Tribhuvan University
Institute of Science and Technology
Course of Study for Four Year Mathematics

Course Title: Computer Programming **Full Marks:** 75 (60 Theory + 15 Lab)

Course No: MAT 301 **Pass Marks:** 26.25 (21 Theory +5.25 Lab)

Level: B. Sc **Year:** III

Nature of course: Theory (6 Hrs.) + Lab (3 Hrs.). **Period Per Week:** 9 Lecture Hrs.

Course Description: This course is designed for third year of Four years B.Sc. program .The course covers the basics of computer systems and programming in the "C" programming language. The course aims at demonstrating the fundamental programming techniques of C. The course includes basics of C-programming, scalar data types and their operators. The course spans the details of flow control, complex data types such as arrays, structures, unions, and pointers, structuring the code using functions, and handling the files.

Examination: There will be a final examination of the theory part of 60 marks for the period of two hours. The examination for the practical (laboratory) part of 15 marks will be conducted by the concerned Department of Mathematics and the marks will be submitted to office of the controller of examination. The candidate must pass in theory and practical (laboratory) part separately.

For the Laboratory examination part, the examination for 10 Marks will be taken by the teacher of the concerned department by giving two programming problems for Laboratory work each carrying 5 Marks and for the rest 5 Marks there will be of a viva voce examination in the presence of the head of the department and the subject teacher.

Course Contents

Unit 1: Introduction to Computer Systems:

Introduction to computers, Architecture of digital computer, Central Processing Unit, Memory system, Primary memory, Secondary memory, Inputs devices, Output devices, Computer software, System Software, Application Software, Operating Systems, Generations of computers, Applications of computers. [11 Lectures]

Unit 2: Introduction to Programming Languages

Programming languages, Evolution of programming languages, Structured programming, The compilation process, Object code, Source code, Executable code, Interpreters, Linkers, Loaders, Fundamentals of algorithms, Flow charts. [7 Lectures]

Unit 3: Fundamentals of C Programming

Introduction to C, History of C, Structure of C program, Compilation and execution, The C-Character set, C-Tokens, Keywords and identifiers, Delimiters, Variables, Declaration of variable, Constants, Data types, Expressions, Statements, Comments, Symbolic constants. [11 Lectures]

Unit 4: Input/ Output Statements

Single character input/ output, Input data using scanf, Writing output data using printf, gets and puts functions. [5 Lectures]

Unit 5: Operators and Expressions

Arithmetic operators, Unary operators, Relational operator, Logical operators, Assignment operators, Increment or decrement operators, Conditional operator, Bitwise operator, Comma operator, Precedence of operators, Arithmetic expressions, Type conversion in expressions.
[10 Lectures]

Unit 6: Control Statