations, Non homogeneous linear equations, Method of undetermined coefficients

Unit 8: Infinite Sequence and Series (5 Hrs.)
Infinite sequence and series, Convergence tests and power series, Taylor's and Maclaurin's series

Unit 9: Plane and Space Vectors (4 Hrs.)
Introduction, Applications, Dot product and cross Product, Equations of lines and Planes, Derivative and integrals of vector functions, Arc length and curvature, Normal and binormal vectors, Motion in space

Unit 10: Partial Derivatives and Multiple Integrals (3 Hrs.)
Limit and continuity, Partial derivatives, Tangent planes, Maximum and minimum values, Multiple integrals

Text Book

1. Calculus Early Transcendentals, James Stewart, 7E, CENGAGE Learning.

Reference Book

1. Calculus Early Transcendentals, Thomas, 12^{th} Editions, Addision Wesley.

Physics

Course Title: Physics
Course No.: PHY118
Nature of the Course: Theory + Lab
Semester: I

Full Marks: 60 + 20 + 20
Pass Marks: 24 + 8 + 8
Credit Hour: 3

Course Description: This course covers the fundamentals of physics including oscillations, electromagnetic theory, and basics of quantum mechanics, band theory, semiconductors and universal logic gates and finally physics of manufacturing integrated circuits.

Course Objectives: The main objective of this course is to provide knowledge in physics and apply this knowledge for computer science and information technology.

Course Contents:

Unit 1: Rotational Dynamics and Oscillatory Motion (5 Hrs.)
Moment of inertia and torque, Rotational kinetic energy, Conservation of angular momentum, Oscillation of spring: frequency, period, amplitude, phase angle and energy

Unit 2: Electric and Magnetic Field (5 Hrs.)
Electric and magnetic field and potential, Force on current carrying wire, magnetic dipole moment, Force on a moving charge, Hall effect, Electromagnetic waves

Unit 3: Fundamentals of Atomic Theory (8 Hrs.)
Blackbody radiation, Bohr atom, Spectrum of Hydrogen, Franck-Hertz experiment, de Broglie's hypothesis and its experimental verification, Uncertainty principle and its origin, matter waves and the uncertainty principle, group velocity.

Unit 4: Methods of Quantum Mechanics (5 Hrs.)
Schrodinger theory of quantum mechanics and its application, Outline of the solution of Schrodinger equation for H-atom, space quantization and spin, Atomic wave functions

Unit 5: Fundamentals of Solid State Physics (6 Hrs.)
Crystal structure, Crystal bonding, Classical and quantum mechanical free electron model, Bloch theorem, Kronig-Penny model, Tight-binding approximation, conductors, insulators and semiconductors, effective mass and holes.

Unit 6: Semiconductor and Semiconductor devices (8 Hrs.)
Intrinsic and extrinsic semiconductors, Electrical conductivity of semiconductors, Photoconductivity, Metal-metal junction: The contact potential, The semiconductor diode, Bipolar junction transistor (BJT), Field effect transistor (FET).

Unit 7: Universal Gates and Physics of Integrated Circuits (8 Hrs.)
Universal gates, RTL and TTL gates, Memory circuits, Clock circuits, Semiconductor purification: Zone refining, Single crystal growth, Processes of IC production, Electronic component fabrication on a chip.

Laboratory Works:
Students should able to perform at least one experiment from units 1, 2 and 5, 6, 7. The details of the experiment will be provided in the manual.

Text Books:

1. Garcia Narciso, Damask Arthur, Physics for Computer Science Students, Springer-Verlag

Reference Books:

1. Heliday David, Resnick Robert and Walker Gearl, Fundamentals of Physics, 9th ed., John-Wiley and Sons, Inc.
2. Francis W. Sears, Hugh D. Young, Roger Freedman, Mark Zemansky, University Physics, Volume 1 & 2, 14th ed., Pearson Publication
3. Knight Randall D., Physics for Scientists and Engineers: A Strategic Approach, 3rd ed., Pearson Publication

Discrete Structures

Course Title: Discrete Structures
Course No: CSC165
Nature of the Course: Theory + Lab
Semester: II

Full Marks: 60 + 20 + 20
Pass Marks: 24 + 8 + 8
Credit Hrs: 3

Course Description: The course covers fundamental concepts of discrete structure like introduce logic, proofs, sets, relations, functions, counting, and probability, with an emphasis on applications in computer science.

Course Objectives: The main objective of the course is to introduce basic discrete structures, explore applications of discrete structures in computer science, understand concepts of Counting, Probability, Relations and Graphs respectively.

Course Contents:

Unit 1: Basic Discrete Structures (7 Hrs.)

1.1. Sets: Sets and Subsets, Power Set, Cartesian Product, Set Operations, Venn Diagram, Inclusion-Exclusion Principle, Computer Representation of Sets
1.2. Functions: Basic Concept, Injective and Bijective Functions, Inverse and Composite Functions, Graph of Functions, Functions for Computer Science (Ceiling Function, Floor Function, Boolean Function, Exponential Function), Fuzzy Sets and Membership Functions, Fuzzy Set Operations
1.3. Sequences and Summations: Basic Concept of Sequences, Geometric and Arithmetic Progression, Single and Double Summation

Unit 2: Integers and Matrices (6 Hrs.)

2.1. Integers: Integers and Division, Primes and Greatest Common Divisor, Extended Euclidean Algorithm, Integers and Algorithms, Applications of Number Theory (Linear Congruencies, Chinese Remainder Theorem, Computer Arithmetic with Large Integers)
2.2. Matrices: Zero-One Matrices, Boolean Matrix Operations

Unit 3: Logic and Proof Methods (6 Hrs.)

3.1. Logic: Propositional Logic, Propositional Equivalences, Predicates and Quantifiers, Negation of Quantified Statements, Proof of quantified statements, Nested Quantifiers, Rules of Inferences
3.2. Proof Methods: Basic Terminologies, Proof Methods (Direct Proof, Indirect Proof, Proof by Contradiction, Proof By Contraposition, Exhaustive Proofs and Proof by Cases), Mistakes in Proof

Unit 4: Induction and Recursion (5 Hrs.)

4.1. Induction: mathematical Induction, Strong Induction and Well Ordering, Induction in General
4.2. Recursive Definitions and Structural Induction, Recursive Algorithms, Proving Correctness of Recursive Algorithms

Unit 5: Counting and Discrete Probability (9 Hrs.)

5.1. Counting: Basics of Counting, Pigeonhole Principle, Permutations and Combinations, Two Element Subsets, Counting Subsets of a Set, Binomial Coefficients, Generalized Permutations and Combinations, Generating Permutations and Combinations

5.2. Discrete Probability: Introduction to Discrete Probability, Probability Theory, Probability Calculation in Hashing, Expected Value and Variance, Randomized Algorithms

5.3. Advanced Counting: Recurrence Relations, Solving Recurrence Relations (Homogeneous and Non-Homogeneous equations), Introduction to Divide and Conquer Recurrence Relations

Unit 6: Relations and Graphs (12 Hrs.)

6.1. Relations: Relations and their Properties, N-ary Relations with Applications, Representing Relations, Closure of Relations, Equivalence Relations, Partial Ordering

6.2. Graphs: Graphs Basics, Graph Types, Graph Models, Graph Representation, Graph Isomorphism, Connectivity in Graphs, Euler and Hamiltonian Path and Circuits, Matching Theory, Shortest Path Algorithm (Dijkstra's Algorithm), Travelling Salesman Problem, Graph Coloring

6.3. Trees: Introduction and Applications, Tree Traversals, Spanning Trees, Minimum Spanning Trees (Kruskal's Algorithm)

6.4. Network Flows: Graph as Models of Flow of Comodities, Flows, Maximal Flows and Minimal Cuts, The Max Flow-Min Cut Theorem

Laboratory Works:

The laboratory work consists of implementing the algorithms and concepts discussed in the class. Student should implement problems with following concepts;

- Set Operations and Boolean Matrix Operations
- Primility Testing, Number Theory Algorithms, and Operations on Integers
- Counting and Some Recursive Algorithms
- Algorithms for Relations, Graphs

Text Books:

1. Kenneth H. Rosen, Discrete mathematics and its applications, Seventh Edition McGraw Hill Publication, 2012.
2. Bernard Kolman, Robert Busby, Sharon C. Ross, Discrete Mathematical Structures, Sixth Edition Pearson Publications, 2015
3. Joe L Mott, Abraham Kandel, Theodore P Baker, Discrete Mathematics for Computer Scientists and Mathematicians, Printice Hall of India, Second Edition, 2008

Reference Books:

1. Ken Bogart, Scot Drysdale, Cliff Stein, Discrete Mathematics for Computer Scientists, First Edition Addison-Wesley, 2010

Object Oriented Programming

Course Title: Object Oriented Programming
Course No: CSC166
Nature of Course: Theory + Lab
Semester: II

Full Marks: 60 + 20 + 20
Pass Marks: 24 + 8 + 8
Credit Hrs: 3

Course Description: The course covers the basic concepts of object oriented programming using C++ programming language.

Course Objectives: The main objective of this course is to understand object oriented programming and advanced C++ concepts such as composition of objects, operator overloads, inheritance and polymorphism, file I/O, exception handling and templates.

Course Contents:

Unit 1: Introduction to Object Oriented Programming (3 Hrs.)
Overview of structured programming approach, Object oriented programming approach, Characteristics of object oriented languages

Unit 2: Basics of C++ programming (5 Hrs.)
C++ Program Structure, Character Set and Tokens, Data Type, Type Conversion, Preprocessor Directives, Namespace, Input/Output Streams and Manipulators, Dynamic Memory Allocation with new and delete, Control Statements.

Functions: Function Overloading, Inline Functions, Default Argument, Pass by Reference, Return by Reference, Scope and Storage Class.

Pointers: Pointer variables declaration & initialization, Operators in pointers, Pointers and Arrays, Pointer and Function.

Unit 3: Classes & Objects (8 Hrs.)
A Simple Class and Object, Accessing members of class, Initialization of class objects: (Constructor, Destructor), Default Constructor, Parameterized Constructor, Copy Constructor, The Default Copy Constructor, Objects as Function Arguments, Returning Objects from Functions, Structures and Classes, Memory allocation for Objects, Static members, Member functions defined outside the class.

Unit 4: Operator Overloading (7 Hrs.)
Fundamental of operator overloading, Restriction on operator overloading, Operator functions as a class members, Overloading unary and binary operator, Data Conversion (basic to basic, basic to user-defined, user-defined to basic, user-defined to user-defined)

Unit 5: Inheritance (7 Hrs.)
Introduction to inheritance, Derived Class and Base Class, Access Specifiers (private, protected, and public), Types of inheritance, Public and Private Inheritance, Constructor and Destructor in derived classes, Aggregation

Unit 6: Virtual Function, Polymorphism, and miscellaneous C++ Features (5 Hrs.)
Concept of Virtual functions, Late Binding, Abstract class and pure virtual functions, Virtual Destructors, Virtual base class, Friend function and Static function, Assignment and copy initialization, Copy constructor, This pointer, Concrete classes, Polymorphism and its roles.

Unit 7: Function Templates and Exception Handling (4 Hrs.)
Function templates, Function templates with multiple arguments, Class templates, templates and inheritance, Exceptional Handling (Try, throw and catch), Use of exceptional handling.

Unit 8: File handling (6 Hrs.)
Stream Class Hierarchy for Console Input /Output, Unformatted Input /Output, Formatted Input /Output with ios Member functions, Formatting with Manipulators, Stream Operator Overloading, File Input/output with Streams, Opening and Closing files, Read/Write from File, File Access Pointers and their Manipulators, Sequential and Random Access to File, Testing Errors during File Operations

Laboratory Works:
Students should be able to implement the concepts of Object Oriented Programming using C++ language.

Text Book:
1. Robert Lafore, Object Oriented Programming in C++, Fourth Edition, SAMS publications.
2. Herbert Schildt, C++ The Complete Reference, Fourth Edition, Tata McGraw Hill Publication.

Reference Books:
1. Deitel and Deitel, C++ How to Program, Third Edition, Pearson Publication.
2. Joyce Farrell, Object-oriented programming using C++, Fourth Edition, Cengage Learning.

Microprocessor

Course Title: Microprocessor
Course No: CSC167
Nature of the Course: Theory + Lab
Semester: II

Full Marks: 60 + 20 + 20
Pass Marks: 24 + 8 + 8
Credit Hrs: 3

Course Description: This course contains of fundamental concepts of computer organization, basic I/O interfaces and Interrupts operations.

Course Objectives: The course objective is to introduce the operation, programming and application of microprocessor.

Course Contents:

Unit1: Introduction (4 Hrs.)
Introduction to Microprocessor, Components of a Microprocessor: Registers, ALU and control & timing, System bus (data, address and control bus), Microprocessor systems with bus organization

Unit 2: Basic Architecture (7 Hrs.)
Microprocessor Architecture and Operations, Memory, I/O devices, Memory and I/O operations, 8085 Microprocessor Architecture, Address, Data And Control Buses, 8085 Pin Functions, Demultiplexing of Buses, Generation Of Control Signals

Unit 3: Instruction Cycle (3 Hrs.)
Fetch Operation and Timing Diagram; Execute Operation and Timing Diagram, Instruction Cycle, Machine Cycle, T-States, T-States, Memory Interfacing

Unit 4: Assembly Language Programming (10 Hrs.)
Assembly instruction format, Instruction Types, Mnemonics, Operands, Macro assemblers, Linking, Assembler directives, Addressing Modes, Simple sequence programs, Flags, Branch, Jumps, While-Do, Repeat-Until, If-Then-Else and Multiple If-then Programs, Debugging

Unit 5: Basic I/O, Memory R/W and Interrupt Operations (6 Hrs.)
Memory Read, Memory Write, I/O Read, I/O Write, Direct Memory Access, Interrupt, Types, Interrupt Masking

Unit 6: Input/ Output Interfaces (6 Hrs.)
Interfacing Concepts, Ports, Interfacing Of I/O Devices, Interrupts In 8085, Programmable Interrupt Controller 8259A, Programmable Peripheral Interface 8255A

Unit 7: Advanced Microprocessors (9 Hrs.)
8086: logical block diagram and segments, 80286: Architecture, Registers, (Real/Protected mode), Privilege levels, descriptor cache, Memory access in GDT and LDT, multitasking, addressing modes, flag register 80386: Architecture, Register organization, Memory access in protected mode, Paging

Laboratory Works:

The laboratory work includes Assembly language programming using 8085/8086/8088 trainer kit. The programming should include: Arithmetic operation, base conversion, conditional branching etc. The lab work list may include following concepts:

1. Assembly language program using 8085 microprocessor kit.
2. Use of all types of instructions and addressing modes.
3. Arrays and the concept of Multiplications and Division operations on Microprocessor.
4. Assembly language programming, using any types of Assembler, including the different functions of Int 10h, and 12h

Text Books:

1. Ramesh S.Gaonkar, Microprocessor Architecture, Programming, and Applications with 8085, Prentice Hall

Reference Books:

1. A.P.Malvino and J.A.Brown, Digital Computer Electronics, 3rd Edition, Tata McGraw Hill D.V.Hall, Microprocessors and Interfacingv – Programming and Hardware, McGraw Hill
2. 8000 to 8085 Introduction to 8085 Microprocessor for Engineers and Scientists, A.K.Gosh, Prentice Hall

Mathematics II

Course Title: Mathematics II
Course No: MTH168
Nature of the Course: Theory
Semester: II

Full Marks: 60 + 40
Pass Marks: 24 + 16
Credit Hrs: 3

Course Description: The course contains concepts and techniques of linear algebra. The course topics include systems of linear equations, determinants, vectors and vector spaces, eigen values and eigenvectors, and singular value decomposition of a matrix.

Course Objectives: The main objective of the course is to make familiarize with the concepts and techniques of linear algebra, solve system of linear equation with Gauss-Jordon method, to impart knowledge of vector space and subspace, eigenvalues and eigenvectors of a matrix and get the idea of diagonalization of a matrix, linear programming, Group, Ring, and Field.

Course Contents:

Unit 1: Linear Equations in Linear Algebra (5 Hrs.)
System of linear equations, Row reduction and Echelon forms, Vector equations, The matrix equations A$\mathbf{x} = \mathbf{b}$, Applications of linear system, Linear independence

Unit 2:Transformation (4 Hrs.)
Introduction to linear transformations, the matrix of a linear Transformation, Linear models in business, science, and engineering

Unit 3: Matrix Algebra (5 Hrs)
Matrix operations, The inverse of a matrix, Characterizations of invertible matrices, Partitioned matrices, Matrix factorization, The Leontief input output model, Subspace of R^n, Dimension and rank

Unit 4: Determinants (4 Hrs.)
Introduction, Properties, Cramer's rule, Volume and linear transformations

Unit 5: Vector Spaces (5 Hrs.)
Vector spaces and subspaces, Null spaces, Column spaces, and Linear transformations, Linearly independent sets: Bases, Coordinate systems

Unit 6: Vector Space Continued (4 Hrs.)
Dimension of vector space and Rank, Change of basis, Applications to difference equations, Applications to Markov Chains

Unit 7: Eigenvalues and Eigen Vectors (5 Hrs.)
Eigenvectors and Eigenvalues, The characteristic equations, Diagonalization, Eigenvectors and linear transformations, Complex eigenvalues, Discrete dynamical systems, Applications to differential equations

Unit 8: Orthogonality and Least Squares (5 Hrs.)
Inner product, Length, and orthoganility, Orthogonal sets, Orthogonal projections, The Gram-Schmidt process, Least squares problems, Application to linear models, Inner product spaces, Applications of inner product spaces

Unit 9: Groups and Subgroups (5 Hrs.)
Binary Operations, Groups, Subgroups, Cyclic Groups

Unit 10: Rings and Fields (4 Hrs.)
Rings and Fields, Integral domains

Text Books:
1. Linear Algebra and Its Applications, David C. Lay, 4th Edition, Pearson Addison Wesley.
2. Linear Algebra and Its Applications, Gilbert Strang, 4th Edition, Addison, CENGAGE Learning.

Statistics I

Course Title: Statistics I
Course No: STA169
Nature of the Course: Theory + Lab
Semester: II

Full Marks: 60 + 20 + 20
Pass Marks: 24 + 8 + 8
Credit Hrs: 3

Course Description: This course contains basics of statistics, descriptive statistics, probability, sampling, random variables and mathematical expectations, probability distribution, correlation and regression.

Course Objectives: The main objective of this course is to impart the knowledge of descriptive statistics, correlation, regression, sampling, theoretical as well as applied knowledge of probability and some probability distributions.

Course Contents:

Unit 1: Introduction (4 Hrs.)
Basic concept of statistics; Application of Statistics in the field of Computer Science & Information technology; Scales of measurement; Variables; Types of Data; Notion of a statistical population

Unit 2: Descriptive Statistics (6 Hrs.)
Measures of central tendency; Measures of dispersion; Measures of skewness; Measures of kurtosis; Moments; Steam and leaf display; five number summary; box plot

Problems and illustrative examples related to computer Science and IT

Unit 3: Introduction to Probability (8 Hrs.)
Concepts of probability; Definitions of probability; Laws of probability; Bayes theorem; prior and posterior probabilities

Problems and illustrative examples related to computer Science and IT

Unit 4: Sampling (3 Hrs.)
Definitions of population; sample survey vs. census survey; sampling error and non sampling error; Types of sampling

5. Random Variables and Mathematical Expectation (5 Hrs.)
Concept of a random variable; Types of random variables; Probability distribution of a random variable; Mathematical expectation of a random variable; Addition and multiplicative theorems of expectation

Problems and illustrative examples related to computer Science and IT

Unit 6: **Probability Distributions (12 Hrs.)**

Probability distribution function**,** Joint probability distribution of two random variables; Discrete distributions: Bernoulli trial, Binomial and Poisson distributions; Continuous distribution: Normal distributions; Standardization of normal distribution; Normal distribution as an approximation of Binomial and Poisson distribution; Exponential, Gamma distribution

Problems and illustrative examples related to computer Science and IT

Unit 7: Correlation and Linear Regression (7 Hrs.)

Bivariate data; Bivariate frequency distribution; Correlation between two variables; Karl Pearson's coefficient of correlation(r); Spearman's rank correlation; Regression Analysis: Fitting of lines of regression by the least squares method; coefficient of determination

Problems and illustrative examples related to computer Science and IT

Laboratory Works:

The laboratory work includes using any statistical software such as Microsoft Excel, SPSS, STATA etc. whichever convenient using Practical problems to be covered in the Computerized Statistics laboratory

Practical problems

S. No.	Title of the practical problems	No. of practical problems
1	Computation of measures of central tendency (ungrouped and grouped data) Use of an appropriate measure and interpretation of results and computation of partition Values	1
2	Computation measures of dispersion (ungrouped and grouped data) and computation of coefficient of variation.	1
3	Measures of skewness and kurtosis using method of moments, Measures of Skewness using Box and whisker plot.	2
4	Scatter diagram, correlation coefficient (ungrouped data) and interpretation. Compute manually and check with computer output.	1
5	Fitting of lines of regression (Results to be verified with computer output)	1
6	Fitting of lines of regression and computation of correlation coefficient, Mean residual sum of squares, residual plot.	1
7	Conditional probability and Bayes theorem	3
8	Obtaining descriptive statistics of probability distributions	2
9	Fitting probability distributions in real data (Binomial, Poisson and Normal)	3
	Total number of practical problems	**15**

Text Books:

1. Michael Baron (2013). Probability and Statistics for Computer Scientists. 2nd Ed., CRC Press, Taylor & Francis Group, A Chapman & Hall Book.
2. Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers, & Keying Ye (2012). Probability & Statistics for Engineers & Scientists. 9th Ed., Printice Hall.

Reference Books:

1. Douglas C. Montgomery & George C. Ranger (2003). Applied Statistics and Probability for Engineers. 3rd Ed., John Willey and Sons, Inc.
2. Richard A. Johnson (2001). Probability and Statistics for Engineers. 6th Ed., Pearson Education, India

Data Structures and Algorithms

Course Title: Data Structures and Algorithms
Course No: CSC211
Nature of the Course: Theory + Lab
Semester: III

Full Marks: 60 + 20 + 20
Pass Marks: 24 + 8 + 8
Credit Hrs: 3

Course Description: This course includes the basic foundations in of data structures and algorithms. This course covers concepts of various data structures like stack, queue, list, tree and graph. Additionally, the course includes idea of sorting and searching.

Course Objectives:

- To introduce data abstraction and data representation in memory
- To describe, design and use of elementary data structures such as stack, queue, linked list, tree and graph
- To discuss decomposition of complex programming problems into manageable sub-problems
- To introduce algorithms and their complexity

Course Contents:

Unit 1: Introduction to Data Structures & Algorithms (4 Hrs.)

1.1 Data types, Data structure and Abstract date type
1.2 Dynamic memory allocation in C
1.3 Introduction to Algorithms
1.4 Asymptotic notations and common functions

Unit 2: Stack (4 Hrs.)

2.1 Basic Concept of Stack, Stack as an ADT, Stack Operations, Stack Applications
2.2 Conversion from infix to postfix/prefix expression, Evaluation of postfix/ prefix expressions

Unit 3: Queue (4 Hrs.)

3.1 Basic Concept of Queue, Queue as an ADT, Primitive Operations in Queue
3.2 Linear Queue, Circular Queue, Priority Queue, Queue Applications

Unit 4: Recursion (3 Hrs.)

4.1 Principle of Recursion, Comparison between Recursion and Iteration, Tail Recursion
4.2 Factorial, Fibonacci Sequence, GCD, Tower of Hanoi(TOH)
4.3 Applications and Efficiency of Recursion

Unit 5: Lists (8 Hrs.)

5.1 Basic Concept, List and ADT, Array Implementation of Lists, Linked List
5.2 Types of Linked List: Singly Linked List, Doubly Linked List, Circular Linked List.
5.3 Basic operations in Linked List: Node Creation, Node Insertion and Deletion from Beginning, End and Specified Position
5.4 Stack and Queue as Linked List

Unit 6: Sorting (8 Hrs.)

6.1 Introduction and Types of sorting: Internal and External sort
6.2 Comparison Sorting Algorithms: Bubble, Selection and Insertion Sort, Shell Sort
6.3 Divide and Conquer Sorting: Merge, Quick and Heap Sort
6.4 Efficiency of Sorting Algorithms

Unit 7: Searching and Hashing (6 Hrs.)

7.1 Introduction to Searching, Search Algorithms: Sequential Search, Binary Search
7.2 Efficiency of Search Algorithms
7.3 Hashing : Hash Function and Hash Tables, Collision Resolution Techniques

Unit 8: Trees and Graphs (8 Hrs.)

8.1 Concept and Definitions, Basic Operations in Binary Tree, Tree Height, Level and Depth
8.2 Binary Search Tree, Insertion, Deletion, Traversals, Search in BST
8.3 AVL tree and Balancing algorithm, Applications of Trees
8.4 Definition and Representation of Graphs, Graph Traversal, Minimum Spanning Trees: Kruskal and Prims Algorithm
8.5 Shortest Path Algorithms: Dijksrtra Algorithm

Laboratory Works:

The laboratory work consists of implementing the algorithms and data structures studied in the course. Student should implement at least following concepts;

- Dynamic memory allocation and deallocation strategies
- Stack operations and Queue operations
- Array and Linked List implementation of List
- Linked List implementation of Stack and Queues
- Sorting, Searching and Hashing algorithms
- Binary Search Trees and AVL Tress
- Graph Representation, Spanning Tree and Shortest Path Algorithms

Text Books:

1. Y Langsam , MJ Augenstein and A.M , Tanenbaum Data Structures using C and C++ , Prentice Hall India, Second Edition 2015

Reference Books:

1. Leen Ammeral, Programmes and Data Structures in C, Wiley Professional Computting
2. G.W Rowe, Introduction to Data Structure and Algroithms with C and C++ , prentice Hall India
3. R.L Kruse, B.P. Leung, C.L. Tondo, Data Structure and Program Design in C Prentice-Hall India

Numerical Method

Course Title: Numerical Method
Course No.: CSC212
Nature of the Course: Theory + Lab
Semester: III

Full Marks: 60 + 20 + 20
Pass Marks: 24 + 8 + 8
Credit Hrs: 3

Course Description: This course contains the concepts of numerical method techniques for solving linear and nonlinear equations, interpolation and regression, differentiation and integration, and partial differential equations.

Course Objectives: The main objective of the course is to provide the knowledge of numerical method techniques for mathematical modeling.

Course Content:

Unit 1: Solution of Nonlinear Equations (8 Hrs.)

1.1 Errors in Numerical Calculations, Sources of Errors, Propagation of Errors, Review of Taylor's Theorem

1.2 Solving Non-linear Equations by Trial and Error method, Half-Interval method and Convergence, Newton's method and Convergence, Secant method and Convergence, Fixed point iteration and its convergence, Newton's method for calculating multiple roots, Horner's method

Unit 2: Interpolation and Regression (8 Hrs.)

2.1 Interpolation vs Extrapolation, Lagrange's Interpolation, Newton's Interpolation using divided differences, forward differences and backward differences, Cubic spline interpolation

2.2 Introduction of Regression, Regression vs Interpolation, Least squares method, Linear Regression, Non-linear Regression by fitting Exponential and Polynomial

Unit 3: Numerical Differentiation and Integration (8 Hrs.)

3.1 Differentiating Continuous Functions (Two-Point and Three-Point Formula), Differentiating Tabulated Functions by using Newton’s Differences, Maxima and minima of Tabulated Functions

3.2 Newton-Cote's Quadrature Formulas, Trapezoidal rule, Multi-Segment Trapezoidal rule, Simpson's 1/3 rule, Multi-Segment Simpson's 1/3 rule, Simpson's 3/8 rule, Multi-Segment Simpson's 3/8 rule, Gaussian integration algorithm, Romberg integration

Unit 4: Solving System of Linear Equations (8 Hrs.)

4.1 Review of the existence of solutions and properties of matrices, Gaussian elimination method, pivoting, Gauss-Jordan method, Inverse of matrix using Gauss-Jordan method

4.2 Matrix factorization and Solving System of Linear Equations by using Dolittle and Cholesky's algorithm

4.3 Iterative Solutions of System of Linear Equations, Jacobi Iteration Method, Gauss-Seidal Method

4.4 Eigen values and eigen vectors problems, Solving eigen value problems using power method.

Unit 5: Solution of Ordinary Differential Equations (8 Hrs.)

5.1 Review of differential equations, Initial value problem, Taylor series method, Picard's method, Euler's method and its accuracy, Heun's method, Runge-Kutta methods

5.2 Solving System of ordinary differential equations, Solution of the higher order equations, Boundary value problems, Shooting method and its algorithm

Unit 6: Solution of Partial Differential Equations (5 Hrs.)

6.1 Review of partial differential equations, Classification of partial differential equation, Deriving difference equations, Laplacian equation and Poisson's equation, engineering examples

Laboratory Works:

The laboratory exercise should consist program development and testing of non-linear equations, system of linear equations, interpolation, numerical integration and differentation, linear algebraic equations, ordinary and partial differential equations.Numerical solutions using C or Matlab.

Text Books:

1. W. Chency and D. Kincaid, "*Numerical Mathematics and Computing*", 7thEdition, Brooks/Cole Publishing Co, 2012
2. C.F. Gerald and P.O. Wheatley, "*Applied Numerical Analysis*", 9thEdition, Addison Wesley Publishing Company, New York, 2011

Reference Books:

1. E. Balagurusamy, “Numerical Methods”, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 1999
2. W.H. Press, B.P. Flannery et al., "*Numerical Recipes: Art of Scientific Computing*", 3rd Edition, Cambridge Press, 2007.
3. J. M. Mathews and K. Fink, “Numerical Methods using MATLAB “, 4rd Edition, Prentice Hall Publication, 2004

Computer Architecture

Course Title: Computer Architecture
Course No: CSC213
Nature of the Course: Theory + Lab
Semester: III

Full Marks: 60 + 20 + 20
Pass Marks: 24 + 8 + 8
Credit Hrs: 3

Course Description: This course includes concepts of instruction set architecture, organization or micro-architecture, and system architecture. The instruction set architecture includes programmer's abstraction of computer. The micro-architecture consist internal representation of computers at register and functional unit level. The system architecture includes organization of computers at the cache and bus level.

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Course Objectives:

- Discuss representation of data and algorithms used to perform operations on data
- Demonstrate different operations in terms of Micro-operations
- Explain architecture of basic computer and micro-programmed control unit
- Understand and memory and I/O organization of a typical computer system
- Demonstrate benefits of pipelined systems

Course Contents:

Unit 1: Data Representation (4 Hrs.)

1.1. Data Representation: Binary Representation, BCD, Alphanumeric Representation, Complements, Fixed Point representation, Representing Negative Numbers, Floating Point Representation, Arithmetic with Complements, Overflow, Detecting Overflow
1.2. Other Binary Codes: Gray Code, self Complementing Code, Weighted Code, Excess-3 Code, EBCDIC
1.3. Error Detection Codes: Parity Bit, Odd Parity, Even parity, Parity Generator & Checker

Unit 2: Register Transfer and Microoperations (5 Hrs.)

2.1. Microoperation, Register Transfer Language, Register Transfer, Control Function
2.2. Arithmetic Microoperations: Binary Adder, Binary Adder-subtractor, Binary Incrementer, Arithmetic Circuit
2.3. Logic Microoperations, Hardware Implementation, Applications of Logic Microoperations.
2.4. Shift Microoperations: Logical Shift, Circular shift, Arithmetic Shift, Hardware Implementation of Shifter.

Unit 3: Basic Computer Organization and Design (8 Hrs.)

3.1. Instruction Code, Operation Code, Stored Program Concept
3.2. Registers and memory of Basic Computer, Common Bus System for Basic Computer.
3.3. Instruction Format, Instruction Set Completeness, Control Unit of Basic Computer, Control Timing Signals

3.4. Instruction Cycle of Basic computer, Determining Type of Instruction, Memory Reference Instructions, Input-Output Instructions, Program Interrupt & Interrupt Cycle.
3.5. Description and Flowchart of Basic Computer

Unit 4: Microprogrammed Control (4 Hrs.)

4.1. Control Word, Microprogram, Control Memory, Control Address Register, Sequencer
4.2. Address Sequencing, Conditional Branch, Mapping of Instructions, Subroutines, Microinstruction Format, Symbolic Microinstructions
4.3. Design of Control Unit

Unit 5: Central Processing Unit (4 Hrs.)

5.1. Major Components of CPU, CPU Organization
5.2. Instruction Formats, Addressing Modes, Data Transfer and manipulation, Program Control, Subroutine Call and Return, Types of Interrupt
5.3. RISC vs CISC, Pros and Cons of RISC and CISC, Overlapped Register Windows

Unit 6: Pipelining (6 Hrs.)

6.1. Parallel Processing, Multiple Functional Units, Flynn's Classification
6.2. Pipelining: Concept and Demonstration with Example, Speedup Equation, Floating Point addition and Subtraction with Pipelining
6.3. Instruction Level Pipelining: Instruction Cycle, Three & Four-Segment Instruction Pipeline, Pipeline Conflicts and Solutions
6.4. Vector Processing, Applications, Vector Operations, Matrix Multiplication

Unit 7: Computer Arithmetic (6 Hrs.)

7.1. Addition and Subtraction with Signed Magnitude Data, Addition and Subtraction with Signed 2's Complement Data
7.2. Multiplication of Signed Magnitude Data, Booth Multiplication, Division of Signed magnitude Data, Divide Overflow

Unit 8: Input Output Organization (4 Hrs.)

8.1. Input-Output Interface: I/O Bus and Interface Modules, I/O vs. Memory Bus, Isolated vs. Memory-Mapped I/O
8.2. Asynchronous Data Transfer: Strobe, Handshaking
8.3. Modes of Transfer: Programmed I/O, Interrupt-Initiated I/O, Direct memory Access
8.4. Priority Interrupt: Polling, Daisy-Chaining, Parallel Priority Interrupt
8.5. Direct Memory Access, Input-Output Processor, DMA vs. IOP

Unit 9: Memory Organization (4 Hrs.)

9.1 Memory Hierarchy, Main Memory, RAM and ROM Chips, Memory address Map, Memory Connection to CPU, Auxiliary Memory (magnetic Disk, Magnetic Tape)
9.1 Associative Memory: Hardware Organization, Match Logic, Read Operation, Write Operation
9.1 Cache Memory: Locality of Reference, Hit & Miss Ratio, Mapping, Write Policies

Laboratory Works:
The laboratory work includes implementing and simulating the algorithms, studied in the course, by using high level languages like C or VHDL. The laboratory works should include at least following concepts;

- Simulate features like overflow, data representation by using VHDL
- Simulate design of different units by using VHDL
- Simulate pipelining by using VHDL
- Implement algorithms for computer arithmetic using high level language like C or C++

Text Books:

1. M. Morris Mano, "Computer System Architecture", Prentice-Hall of India, Pvt. Ltd., Third edition, 2007

References Books:

1. William Stallings, "Computer Organization and Architecture", Prentice-Hall of India, Pvt. Ltd., Seventh edition, 2005.
2. Vincent P. Heuring and Harry F. Jordan, "Computer System Design and Architecture", Prentice-Hall of India, Pvt. Ltd., Second edition, 2003.

Computer Graphics

Course Title: Computer Graphics
Course no: CSC214
Nature of the Course: Theory + Lab
Semester: III

Full Marks: 60 + 20 + 20
Pass Marks: 24 + 8 + 8
Credit Hrs: 3

Course Description: The course covers concepts of graphics hardware, software, and applications, data structures for representing 2D and 3D geometric objects, drawing algorithms for graphical objects, techniques for representing and manipulating geometric objects, illumination and lighting models, and concept of virtual reality.

Course Objectives: The objective of this course is to understand the theoretical foundation as well as the practical applications of 2D and 3D graphics.

Course Contents:

Unit 1: Introduction of Computer Graphics (3 Hrs.)

1.1 A Brief Overview of Computer Graphics, Areas of Applications.
1.2 Graphics Hardware: Display Technology, Architecture of Raster-Scan Displays,Vector Displays, Display Processors, Hard copy device. Input Devices**.**
1.3 Graphics Software: Software standards, Need of machine independent graphics language.

Unit 2: Scan Conversion Algorithm (6 Hrs.)

2.1 Scan Converting a Point and a straight Line: DDA Line Algorithm, Bresenham's Line Algorithm
2.2 Scan Converting Circle and Ellipse :Mid Point Circle and Ellipse Algorithm
2.3 Area Filling: Scan Line Polygon fill Algorithm, Inside-outside Test, Scan line fill of Curved Boundary area, Boundary-fill and Flood-fill algorithm

Unit 3: Two-Dimensional Geometric Transformations (5 Hrs.)

3.1 Two-Dimensional translation, Rotation, Scaling, Reflection and Shearing
3.2 Homogeneous Coordinate and 2D Composite Transformations. Transformation between Co-ordinate Systems.
3.3 Two Dimensional Viewing: Viewing pipeline, Window to viewport coordinate transformation
3.4 Clipping: Point, Lines(Cohen Sutherland line clipping, Liang-Barsky Line Clipping) , Polygon Clipping(Sutherland Hodgeman polygon clipping)

Unit 4: Three-Dimensional Geometric Transformation (5 Hrs.)

4.1 Three-Dimensional translation, Rotation, Scaling, Reflection and Shearing
4.2 Three-Dimensional Composite Transformations
4.3 Three-Dimensional Viewing: Viewing pipeline, world to screen viewing transformation, Projection concepts(Orthographic, parallel, perspective projections)

Unit 5: 3D Objects Representation (7 Hrs.)

5.1 Representing Surfaces: Boundary and Space partitioning

5.1.1 Polygon Surface: Polygon tables , Surface normal and Spatial orientation of surfaces, Plane equations, Polygon meshes
5.1.2 Wireframe Representation
5.1.3 Blobby Objects

5.2 Representing Curves: Parametric Cubic Curves, Spline Representation, Cubic spline interpolation, Hermite Curves, Bezier and B-spline Curve and surface

5.3 Quadric Surface: Sphere and Ellipsoid

Unit 6: Solid Modeling (4 Hrs.)

6.1 Sweep ,Boundary and Spatial-Partitioning Representation

6.2 Binary Space Partition Trees (BSP)

6.3 Octree Representation

Unit 7: Visible Surface Detections (5 Hrs.)

7.1 Image Space and Object Space Techniques

7.2 Back Face Detection, Depth Buffer (Z-buffer), A-Buffer and Scan-Line Algorithms.

7.3 Depth Sorting Method (Painter's Algorithm)

7.4 BSP tree Method, Octree and Ray Tracing

Unit 8: Illumination Models and Surface Rendering Techniques (5 Hrs.)

8.1 Basic Illumination Models: Ambient light, Diffuse reflection, Specular reflection and Phong model

8.2 Intensity attenuation and Color consideration ,Transparency, Shadows

8.3 Polygon Rendering Methods : Constant intensity shading, Gouraud shading , Phong Shading and Fast Phong Shading

Unit 9: Introduction to Virtual Reality (2 Hrs.)

9.1 Concept of Virtual reality

9.2 Virtual Reality Components of VR System, Types of VR System, 3D Position Trackers, Navigation and Manipulation Interfaces

9.3 Application of VR

Unit 10: Introduction to OpenGL (3 Hrs.)

1.1 Introduction, Callback functions, Color commands, Drawings pixels, lines, polygons using OpenGL, Viewing and Lighting

Laboratory Works:

The laboratory course consists of implementing following algorithms using high level languages and OpenGL.

1. DDA Line Algorithm
2. Bresenham's line drawing algorithm
3. Mid Point Circle Algorithm
4. Mid Point Ellipse Algorithm
5. Basic transformation on 2D including Translation, Rotation and Scaling
6. Simple 3D Object with basic transformations including Translation, Rotation and Scaling

7. Clipping
8. Hidden surface removal
9. Basic Drawing Techniques in OpenGL

Text Books:

1. Donald Hearne and M. Pauline Baker, “Computer Graphics, C Versions.” Prentice Hall

Reference Books:

1. J.D. Foley, S.K. Feiner and J.F. Hughes, “Computer Graphics – Principles and Practises” (Second Edition in C)
2. R.K. Maurya, “Computer Graphics with Virtual Reality”, Wiley India
3. F.S. Hill, Stephen M.Kelley, “Computer Graphics using Open GL” Prentice Hall

Statistics II

Course Title: Statistics II
Course No: STA215
Nature of Course: Theory + Lab
Semester: III

Full Marks: 60 + 20 + 20
Pass Marks: 24 + 8 + 8
Credit Hrs: 3

Course Description: The course consists of concepts of sampling, testing hypothesis, parametric and non parametric tests, correlation and regression, experimental designs and stochastic processes.

Course Objectives: The main objective of the course is to acquire the theoretical as well as practical knowledge of estimation, testing of hypothesis, application of parametric and non-parametric statistical tests, design of experiments, multiple regression analysis, and basic concept of stochastic process with special focus to data/problems related with computer science and information technology

Course Contents:

Unit 1: Sampling Distribution and Estimation (6 Hrs.)

Sampling distribution; sampling distribution of mean and proportion; Central Limit Theorem; Concept of inferential Statistics; Estimation; Methods of estimation; Properties of good estimator; Determination of sample size; Relationship of sample size with desired level of error

Problems and illustrative examples related to computer Science and IT

Unit 2: Testing of hypothesis (8 Hrs.)

Types of statistical hypotheses; Power of the test, concept of p-value and use of p -value in decision making, steps used in testing of hypothesis, one sample tests for mean of normal population (for known and unknown variance), test for single proportion, test for difference between two means and two proportions, paired sample t-test; Linkage between confidence interval and testing of hypothesis

Problems and illustrative examples related to computer Science and IT

Unit 3: Non parametric test (8 Hrs.)

Parametric vs. non-parametric test; Needs of applying non-parametric tests; One-sample test: Run test, Binomial test**,** Kolmogorov–Smirnov test; Two independent sample test: Median test, Kolmogorov-Smirnov test, Wilcoxon Mann Whitney test, Chi-square test; Paired-sample test: Wilcoxon signed rank test; Cochran's Q test; Friedman two way analysis of variance test; Kruskal Wallis test

Problems and illustrative examples related to computer Science and IT

Unit 4: Multiple correlation and regression (6 Hrs.)

Multiple and partial correlation; Introduction of multiple linear regression; Hypothesis testing of multiple regression; Test of significance of regression; Test of individual regression coefficient; Model adequacy tests

Problems and illustrative examples related to computer Science and IT

Unit 5: **Design of experiment (10 Hrs.)**
Experimental design; Basic principles of experimental designs; Completely Randomized Design (CRD); Randomized Block Design (RBD); ANOVA table, Efficiency of RBD relative to CRD, Estimations of missing value (one observation only), Advantages and disadvantages; Latin Square Design (LSD): Statistical analysis of $m \times m$ LSD for one observation per experimental unit, ANOVA table, Estimation of missing value in LSD (one observation only), Efficiency of LSD relative to RBD, Advantage and disadvantages.

Problems and illustrative examples related to computer Science and IT

Unit 6: Stochastic Process (7 Hrs.)
Definition and classification; Markov Process: Markov chain, Matrix approach, Steady- State distribution; Counting process: Binomial process, Poisson process; Simulation of stochastic process; Queuing system: Main component of queuing system, Little's law; Bernoulli single server queuing process: system with limited capacity; M/M/1 system: Evaluating the system performance.

Laboratory Works:

The laboratory work includes implementing concepts of statistics using statistical software tools such as SPSS, STATA etc.

S. No.	Practical problems	No. of practical problems
1	Sampling distribution, random number generation, and computation of sample size	1
2	Methods of estimation (including interval estimation)	1
3	Parametric tests (covering most of the tests)	3
4	Non-parametric test(covering most of the tests)	3
5	Partial correlation	1
6	Multiple regression	1
7	Design of Experiments	3
	Stochastic process	2
	Total number of practical problems	**15**

Text Books:

1. Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers, & Keying Ye(2012). Probability & Statistics for Engineers & Scientists. 9th Ed., Printice Hall

2. Michael Baron (2013). Probability and Statistics for Computer Scientists. 2nd Ed., CRC Press, Taylor & Francis Group, A Chapman & Hall Book

Reference Books:

1. Douglas C. Montgomery & George C. Runger (2003). Applied Statistics and Probability for Engineers. 3rd Ed., John Willey and Sons, Inc.

2. Sidney Siegel, & N. John Castellan, Jr. Nonparametric Statistics for the Behavioral Sciences, 2nd Ed., McGraw Hill International Editions.

Theory of Computation

Course Title: Theory of Computation **Full Marks:** 60 + 20 + 20
Course No: CSC262 **Pass Marks:** 24 + 8 + 8
Nature of the Course: Theory + Lab **Credit Hrs:** 3
Semester: IV

Course Description: This course presents a study of Finite State Machines and their languages. It covers the details of finite state automata, regular expressions, context free grammars. More, the course includes design of the Push-down automata and Turing Machines. The course also includes basics of undecidabilty and intractability.

Course Objectives: The main objective of the course is to introduce concepts of the models of computation and formal language approach to computation. The general objectives of this course are to, introduce concepts in automata theory and theory of computation, design different finite state machines and grammars and recognizers for different formal languages, identify different formal language classes and their relationships, determine the decidability and intractability of computational problems.

Course Contents:

Unit I: Basic Foundations (3 Hrs.)

1.1. Review of Set Theory, Logic, Functions, Proofs
1.2. Automata, Computability and Complexity: Complexity Theory, Computability Theory, Automata Theory
1.3. Basic concepts of Automata Theory: Alphabets, Power of Alphabet, Kleen Closure Alphabet, Positive Closure of Alphabet, Strings, Empty String, Substring of a string, Concatenation of strings, Languages, Empty Language

Unit II: Introduction to Finite Automata (8 Hrs.)

2.1 Introduction to Finite Automata, Introduction of Finite State Machine
2.2 Deterministic Finite Automata (DFA), Notations for DFA, Language of DFA, Extended Transition Function of DFA Non-Deterministic Finite Automaton (NFA), Notations for NFA, Language of NFA, Extended Transition
2.3 Equivalence of DFA and NFA, Subset-Construction
2.4 Method for reduction of NFA to DFA, Theorems for equivalence of Language accepted by DFA and NFA
2.5 Finite Automaton with Epsilon Transition (ε - NFA), Notations for ε - NFA, Epsilon Closure of a State, Extended Transition Function of ε – NFA, Removing Epsilon Transition using the concept of Epsilon Closure, Equivalence of NFA and ε –NFA, Equivalence of DFA and ε – NFA
2.6 Finite State Machines with output: Moore machine and Mealy Machines

Unit III: Regular Expressions (6 Hrs.)

3.1 Regular Expressions, Regular Operators, Regular Languages and their applications, Algebraic Rules for Regular Expressions

3.2 Equivalence of Regular Expression and Finite Automata, Reduction of Regular Expression to ε – NFA, Conversion of DFA to Regular Expression

3.3 Properties of Regular Languages, Pumping Lemma, Application of Pumping Lemma, Closure Properties of Regular Languages over (Union, Intersection, Complement) Minimization of Finite State Machines: Table Filling Algorithm

Unit IV: Context Free Grammar (9 Hrs.)

4.1 Introduction to Context Free Grammar (CFG), Components of CFG, Use of CFG, Context Free Language (CFL)

4.2 Types of derivations: Bottomup and Topdown approach, Leftmost and Rightmost, Language of a grammar

4.3 Parse tree and its construction, Ambiguous grammar, Use of parse tree to show ambiguity in grammar

4.4 Regular Grammars: Right Linear and Left Linear, Equivalence of regular grammar and finite automata

4.5 Simplification of CFG: Removal of Useless symbols, Nullable Symbols, and Unit Productions, Chomsky Normal Form (CNF), Greibach Normal Form (GNF), Backus-Naur Form (BNF)

4.6 Context Sensitive Grammar, Chomsky Hierarchy Pumping Lemma for CFL, Application of Pumping Lemma, Closure Properties of CFL

Unit V: Push Down Automata (7 Hrs.)

5.1 Introduction to Push Down Automata (PDA), Representation of PDA, Operations of PDA, Move of a PDA, Instantaneous Description for PDA

5.2 Deterministic PDA, Non Deterministic PDA, Acceptance of strings by PDA, Language of PDA

5.3 Construction of PDA by Final State , Construction of PDA by Empty Stack,

5.4 Conversion of PDA by Final State to PDA accepting by Empty Stack and vice-versa, Conversion of CFG to PDA, Conversion of PDA to CFG

Unit VI: Turing Machines (10 Hrs.)

6.1 Introduction to Turing Machines (TM), Notations of Turing Machine, Language of a Turing Machine, Instantaneous Description for Turing Machine, Acceptance of a string by a Turing Machines

6.2 Turing Machine as a Language Recognizer, Turing Machine as a Computing Function, Turing Machine with Storage in its State, Turing Machine as a enumerator of stings of a language, Turing Machine as Subroutine

6.3 Turing Machine with Multiple Tracks, Turing Machine with Multiple Tapes, Equivalence of Multitape-TM and Multitrack-TM, Non-Deterministic Turing Machines, Restricted Turing Machines: With Semi-infinite Tape, Multistack Machines, Counter Machines

6.4 Curch Turing Thesis, Universal Turing Machine, Turing Machine and Computers, Encoding of Turing Machine, Enumerating Binary Strings, Codes of Turing Machine, Universal Turing Machine for encoding of Turing Machine

Unit VII: Undecidability and Intractability (5 Hrs.)

7.1 Computational Complexity, Time and Space complexity of A Turing Machine, Intractability
7.2 Complexity Classes, Problem and its types: Absract, Decision, Optimization
7.3 Reducibility, Turing Reducible, Circuit Satisfiability, Cook's Theorem,
7.4 Undecidability, Undecidable Problems: Post's Correspondence Problem, Halting Problem and its proof, Undecidable Problem about Turing Machines

Laboratory Works:

The laboratory work consists of design and implementation of finite state machines like DFA, NFA, PDA, and Turing Machine. Students are highly recommended to construct Tokenizers/ Lexers over/for some language. Students are advised to use regex and Perl (for using regular expressions), or any other higher level language for the laboratory works.

Text Books:

1. John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, Introduction to Automata Theory, Languages, and Computation, 3rd Edition, Pearson - Addison-Wesley.

Reference Books:

1. Harry R. Lewis and Christos H. Papadimitriou, Elements of the Theory of Computation, 2nd Edition, Prentice Hall.
2. Michael Sipser, Introduction to the Theory of Computation, 3rd Edition, Thomson Course Technology
3. Efim Kinber, Carl Smith, Theory of Computing: A Gentle introduction, Prentice- Hall.
4. John Martin, Introduction to Languages and the Theory of Computation, 3rd Edition, Tata McGraw Hill.
5. Kenneth H. Rosen, Discrete Mathematics and its Applications to Computers Science, WCB/Mc-Graw Hill.

Computer Networks

Course Title: Computer Networks
Course No: CSC263
Nature of the Course: Theory + Lab
Semester: IV

Full Marks: 60 + 20 + 20
Pass Marks: 24 + 8 + 8
Credit Hrs: 3

Course Description: This course introduces concept of computer networking and discuss the different layers of networking model.

Course Objective: The main objective of this course is to introduce the understanding of the concept of computer networking with its layers, topologies, protocols & standards, IPv4/IPv6 addressing, Routing and Latest Networking Standards

Course Contents:

Unit 1: Introduction to Computer Network (6Hrs.)

1.1. Definitions, Uses, Benefits
1.2. Overview of Network Topologies (Star, Tree, Bus,...)
1.3. Overview of Network Types (PAN, LAN, CAN, MAN,...)
1.4. Networking Types (Client/Server, P2P)
1.5. Overview of Protocols and Standards
1.6. OSI Reference Model
1.7. TCP/IP Models and its comparison with OSI.
1.8. Connection and Connection-Oriented Network Services
1.9. Internet, ISPs, Backbone Network Overview

Unit 2: Physical Layer and Network Media (4Hrs.)

2.1. Network Devices: Repeater, Hub, Switch, Bridge, Router
2.2. Different types of transmission medias (wired: twisted pair, coaxial, fiber optic, Wireless: Radio waves, micro waves, infrared)
2.3. Ethernet Cable Standards (UTP & Fiber cable standards)
2.4. Circuit, Message & Packet Switching
2.5. ISDN: Interface and Standards

Unit 3: Data Link Layer (8Hrs.)

3.1. Function of Data Link Layer (DLL)
3.2. Overview of Logical Link Control (LLC) and Media Access Control (MAC)
3.3. Framing and Flow Control Mechanisms
3.4. Error Detection and Correction techniques
3.5. Channel Allocation Techniques (ALOHA, Slotted ALOHA)
3.6. Ethernet Standards (802.3 CSMA/CD, 802.4 Token Bus, 802.5 Token Ring)
3.7. Wireless LAN: Spread Spectrum, Bluetooth, Wi-Fi
3.8. Overview Virtual Circuit Switching, Frame Relay& ATM
3.9. DLL Protocol: HDLC, PPP

Unit 4: Network Layer (10Hrs.)

4.1. Introduction and Functions
4.2. IPv4 Addressing & Sub-netting
4.3. Class-full and Classless Addressing
4.4. IPv6 Addressing and its Features
4.5. IPv4 and IPv6 Datagram Formats
4.6. Comparison of IPv4 and IPv6 Addressing
4.7. Example Addresses: Unicast, Multicast and Broadcast
4.8. Routing
    4.8.1. Introduction and Definition
    4.8.2. Types of Routing (Static vs Dynamic, Unicast vs Multicast, Link State vs Distance Vector, Interior vs Exterior)
    4.8.3. Path Computation Algorithms: Bellman Ford, Dijkstra's
    4.8.4. Routing Protocols: RIP, OSPF & BGP
4.9. Overview of IPv4 to IPv6 Transition Mechanisms
4.10. Overview of ICMP/ICMPv6&NATing
4.11. Overview of Network Traffic Analysis
4.12. Security Concepts: Firewall & Router Access Control

Unit 5: Transport Layer (6Hrs.)

5.1. Introduction, Functions and Services
5.2. Transport Protocols: TCP, UDP and Their Comparisons
5.3. Connection Oriented and Connectionless Services
5.4. Congestion Control: Open Loop & Closed Loop, TCP Congestion Control
5.5. Traffic Shaping Algorithms: Leaky Bucket & Token Bucket
5.6. Queuing Techniques for Scheduling
5.7. Introduction to Ports and Sockets, Socket Programming

Unit 6: Application Layer (7Hrs.)

6.1. Introduction and Functions
6.2. Web &HTTP
6.3. DNS and the Query Types
6.4. File Transfer and Email Protocols: FTP, SFTP, SMTP, IMAP, POP3
6.5. Overview of Application Server Concepts: Proxy, Web, Mail
6.6. Network Management: SNMP

Unit 7: Multimedia &Future Networking (4Hrs.)

7.1. Overview Multimedia Streaming Protocols: SCTP
7.2. Overview of SDN and its Features, Data and Control Plane
7.3. Overview of NFV
7.4. Overview of NGN

Laboratory Works:

The lab activities under this subject should accommodate at least the following;

1. Understanding of Network equipment, wiring in details
2. OS (Ubuntu/CentOS/Windows) installation, practice on basic Networking commands

(ifconfig/ipconfig, tcpdump, netstat, dnsip, hostname, route...)

3. Overview of IP Addressing and sub-netting, static ip setting on Linux/windows machine, testing
4. Introduction to Packet Tracer, creating of a LAN and connectivity test in the LAN, creation of VLAN and VLAN trunking.
5. Basic Router Configuration, Static Routing Implementation
6. Implementation of Dynamic/interior/exterior routing (RIP, OSPF, BGP)
7. Firewall Implementation, Router Access Control List (ACL)
8. Packet capture and header analysis by wire-shark (TCP,UDP,IP)
9. DNS, Web, FTP server configuration (shall use packet tracer, GNS3)
10. Case Study: Network Operation Center Visit (ISP, Telecom, University Network)
11. LAB Exam, Report and VIVA

Text Books:

1. Data Communications and Networking, 4th Edition, Behrouz A Forouzan. McGraw-Hill
2. Computer Networking; A Top Down Approach Featuring The Internet, 2nd Edition, Kurose James F., Ross W. Keith PEARSON EDUCATION ASIA

Operating Systems

Course Title: Operating Systems **Full Marks:** 60+ 20+20
Course No: CSC264 **Pass Marks:** 24+8+8
Nature of the Course: Theory + Lab **Credit Hrs:** 3
Semester: IV

Course Description: This course includes the basic concepts of operating system components. It consists of process management, deadlocks and process synchronization, memory management techniques, File system implementation, and I/O device management principles. It also includes case study on Linux operating system.

Course Objectives:

- Describe need and role of operating system.
- Understand OS components such a scheduler, memory manager, file system handlers and I/O device managers.
- Analyze and criticize techniques used in OS components
- Demonstrate and simulate algorithms used in OS components
- Identify algorithms and techniques used in different components of Linux

Course Contents:

Unit 1: Operating System Overview (4 Hrs.)

1.1. Definition, Two views of operating system, Evolution of operating system, Types of OS.
1.2. System Call, Handling System Calls, System Programs, Operating System Structures, The Shell, Open Source Operating Systems

Unit 2: Process Management (10 Hrs.)

2.1. Process vs Program, Multiprogramming, Process Model, Process States, Process Control Block.
2.2. Threads, Thread vs Process, User and Kernel Space Threads.
2.3. Inter Process Communication, Race Condition, Critical Section
2.4. Implementing Mutual Exclusion: Mutual Exclusion with Busy Waiting (Disabling Interrupts, Lock Variables, Strict Alteration, Peterson's Solution, Test and Set Lock), Sleep and Wakeup, Semaphore, Monitors, Message Passing,
2.5. Classical IPC problems: Producer Consumer, Sleeping Barber, Dining Philosopher Problem
2.6. Process Scheduling: Goals, Batch System Scheduling (First-Come First-Served, Shortest Job First, Shortest Remaining Time Next), Interactive System Scheduling (Round-Robin Scheduling, Priority Scheduling, Multiple Queues), Overview of Real Time System Scheduling

Unit 3: Process Deadlocks (6 Hrs.)

3.1. Introduction, Deadlock Characterization, Preemptable and Non-preemptable Resources, Resource – Allocation Graph, Conditions for Deadlock

3.2. Handling Deadlocks: Ostrich Algorithm, Deadlock prevention, Deadlock Avoidance, Deadlock Detection (For Single and Multiple Resource Instances), Recovery From Deadlock (Through Preemption and Rollback)

Unit 4: Memory Management (8 Hrs.)

4.1. Introduction, Monoprogramming vs. Multi-programming, Modelling Multiprogramming, Multiprogramming with fixed and variable partitions, Relocation and Protection.
4.2. Memory management (Bitmaps & Linked-list), Memory Allocation Strategies
4.3. Virtual memory: Paging, Page Table, Page Table Structure, Handling Page Faults, TLB's
4.4. Page Replacement Algorithms: FIFO, Second Chance, LRU, Optimal, LFU, Clock, WS-Clock, Concept of Locality of Reference, Belady's Anomaly
4.5. Segmentation: Need of Segmentation, its Drawbacks, Segmentation with Paging(MULTICS)

Unit 5: File Management (6 Hrs.)

5.1. File Overview: File Naming, File Structure, File Types, File Access, File Attributes, File Operations, Single Level, two Level and Hierarchical Directory Systems, File System Layout.
5.2. Implementing Files: Contiguous allocation, Linked List Allocation, Linked List Allocation using Table in Memory, Inodes.
5.3. Directory Operations, Path Names, Directory Implementation, Shared Files
5.4. Free Space Management: Bitmaps, Linked List

Unit 6: Device Management (6 Hrs.)

6.1. Classification of IO devices, Controllers, Memory Mapped IO, DMA Operation, Interrupts
6.2. Goals of IO Software, Handling IO(Programmed IO, Interrupt Driven IO, IO using DMA), IO Software Layers (Interrupt Handlers, Device Drivers)
6.3. Disk Structure, Disk Scheduling (FCFS, SSTF, SCAN, CSCAN, LOOK, CLOOK), Disk Formatting (Cylinder Skew, Interleaving, Error handling), RAID

Unit 7: Linux Case Study (5 Hrs.)

7.1 History, Kernel Modules, Process Management, Scheduling, Inter-process Communication, Memory Management, File System Management Approaches, Device Management Approaches.

Laboratory Works:

The laboratory work includes solving problems in operating system. The lab work should include at least;

- Learn basic Linux Commands
- Create process, threads and implement IPC techniques
- Simulate process Scheduling algorithms and deadlock detection algorithms
- Simulate page replacement algorithms
- Simulate free space management techniques and disk scheduling algorithms.

Text Books:

1. Modern Operating Systems: Andrew S. Tanenbaum, PH1 Publication, Third edition, 2008

Reference Books:

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, "Operating System Concepts", John Wiley & Sons (ASIA) Pvt. Ltd, Seventh edition, 2005.
2. Harvey M. Deitel, Paul J. Deitel, and David R. Choffnes, "Operating Systems, Prentice Hall, Third edition, 2003.

Database Management System

Course Title: Database Management System
Course No: CSC265
Nature of the Course: Theory + Lab
Semester: IV

Full Marks: 60 + 20 + 20
Pass Marks: 24 + 8 + 8
Credit Hrs: 3

Course Description: The course covers the basic concepts of databases, database system concepts and architecture, data modeling using ER diagram, relational model, SQL, relational algebra and calculus, normalization, transaction processing, concurrency control, and database recovery.

Course Objective: The main objective of this course is to introduce the basic concepts of database, data modeling techniques using entity relationship diagram, relational algebra and calculus, basic and advanced features SQL, normalization, transaction processing, concurrency control, and recovery techniques.

Course Contents:

Unit 1: Database and Database Users (2 Hrs.)
Introduction; Characteristics of the Database Approach; Actors on the Scene; Workers behind the Scene; Advantages of Using the DBMS Approach

Unit 2: Database System – Concepts and Architecture (3 Hrs.)
Data Models, Schemas, and Instances; Three-Schema Architecture and Data Independence; Database Languages and Interfaces; the Database System Environment; Centralized and Client/Server Architectures for DBMSs; Classification of Database Management Systems

Unit 3: Data Modeling Using the Entity-Relational Model (6 Hrs.)
Using High-Level Conceptual Data Models for Database Design; Entity Types, Entity Sets, Attributes, and Keys; Relationship Types, Relationship Sets, Roles, and Structural Constraints; Weak Entity Types; ER Diagrams, Naming Conventions, and Design Issues; Relationship Types of Degree Higher Than Two; Subclasses, Superclasses, and Inheritance; Specialization and Generalization; Constraints and Characteristics of Specialization and Generalization

Unit 4: The Relational Data Model and Relational Database Constraints (3 Hrs.)
Relational Model Concepts; Relational Model Constraints and Relational Database Schemas; Update Operations, Transactions, and Dealing with Constraint Violations

Unit 5: The Relational Algebra and Relational Calculus (5 Hrs.)
Unary Relational Operations: SELECT and PROJECT; Relational Algebra Operations from Set Theory; Binary Relational Operations: JOIN and DIVISION; Additional Relational Operations; the Tuple Relational Calculus; the Domain Relational Calculus

Unit 6: SQL (8 Hrs.)
Data Definition and Data Types; Specifying Constraints; Basic Retrieval Queries; Complex Retrieval Queries; INSERT, DELETE, and UPDATE Statements; Views

Unit 7: Relational Database Design (7 Hrs.)
Relational Database Design Using ER-to-Relational Mapping; Informal Design Guidelines for Relational Schemas; Functional Dependencies; Normal Forms Based on Primary Keys; General Definitions of Second and Third Normal Forms; Boyce-Codd Normal Form; Multivalued Dependency and Fourth Normal Form; Properties of Relational Decomposition

Unit 8: Introduction to Transaction Processing Concepts and Theory (4 Hrs.)
Introduction to Transaction Processing; Transaction and System Concepts; Desirable Properties of Transactions; Characterizing Schedules Based on Recoverability; Characterizing Schedules Based on Serializability

Unit 9: Concurrency Control Techniques (4 Hrs.)
Two-Phase Locking Technique; Timestamp Ordering; Multiversion Concurrency Control**;** Validation (Optimistic) Techniques and Snapshot Isolation Concurrency Control

Unit 10: Database Recovery Techniques (3 Hrs.)
Recovery Concepts; NO-UNDO/REDO Recovery Based on Deferred Update; Recovery Technique Based on Immediate Update; Shadow Paging; Database Backup and Recovery from Catastrophic Failures

Laboratory Works:
The laboratory work includes writing database programs to create and query databases using basic and advanced features of structured query language (SQL).

Text Books:
1. Fundamentals of Database Systems; Seventh Edition; Ramez Elmasri, Shamkant B. Navathe; Pearson Education
2. Database System Concepts; Sixth Edition; Avi Silberschatz, Henry F Korth, S Sudarshan; McGraw-Hill

Reference Books:
1. Database Management Systems; Third Edition; Raghu Ramakrishnan, Johannes Gehrke; McGraw-Hill
2. A First Course in Database Systems; Jaffrey D. Ullman, Jennifer Widom; Third Edition; Pearson Education Limited

Artificial Intelligence

Course Title: Artificial Intelligence
Course No: CSC266
Nature of the Course: Theory + Lab
Semester: IV

Full Marks: 60 + 20 + 20
Pass Marks: 24 + 8 + 8
Credit Hrs: 3

Course Description: The course introduces the ideas and techniques underlying the principles and design of artificial intelligent systems. The course covers the basics and applications of AI, including: design of intelligent agents, problem solving, searching, knowledge representation systems, probabilistic reasoning, neural networks, machine learning and natural language processing.

Course Objectives: The main objective of the course is to introduce fundamental concepts of Artificial Intelligence. The general objectives are to learn about computer systems that exhibit intelligent behavior, design intelligent agents, identify AI problems and solve the problems, design knowledge representation and expert systems, design neural networks for solving problems, identify different machine learning paradigms and identify their practical applications.

Course Contents:

Unit I: Introduction (3 Hrs.)

1.1. Artificial Intelligence (AI), AI Perspectives: acting and thinking humanly, acting and thinking rationally
1.2. History of AI
1.3. Foundations of AI
1.4. Applications of AI

Unit II: Intelligent Agents (4 Hrs.)

2.1. Introduction of agents, Structure of Intelligent agent, Properties of Intelligent Agents
2.2. Configuration of Agents, PEAS description of Agents
2.3. Types of Agents: Simple Reflexive, Model Based, Goal Based, Utility Based.
2.4. Environment Types: Deterministic, Stochastic, Static, Dynamic, Observable, Semi-observable, Single Agent, Multi Agent

Unit III: Problem Solving by Searching (9 Hrs.)

3.1. Definition, Problem as a state space search, Problem formulation, Well-defined problems,
3.2. Solving Problems by Searching, Search Strategies, Performance evaluation of search techniques
3.3. Uninformed Search: Depth First Search, Breadth First Search, Depth Limited Search, Iterative Deepening Search, Bidirectional Search
3.4. Informed Search: Greedy Best first search, A* search, Hill Climbing, Simulated Annealing
3.5. Game playing, Adversarial search techniques, Mini-max Search, Alpha-Beta Pruning.
3.6. Constraint Satisfaction Problems

Unit IV: Knowledge Representation (14 Hrs.)

4.1. Definition and importance of Knowledge, Issues in Knowledge Representation, Knowledge Representation Systems, Properties of Knowledge Representation Systems.
4.2. Types of Knowledge Representation Systems: Semantic Nets, Frames, Conceptual Dependencies, Scripts, Rule Based Systems, Propositional Logic, Predicate Logic
4.3. Propositional Logic(PL): Syntax, Semantics, Formal logic-connectives, truth tables, tautology, validity, well-formed-formula, Inference using Resolution, Backward Chaining and Forward Chaining
4.4. Predicate Logic: FOPL, Syntax, Semantics, Quantification, Inference with FOPL: By converting into PL (Existential and universal instantiation), Unification and lifting, Inference using resolution
4.5. Handling Uncertain Knowledge, Radom Variables, Prior and Posterior Probability, Inference using Full Joint Distribution, Bayes' Rule and its use, Bayesian Networks, Reasoning in Belief Networks
4.6. Fuzzy Logic

Unit V: Machine Learning (9 Hrs.)

5.1. Introduction to Machine Learning, Concepts of Learning, Supervised, Unsupervised and Reinforcement Learning
5.2. Statistical-based Learning: Naive Bayes Model
5.3. Learning by Genetic Algorithm
5.4. Learning with Neural Networks: Introduction, Biological Neural Networks Vs. Artificial Neural Networks (ANN), Mathematical Model of ANN, Types of ANN: Feed-forward, Recurrent, Single Layered, Multi-Layered, Application of Artificial Neural Networks, Learning by Training ANN, Supervised vs. Unsupervised Learning, Hebbian Learning, Perceptron Learning, Back-propagation Learning

Unit VI: Applications of AI (6 Hrs.)

6.1. Expert Systems, Development of Expert Systems
6.2. Natural Language Processing: Natural Language Understanding and Natural Language Generation, Steps of Natural Language Processing
6.3. Machine Vision Concepts
6.4. Robotics

Laboratory Works:

The laboratory work consists of design and implementation of intelligent agents and expert systems, searching techniques, knowledge representation systems and machine learning techniques. Students are also advised to implement Neural Networks, Genetic Algorithms for solving practical problems of AI. Students are advised to use LISP, PROLOG, or any other high level language.

Text Books:

1. Stuart Russel and Peter Norvig, *Artificial Intelligence A Modern Approach*, Pearson

Reference Books:

1. E. Rich, K. Knight, Shivashankar B. Nair, *Artificial Intelligence,* Tata McGraw Hill.
2. George F. Luger, *Artificial Intelligence: Structures and Strategies for Complex Problem Solving,* Benjamin/Cummings Publication
3. D. W. Patterson, *Artificial Intelligence and Expert Systems,* Prentice Hall.
4. P. H. Winston, *Artificial Intelligence,* Addison Wesley.

Design and Analysis of Algorithms

Course Title: Design and Analysis of Algorithms
Course No: CSC325
Nature of the Course: Theory + Lab
Semester: V

Full Marks: 60 + 20 + 20
Pass Marks: 24 + 8 + 8
Credit Hrs: 3

Course Description: This course introduces basic elements of the design and analysis of computer algorithms. Topics include asymptotic notations and analysis, divide and conquer strategy, greedy methods, dynamic programming, basic graph algorithms, NP-completeness, and approximation algorithms. For each topic, beside in-depth coverage, one or more representative problems and their algorithms shall be discussed.

Course Objectives:

- Analyze the asymptotic performance of algorithms.
- Demonstrate a familiarity with major algorithm design techniques
- Apply important algorithmic design paradigms and methods of analysis.
- Solve simple to moderately difficult algorithmic problems arising in applications.
- Able to demonstrate the hardness of simple NP-complete problems

Course Contents:

Unit 1: Foundation of Algorithm Analysis (4)

1.1. Algorithm and its properties, RAM model, Time and Space Complexity, detailed analysis of algorithms (Like factorial algorithm), Concept of Aggregate Analysis
1.2. Asymptotic Notations: Big-O, Big-Ω and Big-Θ Notations their Geometrical Interpretation and Examples.
1.3. Recurrences: Recursive Algorithms and Recurrence Relations, Solving Recurrences (Recursion Tree Method, Substitution Method, Application of Masters Theorem)

Unit 2: Iterative Algorithms (4)

12.1. Basic Algorithms: Algorithm for GCD, Fibonacci Number and analysis of their time and space complexity
12.2. Searching Algorithms: Sequential Search and its analysis
12.3. Sorting Algorithms: Bubble, Selection, and Insertion Sort and their Analysis

Unit 3: Divide and Conquer Algorithms (8)

13.1. Searching Algorithms: Binary Search, Min-Max Finding and their Analysis
13.2. Sorting Algorithms: Merge Sort and Analysis, Quick Sort and Analysis (Best Case, Worst Case and Average Case), Heap Sort (Heapify, Build Heap and Heap Sort Algorithms and their Analysis), Randomized Quick sort and its Analysis
13.3. Order Statistics: Selection in Expected Linear Time, Selection in Worst Case Linear Time and their Analysis.

Unit 4: Greedy Algorithms (6)

14.1. Optimization Problems and Optimal Solution, Introduction of Greedy Algorithms, Elements of Greedy Strategy.
14.2. Greedy Algorithms: Fractional Knapsack, Job sequencing with Deadlines, Kruskal's Algorithm, Prims Algorithm, Dijkstra's Algorithm and their Analysis
14.3. Huffman Coding: Purpose of Huffman Coding, Prefix Codes, Huffman Coding Algorithm and its Analysis

Unit 5: Dynamic Programming (8)

15.1. Greedy Algorithms vs Dynamic Programming, Recursion vs Dynamic Programming, Elements of DP Strategy

15.2. DP Algorithms: Matrix Chain Multiplication, String Editing, Zero-One Knapsack Problem, Floyd Warshwall Algorithm, Travelling Salesman Problem and their Analysis.

15.3. Memoization Strategy, Dynamic Programming vs Memoization

Unit 6: Backtracking (5)

16.1. Concept of Backtracking, Recursion vs Backtracking

16.2. Backtracking Algorithms: Subset-sum Problem, Zero-one Knapsack Problem, N-queen Problem and their Analysis.

Unit 7: Number Theoretic Algorithms (5)

7.1. Number Theoretic Notations, Euclid's and Extended Euclid's Algorithms and their Analysis.

7.2. Solving Modular Linear Equations, Chinese Remainder Theorem, Primility Testing: Miller-Rabin Randomized Primility Test and their Analysis

Unit 8: NP Completeness (5)

8.1. Tractable and Intractable Problems, Concept of Polynomial Time and Super Polynomial Time Complexity

8.2. Complexity Classes: P, NP, NP-Hard and NP-Complete

8.3. NP Complete Problems, NP Completeness and Reducibility, Cooks Theorem, Proofs of NP Completeness (CNF-SAT, Vertex Cover and Subset Sum)

8.4. Approximation Algorithms: Concept, Vertex Cover Problem, Subset Sum Problem

Laboratory Work:

This course can be learnt in effective way only if we give focus is given in practical aspects of algorithms and techniques discussed in class. Therefore student should be able to implement the algorithms and analyze their behavior. Students should:

- Implement comparison sorting algorithms and perform their empirical analysis.
- Implement divide-and-conquer sorting algorithms and perform their empirical analysis.
- Implement algorithms for order statistics and perform their empirical analysis.
- Implement algorithms by using Greedy, DP and backtracking paradigm
- Implement NP-complete problems and realize their hardness.

Recommended Books:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to algorithms", Third Edition.. The MIT Press, 2009.
2. Ellis Horowitz, Sartaj Sahni**,** Sanguthevar Rajasekiaran, "Computer Algorithms", Second Edition, Silicon Press, 2007.
3. Kleinberg, Jon, and Eva Tardos**, "** Algorithm Design**" ,** Addison-Wesley**,** First Edition, 2005

System Analysis and Design

Course Title: System Analysis and Design
Course No: CSC326
Nature of the Course: Theory + Lab
Semester: V

Full Marks: 60 + 20 + 20
Pass Marks: 24 + 8 + 8
Credit Hrs: 3

Course Description: This course familiarizes students with the concepts of information systems development including systems development life cycle, different approaches to systems development, project management, planning, analysis, design, implementation and maintenance. This course also covers some fundamental concepts of object oriented systems analysis and design.

Course Objectives: The main objective of this course is to provide knowledge of different concepts of system analysis and design so that students will be able to develop information systems using different methodologies, tools, techniques, and approaches.

Course Contents:

Unit 1: Foundations for Systems Development (10 Hrs.)

1.1. The Systems Development Environment: Introduction; A Modern Approach to Systems Analysis and Design; Developing Information Systems and the Systems Development Life Cycle; The Heart of the Systems Development Process and Traditional Waterfall SDLC; CASE Tools

1.2. Other Approaches: Prototyping; Spiral; Rapid Application Development; Introduction to Agile Development

1.3. Managing the Information Systems Project: Introduction; Managing the Information Systems Project; Representing and Scheduling Project Plans; Using Project Management Software

Unit 2: Planning (5 Hrs.)

2.1. Identifying and Selecting Systems Development Projects: Introduction; Identifying and Selecting Systems Development Projects; Corporate and Information Systems Planning

2.2. Initiating and Planning Systems Development Projects: Introduction; Initiating and Planning Systems Development Projects; Process of Initiating and Planning IS Development Projects, Assessing Project Feasibility; Building and Reviewing the Baseline Project Plan

Unit 3: Analysis (13 Hrs.)

3.1. Determining System Requirements: Introduction; Performing Requirements Determination; Traditional Methods for Determining Requirements; Contemporary Methods for Determining System Requirements; Radical Methods for Determining System Requirements

3.2. Structuring System Process Requirements: Introduction; Process Modeling; Data Flow Diagrams; Modeling Logic with Decision Tables, Decision Trees, and Pseudocodes

3.3. Structuring System Data Requirements: Introduction; Conceptual Data Modeling; Gathering Information for Conceptual Data Modeling; Introduction to E-R Modeling

Unit 4: Design (7 Hrs.)

4.1. Designing Databases: Introduction; Database Design; Relational Database Model; Normalization; Transforming E-R Diagrams Into Relations; Merging Relations; Physical File and Database Design; Designing Fields; Designing Physical Tables

4.2. Designing Forms and Reports: Introduction; Designing Forms and Reports; Formatting Forms and Reports; Assessing Usability

4.3. Designing Interfaces and Dialogues: Introduction; Designing Interfaces and Dialogues; Interaction Methods and Devices; Designing Interfaces; Designing Dialogues; Designing Interfaces and Dialogues in Graphical Environments

Unit 5: Implementation and Maintenance (4 Hrs.)

5.1. System Implementation: Introduction, System Implementation, Software Application Testing, Installation, Documenting the System, Training and Supporting Users, Organizational Issues in Systems Implementation

5.2. Maintaining Information Systems: Introduction, Maintaining Information Systems, Conducting Systems Maintenance

Unit 6: Introduction to Object-Oriented Development (6 Hrs.)

Basic Characteristics of Object-Oriented Systems; Object-Oriented System Analysis and Design (OOSAD); Introduction to Unified Modeling Language, Structural and Behavioral Diagrams

Laboratory / Project Work: In the practical session, students will learn to use project management, CASE, and modeling tools. They also prepare a project report that includes at least analysis, design, and implementation phases of system analysis and design. The project can be done in groups with at most four members in each group using any suitable database, programming, and interfacing technologies.

Text Books:

1. Joseph S. Valacich and Joey F. George, *Modern Systems Analysis and Design*, 8th Edition, Pearson
2. Alan Dennis, Barbara Haley Wixom, and David Tegarden, Systems Analysis and Design – An Object-Oriented Approach with UML, 5th Edition, Wiley

References Books:

1. Kenneth E. Kendall and Julie E. Kendall, System Analysis and Design, 9th Edition, Pearson
2. Jeffrey Whitten and Lonnie Bently, System Analysis and Design Methods, 7th Edition
3. Scott Tilley and Harry J. Rosenblatt, System Analysis and Design, 11th Edition

Cryptography

Course Title: Cryptography
Course No: CSC327
Nature of the Course: Theory + Lab
Semester: V

Full Marks: 60 + 20 + 20
Pass Marks: 24 + 8 + 8
Credit Hrs: 3

Course Description: The course introduces the underlying the principles and design of cryptosystems. The course covers the basics concepts of cryptography including: traditional ciphers, block ciphers, stream ciphers, public and private key cryptosystems. The course also includes the theory of hash functions, authentication systems, network security protocols and malicious logic.

Course Objectives: The objectives of this course are to familiarize the students with cryptography and its applications. The students will be able to develop basic understanding of cryptographic mechanisms.

Course Contents:

Unit I: Introduction and Classical Ciphers (7 hr)

1.1. Security: Computer Security, Information Security, Network Security, CIA Triad, Cryptography, Cryptosystem, Cryptanalysis, Security Threats and Attacks, Security Services, Security Mechanisms

1.2. Classical Cryptosystems:
Substitution Techniques: Ceasar, Monoalphabetic, Playfair, Hill, Polyalphabetic ciphers, One-time pad
Transposition Techniques: Rail Fence Cipher

1.3. Modern Ciphers: Block vs. Stream Ciphers, Symmetric vs. Asymmetric Ciphers

Unit II: Symmetric Ciphers (10 hr)

12.1. Fiestel Cipher Structure, Substitution Permutation Network (SPN)
12.2. Data Encryption Standards (DES), Double DES, Triple DES
12.3. Finite Fields: Groups Rings, Fields, Modular Arithmetic, Euclidean Algorithm, Galois Fields (GF(p) & $GF(2^n)$), Polynomial Arithmetic
12.4. International Data Encryption Standard (IDEA)
12.5. Advanced Encryption Standards (AES) Cipher
12.6. Modes of Block Cipher Encryptions (Electronic Code Book, Cipher Block Chaining, Cipher Feedback Mode, Output Feedback Mode, Counter Mode)

Unit III: Asymmetric Ciphers (8 hr)

13.1. Number Theory: Prime Numbers, Fermat's Theorem, Euler's Theorem, Primility Testing, Miller-Rabin Algorithm, Extended Euclidean Theorem, Discrete Logarithms
13.2. Public Key Cryptosystems, Applications of Public Key Cryptosystems
13.3. Distribution of public key, Distribution of secret key by using public key cryptography, Diffie-Helman Key Exchange, Man-in-the-Middle Attack
13.4. RSA Algorithm
13.5. Elgamal Cryptographic System

Unit IV: Cryptographic Hash Functions and Digital Signatures (8 hr)

14.1. Message Authentication, Message Authentication Functions, Message Authentication Codes
14.2. Hash Functions, Properties of Hash functions, Applications of Hash Functions
14.3. Message Digests: MD4 and MD5
14.4. Secure Hash Algorithms: SHA-1 and SHA-2
14.5. Digital Signatures: Direct Digital Signatures, Arbitrated Digital Signature
14.6. Digital Signature Standard: The DSS Approach, Digital Signature Algorithm
14.7. Digital Signature Standard: The RSA Approach

Unit V: Authentication (3 Hrs)

15.1. Authentication System,
15.2. Password Based Authentication, Dictionary Attacks,
15.3. Challenge Response System,
15.4. Biometric System
15.5. Needham-Schroeder Scheme, Kerberos Protocol

Unit VI: Network Security and Public Key Infrastructure (6 Hrs)

16.1. Overview of Network Security
16.2. Digital Certificates and X.509 certificates, Certificate Life Cycle Management
16.3. PKI trust models, PKIX
16.4. Email Security: Pretty Good Privacy (PGP)
16.5. Secure Socket Layer (SSL) and Transport Layer Security (TLS)
16.6. IP Security (IPSec)
16.7. Firewalls and their types

Unit VII: Malicious Logic (3 Hrs)

7.1. Malicious Logic, Types of Malicious Logic: Virus, Worm, Trojan Horse, Zombies, Denial of Service Attacks,
7.2. Intrusion, Intruders and their types, Intrusion Detection System

Laboratory Works:

The laboratory work includes implementing and simulating the concepts of cryptographic algorithms, hash functions, digital signatures, network security protocols and malicious logic. Students are free to use any of the language and platform as per the skills.

Text Book:

1. W. Stallings, *Cryptography and Network Security*, Pearson Education.

Reference Books:

1. William Stallings, *Network Security, Principles and Practice.*
2. Matt Bishop, *Computer Security, Art and Science*.
3. Mark Stamp, *Information Security: Principles and Practices.*
4. Bruce Schneier, *Applied Cryptography*.
5. Douglas. R. Stinson. *Cryptography: Theory and Practice.*
6. B. A. Forouzan, *Cryptography & Network Security*, Tata Mc Graw Hill.

Simulation and Modeling

Course Title: Simulation and Modeling
Course No: CSC328
Nature of the Course: Theory + Lab
Semester: V

Full Marks: 60 + 20 + 20
Pass Marks: 24 + 8 + 8
Credit Hrs: 3

Course Description: The syllabus consists of introduction to system, modeling and simulation of different types of systems. It includes the modeling of systems, its validation, verification and analysis of simulation output. It comprises the concept of queuing theory, random number generation as well as study of some simulation languages.

Course Objective: To make students understand the concept of simulation and modeling of real time systems.

Course Contents:

Unit 1: Introduction to Simulation (6 Hours)
System and System Environment, Components of System, Discrete and Continuous System, System Simulation, Model of a System, Types of Model, Use of Differential and Partial differential equations in Modeling, Advantages, Disadvantages and Limitations of Simulation, Application Areas, Phases in Simulation Study

Unit 2: Simulation of Continuous and Discrete System (7 Hours)
Continuous System Models, Analog Computer, Analog Methods, Hybrid Simulation, Digital-Analog Simulators, Feedback Systems
Discrete Event Simulation, Representation of time, Simulation Clock and Time Management, Models of Arrival Processes - Poisson Processes, Non-stationary Poisson Processes, Batch Arrivals; Gathering statistics, Probability and Monte Carlo Simulation

Unit 3: Queuing System (6 Hours)
Characteristics and Structure of Basic Queuing System, Models of Queuing System, Queuing notation, Single server and Multiple server Queueing Systems, Measurement of Queueing System Performance, Elementary idea about networks of Queuing with particular emphasis to computer system, Applications of queuing system

Unit 4: Markov Chains (2 Hours)
Features, Process Examples, Applications

Unit 5: Random Numbers (7 Hours)
Random Numbers and its properties, Pseudo Random Numbers, Methods of generation of Random Number, Tests for Randomness - Uniformity and independence, Random Variate Generation

Unit 6: Verification and Validation (4 Hours)
Design of Simulation Models, Verification of Simulation Models, Calibration and Validation of the models, Three-Step Approach for Validation of Simulation Models, Accreditation of Models

Unit 7: Analysis of Simulation Output (4 Hours)
Confidence Intervals and Hypothesis Testing, Estimation Methods, Simulation run statistics, Replication of runs, Elimination of initial bias

Unit 8: Simulation of Computer Systems (9 Hours)
Simulation Tools, Simulation Languages: GPSS, Case Studies of different types of Simulation

Models and Construction of sample mathematical models

Laboratory Work:
Practical should include the simulation of some real time systems (continuous and discrete event systems), Queuing Systems, Random Number generations as well as study of Simulation Tools and Language

Text Book:

1. Jerry Banks, John S. Carson, Barry L. Nelson, David M. Nicole, "Discrete Event system simulation", 5th Edition, Pearson Education

Reference Books:

1. Geoffrey Gordon: System Simulation
2. Law, "Simulation Modeling and Analysis", 5th Edition, McGraw-Hill

Web Technology

Course Title: Web Technology
Course No: CSC329
Nature of the Course: Theory + Lab
Semester: V

Full Marks: 60 + 20 + 20
Pass Marks: 24 + 8 + 8
Credit Hrs: 3

Course Description: This course covers the fundamental concepts of HTML, CSS, JavaScript, XML, and PHP.

Course Objectives: The main objective of this course is to provide basic knowledge of web design using HTML and CSS, client side scripting using JavaScript, handling web data using XML and server side scripting using PHP.

Course Contents:

Unit 1: Introduction (3 Hrs.)
Web Basics: Internet, Intranet, WWW, Static and Dynamic Web Page; Web Clients; Web Servers; Client Server Architecture: Single Tier, Two-Tier, Multi-Tier; HTTP: HTTP Request and Response; URL, Client Side Scripting, Server Side Scripting, Web 1.0, Web 2.0

Unit 2: Hyper Text Markup Language (10 Hrs.)
Introduction to HTML; Elements of HTML Document; HTML Elements and HTML Attributes, Headings, Paragraph, Division, Formating: b, i, small, sup, sub; Spacing: Pre, Br; Formatting Text Phrases: span, strong, tt; Image element; Anchors; Lists: Ordered and Unordered and Definition; Tables; Frames; Forms: Form Elements, ID attributes, Class Attributes of HTML Elements; Meta Tag, Audio, Video, Canvas, Main, Section, Article, Header, Footer, Aside, Nav, Figure Tags; HTML Events: Window Events, Form Element Events, Keyboard Events, Mouse Events

Unit 3: Cascading Style Sheets (8 Hrs.)
Introduction; Cascadding Style Sheets (CSS); CSS Syntax; Inserting CSS: Inline, Internal, External, ID and Class Selectors; Colors; Backgrounds; Borders; Text; Font; List; Table; CSS Box Model; Normal Flow Box Layout: Basic Box Layout, Display Property, Padding, Margin; Positioning: Relative, Float, Absolute; CSS3 Borders, Box Shadows, Text Effects and shadow; Basics of Responsive Web Designs; Media Queries, Introduction to Bootstrap

Unit 4: Client Side Scripting with JavaScript (9 Hrs.)
Structure of JavaScript Program; Variables and Data Types; Statements: Expression, Keyword, Block; Operators; Flow Controls, Looping, Functions; Popup Boxes: Alert, Confirm, Prompt; Objects and properties; Constructors; Arrays; Built-in Objects: Window, String, Number, Boolean, Date, Math, RegExp, Form, DOM; User Defined Objects; Event Handling and Form Validation, Error Handling, Handling Cookies, jQuery Syntax; jQuery Selectors, Events and Effects; Introduction to JSON

Unit 5: AJAX and XML (7 Hrs.)
Basics of AJAX; Introduction to XML and its Application; Syntax Rules for creating XML document; XML Elements; XML Attributes; XML Tree; XML Namespace; XML schema languages: Document Type Definition(DTD), XML Schema Definition (XSD); XSD Simple Types, XSD Attributes; XSD Complex Types; XML Style Sheets (XSLT), XQuery

Unit 6: Server Side Scripting using PHP (8 Hrs.)
PHP Syntax, Variables, Data Types , Strings, Constants, Operators, Control structure, Functions, Array, Creating Class and Objects, PHP Forms, Accessing Form Elements, Form Validation,

Events, Cookies and Sessions, Working with PHP and MySQL, Connecting to Database, Creating, Selecting, Deleting, Updating Records in a table, Inserting Multiple Data, Introduction to CodeIgniter, Laravel, Wordpress etc.

Laboratory Works:
The laboratory work includes creating web pages and applications with using HTML, CSS, JavaScript, XML, and PHP. Students have to prepare a web based application, using above mentioned technologies, as a project work.

Text Books:

1. Web Design with HTML, CSS, JavaScript and jQuery Set, Jon Duckett, *John Wiley & Sons*
2. Web Technologies: A Computer Science Perspective, Jeffrey C. Jackson *, Pearson Prentice Hall*
3. Learning PHP, MySQL & JavaScript: with jQuery, CSS & HTML5, Robin Nixon, *O'Reilly*
4. PHP & MySQL: Server-side Web Development, Jon Ducket, *Wiley*

Reference Books:

1. HTML5 and CSS3 for the Real World", Estelle Weyl, Louis Lazaris, Alexis Goldstein, *Sitepoint*
2. HTML & CSS: Design and Build Websites, Jon Duckett, *John Wiley & Sons*
3. Dynamic Web Programming and HTML5, Paul S. Wang, *CRC Press*
4. HTML5 Programming with JavaScript for Dummies, John Paul Mueller
5. JavaScript and JQuery: Interactive Front-end Web Development, Jon Duckett, *Wiley*
6. The Complete Reference: HTML and CSS, Thomas A. Powell, *Mc Graw Hill*
7. JavaScript: The Web Technologies Series, Don Gosseli, *Course Technology Cengage Learning*
8. Web Technologies: HTML, JAVASCRIPT, PHP, JAVA, JSP, ASP.NET, XML and AJAX, Black Book, *Dreamtech Press*
9. An Introduction to XML and Web Technologies, Anders Møller and Michael I. Schwartzbach, *Addison-Wesley*
10. PHP and MySQL Web Development, Luke Welling, *Addison Wesley*
11. www.w3schools.com

Multimedia Computing

Course Title: Multimedia Computing
Course No: CSC330
Nature of the Course: Theory + Lab
Semester: V

Full Marks: 60 + 20 + 20
Pass Marks: 24 + 8 + 8
Credit Hrs: 3

Course Description: This course familiarizes students with the concepts of multimedia computing including sound, image, video, animations, data compression, and multimedia applications.

Course Objectives: The main objective of this course is to provide knowledge of different concepts of multimedia computing and their applications.

Course Contents:

Unit 1: Introduction (5 Hrs.)
Global Structure of Multimedia; Multimedia Application; Medium; Multimedia System and Properties; Characteristics of a Multimedia System; Challenges for Multimedia Systems; Components of a Multimedia System

Unit 2: Sound /Audio System (6 Hrs.)
Concepts of Sound System; Music and Speech; Speech Generation; Speech Analysis; Speech Transmission

Unit 3: Images and Graphics (5 Hrs.)
Digital Image Representation; Image and graphics Format; Image Synthesis, analysis and Transmission

Unit 4: Video and Animation (6 Hrs.)
Video Signal Representation; Computer Video Format; Computer-Based animation; Animation Language; Methods of Controlling Animation; Display of Animation; Transmission of Animation

Unit 5: Data Compression (8 Hrs.)
Storage Space; Coding Requirements; Source, Entropy and Hybrid Coding; Lossy Sequential DCT-based Mode; Expanded Lossy DCT-based Mode; JPEG and MPEG

Unit 7: User Interfaces (5 Hrs.)
Basic Design Issues; Video and Audio at the User Interface; User- friendliness as the Primary Goal

Unit 8: Abstractions for programming (5 Hrs.)
Abstractions Levels; Libraries; System Software Toolkits; Higher Programming Languages; Object –Oriented Approaches

Unit 9: Multimedia Application (5 Hrs.)
Media Preparation and Composition; Media Integration and Communication; Media Entertainment; Telemedicine; E-learning; Digital Video Editing and Production Systems; Video Conferencing; Video-on-demand

Laboratory Work: The laboratory work includes writing programs of different concepts of multimedia computing.

Recommended Books:

1. Multimedia: Computing, Communications and Applications, Ralf Steinmetz and Klara Nahrstedt, Pearson Education Asia
2. Multimedia Communications, Applications, Networks, Protocols and Standards, Fred Halsall, Pearson Education Asia
3. Multimedia Systems, John F. Koegel Buford, Pearson Education Asia

Wireless Networking

Course Title: Wireless Networking
Course No: CSC331
Nature of the Course: Theory + Lab
Semester: V

Full Marks: 60 + 20 + 20
Pass Marks: 24 + 8 + 8
Credit Hrs: 3

Course Description: This course familiarizes students with different concepts of wireless networking including wireless channels, communication techniques, cellular communications, mobile network, and advanced features.

Objective: The main objective of this course is to provide concepts and principles of wireless networking including protocol stacks and standards with the evolution of latest wireless networks.

Unit 1: Introduction **[4Hrs]**

1.1 History and challenges of wireless communications
1.2 WLAN technologies: Infrared, UHF narrowband, spread spectrum
1.3 Wireless communications standards

Unit 2: Wireless Channel Characterization **[4Hrs]**

2.1 Multipath propagation environment
2.2 LTI channel model
2.3 Channel correlation function
2.4 Large scale path loss
2.5 Small scale multipath fading

Unit 3: Wireless Communication Techniques **[12Hrs]**

3.1 Transmission techniques
  3.1.1 Introduction to bandpass transmission
  3.1.2 Signal space and decision reasons
  3.1.3 Digital modulation
  3.1.4 Power spectral density
3.2 Receiver Techniques
  3.2.1 Introduction to fading dispersive channels
  3.2.2 Channel impairment mitigation techniques
  3.2.3 Diversity
  3.2.4 Channel equalization
3.3 Multiple Access Technologies
  3.3.1 Conflict free multiple access technologies
  3.3.2 Spectral efficiencies

Unit 4: Fundamental of Cellular Communications **[5Hrs]**

4.1 Spectrum reuse and re-farming
4.2 Cell cluster concept
4.3 Co-channel and adjacent channel interference
4.4 Cell site call blocking and delay
4.5 Channel allocation strategies

Unit 5: Mobility Management in Wireless Networks **[6Hrs]**

5.1 Introduction
5.2 Call admission control
5.3 Handoff management

5.4 Location management for cellular and PCS networks
5.5 Traffic calculation

Unit 6: Overview of Mobile Network and Transport Layer [8Hrs]

6.1 Mobile IP: IP packet delivery, Agent discovery, tunneling and encapsulation
6.2 IPv6-Network layer in the internet
6.3 Mobile IP session initiation protocol
6.4 Wireless application protocol
6.5 Mobile routing protocols: DSDV, AODV and DSR
6.6 Classical TCP improvements: Mobile TCP, Time out freezing, Selective retransmission

Unit 7: Advances in Wireless Networking [6Hrs]

7.1 4G: Features, Challenges and Applications
7.2 Overview of 4G Technologies
    7.2.1 Multicarrier Modulation
    7.2.2 Smart antenna techniques
    7.2.3 Adaptive Modulation
    7.2.4 Cognitive Radio
7.3 Introduction to 5G and its vision
7.4 Introduction to wireless network virtualization
7.5 Concepts of Wireless Sensor Network & RFID
7.6 Introduction to optical communication: Li-Fi
7.7 Introduction to Software Defined Wireless Networks
7.8 Concepts of Open BTS and Open Cellular Networks

Laboratory Works:

1. Implement DSSS, Channel coding, line coding in MATLAB or equiv. tool
2. Analyze performance of WiMAX/WiFi network using NetSim or equiv. tool.
3. Develop QPSK detector and understand the relation between BER and SNR.
4. Implement various pulse shaping filers implemented in wireless communication.
5. Implement wireless routing protocol: DSDV & AODV
6. Create IPv6 based (Ad-hoc & Infrastructure) wireless network environment and evaluate connectivity, delay, latency, throughput etc.
7. Understand Contiki OS and implement IoT/WSN

Recommended Books:

1. Vijay Garg. "Wireless Communications and networking", First Edition, Elsevier 2007
2. John W. Mark and Weisua Zhuang. "Wireless communications and Networing", Prentice hall of India Pvt. Ltd., 2005
3. Jochen Schiller, "Mobile Communications", Second Edition, Pearson Education 2012
4. Simon Haykin , Michael Moher, David Koilpillai, "Modern Wireless Communications", First Edition, Pearson Education 2013

Image Processing

Course Title: Image Processing
Course No: CSC332
Nature of the Course: Theory + Lab
Semester: V

Full Marks: 60 + 20 + 20
Pass Marks: 24 + 8 + 8
Credit Hrs: 3

Course Description: This course covers the investigation, creation and manipulation of digital images by computer. The course consists of theoretical material introducing the mathematics of images and imaging. Topics include representation of two-dimensional data, time and frequency domain representations, filtering and enhancement, the Fourier transform, convolution, interpolation. The student will become familiar with Image Enhancement, Image Restoration, Image Compression, Morphological Image Processing, Image Segmentation, Representation and Description, and Object Recognition.

Course Objectives: The objective of this course is to make students able to:

- develop a theoretical foundation of Digital Image Processing concepts.
- provide mathematical foundations for digital manipulation of images; image acquisition; preprocessing; segmentation; Fourier domain processing; and compression.
- gain experience and practical techniques to write programs for digital manipulation of images; image acquisition; preprocessing; segmentation; Fourier domain processing; and compression.

Course Contents:

Unit 1: Introduction (5 Hrs.)
Digital Image, A Simple Image Model,Fundamental steps in Image Processing, Elements of Digital Image Processing systems, Element of visual perception, Sampling and Quantization, Some basic relationships like Neighbors, Connectivity, DistanceMeasures between pixels

Unit 2: Image Enhancement and Filter in Spatial Domain (8 Hrs.)
Point operations, contrast stretching, clipping and thresholding, digital negative, intensity level slicing, bit plane slicing, Histogram Equalization, Spatial operations: Averaging, median, filtering spatial low pass and high pass, high boost filter, high frequency emphasis filter, Laplacian filter, magnification by replication and interpolation.

Unit 3: Image Enhancement in the Frequency Domain (8 Hrs.)
Introduction to Fourier Transform and the frequency Domain, Computing and Visualizing the 2D DFT, Fast Fourier Transform, Smoothing Frequency Domain Filters, Sharpening Frequency Domain Filters, Other Image Transforms (Hadamard transform, Haartransform and Discrete Cosine transform)

Unit 4: Image Restoration and Compression (8 Hrs.)
Image Restoration: Models for Image degradation and restoration process, Noise Models, Estimation of Noise Parameters, Restoration Filters, Bandrejected Filters, Bandpass Filters.
Image Compression: Image compression models, Pixel coding: run length, bit plane, Predictive and inter-frame coding

Unit 5: Introduction to Morphological Image Processing (2 Hrs.)
Logic Operations involving binary images, Dilation and Erosion, Opening and Closing.

Unit 6: Image Segmentation (8 Hrs.)

Image Segmentation: Point Detection, Line Detection, Edge Detection, Gradient Operator, Edge Linking and Boundary Detection, Hough Transform, Thresholding, Region-oriented Segmentation.

Unit 7: Representations, Description and Recognition (6 Hrs.)
Introduction to some descriptors (Chain codes, Signatures, Shape Numbers, Fourier Descriptors), Patterns and pattern classes, Decision-Theoretic Methods, Overview of Neural Networks in Image Processing, Overview of pattern recognition.

Laboratory Work: Students are required to develop programs in related topics using MatLab or suitable programming language.

Text Books:

1. Rafael C. Gonzalez and Richard E. Woods, “Digital Image Processing”, Pearson Edition, Latest Edition.

Reference Books:

1. I. Pitas, "Digital Image Processing Algorithms", Prentice Hall, Latest Edition.
2. A. K. Jain, “Fundamental of Digital Image processing”, Prentice Hall of India Pvt. Ltd., Latest Edition.
3. K. Castlemann, “Digital image processing”, Prentice Hall of India Pvt. Ltd., Latest Edition.
4. P. Monique and M. Dekker, “Fundamentals of Pattern recognition”, Latest Edition.

Knowledge Management

Course Title: Knowledge Management
Course No: CSC333
Nature of the Course: Theory + Lab
Semester: V

Full Marks: 60 + 20 + 20
Pass Marks: 24 + 8 + 8
Credit Hrs: 3

Course Description: This course introduces fundamental concept of knowledge and different l issues in managing the knowledge.

Course Objective: This course enables to learn about the Evolution of Knowledge management, be familiar with tools, be exposed to applications, and be familiar with some case studies.

Course Contents:

Unit 1: (9 Hrs.)

5. An Introduction to Knowledge Management, The foundations of knowledge management, Cultural issues, Technology applications organizational concepts and processes, Management aspects, decision support systems.
6. The Evolution of Knowledge management: From Information Management to Knowledge Management, Key Challenges Facing the Evolution of Knowledge Management, Ethics for Knowledge Management.

Unit 2: (9 Hrs.)

2.1 Organization and Knowledge Management, Building the Learning Organization. Knowledge Markets: Cooperation among Distributed Technical Specialists, Tacit Knowledge and Quality Assurance.

Unit 3: (10 Hrs.)

3.1. Telecommunications and Networks in Knowledge Management, Internet Search Engines and Knowledge Management, Information Technology in Support of Knowledge Management

3.2. Knowledge Management and Vocabulary Control, Information Mapping in Information Retrieval, Information Coding in the Internet Environment, Repackaging Information.

Unit 4: (8 Hrs.)

4.1. Components of a Knowledge Strategy - Case Studies (From Library to Knowledge Center, Knowledge Management in the Health Sciences, Knowledge Management in Developing Countries).

Unit 5: (9 Hrs.)

5.1. Advanced topics and case studies in knowledge management - Development of a knowledge management map/plan that is integrated with an organization's strategic and business plan - A case study on Corporate Memories for supporting various aspects in the process life -cycles of an organization

Laboratory Works:

Upon completion of the course, the student should be able to:

- Use the knowledge management tools.
- Develop knowledge management Applications.
- Design and develop enterprise applications.

Text Book:

1. Srikantaiah. T. K., Koenig, M., “Knowledge Management for the Information Professional” Information Today, Inc., 2000.

Reference Books:

1 Nonaka, I., Takeuchi, H., “The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation”, Oxford University Press, 1995.

Society and Ethics in Information Technology

Course Title: Society and Ethics in Information Technology
Course No: CSC334
Nature of the Course: Theory + Lab
Full Marks: 60 + 20 + 20
Pass Marks: 24 + 8 + 8
Credit Hrs: 3

Course Description:
This course covers different concepts related with sociology, and social and ethical issues related with the use of Information Technology. This course also covers social context of computing, software issues and new frontiers of computer ethics.

Course Objective:
The basic objective of this course is to provide fundamental knowledge on the concept of sociology to understand social, cultural, economic, political and technical aspects, and knowledge of different social and ethical issues related with Information Technology.

Unit 1: Introduction [4 Hrs.]
Concept and Evolution of Sociology; Applications of Sociology; Emergence of Social and Ethical Problems; Computer Ethics and Computer Ethics Education; Ethics and Professions

Unit 2: Social and cultural change [6 Hrs.]
Process; Theories of Social Change (Evolution, Functional, Conflict); Factors of Social Change (Economics, Technology, Education, Demography); Role of Media and Communication in Social and Cultural Change; Innovation and Diffusion; Resistance of Social Change; Technological Changes and its Consequences

Unit 3: Understanding development [5 Hrs.]
Definition and Approaches of Development; Indicators of Development; Features of Developing Countries; Development Planning; Role of National and International Community and State

Unit 4: Process of transformation [4 Hrs.]
Modernization, Globalization and Migration, E-governance, E-commerce

Unit 5: Ethics and Ethical Analysis [4 Hrs.]
Traditional Definition; Ethical Theories; Functional Definition of Ethics; Ethical Reasoning and Decision Making; Codes of Ethics; Reflections on Computer Ethics; Technology and Values

Unit 6: Intellectual Property Rights and Computer Technology [6 Hrs.]
Definitions; Computer Products and Services; Foundations of Intellectual Property; Ownership; Intellectual Property Crimes; Protection of Ownership Rights; Protecting Computer Software; Transnational Issues and Intellectual Property

Unit 7: Social Context of Computing [4 Hrs.]
Introduction; Digital Divide; Obstacles to Overcome the Digital Divide; ICT in the Workplace; Employee Monitoring; Workplace, Employee, Health, and Productivity

Unit 8: Software Issues [5 Hrs.]
Definitions; Causes of Software Failures; Risk; Consumer Protection; Improving Software Quality; Producer Protection

Unit 9: New Frontiers for Computer Ethics [7 Hrs.]
Artificial Intelligence ad Ethics; Virtualization, Virtual Reality, and Ethics; Cyberspace and Ethics; Cyberbullying

Recommended Books:

1. Alex Inkles, "*What is Sociology? Introduction in the Discipline & Profession*", Prentice Hall of India
2. Joseph Migga Kizza, Ethical and Social Issues in the Information Age, Springer International Publishing , 6th Edition, 2017
3. Michael J. Quinn, Ethics for the Information Age, 7th Edition, Pearson Education, 2017
4. G. M. Foster, "*Traditional Culture & Impact of Technological Change*"
5. C.N.S. Rao, "*Principle of Sociology with an Introduction of Social Thought*", S. Chand & Co. Ltd.
6. Pratley Peter, "*The Essence of Business Ethics*", Prentice Hall of India, New Delhi
7. A .Giddens & D. Mitchell, "*Introduction to Sociology*", 3rd Ed., London, W.W. Norton & company

Microprocessor Based Design

Course Title: Microprocessor Based Design
Course No: CSC335
Nature of the Course: Theory + Lab
Semester: V

Full Marks: 60 + 20 + 20
Pass Marks: 24 + 8 + 8
Credit Hrs: 3

Course Description: This course covers range of issues to be considered in designing a microprocessor-based system. First, the criteria for selecting a microprocessor/microcontroller are discussed, and second, the hardware and software aspects of designing systems are focused.

Course Objective: The course objective is to demonstrate the concept of microprocessor and to be able to design a microprocessor based system to get desired results. It also emphasizes on hardware interfacing of 8051 to develop solutions of real world problems.

Course Contents:

Unit 1: Introduction to Microcontroller (12 Hrs.)
Overview of Typical Microcontroller, The Picocontroller, The Microcontroller's Memory, The Central Processor, Timing, The I/O Interface, The Address, Data, and Control Buses, The Picocontroller Design, Software/Firmware Development Architecture, Interfacing, Interfacing Types, Interfacing Techniques, Introduction of PIC, and ARM

Unit 2:Sensors and Actuators (7 Hrs.)
Sensors, Analog to Digital Conversion, Control Algorithm, Digital to Analog Conversion, Actuator

Unit 3: Bus and Communication Technology (8 Hrs.)
Common Parallel and Serial Bus Systems, Topology, Arbitration, Synchronization, CAN-Protocol, Bluetooth, PCI, ISA, WIFI

Unit 4: Introduction to 8051 Microcontroller and Programming (12 Hrs.)
8051 architecture and pin diagram, Registers, Timers, Counters, Flags, Special Function Registers, Addressing Modes, Data types, Instructions and Programming, Single–bit Operations, Timer and Counter Programming, Interrupts Programming, Serial Communication, Memory Accessing and their Simple Programming Applications

Unit 5: Electromagnetic Interference and Compatibility (6 Hrs.)
Basics of PCB Design, Design Consideration, Impact of EMI, Sources of EMI, Types of Noise, Grounding, Shielding, EMI, and EMC Standard

Laboratory works:
Programming and Application development around 8051, Interfacing to ADC, DAC, and Sensors

Recommended Books:

1. D. V. Hall, **Microprocessors and Interfacing - Programming and Hardware**, McGraw Hill
2. K. J. Ayala, **The 8051 Microcontroller: Architecture, Programming and Applications**, West
3. Mazidi, M.A., **The 8051 Microcontroller and Embedded System**, Pearson Education (2008)
4. T. Bansod, Pratik Tawde, **Microcontroller Programming (8051, PIC, ARM7 ARM Cortex)**, Shroff Publishers & Distributors Pvt. Ltd

Software Engineering

Course Title: Software Engineering
Course No: CSC375
Nature of the Course: Theory + Lab
Semester: VI

Full Marks: 60 + 20 + 20
Pass Marks: 24 + 8 + 8
Credit Hrs: 3

Course Description:
This course familiarizes students with different concepts of software engineering mainly focusing on software process models, agile development, requirements engineering, models, design, implementation, testing, evolution, and software project management.

Course Objectives:
The main objective of this course is to provide knowledge of different concepts of software engineering so that students will be able to develop high quality software using different software management skills.

Course Contents:

Unit 1: Introduction (2 Hrs.)
Software and its Types; Attributes of Good Software; Software Engineering and its Importance; Fundamental Software Engineering Activities; Difference between Software Engineering and Computer Science; Difference between Software Engineering and System Engineering; Challenges and Cost of Software Engineering; Professional Software Development; Software Engineering Diversity; Internet Software Engineering; Software Engineering Ethics

Unit 2: Software Processes (5 Hrs.)
Software Process; Software Process Models (Waterfall Model; Incremental Development; Integration and Configuration); Software Process Activities (Software Specification, Software Design and Implementation; Software Validation; Software Evolution); Coping with Change (Prototyping, Incremental Delivery); Process Improvement

Unit 3: Agile Software Development (3 Hrs.)
Agile Development; Plan-Driven vs. Agile Development; Agile Methods; Agile Development Techniques; Introduction to Agile Project Management

Unit 4: Requirements Engineering (3 Hrs.)
Concept of User and System Requirements; Functional and Non-Functional Requirements; Requirements Engineering Process; Requirements Elicitation; Requirements Specification; Requirements Validation; Requirements Change

Unit 5: System Modeling (6 Hrs.)
Introduction to System Modeling; Context Models; Interaction Models; Structural Models; Behavioral Models; Model-Driven Architecture

Unit 6: Architectural Design (6 Hrs.)
Introduction; Architectural Design Decisions; Architectural Views; Architectural Patterns; Application Architectures

Unit 7: Design and Implementation (5 Hrs.)
Introduction; Object-Oriented Design using UML; Design Patterns; Implementation Issues; Open-Source Development

Unit 8: Software Testing (5 Hrs.)
Introduction; Validation and Verification Testing; Software Inspection; Software Testing Process; Development Testing; Test-Driven Development; Release Testing; User Testing

Unit 9: Software Evolution (3 Hrs.)
Evolution Process; Legacy Systems; Software Maintenance

Unit 10: Software Management (7 Hrs.)
Software Project Management; Project Management Activities (Project Planning, Risk Management, People Management, Reporting and Proposal Writing); Project Planning (Software Pricing, Plan-Driven Development, Project Scheduling, Estimation Techniques, COCOMO Cost Modeling); Introduction to Quality Management and Configuration Management

Laboratory / Project Work:
Students should prepare a project report along with software product using different concepts of software engineering. The project can be done in groups with at most four members in each group using any suitable database, programming, interfacing technologies, and project management concepts.

Text Book:
1. Software Engineering, 10th Edition, Ian Sommerville, Pearson Education 2016

References Books:
1. Software Engineering: A Practitioner's Approach, 8th Edition, Roger S. Pressman and Bruce R. Maxim, McGraw-Hill Education 2015
2. Beginning Software Engineering, Rod Stephens, John Wiley & Sons Inc 2015

Compiler Design and Construction

Course Title: Compiler Design and Construction
Course No: CSC376
Nature of the Course: Theory + Lab
Semester: VI

Full Marks: 60 + 20 + 20
Pass Marks: 24 + 8 + 8
Credit Hrs: 3

Course Description:
This course is designed to develop acquaintance with fundamental concepts of compiler design. The course starts with the basic concepts and also includes different phases of compilers like lexical analysis, syntax analysis, syntax-directed translation, type checking etc. in detail.

Course Objectives:

- To develop knowledge in compiler design
- To develop lexical analyzers, parsers, and small compilers using different tools
- To develop lexical analyzers, parsers, and small compilers by using general purpose programming languages.

Course Contents:

Unit 1: (3 hrs)

1.1 Compiler Structure: Analysis and Synthesis Model of Compilation, different sub-phases within analysis and synthesis phases
1.2 Basic concepts related to Compiler such as interpreter, simple One-Pass Compiler, preprocessor, macros, symbol table and error handler.

Unit 2: (22 hrs)

2.1 Lexical Analysis: Its role, Specification and Recognition of tokens, Input Buffer, Finite Automata relevant to compiler construction syntactic specification of languages, Optimization of DFA based pattern matchers
2.2 Syntax Analysis: Its role, Basic parsing techniques: Problem of Left Recursion, Left Factoring, Ambiguous Grammar, Top-down parsing, Bottom-up parsing, LR parsing
2.3 Semantic Analysis: Static & Dynamic Checks, Typical Semantic errors, Scoping, Type Checking; Syntax directed definitions (SDD) & Translation (SDT), Attribute Types: Synthesized & Inherited, Annotated Parse Tree, S-attributed and L-attributed grammar, Applications of syntax directed translation, Type Systems, Type Checking and Conversion

Unit 3: (4hrs)

3.1 Symbol Table Design: Function of Symbol Table, Information provided by Symbol Table, Attributes and Data Structures for symbol table
3.2 Run–time storage management

Unit 4: (16 hrs)

4.1 Intermediate Code Generator: High-level and Low-level Intermediate representation, Syntax tree & DAG representations, Three-address code, Quadruples, Triples, SDT for intermediate code, Intermediate code generation for Declarations, Assignments, Control Flow, Boolean Expressions and Procedure Calls; Back patching
4.2 Code Generator: Factors affecting a code generator, Target Language, Basic blocks and flow graphs, Dynamic programming code-generation algorithm

4.3 Code Optimization: Need and criteria of Code Optimization, Basic optimization techniques
4.4 Case Studies of some compilers like C compiler, C++ complier

Laboratory Works:
The laboratory work develops practical knowledge on different concepts of compiler design. Students should

- Create a project by using lexical analyzer generator or any high level language
- Create a parser by using parser generator or any high level language
- Write programs for intermediate code generation and machine code generation
- Create front end of a compiler and using general purpose programming languages

Recommended Books:

1. Compilers Principles, Techniques, and Tools, Alfred V. Aho, Ravi Sethi, Jeffrey D. Ullman; Pearson Education
2. Introduction to Automata Theory, Languages, and Computation, Johne E. Hopcroft, Rajeev Motwani, Jeffrey D. Ulman, Pearson Education
3. Advanced Compiler Design and Implementation, Steven Muchnick, Morgan Kaufman Publication

E-Governance

Course Title: E-Governance
Course No: CSC377
Nature of the Course: Theory + Lab
Semester: VI

Full Marks: 60 + 20 + 20
Pass Marks: 24 + 8 + 8
Credit Hrs: 3

Course Description:
This course familiarizes students with different concepts of E-Government and E-Governance, different E-Governance models and infrastructure development, E-government security, and data warehousing and data mining for e-governance.

Course Objectives:

- To develop knowledge of e-governance and e-government
- To know different e-governance models and infrastructure development
- To implement security and use data warehousing and mining in e-governance

Course Detail:

Unit 1: Introduction to E-Government and E-Governance (5 Hrs.)
Difference between E-Government and E-Governance; E-Government as Information System; Benefits of E-Government; E-Government Life Cycle; Online Service Delivery and Electronic Service Delivery; Evolution, Scope and Content of E-Governance; Present Global Trends of Growth in E-Governance

Unit 2: Models of E-Governance (10 Hrs.)
Introduction; Model of Digital Governance: Broadcasting / Wider Dissemination Model, Critical Flow Model, Comparative Analysis Model, Mobilization and Lobbying Model, Interactive – Service Model / Government-to-Citizen-to-Government Model (G2C2G); Evolution in E-Governance and Maturity Models: Five Maturity Levels; Characteristics of Maturity Levels; Towards Good Governance through E-Governance Models

Unit 3: E-Government Infrastructure Development (10 Hrs.)
Network Infrastructure; Computing Infrastructure; Data centers; E-Government Architecture; Interoperability Framework; Cloud Governance; E-readiness; Data System Infrastructure; Legal Infrastructural Preparedness; Institutional Infrastructural Preparedness; Human Infrastructural Preparedness; Technological Infrastructural Preparedness

Unit 4: Security for e-Government (5 Hrs.)
Challenges and Approach of E-government Security; Security Management Model; E-Government Security Architecture; Security Standards

Unit 5: Applications of Data Warehousing and Data Mining in Government (5 Hrs.)
Introduction; National Data Warehouses: Census Data, Prices of Essential Commodities; Other Areas for Data Warehousing and Data Mining: Agriculture, Rural Development, Health, Planning, Education, Commerce and Trade, Other Sectors

Unit 6: Case Studies (10 Hrs.)
E-Government Initiatives in Nepal, Cyber Laws, Implementation in the Land Reform, Human Resource Management Software, NICNET, Collectorate , Computer-aided Administration of Registration Department (CARD), Smart Nagarpalika, National Reservoir Level and

Capacity Monitoring System, Computerization in Andra Pradesh, Ekal Seva Kendra, Sachivalaya Vahini, Bhoomi, IT in Judiciary, E-Khazana , DGFT, PRAJA, E-Seva, E-Panchyat, General Information Services of National Informatics, Centre E-Governance initiative in USA, E-Governance in China, E-Governance in Brazil and Sri Lanka

Laboratory Work:
The laboratory work includes implementing e-governance models and systems using suitable platform.

Text / Reference books:

1. Richard Heeks, Implementing and managing e-Government
2. C.S. R Prabhu, e-Governance: Concepts and Case studies, prentice hall of India Pvt. Ltd.
3. J. Satyanarayana, e-Government, , prentice hall of India Pvt. Ltd
4. Backus, Michiel, e-Governance in Developing Countries, IICD Research Brief, No. 1, March 2001

NET Centric Computing

Course Title: NET Centric Computing
Course No: CSC378
Nature of the Course: Theory + Lab
Semester: VI

Full Marks: 60 + 20 + 20
Pass Marks: 24 + 8 + 8
Credit Hrs: 3

Course Description:
The course covers the concepts of cross-platform web application development using the ASP.NET Core MVC framework using C# programming Language.

Course Objectives:
The objective of this course is to understand the theoretical foundation as well as its practical aspects of ASP.NET Core web application framework and C# language features.

Course Contents:

Unit 1: Language Preliminaries (8 Hrs.)
Introduction to .Net framework, Compilation and execution of .Net applications, Basic Languages constructs, Constructor, Properties, Arrays and String, Indexers, Inheritance, use of "base" keyword, Method hiding and overriding, applying polymorphism in code extensibility, structs and enums, abstract class sealed class, interface, Delegate and Events, Partial class, Collections, Generics, File IO, LINQ (Language Integrated Query) Fundamentals: Lambda Expressions, Try statements and Exceptions, Attributes: Attribute Classes, Named and Positional Attribute Parameters, Attribute Targets, Specifying Multiple Attributes, Asynchronous Programming: Principle of Asynchrony, Async/Await patterns in C#

Unit 2: Introduction to ASP.NET (3 Hrs.)
.NET and ASP.NET frameworks: .NET, .NET Core, Mono, ASP.NET Web Forms, ASP.NET MVC, ASP.NET Web API, ASP.NET Core, .NET Architecture and Design Principles, Compilation and Execution of .NET applications: CLI, MSIL and CLR, .NET Core in detail, .NET CLI: build, run, test and deploy .NET Core Applications

Unit 3: HTTP and ASP.NET Core (3 Hrs.)
HTTP, Request and Response Message Format, Common web application architectures, MVC Pattern, ASP.NET Core Architecture Overview, Projects, and Conventions, ASP.NET and ASP.NET MVC

Unit 4: Creating ASP.NET core MVC applications (10 Hrs.)
Setting up the Environment, Controllers and Actions: Create Controllers, Create Actions and Action Results Types, Rendering HTML with Views: Razor Syntax, Understanding Tag Helpers, Models: Binding and Validations, URL Routing and features, Web API Applications: API Controllers, JSON, Dependency Injection and IOC containers

Unit 5: Working with Database (6 Hrs.)
ADO.NET basics: Connection, Command, Reader and Adapter classes, Entity Framework (EF) Core, Object-Relational Mapper (ORM), Adding EF Core to an application: Choosing database provider, data models and data context, Querying and Saving data to database: Create, read, update and delete records

Unit 6: State Management on ASP.NET Core Application (4 Hrs.)
State Management on stateless HTTP, Server-side strategies: Session State, TempData, Using HttpContext, Cache Client-side strategies: Cookies, Query Strings, Hidden Fields

Unit 7: Client-side Development in ASP.NET Core (4 Hrs.)
Common client-side web technologies, JQuery, Forms and Validation, Single Page Application (SPA) Frameworks: Angular, React

Unit 8: Securing in ASP.NET Core Application (5 Hrs.)
Authentication: ASP.NET Core Identity, Adding authentication to apps and identity service configurations, Authorization: Roles, Claims and Policies, Securing Controllers and Action Methods, Common Vulnerabilities: Cross-site Scripting attacks, SQL Injection attacks, Cross -site Request Forgery (CSRF), Open Redirect Attacks

Unit 9: Hosting and Deploying ASP.NET Core Application (2 Hrs.)
App Servers and Hosting models: IIS, Nginx, Apache, ASP.NET Core Module, Kestrel, Docker and Containerization, Publish to Azure cloud

Laboratory works:
The laboratory work includes writing programs covering most of the concepts of above units using C# and .NET core SDK (3.0 or above)

Text / Reference Books:

1. C# 8.0 and .NET Core 3.0 – Modern Cross-Platform Development, Fourth Edition, by Mark J. Price, 2019
2. ASP.NET Core in Action, by Andrew Lock, 2018
3. Learning ASP.NET Core 2.0, Michel Bruchet, Jason De Oliveira, 2017

4. Learn ASP.NET Core 3 - Second Edition, Kenneth Yamikani Fukizi, Jason De Oliveira, Michel Bruchet, 2019

Technical Writing

Course Title: Technical Writing
Course No: CSC379
Nature of the Course: Theory
Semester: VI

Full Marks: 60 + 40
Pass Marks: 24 + 16
Credit Hrs: 3

Course Description:
This course is designed for students to enhance their skills for workplace writing. It helps them in the process of 'listening, researching, planning, composing, revising, and editing' documents for use in business, science, hi-tech, and other practical fields. *Technical Writing for Success* provides students with practical approach to producing their own proposal content, manual instructions, informative briefs, news releases, and other pragmatic documents. Abundant in sample documents, critical thinking questions, and insightful writing advice on style and voice, this textbook prepares students for successful technical writing.

Course Objectives:
Enable students to identify the importance and characteristics of technical writing and produce some quality technical pieces of workplace writing.

Course Detail:
Unit 1: What Is Technical Writing (3 Hrs.)
Introduction; You Are a Technical Writer!; Characteristics of a Technical Writing; How Technical Writing Compares to Other Writing

Unit 2: Audience and Purpose (3 Hrs.)
Introduction; Meeting the Audience's Needs; Planning Your Document's Purpose, Scope, and Medium

Unit 3: Writing Process (4 Hrs.)
Introduction; A Process for Technical Writing; Planning; Drafting and Revising; Copyediting and Publishing; Writing Collaboratively

Unit 4: Brief Correspondence (4 Hrs.)
Introduction; Introduction to Text Messages; E-mails; Memos, and Letters; Audience; Prewriting; Formatting; Composing the Message

Unit 5: Document Design and Graphics (4 Hrs.)
Introduction; Designing the Document; Who Reads Graphics?; Designing Graphics; Constructing Graphics

Unit 6: Writing for the Web (4 Hrs.)
Introduction; Getting Started on Web Pages; Organizing and Designing Web Pages; Writing Text for the Web; Special Web Pages

Unit 7: Information Reports (5 Hrs.)
Introduction; Getting Started on Informative Reports; Summary and Abstract; Mechanism and Description; Periodic Reports; Progress Reports; News Releases

Unit 8: Employment Communication (5 Hrs.)
Introduction; Getting Started on Employment Communication; Formatting and Organizing Resumes; Types of Resumes; Composing Resumes; Composing Employment Letters

Unit 9: Presentations (5 Hrs.)
Introduction; Getting Started on Presentations; Planning; Organizing and Composing; Preparing; Rehearsing; Presenting; Organizing a Group Presentation

Unit 10: Recommendation Reports (3 Hrs.)
Introduction; What Is a Recommendation Report?; Starting a Recommendation Report; Formatting and Organizing Recommendation Reports; Composing Recommendation Reports

Unit 11: Proposals (3 Hrs.)
Introduction; What Is a Proposal?; Getting Started on Proposal; Composing Informal Proposals; Composing Formal Proposals

Unit 12: Ethics in the Workplace (2 Hrs.)
Introduction; What Is Ethics?; Creating a Culture of Ethics; What Do you When Faces with an Ethical Dilemma?; Why Is It So Difficult to Behave Ethically?

Inside Track (Ask students to go through the ideas discussed in this section as they make much sense to writing. Explain if necessary.)

Text Book:

1. Smith-Worthington, Daelene and Sue Jefferson. *Technical Writing for Success*. 3rd ed. USA: Cengage Writing, 2011.

Reference Books:

1. Anderson, Paul V. *Technical Communication: A Reader-Centered Approach*. 7th ed. USA: Wadsworth Publishing, 2010.
2. Markel, Mike and Stuart A. Selber. *Technical Communication*. 12th edition. USA: Bedford Books, 2017.
3. Tebeaux, Elizabeth and Sam Dragga. *The Essentials of Technical Communication*. 4th ed. London: Oxford University Press, 2010.

Applied Logic

Course Title: Applied Logic
Course No: CSC380
Nature of the Course: Theory + Lab
Semester: VI

Full Marks: 60 + 20 + 20
Pass Marks: 24 + 8 + 8
Credit Hrs: 3

Course Description:
This course covers different concepts of logic including arguments, proposition and syllogism, symbolic logic, quantification, fallacies, and reasoning.

Course Objectives:
The objectives of this course are to

- Understand Concept of Validity and Invalidity
- Discuss argument and fallacy analysis techniques
- Demonstrate proof of validity and invalidity
- Understand Syllogistic rules and immediate inferences
- Discuss inductive and casual reasoning

Course Contents:

Unit 1: Argument Analysis (6 Hrs.)

1.1. Concept of Logic, Proposition and Arguments, Recognizing Arguments, Arguments vs Explanations, Validity and Truth, Deductive and Inductive Arguments

1.2. Paraphrasing Arguments, Diagramming Arguments, Complex Argumentative Passages, Problems in Reasoning

Unit 2: Categorical Propositions and Syllogisms (10 Hrs.)

12.1. Theory of Deduction, Classes of Categorical Propositions, Types Categorical Propositions, Quality, Quantity and Distribution, Square of Oppositions, Immediate Inferences, Venn Diagrams of Categorical Propositions.

12.2. Standard form of Categorical Syllogism, Mood and Figure, Testing Validity by Using Venn Diagrams, Syllogistic Rules and Fallacies

12.3. Syllogistic Arguments, Reducing Number of Terms, Translating Categorical Propositions into Standard Form, Enthymemes and Sorites

Unit 3: Symbolic Logic (12 Hrs.)

13.1. Modern Logic and Symbolic Language, Conjunction, Disjunction, negation, Material Implication, Material Equivalence

13.2. Argument Forms and Refutation by Analogy, Testing Validity of Arguments by using Truth Tables, Statement Forms, Logical Equivalences

13.3. Valid Argument Forms, Formal Proof of Validity, Replacement Rules, Proof of Invalidity, Inconsistency

Unit 4: Quantification Theory (6 Hrs.)

14.1. Need of Quantification, Singular Propositions, Types of Quantifiers, Representing Categorical Propositions in Quantification Theory

14.2. Generalization and Instantiation, Proving Validity, Proving Invalidity

Unit 5: Fallacies (6 Hrs.)

15.1. Concept and Classification of Fallacies, Fallacies of Relevance, Fallacies of Deductive Induction, Fallacies of Presumption, Fallacies of Ambiguity

Unit 6: Analogical and Casual Reasoning (5 Hrs.)

16.1. Review of Induction and Deduction, Arguments by Analogy, Analogical Arguments, Refutation by Logical Analogy

16.2. Cause and Effect, Casual Laws, Induction by Enumeration, Casual Analysis Methods, Limitations of Inductive Arguments

Laboratory Works:

The laboratory work includes realizing representation techniques and makes proper inferences. Student should be able to

- Represent complex argumentative Passages by using Symbolic Logic
- Generate proper reasoning and inferences to reach to the conclusion

Recommended Books:

1. Irving M. Copy, Carl Cohen, Priyadarshi Jetli, Monica Prabhakar, Introduction to Logic, Pearson Publication, 14th Edition, 2013
2. Patrick J. Hurley, A Concise introduction to Logic, Wadsworth Publication, 12th Edition, 2014
3. Peter Kreeft, Trent Doughherty, Socratic Logic: A Logic Text Using Socratic Method, Platonic Question, and Aristotelian Principles, St. Augustines Press, 3rd Edition 2010.

E-Commerce

Course Title: E-Commerce
Course No: CSC381
Nature of the Course: Theory + Lab
Semester: VI

Full Marks: 60 + 20 + 20
Pass Marks: 24 + 8 + 8
Credit Hrs: 3

Course Description:
This course covers the fundamental concepts of E-commerce and E-business models, and components of E-commerce system.

Course Objectives:
The main objective of this course is to provide basic concepts of E-commerce, E-commerce Business Models, E-Payments, E-commerce Security, Digital Marketing, Search Engine Optimization, and Basics of Recommendation System.

Course Contents:

Unit 1: Introduction (4 Hrs.)
E-commerce, E-business, Features of E-commerce, Pure vs. Partial E-commerce, History of E-commerce, E-commerce Framework (People, Public Policy, Marketing and Advertisement, Support Services, Business Partnerships), Types of E-commerce: B2C, B2B, C2B, C2C, M-Commerce, U-commerce, Social-Ecommerce, Local E-commerce, Challenges in E-commerce, Status of E-commerce in Nepal, Overview of Electronic Transaction Act of Nepal

Unit 2: E-commerce Business Model (8 Hrs.)
E-commerce Business Model, Elements of Business Model, Types of Revenue Models, B2C Business Models: E-tailer, Community Provider, Content Provider, Portal, Transaction Broker, Market Creator, Service Provider, B2B Business Models: Net Market Places (E-distributer, E-procurement, Exchanges, Industry Consortia), Private Industrial Networks (Single Firm, Industry Wide), Electronic Data Interchange (EDI), EDI Layered Architecture, EDI in E-commerce, E-commerce and Industry Value Chain, Firm Value Chain, Firm Value Web, Case Studies of Global and Local E-commerce Systems

Unit 3: Electronic Payment System (9 Hrs.)
E-payment System, Online Credit Card Transaction, Online Stored Value Payment System, Digital and Mobile Wallet, Smart Cards, Social/Mobile Peer-to-Peer Payment Systems, Digital Cash/e-cash, E-Checks, Virtual Currency, Electronic Billing Presentment and Payment (EBPP) System, Auctioning in E-commerce (English, Dutch, Vickery, Double), SET Protocol, Features of SET, Participants in SET, Card Holder Registration, Merchant Registration, Purchase Request, Dual Signature, Payment Authorization, Payment Capture, Status of E-Payment Systems in Nepal, Case Studies of Global and Local Payment Systems

Unit 4: Building E-commerce System (5 Hrs.)
E-commerce Website/Software, Building Catalogs: Static, Dynamic, Building Shopping Cart, Transaction Processing, Development of E-commerce Website/Software: Databases, Application Programs, Integration with ERP Systems, Integration with Payment Gateways, Using Open Source CMS for Development of E-commerce Applications

Unit 5: Security in E-Commerce (7 Hrs.)
E-commerce Security, Dimensions of E-commerce Security: Confidentiality, Integrity, Availability, Authenticity, Nonrepudiation, Privacy, Security Threats in E-commerce: Vulnerabilities in E-commerce, Malicious Code, Adware, Spyware, Social Engineering, Phishing, Hacking, Credit card fraud and Identity theft, Spoofing and Pharming, Client and Server Security, Data Transaction Security, Security Mechanisms: Cryptography, Hash Functions, Digital Signatures, Authentication, Access Controls, Intrusion Detection System, Secured Socket Layer(SSL)

Unit 6: Digital Marketing (7 Hrs.)
Digital Marketing, Online Advertisement, Ad Targeting, Search Engine Marketing, Keyword Advertising, Search Engine Optimization, Display Ad Marketing, Interstitial Ad, Video Ad, Advertising Exchanges, Programmatic Advertising, Real-Time Bidding, E-mail Marketing, Affiliate Marketing, Social Marketing, Mobile Marketing, Local Marketing, Online Marketing Metrics, Pricing Models for Online Advertisements, Case Studies: Facebook Marketing Tools, Twitter Marketing Tools, Pinterest Marketing Tools, Location Based Marketing Tools: Google AdSense

Unit 7: Optimizing E-commerce Systems (5 Hrs.)
Search Engine Optimization, Working mechinaism of Search Engines, On Page SEO, Off Page SEO, Page Ranks, Using Google Aanalytics, Social Media Analytics, Recommendation Systems: Collaborative, Content Based, Use of Recommendation Systems in E-commerce

Laboratory Works:
The laboratory work includes developing E-commerce applications. The students are highly encouraged to use server side and client side scripting for developing the applications with categories, shopping carts, payment gateways. Students can also use open source ecommerce CMS frameworks and configure them to simulate e-commerce systems. The laboratory work for e-comerce optimization includes SEO tools like Google Analytics, Facebook Analytics, Twitter Analytics etc. Students can also implement basic recommendation system in the e-commerce systems.

Text / Reference Books:

1. Kenneth C. Laudon and Carol Guercio Traver, E-commerce Business Technology Society, Pearson
2. Electronic Transaction ACT of Nepal
3. SET Secure Electronic Transaction Specification Book 1: Business Description
4. Efraim Turban, Jon Outland, David King, Jae Kyu Lee, Ting-Peng Liang, Deborrah C. Turban, Electronic Commerce A Managerial and Social Networks Perspective, Springer
5. Gary P. Schneider, Electronic Commerce, Course Technology, Cengage Learning
6. Colin Combe, Introduction to E-business Management and strategy, Elsevier
7. Dave Chaffey, E-Business & E-Commerce Management Strategy, Implementation And Practice, Pearson
8. Cristian Darie and Emilian Balanescu, Beginning PHP and MySQL E-Commerce From Novice to Professional, Apress
9. Cristian Darie and Karli Watson, Beginning ASP.NET E-Commerce in C# From Novice to Professional, Apress
10. Larry Ullaman, Effortless E-commerce with PHP and MySQL, New Riders

11. Eric Enge, Stephan Spencer, Rand Fishkin, and Jessie C. Stricchiola foreword by John Battelle, The Art of SEO: Mastering Search Engine Optimization, O'Reilly
12. Adam Clarke, SEO Learn Search Engine Optimization With Smart Internet Marketing Strategies: Learn SEO with smart internet marketing strategies
13. Charu C. Aggrawal, Recommender Systems, Springer

Automation and Robotics

Course Title: Automation and Robotics
Course No: CSC382
Nature of the Course: Theory + Lab
Semester: VI

Full Marks: 60 + 20 + 20
Pass Marks: 24 + 8 + 8
Credit Hrs: 3

Course Description:
This course provides the detailed idea about fields of robotics and its control mechanisms.

Course Objective:
The main objective is to provide information on various parts of robots and idea on fields of robotics. It also focuses on various kinematics and inverse kinematics of robots, trajectory planning of robots and to study the control of robots for some specific applications.

Course Contents:

Unit 1: Introduction (8 Hrs.)
Definition and Origin of Robotics, Types of Robotics, Major Components, Historical development of Robot, Robotic System and Robot anatomy, Degrees of freedom, Coordinate System and its type Asimov's laws of robotics, Dynamic stabilization of robots

Unit 2: Power Sources and Sensors (8 Hrs.)
Hydraulic, pneumatic and electric drives, determination of HP of motor and gearing ratio, variable speed arrangements, path determination, micro machines in robotics, machine vision, ranging, laser, acoustic, magnetic, fiber optic and tactile sensors.

Unit 3: Manipulators, Actuators, and Grippers (8 Hrs.)
Manipulators, Classification, Construction of manipulators, manipulator dynamics and force control, electronic and pneumatic manipulator control, End effectors, Loads and Forces, Grippers, design considerations, Robot motion Control, Position Sensing

Unit 4: Kinematics and Path Planning (8 Hrs.)
Solution of Inverse Kinematics Problem, Multiple Solution Jacobian Work Envelop, Hill Climbing Techniques, Robot Programming Languages

Unit 5: Process Control (8 Hrs.)
Process Control and Types, On-Off Control Systems, Proportional Control Systems, Proportional Plus Integral (PI) Control Systems, Three Mode Control (PID) Control Systems, Process Control Tuning.

Unit 6: Case Studies (5 Hrs.)
Multiple robots, Machine Interface, Robots in Manufacturing and not-Manufacturing Application, Robot Cell Design, Selection of a Robot

Laboratory Works:
The laboratory work should be focused on implementation of sensors, design of control systems. It should also deal with developing programs related Robot design and control using python.

Text Books:

1. Mikell P. Weiss G.M., Nagel R.N., Odraj N.G., **Industrial Robotics**, McGraw Hill.
2. Ghosh, **Control in Robotics and Automation: Sensor Based Integration**, Allied Publishers.

References:

1. Jain K.C. and Aggarwal B.E., **Robotics – Principles and Practice**, Khanna Publishers
2. Schuler, C.A. and McNamee, W.L. **Modern Industrial Electronics**, Macmillan/McGraw-Hill
3. Klafter R.D., Chimielewski T.A., Negin M., **Robotic Engineering – An Integrated Approach**, Prentice Hall of India.
4. Deb.S.R., **Robotics Technology and Flexible Automation**, John Wiley, USA 1992.
5. Asfahl C.R., **Robots and Manufacturing Automation**, John Wiley, USA 1992
6. Mc Kerrow P.J. **Introduction to Robotics**, Addison Wesley, USA, 1991.
7. Issac Asimov I. **Robot**, Ballantine Books, New York, 1986.

Neural Networks

Course Title: Neural Networks
Course No: CSC383
Nature of the Course: Theory + Lab
Semester: VI

Full Marks: 60 + 20 + 20
Pass Marks: 24 + 8 + 8
Credit Hrs: 3

Course Description:
The course introduces the underlying principles and design of Neural Network. The course covers the basics concepts of Neural Network including: its architecture, learning processes, single layer and multilayer perceptron followed by Recurrent Neural Network

Course Objective:
The course objective is to demonstrate the concept of supervised learning, unsupervised learning in conjunction with different architectures of Neural Network

Course Contents:

Unit 1: Introduction to Neural Network (4 Hrs.)
Basics of neural networks and human brain, Models of a neuron, Neural Network viewed as Directed Graphs, Feedback, Network Architectures, Knowledge Representation, Learning Processes, Learning Tasks

Unit 2: Rosenblatt's Perceptron (3 Hrs.)
Introduction, Perceptron, The Perceptron Convergence Theorem, Relation between the Perceptron and Bayes Classifier for a Gaussian Environment, The Batch Perceptron Algorithm

Unit 3: Model Building through Regression (5 Hrs.)
Introduction, Linear Regression Model: Preliminary Considerations, Maximum a Posteriori Estimation of the Parameter Vector, Relationship Between Regularized Least-Squares Estimation and Map Estimation, Computer Experiment: Pattern Classification, The Minimum -Description-Length Principle, Finite Sample-Size Considerations, The instrumental-Variables Method

Unit 4: The Least-Mean-Square Algorithm (5 Hrs.)
Introduction, Filtering Structure of the LMS Algorithm, Unconstrained Optimization: A Review, The Wiener Filter, The Least-Mean-Square Algorithm, Markov Model Portraying the Deviation of the LMS Algorithm from the Wiener Filter, The Langevin Equation: Characterization of Brownian Motion, Kushner's Direct-Averaging Method, Statistical LMS Learning Theory for Small Learning-Rate Parameter, Virtues and Limitations of the LMS Algorithm, Learning-Rate Annealing Schedules

Unit 5: Multilayer Perceptron (8 Hrs.)
Introduction, Batch Learning and On-Line Learning, The Back-Propagation Algorithm, XOR problem, Heuristics for Making the back-propagation Algorithm Perform Better, Back Propagation and Differentiation, The Hessian and Its Role in On-Line Learning, Optimal Annealing and Adaptive Control of the Learning Rate, Generalization, Approximations of Functions, Cross Validation, Complexity Regularization and Network Pruning, Virtues and Limitations of Back-Propagation Learning, Supervised Learning Viewed as Optimization Problem, Convolutional Networks, Nonlinear Filtering, Small-Scale Versus Large-Scale

Learning Problems

Unit 6: Kernel Methods and Radial-Basis Function Networks (7 Hrs.)
Introduction, Cover's Theorem on the separability of Patterns, The Interpolation problem, Radial-Basis-Function Networks, K-Means Clustering, Recursive Least-Squares Estimation of the Weight Vector, Hybrid Learning Procedure for RBF Networks, Kernel Regression and Its Relation to RBF Networks

Unit 7: Self-Organizing Maps (6 Hrs.)
Introduction, Two Basic Feature-Mapping Models, Self-Organizing Map, Properties of the Feature Map, Contextual Maps, Hierarchical Vector Quantization, Kernel Self-Organizing Map, Relationship between Kernel SOM and Kullback-Leibler Divergence

Unit 8: Dynamic Driven Recurrent Networks (7 Hrs.)
Introduction, Recurrent Network Architectures, Universal Approximation Theorem, Controllability and Observability, Computational Power of Recurrent Networks, Learning Algorithms, Back Propagation through Time, Real-Time Recurrent Learning, Vanishing Gradients in Recurrent Networks, Supervised Training Framework for Recurrent Networks Using Non Sate Estimators, Adaptivity Considerations, Case Study: Model Reference Applied to Neurocontrol

Laboratory works:
Practical should be focused on Single Layer Perceptron, Multilayer Perceptron, Supervised Learning, Unsupervised Learning, Recurrent Neural Network, Linear Prediction and Pattern Classification

Text Book:
1. Simon Haykin, Neural Networks and Learning Machines, 3rd Edition, Pearson

Reference Books:
1. Christopher M. Bishop, Neural Networks for Pattern Recognition, Oxford University Press, 2003
2. Martin T. Hagan, Neural Network Design, 2nd Edition PWS pub co.

Computer Hardware Design

Course Title: Computer Hardware Design
Course No: CSC384
Nature of the Course: Theory + Lab
Semester: VI

Full Marks: 60 + 20 + 20
Pass Marks: 24 + 8 + 8
Credit Hrs: 3

Course Description:
This course provides the detailed idea about the design of computer hardware.

Course Objective:
The main objective is to provide information on various computer hardware and their design. It focuses on various concepts regarding processor, memory and arithmetic operations. It also emphasizes on multicores, multiprocessors and clusters. It also deals with non-functional requirements that play vital role in the design.

Course Contents:

Unit 1: Computer Abstractions and Technology (3 Hrs.)
Introduction, Performance, The Power Wall, The Sea Change: The Switch from Uniprocessors to Multiprocessors, Manufacturing and Benchmarking the AMD Opteron X4

Unit 2: Instructions: Language of the Computer (8 Hrs.)
Introduction, Operations of the Computer Hardware, Operands of the Computer Hardware, Signed and Unsigned Numbers, Representing Instructions in the Computer, Logical Operations,Instructions for Making Decisions, Supporting Procedures in Computer Hardware, MIPS Addressing for 32-Bit Immediates and Addresses, Parallelism and Instructions, Translating and Starting a Program, Arrays versus Pointers, Advanced Material: Compiling C and Interpreting Java, ARM Instructions, x86 Instructions.

Unit 3: Arithmetic for Computers (5 Hrs.)
Introduction, Addition and Subtraction, Multiplication, Division, Floating Point, Parallelism and Computer Arithmetic: Associativity, Real Stuff: Floating Point in the x86.

Unit 4: The Processor (8 Hrs.)
Introduction, Logic Design Conventions, Building a Data path, A Simple Implementation Scheme, An Overview of Pipelining, Pipelined Data path and Control, Data Hazards: Forwarding versus Stalling, Control Hazards, Exceptions, Parallelism and Advanced Instruction-Level Parallelism, Real Stuff: the AMD Opteron X4 Pipeline, Advanced Topic: an Introduction to Digital DesignUsing a Hardware Design Language to Describe andModel a Pipeline and More Pipelining Illustrations.

Unit 5: Large and Fast: Exploiting Memory Hierarchy (8 Hrs.)
Introduction, The Basics of Caches, Measuring and Improving Cache Performance, Virtual Memory, A Common Framework for Memory Hierarchies, Virtual Machines, Using a Finite-State Machine to Control a Simple Cache, Parallelism and Memory Hierarchies: Cache Coherence, Advanced Material: Implementing Cache Controllers, Real Stuff: the AMD Opteron X4 and Intel Nehalem Memory Hierarchies.

Unit 6: Storage and Other I/O Topics (5 Hrs.)
Introduction, Dependability, Reliability, and Availability, Disk Storage, Flash Storage, Connecting Processors, Memory, and I/O Devices, Interfacing I/O Devices to the Processor, Memory, and Operating System, I/O Performance Measures: Examples from Disk and File Systems, Designing an I/O System, Parallelism and I/O: Redundant Arrays of Inexpensive Disks, Real Stuff: Sun Fire x4 Server, Advanced Topics: Networks.

Unit 7: Multicores, Multiprocessors, and Clusters (8 Hrs.)
Introduction, The Difficulty of Creating Parallel Processing Programs, Shared Memory Multiprocessors, Clusters and Other Message-Passing Multiprocessors, Hardware Multithreading, SISD, MIMD, SIMD, SPMD, and Vector, Introduction to Graphics Processing Units, Introduction to Multiprocessor Network Topologies, Multiprocessor Benchmarks, Roofline: A Simple Performance Model, Real Stuff: Benchmarking Four Multicores Using theRoofline Model.

Laboratory Works:
The practical work should focus on use of hardware design language and programming. It should also focus on x86 instructions. There should also be practical related to processor, memory, clusters, multithreading, Interfaces, pipelining.

Text Book:
1. David A. Patterson and John L. Hennessy., Computer Organization and Design: The Hardware/Software Interface, 4th Edition.

References:
1. M. M. Mano., Computer Organization, 3rd Edition
2. M. M. Mano., Computer System Architecture, 3rd Edition

Cognitive Science

Course Title: Cognitive Science
Course No: CSC385
Nature of the Course: Theory + Lab
Semester: VI

Full Marks: 60 + 20 + 20
Pass Marks: 24 + 8 + 8
Credit Hrs: 3

Course Description:
This course covers the fundamental concepts of cognitive science and brain computation.

Course Objectives:
The main objective of this course is to provide basic knowledge of web cognition process, mind theory, physical symbol systems, cognitive systems, concepts of brain mappings and neural network structures.

Course Contents:

Unit 1: Introduction (7 Hrs.)
Cognition Process, Cognitive Psychology, Cognitive Science; Foundations of Cognitive Science, Cognitive Science and Multi-disciplinary; Machines and Minds; Laws thoughts to binary logic; Classical Cognitive Science; Connectionist Cognitive Science; Mind body Problem; Turing Response to Mind Body Problem; Pinker, Penerose and Searle's Responses to Mind Body Problem; Representational Theory of Mind; Theories of Mental Representation: Minimal Analysis of mental representation, Resemblance theories of mental representation, Casual covariation theories of mental representation, internal roles theories of mental representation

Unit 2: Precursors of Cognitive Science (5 Hrs.)
Behaviorism; Theory of Computation and Algorithms; Algorithms and Turing Machines; Marr's Three Level of Computation; Linguistics and Formal Language; Information Processing Models in Psychology

Unit 3: Psycological Perspective of Cognition (5 Hrs)
Cognitive Models of Memory, Atkinson-Shiffrin's Model, Tulving's Model, Mental Imagery, Kosslyn's View, Moyer's View, Peterson's View, Cognitive Maps, Problem Understanding, States of Cognition, Cognition in AI

Unit 4: Physical Symbol System and Language of Thought (7 Hrs.)
Physical Symbol System Hypothesis; Symbol and Symbol Systems; Problem Solving by Symbol Structure; Physical Symbol System to Language of Thoughts; The Computer Model of the Mind; Syntax and the Language of Thought: Fodor's Argument for the Language of Thought Hypothesis; The Chinese Room Argument; Chinese Room and Turing Test; The Symbol Ground Problem

Unit 5: Cognitive System (4 Hrs.)
Cognitive System; Architecture for intelligent agents; Modularity of Mind; Modularity Hypothesis; The ACT-R/PM architecture

Unit 6: Brain Mapping (6 Hrs.)
Structure and Function in Brain; Anatomical Connectivity; Cognitive Functioning Techniques from Neuroscience; Mapping the brain's electrical activity: EEG and MEG; Mapping the brain's blood flow and blood oxygen levels: PET and fMRI; Attention; Visuospatial attention

Unit 7: Mind Reading (5 Hrs.)
Metarepresentation; Metarepresentation, autism, and theory of mind; Mind Reading System; Understanding False Belief; Mind Reading as Simulation

Unit 8: Neural Networks and Distributed Information Processing (6 Hrs.)
Neurally Inspired Models of Information Processing; Single-Layer Networks and Boolean Functions; Multilayer Networks; Information Processing in Neural Networks; Language Learning in Neural Networks; Neural Network Models of Children's Physical Reasoning

Laboratory Works:
The laboratory work includes implementing and simulating the concepts of cognition process, intelligent agents, neural networks. In addition, laboratory work can be extended to use the tools like PSY Toolkit, PsyNeuLink etc.

Text Book / Reference Books:

1. José Luis Bermúdez, Cognitive Science: An Introduction to the Science of the Mind, Cambridge University Press
2. Michael R. W. Dawson , Mind, Body, World: Foundations of Cognitive Science, UBC Press
3. Daniel Kolak, William Hirstein, Peter Mandik, Jonathan Waskan, Cognitive Science, An Introduction to Mind and Brain, Routledge Taylor and Francis Group
4. Amit Konar – Artificial Intelligence and Soft computing: Behavioral and Cognitive Modeling of the Human Brain, CRC Press

Advanced Java Programming

Course Title: Advanced Java Programming
Course No: CSC409
Nature of the Course: Theory + Lab
Semester: VII

Full Marks: 60 + 20 + 20
Pass Marks: 24 + 8 + 8
Credit Hrs: 3

Course Description:
This course familiarizes students with basic as well as advanced features of Java Programming Emphasis will be given to GUI and event-driven programming, Database Connectivity, Socket Programming, Servlets and JSP Technology, and Distributed Programming.

Course Objectives:
The main objective of this course is to

- Introduce basic concepts of Java Programming.
- Exemplify the concept of GUI programming and JDBC
- Demonstrate socket programming. remote objects, and servlet and JSP Technology

Course Contents:

Unit 1: Programming in Java (8 Hrs.)

1.1. Java Architecture, Java Buzzwords, Path and ClassPath variables, Sample Java Program, Compiling and Running Java Programs.
1.2. Arrays, for each loop, Class and Object, Overloading, Access Privileges, Interface, Inner Class, Final and Static Modifiers, Packages, Inheritance, Overriding.
1.3. Handling Exceptions: Try, Catch, Finally, Throws, and Throw keywords, Creating Exception Class
1.4. Concurrency: Introduction, Thread States, Writing Multithreaded Programs, Thread Properties, Thread Synchronization, Thread Priorities
1.5. Working with Files: Byte Stream Classes, Character Stream Classes, Random Access File, Reading and Writing Objects.

Unit 2: User Interface Components with Swing (10 Hrs.)

2.1. Introduction: Concept of AWT, AWT vs Swing, Java Applets, Applet Life Cycle, Swing Class Hierarchy, Component and Containers
2.2. Layout Management: No Layout, Flow layout, Border Layout, Grid Layout, Gridbag Layout, Group Layout.
2.3. GUI Controls: Text Fields, Password Fields, Text Areas, Scroll Pane, Labels, Check Boxes, Radio Buttons, Borders, Combo Boxes, Sliders
2.4. Menu, Menu Item, Icons in Menu Items, Check Box and Radio Buttons in Menu Items, Pop-up Menus, Keyboard Mnemonics and Accelerators, Enabling and Disabling Menu Items, Toolbars, Tooltips
2.5. Option Dialogs, Creating Dialogs, File Choosers, Color Choosers, Internal Frames, Frames, Tables, Trees, and Tables.

Unit 3: Event Handling (4 Hrs.)

3.1. Event Handling Concept, Listener Interfaces, Using Action Commands, Adapter Classes

3.2. Handling Action Events, Key Events, Focus Events, Mouse Event, Window Event, Item Events

Unit 4: Database Connectivity (4 Hrs.)

4.1. JDBC Architecture, JDBC Driver Types, JDBC Configuration, Managing Connections, Statements, Result Set, SQL Exceptions

4.2. DDL and DML Operations using Java, Prepared Statements, Multiple Results, Scrollable Result Sets, Updateable Result Sets, Row Sets and Cached Row Sets, Transactions, SQL Escapes.

Unit 5: Network Programming (5 Hrs.)

5.1. Transmission control Protocol (TCP), User Datagram Protocol (UDP), Ports, IP Address Network Classes in JDK

5.2. Socket programming using TCP, Socket programming using UDP, Working with URL's, Working with URL Connection Class.

5.3. Java Mail API, Sending and Receiving Email

Unit 6: GUI with JavaFX (3 Hrs.)

6.1. Introduction, JavaFX vs Swing, JavaFX Layouts: FlowPane, BorderPane, Hbox, VBox, GridPane

6.2. JavaFX UI Controls: Label, TextField, Button, RadioButton, CheckBox, Hyperlink, Menu, Tooltip, FileChooser.

Unit 7: Servlets and Java Server pages (8 Hrs.)

7.1. Web Container, Introduction to Servlets, Life cycle of servlets, The servlet APIs, Writing Servlet Programs, Reading Form Parameters, Processing Forms, Handling HTTP Request and Response (GET / POST Request), Database Access with Servlets, Handling Cookies and Session.

7.2. Servlet vs JSP, JSP Access Model, JSP Syntax (Directions, Declarations, Expression, Scriplets, Comments), JSP Implicit Objects, Object Scope, Processing Forms, Database Access with JSP.

7.3. Introduction to Java Web Frameworks

Unit 8: RMI and CORBA (3 Hrs.)

8.1 Introduction of RMI, Architecture of RMI, Creating and Executing RMI Applications

8.2 Introduction to CORBA, RMI vs CORBA, Architecture of CORBA, IDL, Simple CORBA Program.

Laboratory Works:

The laboratory work includes writing programs related to basic java programming concepts, Designing GUI, Event Handling, JDBC, Network Programming, Web Programming, and Distributed Programming. They also learn to develop web applications using Java Web Frameworks.

Text Books:

1. Cay S. Horstmann, Core Java Volume I--Fundamentals, Pearson, Eleventh Edition, 2018
2. Cay S. Horstmann, Core Java Volume II-Advance Features, Pearson, Eleventh Edition, 2019
3. Herbert Schildt, Java: The Complete Reference, McGraw-Hill Education, Eleventh Edition, 2018

Reference Book:

1. D.T. Editorial Services, Java 8 Programming Black Book, Dreamtech Press, 2015

Data Warehousing and Data Mining

Course Title: Data Warehousing and Data Mining
Course No: CSC410
Nature of the Course: Theory + Lab
Semester: VII

Full Marks: 60 + 20 + 20
Pass Marks: 24 + 8 + 8
Credit Hrs: 3

Course Description:
This course introduces advanced aspects of data warehousing and data mining, encompassing the principles, research results and commercial application of the current technologies.

Course Objective:
The main objective of this course is to provide knowledge of different data mining techniques and data warehousing.

Course Contents:

Unit 1: Introduction to Data Warehousing (5 Hrs.)
Lifecycle of data, Types of data, Data warehouse and data warehousing , Differences between operational database and data warehouse, A multidimensional data model, OLAP operation in multidimensional data model, Conceptual modeling of data warehouse, Architecture of data warehouse, Data warehouse implementation, Data marts, Components of data warehouse, Need for data warehousing ,Trends in data warehousing

Unit 2: Introduction to Data Mining (2 Hrs.)
Motivation for data mining, Introduction to data mining system, Data mining functionalities, KDD, Data object and attribute types, Statistical description of data, Issues and Applications

Unit 3: Data Preprocessing (3 Hrs.)
Data cleaning, Data integration and transformation, Data reduction, Data discretization and Concept Hierarchy Generation, Data mining primitives

Unit 4: Data Cube Technology (4 Hrs.)
Efficient method for data cube computation, Cube materialization (Introduction to Full cube, Iceberg cube, Closed cube, Shell cube), General strategies for cube computation, Attribute oriented induction for data characterization, Mining class comparison, Discriminating between different classes

Unit 5: Mining Frequent Patterns (6 Hrs.)
Frequent patterns, Market basket analysis, Frequent itemsets, closed itemsets, association rules, Types of association rule (Single dimensional, multidimensional, multilevel, quantitative), Finding frequent itemset (Apriori algorithm, FP growth), Generating association rules from frequent itemset, Limitation and improving Apriori, From Association Mining to Correlation Analysis, Lift

Unit 6: Classification and Prediction (10 Hrs.)
Definition (Classification, Prediction), Learning and testing of classification, Classification by decision tree induction, ID3 as attribute selection algorithm, Bayesian classification, Laplace smoothing, Classification by backpropagation, Rule based classifier (Decision tree to rules, rule coverage and accuracy, efficient of rule simplification), Support vector machine, Evaluating accuracy (precision, recall, f-measure), Issues in classification, Overfitting and underfitting, K-fold cross validation, Comparing two classifier (McNemar's test)

Unit 7: Cluster Analysis (8 Hrs.)
Types of data in cluster analysis, Similarity and dissimilarity between objects, Clustering techniques: - Partitioning (k-means, k-means++, Mini-Batch k-means, k-medoids), Hierarchical (Agglomerative and Divisive), Density based (DBSCAN), Outlier analysis

Unit 8: Graph Mining and Social Network Analysis (5 Hrs.)
Graph mining, Why graph mining, Graph mining algorithm (Beam search, Inductive logic programming), Social network analysis, Link mining, Friends of friends, Degree assortativity, Signed network (Theory of structured balance, Theory of status, Conflict between the theory of balance and status), Trust in a network (Atomic propagation, Propagation of distrust, Iterative propagation), Predicting positive and negative links

Unit 9: Mining Spatial, Multimedia, Text and Web Data (2 Hrs.)
Spatial data mining, Spatial data cube, Mining spatial association, Multimedia data mining, Similarity search in multimedia data, Mining association in multimedia data, An introduction to text mining, natural language processing and information extraction, Web mining (Web content mining, Web structure mining, Web usage mining)

Laboratory Works:
The laboratory should contain all the features mentioned in a course, which should include data preprocessing and cleaning, implementing classification, clustering, association algorithms in any programming language, and data visualization through data mining tools.

Text Book:
1. Data Mining: Concepts and Techniques, 3rd ed. Jiawei Han, Micheline Kamber, and Jian Pei. Morgan Kaufmann Series in Data Management Systems Morgan Kaufmann Publishers, July 2011.

Reference Books:
1. Introduction to Data Mining, 2nd ed. Pang-Ning Tan, Michael Steinbach, Anuj Karpatne, Vipin Kumar. Pearson Publisher, 2019.
2. Mining of Massive Datasets by Jure Leskovec, Anand Rajaraman, Jeffrey D. Ullman, 2014.

Principles of Management

Course Title: Principles of Management
Course No: MGT411
Nature of the Course: Theory
Semester: VII

Full Marks: 80 + 20
Pass Marks: 32 + 8
Credit Hrs: 3

Course Description:
This course contains The Nature of Organizations, Introduction to Management, Evolution of Management Thought, Environmental Context of Management, Planning and Decision Making, Organizing Function, Leadership, Motivation, Communication, Control and Quality Management, Global Context of Management, Management Trends and Scenario in Nepal.

Course Objective:
The basic objective of this course is to give a comprehensive knowledge to students about organization and help them understand the major functions, principles, and techniques of management. The course deals with basic functions like planning, organizing, leading, and controlling with special orientation to modern management practices which are essential to manage business successfully and other organizations.

Course Contents:

Unit 1: The Nature of Organizations (3 Hrs.)

Concept of organization. Organizational goals – concept, purposes, and types. Features of effective organizational goals. Goal formulation – processes and approaches. Goal succession and displacement. Problems of goal formulation. Changing perspectives of organization.

Unit 2: Introduction to Management (3 Hrs.)

Definition, characteristics, and principles of management. Process and functions of management. Managerial hierarchy. Types of managers. Managerial skills and roles. Emerging challenges for management.

Unit 3: Evolution of Management Thought (5 Hrs.)

Introduction, contribution and limitation of Classical theory, Human relations and Behavioural science theories, System theory, Decision theory, Management science theory, and Contingency theory. Emerging management concepts: workforce diversity, outsourcing, knowledge management, learning organization.

Unit 4: Environmental Context of Management (5 Hrs.)

Concept of business environment. Types of business environment – internal and external. Basic components of economic, socio – cultural, political, and technological environments. Social responsibility of business – concept and approaches. Areas of social responsibility. Business ethics – meaning and significance. Emerging business environment in Nepal.

Unit 5: Planning and Decision Making (5 Hrs.)

Concept, types, hierarchy of planning. Process and importance of planning. Strategic planning. Environmental scanning – concept and methods. SWOT analysis. Formulation and

implementation of strategic plans. Quantitative tools for planning. Decision making – definition and approaches. Types of decisions. Decision making under conditions of certainty and uncertainty. Problem solving – concepts, types of problem. Problem solving strategies.

Unit 6: Organizing Function (6 Hrs.)

Concept and principles of organizing. Approaches to organizing – classical, behavioural, and contingency. Process of structuring an organization. Departmentalization – meaning and types. Delegation of authority – meaning, features, advantages, and barriers. Centralization and decentralization – meaning, advantages and disadvantages. Concept of organic and mechanistic views of organization. Types of modern organizational structures – matrix, team, and network.

Unit 7: Leadership & Conflict (3 Hrs.)

Concept and functions of leadership. Leadership styles. Approaches to leadership – trait, behavioral, and situational. Group formation. Types and characteristics of groups. Conflict – meaning and types. Managing conflicts in organization.

Unit 8: Motivation (3 Hrs.)

Concept. Theories of motivation – Need Hierarchy, and Motivation-Hygiene. Reward system to motivate performance. Motivation through employee participation – quality of work life, and self- managed teams.

Unit 9: Communication (3 Hrs.)

Concept, structure, and process. Types of communication – formal and informal. Interpersonal and nonverbal communication. Barriers to effective communication. Enhancing effective communication.

Unit 10: Control and Quality Management (3 Hrs.)

Concept, process, and types of control systems. Characteristics of effective control system. Quality control systems – concept of quality. Total Quality Management (TQM) – concept and tools. Deming management – principles and techniques.

Unit 11: Global Context of Management (3 Hrs.)

Concept of globalization. Methods of globalization. Effects of globalization. Multinational companies – meaning, types, advantages, and disadvantages.

Unit 12: Management Trends and Scenario in Nepal (3 Hrs.)

Growth of business sector in Nepal. Major industries in Nepal – manufacturing, export – oriented, import-substitution, and service sector. Existing management practices and business culture. Major problems of businesses in Nepal.

Recommended Books:

1. Griffin, Ricky W., ***Management***, AITBS Publishers and Distributors, Delhi.
2. Hitt, Michael A., J. Black, Stweart, and Porter, Lyman W., ***Management,*** Pearson, India.
3. Robbins, Stephen P., and Coulter, Mary, ***Management***, Prentice-Hall of India, New Delhi.

Project Work

Course Title: Project Work
Course No: CSC412
Nature of the Course: Project
Semester: VII

Full Marks: 80 + 20
Pass Marks: 32+ 8
Credit Hrs: 3

Course Description: This course covers theoretical and practical concepts needed to develop a real world software system. The course focuses on enabling students with the skills related to software development. The course includes practicing the abilities pertaining to the planning, analysis, design, implementation and testing of software applications.

Course Objectives: The objective of this course is to develop theoretical and practical skills needed to develop real world software applications using different software development tools and techniques.

Course Details:

Nature of Project:

The project work should include development of an application/system software. Students are highly recommended to implement relevant algorithms, theories and concepts that they have learned. The project should be practiced by following analysis, design, implementation and testing phases. The project can be done in group with at most **three members** in each group. For the implementation of the project, students can choose appropriate language technologies as per comfort and skills. While implementing the project, students should be able to write their own program modules rather than relying on predefined APIs or Plugins except in some unavoidable circumstances.

Phases of Project:

The following are the phases of project work:

1. **Proposal Submission and Presentation:** Students must submit and present project proposal on 3rd to 4th week of start of the seventh semester.

2. **Mid-Term:** Students must submit progress report and defend midterm progress of their project work on the 10th to 11th week of the seventh semester.

3. **Final Submission:** Students must submit and defend the project work during last week of the seventh semester but before final board examination. The final defense will include a viva voice followed by a demonstration of the project. The final defense will be conducted by an evaluation committee with an external from the university. Students must have to submit the project final report to their respective department of college/campus before at least 10 days of final defense date. The report should be

submitted in standard format as prescribed. The hard/soft copy of report should be made available to the external before a week of presentation date.

Provision of Supervision:

The supervisor should be a regular faculty of the campus/college. The role of supervisor is to provide appropriate guidance to the students throughout the project. A supervisor can supervise at most **three groups** of the project in a section. The supervisor should rigorously supervise, monitor, feedback and evaluate the project groups under his/her supervision.

Evaluation Scheme:

1. **Proposal Defense -** 10% Marks of 100 (2 Marks Head/Program Coordinator + 6 Marks Supervisor + 2 Marks Internal Examiner)
2. **Midterm -** 20% Marks of 100 (3 Marks Head/Program Coordinator + 14 Marks Supervisor + 3 Marks Internal Examiner)
3. **Final Defense -** 70% Marks of 100 (5 Marks Head/Program Coordinator + 40 Marks Supervisor + 5 Marks Internal Examiner + 20 Marks External Examiner)

The evaluation committee and evaluation criteria should be as follow;

a. Evaluation committee

- HOD/Coordinator of the campus/college
- Project Supervisor (Regular faculty of the campus/college)
- Internal Examiner (Regular faculty of the campus/college)
- External Examiner (Allocated from university at the final defense)

b. Marks Allocation:

- Head / Program Coordinator – 10
- Project Supervisor – 60
- Internal Examiner – 10
- External Examiner – 20

Total – 100

c. Focus of the evaluation:

- Presentation Skills
- Level of Work and Understanding(Level of Analysis, Design, Implementation, Testing, Result Analysis done for the project)
- Project Report
- Viva/Question Answer
- Demonstration of the project
- Teamwork and Contribution

Roles and Responsibilities:

- **HOD/Coordinator:** The role of HOD/Coordinator is to coordinate with supervisor, internal examiner, external examiner and students. The HOD/Coordinator should monitor the students' project progress in coordination with the respective supervisors. The HOD/Coordinator is responsible for arranging the proposal defense, midterm and final defense. The HOD/Coordinator should participate and evaluate proposal defense, midterm, and final defense.

- **Project Supervisor:** The role of project supervisor is to supervise students' project throughout the semester. The supervisor should rigorously feedback and guide the students. Supervisor is to participate and evaluate proposal defense, midterm, and final defense. The supervisor should monitor the progress of projects under supervision.

- **Internal Examiner:** The role of internal examiner is to evaluate the students' project during different evaluation phases of the project. The internal examiner should participate and evaluate proposal defense, midterm, and final defense.

- **External Examiner:** The role of external examiner is to evaluate the students' project during final defense evaluation. The examiner should participate and evaluate viva voce and demonstration session during the final defense.

- **Student:** The role and responsibilities of student include development of the project, project report preparation, and defending the project work throughout each evaluation phases. Despite of project work being group work, each student should have equal role and responsibilities in the project. Each student will be evaluated individually so student should be able to demonstrate his/her contribution in the project work individually. Students should maintain a log visits with their supervisors at different dates during their work. The log should include technical feedbacks from their supervisors.

Report Contents:

1. **Prescribed content flow for the project proposal**

    1. Introduction
    2. Problem Statement
    3. Objectives
    4. Methodology
        a. Requirement Identification
            i. Study of Existing System / Literature Review
            ii. Requirement Analysis
        b. Feasibility Study
            i. Technical
            ii. Operational
            iii. Economic
            iv. Schedule (Gantt chart showing the project timeline)

c. High Level Design of System (Methodology of the proposed system/ Flow Charts/ Working Mechanism of Proposed System / Description of Algorithms)

5. Expected Outcome
6. References

2. Prescribed content flow for the project report

1. Cover & Title Page
2. Certificate Page
   i. Supervisor Recommendation
   ii. Head / Program Coordinator, Supervisor, Internal and External Examiners' Approval Letter
3. Acknowledgement
4. Abstract Page
5. Table of Contents
6. List of Abbreviations, List of Figures, List of Tables
7. Main Report
8. References
9. Bibliography (if any)
10. Appendices (Screenshots + Snippets of major source code components + Log of visits to supervisor)

3. Prescribed chapters in the main report

1. Chapter 1: Introduction

1.1. Introduction
1.2. Problem Statement
1.3. Objectives
1.4. Scope and Limitation
1.5. Development Methodology
1.6. Report Organization

2. **Chapter 2: Background Study and Literature Review**

2.1. Background Study (Description of fundamental theories, general concepts and terminologies related to the project)
2.2. Literature Review (Review of the similar/relevant projects, theories and results by other researchers)

3. Chapter 3: System Analysis

3.1. System Analysis
   3.1.1. Requirement Analysis
      i. Functional Requirements (Illustrated using use case diagram/use case descriptions)
      ii. Non Functional Requirements
   3.1.2. Feasibility Analysis
      i. Technical

ii. Operational
iii. Economic
iv. Schedule

3.1.3. Analysis (May be Structured or Object Oriented)

If structured approach:

- Data modelling using ER Diagrams
- Process modelling using DFD

If object oriented approach:

- Object modelling using Class and Object Diagrams,
- Dynamic modelling using State and Sequence Diagrams
- Process modelling using Activity Diagrams

4. Chapter 4: System Design

4.1. Design (May be Structured or Object Oriented as per the approach followed in analysis chapter)

If structured approach:

- Database Design: Transformation of ER to relations and normalizations
- Forms and Report Design
- Interface and Dialogue Design

If object oriented approach:

- Refinement of Class, Object, State, Sequence and Activity diagrams
- Component Diagrams
- Deployment Diagrams

4.2. Algorithm Details

5. Chapter 5: Implementation and Testing

5.1. Implementation

5.1.1. Tools Used (CASE tools, Programming languages, Database platforms)

5.1.2. Implementation Details of Modules (Description of classes/procedures/functions/methods/algorithms)

5.2. Testing

5.2.1. Test Cases for Unit Testing

5.2.2. Test Cases for System Testing

5.3. Result Analysis

6. Chapter 6: Conclusion and Future Recommendations

6.1. Conclusion

6.2. Future Recommendations

While writing above chapters students should avoid basic definitions. They should relate and contextualize the above mentioned concepts with their project work.

Citation and Referencing:

The listing of references should be listed in the references section. The references contain the list of articles, books, urls, etc. that are cited in the document. The books, articles, and others that are studied during the study but are not cited in the document can be listed in the bibliography section. The citation and referencing standard should be IEEE referencing standard. The text inside the document should be cited in IEEE style. The IEEE referencing standard can be found in the web.

Report Format Standards:

A. Page Number

The pages from certificate page to the list of tables/figures/abbreviations/approvals should be numbered in roman starting from i. The pages from chapter 1 onwards should be numbered in numeric starting from 1. The page number should be inserted at bottom, aligned center.

B. Page Size and Margin

The paper size must be a page size corresponding to A4. The margins must be set as

- Top = 1 in (2.54 cm)
- Bottom = 1 in (2.54 cm)
- Left = 1.25 in (3.17 cm)
- Right = 1 in (2.54 cm)

C. Paragraph Style

- All paragraphs must be justified and have spacing of 1.5.

D. Text Font of Document

- The contents in the document should be in Times New Roman font
- The font size in the paragraphs of document should be 12

E. Section Headings

- Font size for the headings should be 16 for chapter headings, 14 for section headings, 12 for sub-section headings. All the headings should be bold faced.

F. Figures and Tables

- Position of figures and tables should be aligned center. The figure caption should be centred below the figure and table captions should be centred above the table. All the captions should be of bold face with 12 font size.

Final Report Binding and Submission:

No of Copies: 3 (College Library + Self + Dean Office)

Look and Feel: Golden Embracing with Black Binding

A final approved signed copy of the report should be submitted to the Dean Office, Exam Section, Institute of Science and Technology, Tribhuvan University

Text Book: None

Information Retrieval

Course Title: Information Retrieval
Course No: CSC413
Nature of the Course: Theory + Lab
Semester: VII

Full Marks: 60 + 20 + 20
Pass Marks: 24 + 8 + 8
Credit Hrs: 3

Course Description:
This course familiarizes students with different concepts of information retrieval techniques mainly focused on clustering, classification, search engine, ranking and query operations techniques.

Course Objective:
The main objective of this course is to provide knowledge of different information retrieval techniques so that the students will be able to develop information retrieval engine.

Course Contents:

Unit 1: Introduction to IR and Web Search (2 Hrs.)
Introduction, Data vs Information Retrieval, Logical view of the documents, Architecture of IR System, Web search system, History of IR, Related areas

Unit 2: Text properties, operations and preprocessing (5 Hrs.)
Tokenization, Text Normalization, Stop-word removal, Morphological Analysis, Word Stemming (Porter Algorithm), Case folding, Lemmatization, Word statistics (Zipf's law, Heaps' Law), Index term selection, Inverted indices, Positional Inverted index, Natural Language Processing in Information Retrieval, Basic NLP tasks – POS tagging; shallow parsing

Unit 3: Basic IR Models (5 Hrs.)
Classes of Retrieval Model, Boolean model, Term weighting mechanism – TF, IDF, TF-IDF weighting, Cosine Similarity, Vector space model , Probabilistic models (the binary independence model ,Language models; · KL-divergence; · Smoothing), Non-Overlapping Lists, Proximal Nodes Mode

Unit 4: Evaluation of IR (2 Hrs.)
Precision, Recall, F-Measure, MAP (Mean Average Precision), (DCG) Discounted Cumulative Gain, Known-item Search Evaluation

Unit 5: Query Operations and Languages (4 Hrs.)
Relevance feedback and pseudo relevance feedback, Query expansion (with a thesaurus or WordNet and correlation matrix), Spelling correction (Edit distance, K – Gram indexes, Context sensitive spelling correction), Query languages (Single-Word Queries, Context Queries, Boolean Queries, Structural Query, Natural Language)

Unit 6: Web Search (6 Hrs.)
Search engines (working principle), Spidering (Structure of a spider, Simple spidering algorithm, multithreaded spidering, Bot), Directed spidering (Topic directed, Link directed), Crawlers

(Basic crawler architecture), Link analysis (HITS, Page ranking), Query log analysis, Handling "invisible" Web – Snippet generation, CLIR (Cross Language Information Retrieval)

Unit 7: Text Categorization (4 Hrs.)
Categorization, Learning for Categorization, General learning issues, Learning algorithms: Bayesian (naïve), Decision tree, KNN, Rocchio)

Unit 8: Text Clustering (4 Hrs.)
Clustering, Clustering algorithms (Hierarchical clustering, k-means, k-medoid, Expectation maximization (EM), Text shingling)

Unit 9: Recommender System (3 Hrs.)
Personalization, Collaborative filtering recommendation, Content-based recommendation

Unit 10: Question Answering (5 Hrs.)
Information bottleneck, Information Extraction, Ambiguities in IE, Architecture of QA system, Question processing, Paragraph retrieval, Answer processing

Unit 11: Advanced IR Models (5 Hrs.)
Latent Semantic Indexing (LSI), Singular value decomposition, Latent Dirichlet Allocation, Efficient string searching, Knuth – Morris – Pratt, Boyer – Moore Family, Pattern matching

Laboratory Works:
The laboratory should contain all the features mentioned in a course. The Laboratory work should contain at least following tasks

1. Program to demonstrate the Boolean Retrieval Model and Vector Space Model
2. Tokenize the words of large documents according to type and token
3. Program to find the similarity between documents
4. Implement Porter stemmer
5. Build a spider that tracks only the link of nepali documents
6. Group the online news onto different categorize like sports, entertainment, politics
7. Build a recommender system for online music store

Recommended Books:

1. Modern Information Retrieval, Ricardo Baeza-Yates, Berthier Ribeiro-Neto.
2. Information Retrieval; Data Structures & Algorithms: Bill Frakes

Database Administration

Course Title: Database Administration
Course No: CSC414
Nature of the Course: Theory + Lab
Semester: VII

Full Marks: 60 + 20 + 20
Pass Marks: 24 + 8 + 8
Credit Hrs: 3

Course Description:
This course familiarizes students with different concepts of database administration including DBA Roles and responsibilities, tablespace and storage management, DB backup, restoration and recovery, security, multitenant, and performance tuning.

Course Objective:
The main objective of this course is to provide knowledge of different concepts of database administration so that the students will be able handle

- Install DBMS Software
- Create and manage databases
- Manage backup and recovery
- Control user security
- Managing database performance and multitenant architecture

Course Contents:

Unit 1: Introduction (5 Hrs.)
DBA Roles and Responsibilities; Database Architecture; ORACLE logical and physical database structure; Memory and Process Structure, SQLPLUS Overview, creating a database;

Unit 2: Tablespace and Storage management (5 Hrs.)
Working with Tablespaces and Data Files, Creating and adding tablespace and datafiles, Managing Control Files, Online Redo Logs and Archive logs; Multiplexing;

Unit 3: Managing Database Objects (8 Hrs.)
Working with Tables and Constraints; Working with Indexes, Views, Synonyms, and Sequences; Partitioning and Materialized Views, Introduction of PLSQL, Stored Procedure, Functions, Trigger, package.

Unit 4: Database Backup, Restore, and Recovery (10 Hrs.)
Backup and Recovery Overview, Database backup, restoration and recovery, defining a backup and recovery strategy, Backup and Recovery options; Data Dump; User-Managed Backup and Recovery; Configuring RMAN; RMAN Backups, Restore and Recovery; High Availability Features; Oracle Data Guard; Flashback operations.

Unit 5: Database Security and Auditing (7 Hrs.)
Database Security and Auditing; Database Authentication Methods; Database Authorization Methods; Data Encryption Techniques, Virtual Private Database; Managing Users and Security: Profiles, managing users, managing privileges, managing roles,

Unit 6: Multitenant Database Architecture (5 Hrs.)
Understanding the Multitenant Architecture, Pluggable Architecture; Creating CDB; Administrating Root Container; Creating Pluggable Databases (PDBs) within a CDB; Administrating Pluggable Databases; Backup and Recovery in multitenant Environment; Databases in the Cloud

Unit 7: Database Tuning (5 Hrs.)
Tuning Application Design; Tuning Memory Usage; Tuning Data Access; Tuning Data Manipulation; Reducing Network Traffic; Using Automatic Workload Repository(AWR); Automatic Database Diagnostic Monitor(ADDM), Tuning SQL; SQL Tuning Advisor, Performance Tuning in a Multitenant Environment; Distributed Databases and Networking Tool

Laboratory Works:
The laboratory work should include all the concepts mentioned in the course using any appropriate DBMS system.

Recommended Books:

1. Pro Oracle Database 18c Administration: Manage and Safeguard Your Organization's Data, Michelle Malcher and Darl Kuhn, Third Edition.
2. Oracle Database 12c DBA Handbook, Manage a Scalable, Secure Oracle Enterprise Database Environment, Bob Bryla.
3. Oracle DBA Mentor: Succeding as an Oracle Database Administrator, Brian Peasland.

Software Project Management

Course Title: Software Project Management
Course No: CSC415
Nature of the Course: Theory + Lab
Semester: VII

Full Marks: 60+20+20
Pass Marks: 24+8 + 8
Credit Hrs: 3

Course Description:
This course familiarizes students with different concepts of software project management mainly focusing on project analysis, scheduling, resource allocation, risk analysis, monitoring, control and software configuration management.

Course Objectives:
The main objective of this course is to provide knowledge of different concepts of software project management so that students will be able to understand and handle various projects including very high risky and innovative projects using different project management skills.

Course Contents:

Unit 1: Introduction to Software Project Management (5 Hrs.)
Software engineering problem and software product, software product attributes, Definition of a Software Project (SP), SP Vs. other types of projects activities covered by SPM, categorizing SPs, Project management cycle, SPM framework, types of project plan.

Unit 2: Project Analysis (8 Hrs.)
Introduction, strategic assessment, technical assessment, economic analysis: Present worth, future worth, annual worth, internal rate of return (IRR) method, benefit-cost ratio analysis, including uniform gradient cash flow and comparison of mutually exclusive alternatives.

Unit 3: Activity Planning and Scheduling (7 Hrs.)
Objectives of activity planning, Work breakdown structure, Bar chart, Network planning model: Critical path method (CPM), Program evaluation and review technique (PERT), Precedence diagramming method (PDM), Shortening project duration, Identifying critical activities.

Unit 4: Risk Management (4 Hrs.)
Introduction, nature and identification of risk, risk analysis, evaluation of risk to the schedule using Z-values.

Unit 5: Resource Allocation (4 Hrs.)
Identifying resource requirements, resource allocation, resource smoothening and resource balancing.

Unit 6: Monitoring and Control (4 Hrs.)
Introduction, collecting data, visualizing progress, cost monitoring, earned value analysis, project control.

Unit 7: Managing Contracts and people (5 Hrs.)
Introduction, types of contract, stages in contract, placement, typical terms of a contract, contract management, acceptance, Managing people and organizing terms: Introduction, understanding behavior, organizational behavior: a back ground, selecting the right person for the job, instruction in the best methods, motivation, working in groups, becoming a team, decision making, leadership, organizational structures, conclusion, further exercises.

Unit 8: Software quality assurance and testing (5 Hrs.)
Testing principles and objectives, test plan, types and levels of testing, test strategies, program verification and validation, software quality, SEI-CMM,SQA activities, QA organization structure, SQA plan.

Unit 9: Software Configuration Management (3 Hrs.)
Introduction, need, basic configuration, management function, baseline, configuration management responsibilities.

Laboratory / Project Work:
Students should prepare a project report using different concepts of software project management. The project can be done in groups with at most four members in each group. Each group can select a case study and apply the concepts of software project management focusing on project analysis, scheduling, risk analysis, resource allocation, testing.

Text Book:
1. Software Project Management by Bob Hughes and Mike Cotterell, Latest Publication

Reference Books:
1. "Introduction to Software Project Management & Quality Assurance", Darrel Ince, I. Sharp, M. Woodman, Tata McGraw Hill
2. "Software Project Management: A Unified Framework", Walker Royce, Addison-Wesley, An Imprint of Pearson Education
3. "Managing the Software Process", Watts S. Humphrey, Addison-Wesley, An Imprint of Pearson Education

Network Security

Course Title: Network Security
Course No: CSC416
Nature of the Course: Theory + Lab
Semester: VII

Full Marks: 60 + 20 + 20
Pass Marks: 24 + 8 + 8
Credit Hrs: 3

Course Description:
This course covers the fundamental concepts of network security protocols, wireless security concepts, basics of security in cloud and IoT.

Course Objectives:
The main objective of this course is to provide knowledge of network security so that students will be able to implement a secure network architecture using different security protocols and technologies.

Course Contents:

Unit 1: Computer Network Security Fundamentals (3 Hrs.)
1.1. Introduction
1.2. Securing the Computer Network
1.3. Forms of Protection
1.4. Security Standards

Unit 2: User Authentication (4 Hrs.)
2.1. Remote User-Authentication Principles
2.2. Remote User-Authentication Using Symmetric Encryption
2.3. Remote User-Authentication Using Asymmetric Encryption
2.4. Federated Identity Management

Unit 3: Transport Level Security (6 Hrs.)
3.1. Web Security
3.2. Transport Layer Security (TLS)
3.3. HTTPS
3.4. Secure Shell (SSH)

Unit 4: Wireless Network Security (6 Hrs.)
4.1. Wireless Security
4.2. Mobile Device Security
4.3. IEEE 802.11 Wireless LAN Overview
4.4. IEEE 802.11i Wireless LAN Security

Unit 5: Electronic Mail Security (8 Hrs.)
5.1. Internet Mail Architecture
5.2. E-mail Formats
5.3. Email Threats and Comprehensive Email Security
5.4. S/MIME

5.5. Pretty Good Privacy (PGP)
5.6. DNSSEC
5.7. DNS-Based Authentication of Named Entities
5.8. Sender Policy Framework
5.9. Domain Keys Identified Mail
5.10. Domain-Based Message Authentication, Reporting, and Conformance

Unit 6: IP Security (6 Hrs.)
6.1. IP Security Overview
6.2. IP Security Policy
6.3. Authentication Header
6.4. Encapsulating Security Payload
6.5. Security Associations
6.6. Internet Key Exchange

Unit 7: Network Endpoint Security (5 Hrs.)
7.1. Firewalls
7.2. Intrusion Detection System
7.3. Malicious Software
7.4. Distributed Denial of Service Attacks

Unit 8: Cloud and Internet of Things (IOT) Security (7 Hrs.)
8.1. Cloud Computing
8.2. Cloud Security Concepts
8.3. Cloud Security Risks and Countermeasures
8.4. Cloud Security as a Service
8.5. Open-source Cloud Security Module
8.6. Internet of Things (IoT)
8.7. IoT Security Concepts and Objectives
8.8. Open-source IoT Security Module

Laboratory Works:
The laboratory work includes implementation and simulation of Network Security Protocols, Intrusion Detection Systems, DDoS Attacks, Cloud Security and IoT Security Systems.

Text Books:

1. William Stallings, Cryptography and Network Security: Principles and Practice, 8th Edition, Pearson, 2020
2. Joseph Migga Kizza, Computer Network Security Fundamentals, 5th Edition, Springer, 2020

Reference Books:

1. William Stallings, Network Security Essentials: Applications and Standards, 6th Edition, Pearson, 2017
2. Sarhan M. Musa, Network Security and Cryptography: A Self-Teaching Introduction, Mercury Learning and Information LLC, 2018

Digital System Design

Course Title: Digital System Design
Course No: CSC417
Nature of the Course: Theory + Lab
Semester: VII

Full Marks: 60 + 20 + 20
Pass Marks: 24 + 8 + 8
Credit Hrs: 3

Course Description:
This course contains the introductory part of combinational Logic along with the clear concepts of K-Maps and Quine- Mc Cluskey Method. It also introduces sequential networks with flip flops and FSM. Another concept includes FPGA and VHDL and also testing and verification.

Course Objective:
The course objective is to provide ample knowledge on digital design process and to enhance the knowledge of hardware design in real scenarios.

Course Content:

Unit 1	Introduction of logic design, Digital System and Integration, Electronic Design Automation, IC Manufacturing, Logic Families, IC Design Techniques, IC characteristics: fan-out, power dissipation, propagation delay, and noise margin of TTL and CMOS integrated circuit logic devices	5Hrs
Unit 2	Review of Boolean Algebra and Combinational Logic, Canonical Form, Shannon's Expansion, Minterms, Maxterms, Prime Implication	4 Hrs.
Unit 3	Combinational Network Design: K – Map, Synthesis and Minimization with K – Maps (AND – OR, OR-AND, NAND-NAND, NOR-NOR), Standard Combinational Networks	5 Hrs.
Unit 4	Quine- Mc Cluskey Method, Minimization of Boolean expression with Quine-Mc Cluskey method, PROMs and EPROMs, Programmable Array Logic (PAL), Programmed Logic Array (PLA), Gate Arrays, Programmable Gate Array, Full Custom Design	7 Hrs.
Unit 5	Sequential Networks: Transition from combinational to sequential network, Direct command flip flop, Initialization of sequential network, Level Enabled Flip-Flops, Synchronization of sequential networks, Edge-triggered Flip Flops, Synchronous and Asynchronous Signals	8 Hrs.
Unit 6	Sequential Networks as Finite State Machines: Standard Models, Realization with ASM Diagrams, Synthesis of Synchronous FSM, Time	6 Hrs.

	Behavior of Synchronous FSM, Design of input forming, Logic and Output Forming Logic of state machine.	
Unit 7	Field Programmable Gate Arrays (FPGA), VHDL and its use in programmable logic devices (PLDs) like FPGA	4 Hrs.
Unit 8	Testing and Verification, Testing Logic Circuits, Combinational gate testing, Combinational network testing, Sequential Testing, Test vector generation, fault, fault model and fault detection, SA0, SA1, Design for Testability	6 Hrs.

Laboratory Works:
Laboratory Exercise should cover the implementation of combinational and sequential circuits, FSM, FPGA and VHDL. Testing and verification of circuits.

Project Work:
Design a sample of tool kit by using the design concepts of the course.

Reference Books:

1. Giuliano Donzellini, Luca Oneto, Domenico Ponta, Davide Anguita, Introduction to Digital System Design, Springer
2. Wolf, Wayne, Modern VLSI Design-System on Silicon, Third Edition, Pearson
3. Comer, David J. Digital Logic State Machine Design, Third Edition, Oxford University Press
4. Ashenden, Peter J, The Student's Guide to VHDL, Morgan Kaufman

International Marketing

Course Title: International Marketing
Course No: MGT418
Nature of the Course: Theory
Semester: VII

Full Marks: 80 + 20
Pass Marks: 32 + 8
Credit Hrs: 3

Course Objective:
This course aims to provide an understanding of the process and dynamism of marketing practiced across the international markets.

Course Description:
This is a comprehensive course that deals on the process and challenges of international marketing. The course includes topics such as scope and challenges of international marketing, dynamism in international trade, the cultural, political, and legal international environment, global marketing strategies, regional and multinational trade arrangements, and structure and dynamism in Nepal's international trade.

Course Contents:

Unit 1. Introduction (6 Hrs.)
Concept and growth of international marketing. International marketing tasks. Stages of international marketing involvement. Strategic orientations in international marketing. The dynamism in international trade – trade barriers, balance of payments, protectionism, tariffs, quotas, and embargoes. Movements against trade restrictions – GATT and WTO. Regional trading blocks.

Unit 2. International Marketing Environment (10 Hrs.)
Cultural environment: Concept and origins of culture. Elements of culture. Cultural barriers in international trade. Importance of international cultural knowledge and cultural change in marketing. Political environment: Sovereignty of nations. Political risks of international business. Political vulnerability assessment and risk minimization strategies. Legal environment: Bases of legal systems. Jurisdictions in international legal disputes and dispute resolution methods.

Unit 3: International Marketing Research Global Marketing Information System (8 Hrs.)
Concept and Scope of international marketing research. Process of research – problem identification and research objectives. Concept and components of marketing information system, sources of global marketing information.

Unit 4: International Marketing Management (11 Hrs.)
Product development for international markets – quality, green marketing, and adaptation issues. Marketing opportunities in services. Challenges of managing brands globally. International marketing channels – distribution patterns in international markets. Marketing intermediaries and choice factors. Communications – Integrated marketing communications in international marketing. International advertising goals and strategy. International pricing – approaches to international pricing, price escalation and its effects. Transfer pricing strategy.

Unit 5: Nepal's International Trade (10 Hrs.)

Structural dynamism in Nepal's foreign trade. Import and export sources. Import and export procedures and documentations. Institutional mechanism for international trade – Public, private, and non-governmental agencies for trade and export promotions. Key problems in Nepal's international trade. SAPTA and SAFTA.

Recommended Books:

1. Cateora, Philip, John Graham, and Prasant Salwan, International Marketing, Tata McGraw Hill.
2. Terpstra, Vern and Ravi Sarathy, International Marketing, Dryden Press.
3. Jain, Subhash, International Marketing Management, CBS Publications.

Advanced Database

Course Title: Advanced Database
Course No: CSC475
Nature of the Course: Theory + Lab
Semester: VIII

Full Marks: 60 + 20 + 20
Pass Marks: 24 + 8 + 8
Credit Hrs: 3

Course Description:
This course includes advanced concept of database system. The main topics covered are advanced concept of relational data model, Extended E-R model, new database management technologies, query optimization, NoSQL database and big data processing techniques.

Course Objectives:
At the end of the course students should be able to know new developments in database technology, interpret and explain the impact of emerging database standards, evaluate the contribution of database theory to practical implementations of database management systems. Also, students should be able to develop more advanced application using MapReduce and Hadoop.

Course Contents:

Unit 1: Enhanced Entity Relationship Model and Relational Model (8 Hrs.)
Entity Relationship Model Revised; Subclasses, Superclasses and Inheritance; Specialization and Generalization; Constraints and characteristics of specialization and Generalization; Union Types; Aggregation; Relational Model Revised; Converting ER and EER Model to Relational Model; SQL and Advanced Features; Concepts of File Structures, Hashing, and Indexing

Unit 2: Object and Object Relational Databases (10 Hrs.)
Object Database Concepts; Object Database Extensions to SQL; The ODMG Object Model and the Object Definition Language ODL; Object Database Conceptual Design; Object Query Language OQL; Language Binding in the ODMG Standard

Unit 3: Query Processing and Optimization (7 Hrs.)
Concept of Query Processing; Query Trees and Heuristics for Query Optimization; Choice of Query Execution Plans; Cost-Based Optimization

Unit 4: Distributed Databases, NOSQL Systems, and BigData (12 Hrs.)
Distributed Database Concepts and Advantages; Data Fragmentation, Replication and Allocation Techniques for Distributed Database Design; Types of Distributed Database Systems; Distributed Database Architectures
Introduction to NOSQL Systems; The CAP Theorem; Document-based, Key-value Stores, Column-based, and Graph-based Systems; BigData; MapReduce; Hadoop

Unit 5: Advanced Database Models, Systems, and Applications (8 Hrs.)
Active Database Concepts and Triggers; Temporal Database Concepts; Spatial Database Concepts; Multimedia Database Concepts; Deductive Database Concepts; Introduction to Information Retrieval and Web Search

Laboratory Works:
Students should implement different concepts of database system studied in each unit of the course during lab time and should submit a mini project at the end the course.

Recommended Books:

1. Elmasri and Navathe, Fundamentals of Database Systems, Pearson Education.
2. Raghu Ramakrishnan, Johannes Gehrke, Database Management Systems, McGraw-Hill
3. Korth, Silberchatz, Sudarshan, Database System Concepts, McGraw-Hill.
4. Peter Rob and Coronel, Database Systems, Design, Implementation and Management, Thomson Learning.
5. C. J. Date & Longman, Introduction to Database Systems, Pearson Education
6. Tiwari, Shashank and Safari, professional Nosql, O'Reilly Media Company.
7. Gunarathne, Thilina Hadoop MapReduce v2 Cookbook: Explore the Hadoop MapReduce v2.
8. Ecosystem to Gain Insights from very Large Datasets, 2nd Edition, PACKT Publishing.

Internship

Course Title: Internship
Course No:CSC476
Nature of the Course: Internship
Semester: VIII

Full Marks:160+40
Pass Marks:64 +16
Credit Hrs: 6

Course Description: This course covers the real-world practice in industry. It includes using theoretical and practical knowledge while working in industry together with the understanding of industry culture.

Course Objectives: The objective of this course is to allow students into market industry and gain real world experience. The course is expected to make students more pragmatic and professional.

Course Details:

Nature of Internship:

The internship work should be relevant to the field of computer science and information technology. The nature internship may include design and development of software, hardware, network services, database systems etc. The internship durationshould be minimum of 180 hours or ten weeks. The internship should be started tentatively by the 3rd week of start of eighth semester. The internship host organizations can be software/hardware development companies, telecommunications companies, network and internet service providers, financial organizations, health organizations etc.

The internship is an individual activity. The student should be responsible for the timely completion of all the activities and projects assigned, maintaining the professional quality. Each student should be facilitated with a mentor at the intern organization and a supervisor at the college/campus. Student should inform the status of all assignments to the mentor and supervisor. The student is expected to communicate frequently with the advisors on the progress and status of intern project(s)/activities. Each student must prepare and submit individual internship report on the basis of his/her work done during the internship period. Students working in group at the same organization should be able to distinguish their nature of work.

Phases of Internship:

The following are the phases of internship evaluation:

1. **Proposal Submission:** Students must submit and present internship proposal planafter 2nd weekof start of the internship.

2. **Mid-Term Submission:** Students must submit progress report and defend midterm progress of their internship work in the 11thweek of the eight semester.

3. **Final Submission:** Students must submit and defend the internship work during last week of the eight semester but before final board examination. The final defense will be

followed a viva voice conducted by an evaluation committee.Students must have to submit the internship final report to their respective department of college/campus before at least 10 days of final defense date. The report should be submitted in standard format as prescribed. The hard/soft copy of report should be made available to the external before a week of presentation date.

Provision of Supervision:

There should be a regular faculty member of the college assigned as a supervisor. The role of supervisor is to supervise the students throughout the internshipperiod. A supervisor can supervise at most four internship students in a section.

Provision of Mentorship:

There should be a regular employee of the intern providing organization assigned as a mentor. The role of mentor is to guide the students throughout the internshipperiod at the organization.

Evaluation Scheme:

1. **ProposalDefense**- 5% Marks of 200 (5 Marks Head/Program Coordinator + 5 Marks Supervisor)
2. **Midterm**- 15% Marks of 200 (5 Marks Head/Program Coordinator + 25 Marks Supervisor)
3. **Final Defense -** 80% Marks of 200 (100 Marks Mentor + 20 Marks Supervisor + 40 Marks External)

The evaluation committee and evaluation criteria should be as follow;

a. Evaluation committee
- HOD/Coordinator
- Project Supervisor
- Mentor
- External Examiner

b. Marks Distribution:
- Head / Program Coordinator – 10
- Supervisor – 50
- Mentor – 100
- External Examiner – 40
- Total – 200

c. Focus of the evaluation
- Presentation Skills
- Level of Work Done and Understanding of Internship Activities
- Internship Report
- Viva/Question Answer

Report Contents:

1. **Prescribed content flow for the project proposal**

    1. Introduction
    2. Problem Statement
    3. Objectives
    4. Description of Internship Work/Project
    5. Internship Plan
    6. Expected Outcome of Internship Activities
    7. References

2. **Prescribed content flowfor the internship report**

    1. Cover & Title Page
    2. Certificate Page
        i. Mentors' Recommendation from Company
        ii. Supervisors' Recommendation
        iii. Examiners' Approval Letter
    3. Acknowledgement
    4. Abstract Page
    5. Table of Contents
    6. List of Abbreviations, List of Figures, List of Tables, List of Abbreviations
    7. Main Report
    8. References
    9. Bibliography (if any)
    10. Appendices (Screen Shots/ Source Codes/ Work Logs etc…)

3. **Prescribed chapters in the main report**

    1. **Chapter 1: Introduction**
        1.1. Introduction (Introduce the project/ work done during internship)
        1.2. Problem Statement
        1.3. Objectives
        1.4. Scope and Limitation
        1.5. Report Organization

    2. **Chapter 2: Organization Details and Literature Review**
        2.1. Introduction to Organization
        2.2. Organizational Hierarchy
        2.3. Working Domains of Organization
        2.4. Description of Intern Department/Unit
        2.5. Literature Review / Related Study

    3. **Chapter 3: Internship Activities**
        3.1. Roles and Responsibilities
        3.2. Weekly log (Log should contain the list of technical activities performed)
        3.3. Description of the Project(s) Involved During Internship

3.4. Tasks / Activities Performed (Technical details of the activities done during the internship)

4. **Chapter 4: Conclusion and Learning Outcomes**
   4.1. Conclusion
   4.2. Learning Outcome

Students should be able to relate and contextualize the above-mentioned concepts with their project work/activities done during internship at the host organization.

Citation and Referencing

The listing of references should be listed in the references section. The references contain the list of articles, books, URLs that are cited in the document. The books, articles, and others that are studied during the study but are not cited in the document can be listed in the bibliography section. The citation and referencing standard should be APA referencing standard. The text inside the document should be cited accordingly. The APA referencing standard can be found in the web at https://apastyle.apa.org/

Report Format Standards

A. Page Number

The pages from certificate page to the list of tables/figures/abbreviations/approvals should be numbered in roman starting from i. The pages from chapter 1 onwards should be numbered in numeric starting from 1. The page number should be inserted at bottom, aligned center.

B. Page Size and Margin

- The paper size must be a page size corresponding to A4. The margins must be set as

  Top = 1; Bottom = 1; Right = 1; Left 1.25

C. Paragraph Style

- All paragraphs must be justified and have spacing of 1.5.

D. Text Font of Document

- The contents in the document should be in Times New Roman font
- The font size in the paragraphs of document should be 12

E. Section Headings

- Font size for the headings should be 16 for chapter headings,14 for section headings, 12 for sub-section headings. All the headings should be bold faced.

F. Figures and Tables

- Position of figures and tables should be aligned center. The figure caption should be centred below the figure and table captions should be centred above the table. All the captions should be of bold face with 12 font size.

Final Report Binding and Submission:

No of Copies: 3 (College Library + Self + Dean Office)

Look and Feel: Golden Embracing with Black Binding

A final approved signed copy of the report should be submitted to the Dean Office, Exam Section, Institute of Science and Technology, Tribhuvan University

Text Book: None

Advanced Networking with IPv6

Course Title: Advanced Networking with IPv6
Course No: CSC477
Nature of the Course: Theory + Lab
Semester: VIII

Full Marks: 60 + 20 + 20
Pass Marks: 24 + 8 + 8
Credit Hrs: 3

Course Description:
The course covers principles underlying IPv6 Network Design, Internet routing protocols (unicast, multicast and unidirectional) with IPv6, algorithmic issues related to the Internet, IPv6 Migration, measurement and performance, next generation Internet (IPv6, QoS) and applications.

Course Objectives:
The main objective of this course is to provide knowledge of different concepts of advanced networking with IPv6 including network design, routing, migration etc.

Course Contents:

Unit 1: Introduction to Networking (6 Hrs.)
1.1.OSI Model
1.2.IPv4 addressing overview
1.3.VLSM & CIDR
1.4.Operational and managerial issues of Legacy IPv4 networking
1.5.Introduction to smart networking
1.6.Overview of Programmable networks: SDN and NFV
1.7.IPv6 network migration status

Unit 2: IP Next Generation (8 Hrs.)
2.1.Internet Protocol Version 6 (IPv6)
2.2.History of IPv6
2.3.IPv6 Header Format
2.4.Features of IPv6
2.5.IPv6 Addressing
2.5.1. Unicast addressing and its types
2.5.2. Anycast addressing
2.5.3. Multicast addressing and its scope
2.6.Static and Dynamic addressing with IPv6
2.7.IPv6 extension headers

Unit 3: ICMPv6 and Neighbor Discovery (6 Hrs.)
3.1.ICMPv6 General Message Format
3.2.ICMPv6 Error and Information Message Types
3.3.ICMPv6 features and its comparison with ICMPv4
3.4.Neighbor Cache and Destination Cache
3.5.Neighbor Discovery Processes and Messages
3.6.Path MTU Discovery
3.7.MLD overview

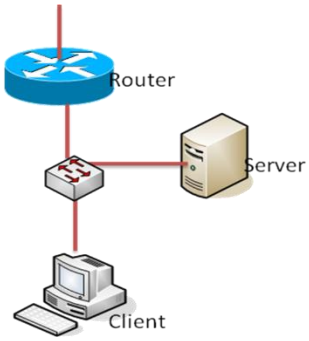
Unit 4: Security and Quality of Service in IPv6 (4 Hrs.)
4.1.Types of Threats
4.2.Security Techniques
4.3.IPSEC Framework
4.4.QoS Paradigms
4.5.QoS in IPv6 Protocols

Unit 5: IPv6 Routing (5 Hrs.)
5.1.RIPng
5.2.OSPF for IPv6
5.3.BGP extensions for IPv6
5.4.PIM-SM & DVMRP for IPv6

Unit 6: IPv4/IPv6 Transition Mechanisms (8 Hrs.)
6.1.Migration Strategies
6.2.Tunneling, dual stack and translations
6.3.Transition techniques
6.3.1. 6RD
6.3.2. Dual-stack lite
6.3.3. Stateful/Stateless AFT
6.3.4. 464XLAT, CGNAT
6.3.5. Other recent techniques

Unit 7: Future networking (8 Hrs.)
7.1.Operation of SDN and NFV
7.2.Introduction to SDN based IPv6 Networking
7.3.SDN migration methods and practices
7.4.Features of Software-Defined IPv6 Networks (SoDIP6)
7.5.SoDIP6 Network Deployment: Challenges and Risks
7.6.SoDIP6 based NGN
7.7.Routing in Multi-Domain SoDIP6 Networks

Laboratory work:
For the lab work, one PC to one student either in virtual environment or real environment will be provided. Students will be divided into group of 3 students. The working environment and machine connectivity will look like the following:



Tools Needed: TCPDUMP & WIRESHARK, VMWare Environment, Linux/FreeBSD, Windows

Lab 1: Enable IPv6 in Windows/Linux
Lab 2: IPv6 Header Analysis
Lab 3: IPv6 Packet analysis (neighbor/router solicitation/discovery)
Lab 4: Unicast Routing Implementation using Zebra-OSPF & OSPF phase analysis
Lab 5: Multicast Routing Implementation using XORP-PIM/SM & PIM/SM phase analysis
Lab 6: SDN enabled IPv6 network implementaion with Mininet
Lab 7: ONOS, SDN-IP implementation for routing implementaiotn in SoDIP6 network

Reference Books:

1. Silvia Hagen: IPv6 Essentials, O'reilly
2. Joseph Davies: Understanding IPv6; eastern economy edition
3. SDN and NFV simplified: A Visual Guide to Understanding Software Defined Networks and Network Function Virtualization, by Jim Doherty

Prerequisite: Networking & Communications Fundamentals

Distributed Networking

Course Title: Distributed Networking
Course No: CSC478
Nature of the Course: Theory + Lab
Semester: VIII

Full Marks: 60 + 20 + 20
Pass Marks: 24 + 8 + 8
Credit Hrs: 3

Course Description:
The course covers overview of distributed networking model, client server model, communication models, internetworking, interprocess communication, fault tolerance, reliability, replication, security issues and new developments in distributed networking.

Course Objectives:
The course objective to make the students familiar with Distributed Network Systems, its models, communication paradigms, related protocols and architectures, its reliability and replication systems, and security issues. It also briefly introduces the current developments in distributed networking.

Course Contents:

Unit 1	Overview: Distributed Systems, Computer Networks, Protocols and QoS, Software for Distributed Computing, Agent – based computing model	4 Hrs.
Unit 2	Client Server Model: Issues, Client Server Model in Distributed Computing System, Cooperation between clients and servers, Extensions to the Client Server Model, Service Discovery, Client Server Interoperability	8 Hrs.
Unit 3	Communication Paradigm: Message and message passing mechanisms, Remote Procedure Calls, Remote Method Invocation, Distributed Shared Memory, its design and implementation and consistency models	6 Hrs.
Unit 4	Internetworking: Communication Protocol Architectures, TCP/IP Protocol Suite, IPv6	5 Hrs.
Unit 5	Interprocess communication using message passing: Developing distributed applications using message passing, sockets and system calls	5 Hrs.
Unit 6	Reliability and Replication Techniques: Fault Tolerance, Reliability, Availability, Failure Classification, Techniques to achieve reliability, Reliability Modelling, Fault Tolerant Distributed Algorithms, Replication and reliability, Replication schemes and consistency	7 Hrs.
Unit 7	Security: Secure Networks, Security Mechanisms on Internet, DDoS Attacks, Active and Passive Defense against DDoS attack	6 Hrs.
Unit 8	Current Developments in Distributed Network System: Introduction and characteristics of Cluster Computing, Grid Computing, P2P Computing, Pervasive Computing	4 Hrs.

Laboratory Works:
Laboratory exercise should consist of tasks related configuration of distributed system, client server applications, message passing, remote method invocation, remote procedure calls, socket and system calls, and reliability and replication techniques.

Text Book:

1. Weijia Jia, Wanlei Zhou, Distributed Network Systems from Concept to Implementation, Springer

Reference Books:

1. HagitAttiya, Jennifer Welch, Distributed Computing: Fundamentals, Simulations and Advanced Topics, 2nd Edition, March 2004
2. Distributed Systems: Principles and Paradigms – Andrew Tanenbaum and Maarten van Steen, Prentice Hall, 2007

Prerequisite: Networking and Communication Fundamentals

Game Technology

Course Title: Game Technology
Course No: CSC479
Nature of the Course: Theory + Lab
Semester: VIII

Full Marks: 60 + 20 + 20
Pass Marks: 24 + 8 + 8
Credit Hrs: 3

Course Description:
This course is a practical and conceptual introduction to game design and development including basic ideas of game design, learn to design a game, and working as a game designer. This course will provide ample opportunities to try out concepts and theories to design, develop and test 2D and 3D games. The main platform will be Unity, a cross-platform game editor and engine widely in use by many companies in the game industry.

Course Objectives:
After completion of the course, students will learn

- basics of game development
- to design games
- to work as a game designer
- to use Unity game editor and engine to develop games

Course Contents:

Unit 1: Game Design Basics (12 Hrs.)
Role of the Game Designer: An Advocate for the Player, Passions and Skills, A Playcentric Design Process, Designing for Innovation; Structure of Games: Engaging the Player, The Sum of the Parts, Defining Games, Beyond Definitions; Working with Formal Elements: Players, Objectives, Procedures, Rules, Resources, Conflict, Boundaries, Outcome; Working with Dramatic Elements: Challenge, Play, Premise, Character, Story, World Building, The Dramatic Arc; Working with System Dynamics: Games as Systems, System Dynamics, Interacting with Systems, Tuning Game Systems

Unit 2: Designing a Game (25 Hrs.)
Conceptualization: Where Do Ideas Come From, Alternative Methods, Editing and Refining, Turning Ideas into a Game, Ideas vs. Designs; Prototyping: Methods of Prototyping, Prototyping Your Original Game Idea, Making the Physical Prototype Better, Beyond the Physical Prototype; Digital Prototyping: Types, Designing Control Schemes, Selecting Viewpoints, Effective Interface Design, Prototyping Tools; Playtesting: Playtesting and Iterative Design, Recruiting Playtesters, Conducting a Playtesting Session, Methods of Playtesting, The Play Matrix, Taking Notes, Basic Usability Techniques, Data Gathering, Test Control Situations, Playtesting Practice; Functionality, Completeness, and Balance: What Are You Testing For? Is Your Game Functional? Is Your Game Internally Complete? Is Your Game Balanced? Techniques for Balancing Your Game; Fun and Accessibility: Is Your Game Fun? Improving Player Choices, Fun Killers, Beyond Fun, Is Your Game Accessible?

Unit 3: Working as a Game Designer (8 Hrs.)

Team Structures: Team Structure, Developer's Team, Publisher's Team, Team Profile, All Contribute to the Design, Team Communication; Stages and Methods of Development: Stages, Using Agile Development; Communication your Designs: Visualization, Flowcharts, Tables and Spreadsheets, Concept Art, Description, Formats, Contents, Design Macros; Understanding the New Game Industry: Size, Platform for Distribution, Genres of Gameplay, Publishers, Developers, The Business of Game Publishing; Selling Yourself and Your Ideas to the Game Industry: Getting a Job at a Publisher or Developer, Pitching Your Original Ideas, Independent Production

Laboratory Works:

The Laboratory work includes designing and developing games using Unity game editor and engine.

Recommended Books:

1. Tracy Fullerton, Game Design Workshop: A Playcentric Approach to Creating Innovative Games, Fourth Edition, CRC Press, 2019.
2. The Digital Gaming Handbook, Edited by Roberto Dillon, CRC Press, 2021.

Distributed and Object Oriented Database

Course Title: Distributed and Object Oriented Database
Course No: CSC480
Nature of the Course: Theory + Lab
Semester: VIII

Full Marks: 60 + 20 + 20
Pass Marks: 24 + 8 + 8
Credit Hrs: 3

Course Description:
This course aims to discuss concepts of distributed and object oriented database management systems. Main focus is given to basic concepts of DDBMS, distributed database design, distributed query processing, distributed concurrency control, concepts of OODBMS, and language and design of object oriented database.

Course Objectives:

- Discuss basic concepts related to distribute DBMS.
- Exemplify design of distributed database.
- Describe distributed query processing and concurrency control.
- Discuss basic concepts of OODBMS.
- Demonstrate language and design for distributed database.

Course Contents:

Unit 1: Introduction to Distributed Database (4 Hrs.)
Distributed Data Processing, Distributed Database Systems, Promises of DDBS, Complicating Factors, Design Issues of DDBMS, and Distributed DBMS Architectures: Autonomy, Distribution, Heterogeneity DDBMS Architecture – Client/Server, Peer to peer, MDBS.

Unit 2: Distributed Database Design and Access Control (4 Hrs.)
Top-Down Design Process, Distribution Design Issues, Fragmentation, Allocation, Data Directory, View Management, Data Security, Semantic Integrity Control.

Unit 3: Query Processing, Decomposition, and Localization (6 Hrs.)
Query Processing Problem, Objectives of Query processing, Complexity of RA Operations, Characterization of Query Processors, Layers of Query Processing, Query Decomposition, Localization of Distributed Data.

Unit 4: Distributed Concurrency Control(8 Hrs.)
Serializability Theory, Taxonomy of Concurrency Control Mechanisms, Lock Based Concurrency Control Algorithms, Time-Stamp Based Concurrency Control Algorithms, Optimistic Concurrency Control Algorithms, Deadlock management.

Unit 5: Object Oriented Database Concepts (6 Hrs.)
Overview of Object-Oriented Concepts, Object Identity, Object Structure, and Type Constructors, Encapsulation of Operations, Methods, and Persistence, Type Hierarchies and Inheritance, Complex Objects, Other Objected-Oriented Concepts

Unit 6: OODBMS Languages and Design (6 Hrs.)
Object Model, Object Definition Language, Object Query Language, Object Database Conceptual Design, Examples of ODBMSs.

Laboratory Works:
Students should implement all the concepts of object oriented and distributed databases mentioned in the course.

Text Books:

1. M. Tamer Özsu and Patrick Valduriez, Principles of Distributed Database Systems, Fourth Edition, Springer, 2019.
2. ElmasriRamez and NavatheShamkant, Fundamentals of Database System, Seventh Edition, Pearson Education, 2017.

Introduction to Cloud Computing

Course Title: Introduction to Cloud Computing
Course No: CSC481
Nature of the Course: Theory + Lab
Semester: VIII

Full Marks: 60 + 20 + 20
Pass Marks: 24 + 8 + 8
Credit Hrs: 3

Course Description:
This course covers different concepts of cloud computing including introduction, architectures, cloud virtualization, programming models, security, and platforms and applications of cloud computing.

Course Objectives:
The main objective of this course is to provide theoretical as well as practical knowledge of cloud computing including designing, implementing and managing the cloud computing.

Course Contents:

Unit 1: Introduction to Cloud Computing (6 Hrs.)
Evolution of Cloud Computing, Characteristics of Cloud Computing, Types of cloud and its Cloud services, Benefits and challenges of cloud computing, Applications cloud computing, Cloud Storage, Cloud services requirements, cloud and dynamic infrastructure, Cloud adoption

Unit 2: Cloud Computing Architecture (6 Hrs.)
Platform as service, Software as a service, Infrastructure as service, Public clouds, Private clouds, Community cloud, Hybrid clouds, Cloud design and implementation using SOA, security, trust and privacy

Unit 3: Cloud Virtualization technology (10 Hrs.)
Introduction to Virtualization, different types of Virtualization, Implementation Levels of Virtualization Structures, Benefits of virtualization, server virtualization, virtualization software, Types of Hypervisor, and Load balancing, Infrastructure requirement for virtualization

Unit 4: Cloud Programming Models (12 Hrs.)
Thread programming, Task programming, Map-reduce programming, Parallel efficiency of Map-Reduce, Enterprise batch processing using Map-Reduce, Comparisons between Thread, Task and Map reduce

Unit 5: Cloud security (6 Hrs.)
Cloud Security issues, challenges and Risks, Software-as-a-Service Security, Security Monitoring, Security Architecture Design, Data and application Security, Virtual Machine Security, Legal issues and Aspects, Multi-tenancy issues

Unit 6: Cloud Platforms and Applications (12 Hrs.)
Web services, AppEngine, Azures Platform, Aneka, Open challenges, Scientific applications,Business and Consumer applications

Laboratory Works:
The practical work consists of all features of cloud computing.

Text Books:
1. Dr. Kumar Saurabh, Cloud Computing
2. Raj Kumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, Mastering Cloud Computing

Reference Books:
1. David S. Linthicum, Cloud Computing and SOA Convergence in your enterprise
2. Barrie Sosinsky, Cloud Computing Bible
3. Saurabh, K. (2011). Cloud Computing – Insights into New -Era Infrastructure, Wiley India.

Geographical Information System

Course Title: Geographical Information System
Course No: CSC482
Nature of the Course: Theory + Lab
Semester: VIII

Full Marks: 60 + 20 + 20
Pass Marks: 24 + 8 + 8
Credit Hrs: 3

Course Description:
The course covers about spatial data structure, modeling and database design, different techniques for capturing the real world, spatial data manipulation, analysis and visualization, spatial data infrastructure and data standardization, overview of open GIS and open source GIS data.

Course Objectives:
The main objective of this course is to provide both theoretical and practical knowledge of Geographical Information System.

Course Contents:

Unit 1: Introduction to Geographic Information System (GIS) (5 Hrs.)

1.1 Overview, concepts of GIS, components of GIS
1.2 Origin of GIS, History of *GIS* and geospatial technology
1.3 Functions and benefits of GIS
1.4 Scope and application areas of GIS
1.5 Data base management system (DBMS) and concept of spatial and attribute data

Unit2: Digital Mapping Concepts and Visualization (5 Hrs.)

2.1 Database and mapping concept: geographic features and attributes, thematic maps, map layers, map scales, resolution and representation
2.2 Map outputs and elements, map design and layout
2.3 Map projection: coordinate systems, projection systems, common map projections in GIS, conversion among coordinate systems

Unit 3: Spatial Data Structure and Database Design (6 Hrs.)

3.1 concepts of geographic phenomena and data modeling, geographic objects and fields
3.2 vector data and raster data model
3.3 spatial relationships and topology
3.4 GIS data formats and data conversion
3.5 Spatial database design with the concepts of geo-database

Unit 4: Data Acquisition, Data Quality and Management (9 Hrs.)

4.1 different methods of data capture
4.2 geo-referencing and digitization
4.3 data preparation, conversion and integration
4.4 spatial data quality and accuracy
4.5 introduction to global navigation and satellite systems (GNSS)
4.6 Basics of remote sensing (RS) technology

4.7 integration of RS and GNSS data into GIS

Unit 5: Spatial Analysis (10 Hrs.)

5.1 vector data analysis: geo-processing, overlay analysis, buffering, network analysis

5.2 raster analysis: local operations, focal operations, zonal operations, re-sampling, mosaic and clip, distance measurement

5.2 spatial interpolation techniques, geo-statistics, GIS modeling

5.3 GIS programming and customization: Opening and exploring Model Builder, Python script tools, Customizing QGIS with Python

Unit 6: Introduction to Spatial Data Infrastructure (3 Hrs.)

6.1 SDI concepts, components of SDI and trends

6.2 The concept of metadata and clearing house

6.3 System Architecture for SDI Interoperability, Client Server Architecture, SDI technologies

6.4 legal aspects of SDI

Unit 7: Open GIS (7 Hrs.)

7.1 Introduction of open concept in GIS

7.2 Open source software for spatial data analysis

7.3 Web Based GIS system

7.4 Open source GIS data

7.5 GIS application case studies

Laboratory work:

The lab should cover at least the concepts given in each chapter.

Recommended Books:

1. Chang, K. T. *Introduction to geographic information systems*. Ninth edition, Boston: McGraw-Hill.
2. Principles of geographic information systems: An introductory textbook, international institute for Geo-information science and Earth observation, the Netherlands- By rolf De By, Richard A. knippers, yuxian sun
3. ESRI guide to GIS analysis Andy Mitchell, ESRI press, Red lands
4. GIS Cook BOOK

Decision Support System and Expert System

Course Title: Decision Support System and Expert System
Course No: CSC483
Nature of the Course: Theory + Lab
Semester: VIII

Full Marks:60+ 20+20
Pass Marks: 24+8+8
Credit Hrs: 3

Course Description:

This course is a study uses of artificial intelligence in business decision making. Emphasis will be given in business decision making process, design and development of decision support systems and expert systems.

Course Objectives:

- Introduce intelligent business decision making
- Discuss design, development and evaluation of DSS Systems
- Discuss various models of building DSS systems
- Explain Concept behind expert systems

Course Contents:

Unit 1: Business Decision Making (10 Hrs.)

1.1. Supporting Business Decision Making: Introduction, History, Conceptual Perspective, Decision Support vs. Transaction Processing System, Categories of DSS Applications and Products, DSS Framework, Building Decision Support Systems
1.2. Gaining Competitive Advantage with Decision Support Systems: Introduction, Technology Trends, Gaining Competitive Advantage, Examples of Strategic DSS, Opportunities and IS Planning, DSS Benefits, Limitations, and Risks, Resistances to Using DSS
1.3. Business Decision Making Process: Introduction, Managerial Decisions, Decision Making Context, Decision Making Process, Good Decision Making, Redesigning Decision Making Process

Unit 2: Designing, Developing, and Evaluating DSS Systems (10Hrs.)

2.1. Designing and Evaluating DSS Systems:Introduction, Design and Development Issues, Decision Oriented Diagnosis, Prepare a Feasibility Study, Choose a Development Approach, DSS Project Management and Participants.
2.2. Designing and Evaluating DSS User Interfaces:Introduction, Overview of User Interface, User Interface Styles, ROMC Design Approach, Building DSS User Interface, Comments on Design Elements, Guidelines of Dialog and UI Design, Factors of UI Design Success.
2.3. DSS Architecture, Networking, and Security Issues:Introduction, DSS Architecture and IT Infrastructure, Networking Issues, Improving Security for Decision Support Systems.

Unit 3: Building DSS Systems (10 Hrs.)

3.1. Implementing Communication-Driven and Group Decision Support Systems, Building Data and Document Driven Decision Support Systems, Building Knowledge Driven Decision Support Systems, Building Model Driven Decision Support Systems, Building Web Based and Interorganizational Decision Support Systems, Evaluating DSS Projects

Unit 4: Expert Systems (8 Hrs.)

4.1. Definition and Features of Expert Systems, Architecture and Components of Expert Systems, Persons Who Interact with Expert Systems, Advantages and Disadvantages of Expert Systems, Expert Systems Development Life Cycle, Error Sources on Expert System Development

Unit 5: Fuzzy Expert Systems (7 Hrs.)

5.1. Fuzzy Rule, Fuzzy Reasoning, Need of Fuzzy Expert Systems, Operations on Fuzzy Expert Systems, Fuzzy Inference Systems, Fuzzy Inference Process, Types of Fuzzy Expert Systems, Fuzzy Controller.

Laboratory Work: Student should study some widely used decision support systems and expert systems. Besides, student need to develop decision support systems or expert systems as a mini-project.

Text Books:

1. Daniel J. Power, Decision Support Systems: Concepts and Resources for Managers, Illustrated Edition,Praeger.
2. I. Gupta and G. Nagpal, Artificial Intelligence and Expert Systems,Mercury Learning & Information, 2020

Mobile Application Development

Course Title: Mobile Application Development
Course No: CSC484
Nature of the course: Theory + Lab
Semester: VIII

Full Marks:60+20+20
Pass Marks:24 + 8 + 8
Credit Hrs: 3

Course Description:
This course introduces mobile application development frameworks, architectures, design and engineering issues, techniques, methodologies for mobile application development.

Course Objective:
The main objective of this course is to provide knowledge of understanding characterization and architecture with designing and developing of mobile applications.

Course Contents:

Unit 1: Introduction to Mobile Computing (5 Hrs.)
Introduction to Mobile Computing, 3-tier architecture of mobile computing, History of mobile, the evolution of devices (Brick era, Candy bar era, Feature phone era, Smartphone era, Touch era), Introduction to mobile application development frameworks (Swiftic, React Native, Xamarin, Ionic, Sencha, Adobe PhoneGap), Mobile ecosystem, Mobile application development environments, Factors in Developing Mobile Applications (Mobile Software Engineering, Framework and tools, User interface), Adding dimensions of mobile computing

Unit 2: Architecture, Design and Mobile Development Frameworks (10 Hrs.)
Mobile computing architectures, Fully centralized and client server architectures, N-tier architecture, Mobile information architecture, Mobile design, The mobile design tent-pole, Elements of mobile design, Designing for right device and different size screen, Fully centralized framework, N-tier client server framework, Mobile operating system and Virtual machine, Hardware specific tools and frameworks, BREW (Binary Runtime Environment for Wireless), BREW SDK, Building and deploying BREW application, WAP Architecture, WAP UI, WAP proxies and gateways, Multimedia messaging services, WAP push, security, Publishing frameworks (cocoon architecture)

Unit 3: User Interfaces (10 Hrs.)
Generic UI development, Human factors, Elements of the user interfaces (channels, interaction, prompts, response, commands, menus, forms, natural language), Resource files, Using UI widgets, Event driven programming, Context, (Taxonomy of context by domain, Extrinsic and Intrinsic context), User interface components, XForms, Developing mobile GUI, MVC, PAC, VUIs and mobile apps, Qualities of speech, Voice transcription, Voice recognition (Speech Grammar), Text to speech technologies, Speech synthesis, Multichannel and Multimodal UIs

Unit 4: Testing and Publishing Apps (5 Hrs.)
Mobile application build and delivery, Testing mobile applications, Automated versus Manual testing, Testing the mobile infrastructure, Coding standards, Unit testing, Black box testing, White box testing, Regression testing, App distribution through App stores, Monetizing Apps

Unit 5:Mobile Agent and Peer-to-Peer Architectures for Mobile Applications (3 Hrs.)
Basics of Agent technologies, Mobile agents for mobile computing, Peer to peer applications for mobile computing, JXTA

Unit 6:Wireless Connectivity and Mobile Applications (3 Hrs.)
Modulation and Transmission techniques, Short range and long range wireless communication, Security in wireless network, Bluetooth security, Security in long range wireless networking technologies, Mobile IP, SMS

Unit 7:Synchronization and Replication of Mobile Data (3 Hrs.)
Taxonomy of synchronization and replication, Scalability issues, Solving the mobile synchronization, Bluetooth synchronization, Working with the content provider

Unit 8:Location and Sensing (4 Hrs.)
Mobility and location based service, Data acquisition of location information, GPS based solution, Non GPS solution, Using GIS for mobile applications, Location information modeling, Location based service, Architecture for offering location services, Security and privacy of location information

Unit 9:Active Transactions (2 Hrs.)
Active computing and wireless infrastructure, WAP Push, Mobile IP and Push, Session initiation protocol

Laboratory Works: The laboratory should contain all the features mentioned in a course, which should include

- Language overview (Java, Object oriented concept)
- Basic Concept of Android application architecture
    - source, resource folder concept
    - Terminology for android
- Concept of android Layouts
    - Concept of Linear layout, Relative layout, toolbar
    - Concepts of list view, recycler view, grid view, scroll view, view pager, tab Layout
    - Create form and form validation
    - Alert Dialogs, Toast
    - Popup
- Shared Preference
- Menu
    - Option menu, context menu
- Introduction to Activity, Fragment
    - Simple activity information
    - Working with intents
- Theme and Style
- Database
    - Simple overview to database (simple query)
    - SQLite overview

- API Implementation
    - Working with volley
    - Working with Retrofit
- Advanced
    - Thread
    - JSON Parsing
    - Google Play Service (Maps, GPS)
    - FCM (Firebase Cloud Messaging)

Text Books:

1. Mobile Computing Principles: Designing and Developing Mobile Applications with UML and XML, Reza B'Far, Cambridge University Press, 2005
2. Mobile Design and Development, Brian Fling, O'Reilly, 2009

Real Time Systems

Course Title: Real Time Systems
Course No: CSC485
Nature of the Course: Theory + Lab
Semester: VIII

Full Marks: 60+20+20
Pass Marks: 24+8 + 8
Credit Hrs: 3

Course Description:
This course familiarizes students with different concepts of real time systems mainly focusing on scheduling, access control, memory management, optimization, and real time communications.

Course Objective:
The main objective of this course is to provide core knowledge of different concepts of real time system which will enhance the student capacity in building real time systems.

Course Contents:

Unit 1: Introduction (4 Hrs.)
Definition, Hard, Soft and Firm Real Time System, Real Time Vs. Embedded System, Timing Constraints, Application of Real Time System, Brief Survey of Real Time Programming: Ada 95, C, C++, C#, Fortran, Java, Occam 2, Special Real-Time Languages

Unit 2: Reference Model of Real Time System (4 Hrs.)
Processor and Resources, Temporal Parameters of Real-Time Workload, Periodic and Aperiodic Task Model, Precedence Constraints and Data Dependency, Other Dependencies, Functional Parameters, Resource Parameters of Jobs and Parameters of Resources

Unit 3: Periodic Task Scheduling (7 Hrs.)
Clock Driven Scheduling – Definition, Notations and Assumption, Scheduler Concepts, General Scheduling Structure, Cyclic Executives. Priority Driven Scheduling - Notations and Assumption, Fixed Priority Verses Dynamic Priority, Fixed Priority Scheduling Algorithms (RM and DM) and their Schedulability Analysis, Concept of Schedulability Tests – Inexact and Exact Schedulability Tests for RM and DM, Optimality of the RM and DM Algorithms, Practical Factors.

Unit 4: Aperiodic Task Scheduling (7 Hrs.)
Aperiodic Task Scheduling: Assumption and Approaches, Server Based and Non-Server Based Fixed Priority Scheduling Algorithms: Polling Server, Deferrable Server, Simple Sporadic Server, Priority Exchange, Extended Priority Exchange, Slack Stealing. Introduction to Scheduling of Flexible Computations: Flexible Applications, Imprecise Computation Model and Firm Deadline Model. Introduction to Scheduling of Flexible Computations –Flexible Applications, Imprecise Computation Model and Firm Deadline Model.

Unit 5: Real-Time Memory Management (5 Hrs.)
Process Stack Management, Multiple-Stack Arrangements, Memory Management in the Task-Control-Block Model, Swapping, Overlays, Block or Page Management, Memory Locking, Working Sets, Real-Time Garbage Collection, Contiguous File Systems

Unit 6: Resources and Resource Access Control (5 Hrs.)
Assumptions on Resources and their Usage, Effects of Resources Contention and Resource Access Control, Non Preemptive Critical Sections, Basic Priority-Inheritance Protocol, Basic Priority-Ceiling Protocol, Stack-Based, Priority-Ceiling (Ceiling-Priority) Protocol, Use of Priority-Ceiling Protocol In Dynamic-Priority System, Preemption-Ceiling Protocol, Controlling Accesses to Multiple-Unit Resources, Controlling Concurrent Accesses to Data Objects

Unit 7: Performance Analysis and Optimization of Real-Time Systems (6 Hrs.)
Challenges in Analyzing Real-Time Systems, Performance Analysis: Analysis of Round-Robin Systems, Response-Time Analysis for Fixed-Period Systems, Response-Time Analysis: RMA Example, Analysis of Sporadic and Aperiodic Interrupt Systems, Performance Optimization: Compute at Slowest Cycle, Scaled Numbers, Binary Angular Measure, Optimizing Memory Usage; Analysis of Memory Requirements; Reducing Memory Utilization: Variable Selection, Memory Fragmentation

Unit 8: Real Time Communication (7 Hrs.)
Introduction, Model of Real-Time Communication, Real Time Traffic Model, Real Time Connections and Service Disciplines, Priority – Based Service Disciplines for Switched Network, Weighted Round-Robin Service Disciplines, Medium Access-Control Protocols of Broadcast Networks, Internet and Resource Reservation Protocols, Real-Time Protocol

Laboratory Work / Case Study:
The laboratory work should focus on implementation of concepts related to scheduling, memory management, synchronization and optimization using suitable simulators and programming languages. There should also be a case study in group with at most 4 students focusing on any real time system implemented system.

Text Books:
1. Real-Time Systems, Jane W. S. Liu, Pearson Education Asia, Latest Edition
2. Real-Time Systems, Design Principles for Distributed Embedded Applications Kopetz, Hermann, Springer Latest Edition

Network and System Administration

Course Title: Network and System Administration
Course No: CSC486
Nature of the Course: Theory + Lab
Semester: VIII

Full Marks: 60 + 20 + 20
Pass Marks: 24 + 8 + 8
Credit Hrs: 3

Course Description:
The course covers different concepts of network and system administration including subjects ranging from initial installation of OS to day-to-day administrative tasks such as Network and Server Configurations, management of user accounts and disk space, and even imparting the trouble-shooting skills future system administrators will need to cope with unexpected behavior.

Course Objectives:
The main objective of this course is to provide knowledge of different concepts of network and system administration, configuration, and management.

Course Contents:

Unit 1: Networking Overview (4 Hrs.)
1.1 Overview of Reference Model (OSI, TCP/IP)
1.2 Overview of IPv4 and IPv6 addressing
1.3 Windows and Linux Networking Basics
1.4 Switching and Routing basics
1.5 Overview of SDN and OpenFlow

Unit 2: Server Administration Basics (8 Hrs.)
2.1 Open Source Server and Client Installation
2.2 Linux installation, disk partitioning, logical volume manager
2.3 Boot Process and Startup Services: Xinetd/Inetd
2.4 Managing accounts: users, groups and other privileges
2.5 File Systems and Quota Management
2.6 Job Scheduling with cron, crontab, anacron and system log analysis
2.7 Process controlling and management
2.8 Online Server upgrade/update process
2.9 Administering Database, web, and proxy server
2.10 Shell programming fundamentals

Unit 3: Network Configuration Basics (7 Hrs.)
3.1 Network Interface Configuration
3.2 Diagnosing Network startup issues
3.3 Linux and Windows Firewall configuration
3.4 Network troubleshooting commands
3.5 Introduction to network programming with Mininet
3.6 SDN controller and dataplane communication
3.7 Routing configuration in SDN
3.8 Open source networking monitoring (e.g. Nagios)

Unit 4: Dynamic Host Configuration Protocol (DHCP) (3 Hrs.)
4.1 DHCP Principle
4.2 DHCP Options, Scope, Reservation and Relaying
4.3 DHCP Troubleshooting

Unit 5: Name Server and Configuration (7 Hrs.)
5.1 DNS principles and Operations
5.2 Basic Name Server and Client Configuration
5.3 Caching Only name server
5.4 Primary and Slave Name Server
5.5 DNS Zone Transfers
5.6 DNS Dynamic Updates
5.7 DNS Delegation
5.8 DNS Server Security
5.9 Troubleshooting

Unit 6: Web and Proxy Server Configuration (7 Hrs.)
6.1 HTTP Server Configuration Basics
6.2 Virtual Hosting
6.3 HTTP Caching
6.4 Proxy Caching Server Configuration
6.5 Proxy ACL
6.6 Proxy-Authentication Mechanisms
6.7 Troubleshooting

Unit 7: FTP, File, and Print Server (4 Hrs.)
7.1 General Samba Configuration
7.2 CUPS configuration basics
7.3 FTP Principles
7.4 Anonymous FTP Server
7.5 Troubleshooting

Unit 8: Mail Server basics (5 Hrs.)
8.1 SMTP, POP and IMAP principles
8.2 SMTP Relaying Principles
8.3 Mail Domain Administration
8.4 Basic Mail Server Configuration (Sendmail, postfix, qmail, exim..)
8.5 SPAM control and Filtering
8.6 Troubleshooting

Laboratory work:
The laboratory work includes all the features mentioned in the course.

Samples:
1. Server/Client Installation over VMware Environment
2. Packet Analysis by using TCPDUMP and WIRESHARK

3. Network Practice with Packet Tracer
4. System Administration: User/Group management, File System Management ….
5. Network Configuration: Start/Stop network Service, network interface configuration
6. Firewall Configuration
7. DNS and DHCP Configuration and Troubleshooting
8. Web and Proxy Server Configuration and Troubleshooting
9. Basic Mail Server Configuration and Troubleshooting
10. SAMBA, NFS, CUPS and FTP configuration and Troubleshooting
11. SDN controller installation and client network implementation (OpenDaylight)
12. Network topology programming with Mininet and visualization

Recommended Books:

1. The Practice of System and Network Administration, Second Edition
   Thomas A. Limoncelli, Christina J. Hogan, Strata R. Chalup
2. Advanced Linux Networking, Roderick W. Smith, Addison-Wesley Professional (Pearson Education), 2002.
3. Linux Network Administrator's Guide, Tony Bautts, Terry Dawson, Gregor N. Purdy, O'Reilly, Third Edition, 2005

Prerequisite: Computer Networking Course

Embedded Systems Programming

Course Title: Embedded Systems Programming
Course No: CSC487
Nature of the Course: Theory + Lab
Semester: VIII

Full Marks: 60+20+20
Pass Marks: 24 + 8 + 8
Credit Hrs: 3

Course Description:
The course covers ARM based embedded system overview – assembly level programming, efficient C programming and embedded OS.

Course Objective:
The main objective of this course is to introduce the underlying principle of embedded system programming in assembly language and C language for ARM based embedded processor.

Course Contents:

Unit 1: ARM Embedded System (4 Hrs.)
Introduction to Embedded Systems, Introduction to RISC Design Philosophy, The ARM Design Philosophy, Embedded System Hardware, Embedded System Software

Unit 2: ARM Processor Fundamentals (4 Hrs.)
The Acron RISC Machine, The ARM Programmer's Model, ARM Development Tools, Registers, Current Program Status Register, Pipeline, Exceptions, Interrupts, Vector Table, ARM Processor Families

Unit 3: Introduction to ARM Instruction Set (8 Hrs.)
Data Processing Instructions, Branch Instructions, Load – Store instructions, Software Interrupt Instructions, Program Status Register Instructions, Loading Constraints, Conditional Execution

Unit 4: Thumb Instruction Set (8 Hrs.)
The Thumb bit in the CPSR, The Thumb Programmer's Model, Thumb Branch Instructions, Thumb Software Interrupt Instructions, Thumb Data Processing Instructions, Thumb Single Register Data Transfer Instructions, Thumb Multiple Register Data Transfer Instructions, Thumb Breakdown Instruction, Thumb Implementation, Thumb Application

Unit 5: Efficient C Programming for ARM (8 Hrs.)
Basic Data Types, Expressions, Conditional Statements, Loops, Function Calls, Procedures, Use of Memory, Pointer Aliasing, Bit Field

Unit 6: Writing and Optimizing ARM Assembly Code (8 Hrs.)
Writing Assembly Code, Profiling and Cycle Counting, Instruction Scheduling, Register Allocation, Conditional Execution, Looping Constructs, Bit Manipulation, Efficient Switches, Handling Unaligned Data

Unit 7: Firmware and Embedded OS (5 Hrs.)

Firmware and Bootloader, Fundamental Components of Embedded OS, Embedded Linux, Android OS

Laboratory Works:
Programming in C and Assembly (KEIL and PROTEUS), GPIO Programming (LED, LCD, Keypad, Buzzer)

Text Book:
1. Andrew N. Sloss, Dominic Symes, Chris Wright "ARM System Developer's Guide: Designing and Optimizing System Software", Latest Edition, Morgan Kaufmann Publisher, An imprint of Elsevier

Reference Books:
1. Steve Furber "ARM System – on – Chip Architecture", Second Edition, Pearson Education Limited
2. Warwick A. Smith "C Programming for Embedded Micricontrollers"

International Business Management

Course Title: International Business Management
Course No: MGT488
Nature of the Course: Theory
Semester: VIII

Full Marks: 80 + 20
Pass Marks:32+ 8
Credit Hrs: 3

Course Description:
This course contains globalization and international business, global economy and regional, international trade and investment theories and practices, national difference in political, economic and socio-cultural environment, strategies for international business and international financial environment to provide the basic knowledge to students.

Course Objectives:
The objective of this course is to familiarize students with the environment and challenges of doing business abroad. The course presents students with the opportunities to explore a number of issues and concerns relating to international business.

Course Contents:

Unit 1: Globalization and International Business (8 Hrs.)
Concept of domestic, international and global business. Opportunities and challenges of IB. Globalization: Concept and drivers, Types of globalization:economic, cultural, political, environmental, production, market.International Business Environment: Economic, demographic, cultural and political-legal environment; Globalization debate: positive and negative impact.

Unit 2: Global Economy and Regional Economy (6 Hrs.)
Global economy: concept, features and structures; changing demographics of global business. MNCs: Concept, types, structures, strategies, and problems. Global economic integration: WTO (Origin, goals, structure, and functions). Regional economic integrationlevels: preferential trading, free trade areas, customs union, common market, economic union, and political union; International Economic Organizations: WTO, UNCTAD, World Bank, IMF EU, NAFTA, SAFTA, BIMSTEC (Origin, goals and structure).

Unit 3: National Differences in Socio-cultural Environment (3 Hrs.)
Socio-cultural implication on IB. Cultural differences: Determinants of culture: Awareness, values, norms, communication, language and religion. Dealing with cultural differences.

Unit 4: National Differences in Political Environment (3 Hrs.)
Political systems: Democracy & totalitarian spectrum. Business-government relations. Political risk: concept and types. Impact of political environment on international business. Implications of legal systems in business. Intellectual property rights.

Unit 5: National Differences in Economic Environment (3 Hrs.)
Economic system: market, command, mixed. Determinants of economic development: Inflation, Income (GDP, per capita income nominal & PPP, HDI). Level of economic development: developed, developing, and emerging economies (World Bank's Criteria).

Unit 6: International Financial Environment (8 Hrs.)

Foreign exchange markets, Spot market, spot rate quotations, bid-ask spreads, trading in spot markets, cross exchange rates, forward markets, forward rate, long and short forward positions, forwards premium and discount; Arbitrage, Hedging and Speculation; Types of exchange rate systems: fixed and floating, soft peg, crawling peg, free float, managed float; Factors affecting exchange rate- relative inflation rates, interest rates, relative interest rates, relative income levels, government controls, expectations; Mode of payment in international trade.

Unit 7: Strategies for IB (6 Hrs.)

International strategic management: Concept and importance; Modes of entry into a foreign market:Export and import; strategic alliances: equity based (wholly owned subsidiaries, acquisition, greenfield venture, equity alliances, joint venture) and contractual based (licensing, franchising, turnkey operations, BOT, management contract). FDI & portfolio investment: benefits and drawbacks.

Unit 8: Functional Management and Operation of IB (8 Hrs.)

Polycentric, ethnocentric, regiocentric and geocentric approach in functional management of IB. Global marketing strategies: Product strategy, distribution strategy, promotion strategy, pricing strategy. Global production strategies: location, outsourcing, managing global supply chain. Global finance strategies: sources of fund, tax practices, tax haven. Global human resource management strategies: Staffing policy, expatriate management, compensation, cultivating global mindsets.

Recommended Books:

1. Cavusgil S.T., Knight G. and Riesenberger J. (2017). *International Business.* Fourth Edition.England: Pearson Education Limited.
2. Hill, Charles and Hult, Tomas. (2019). *International Business.* Twelfth Edition. New York:McGraw Hill Education.
3. Daniel J.D., Radebaugh L.H., Sullivan D.P. (2015). *International business.* Fifteenth Edition.England: Pearson Education Limited.
4. Rugman A.M. and Collinson, S. (2012). *International business.* Sixth Edution. England:Pearson Education Limited.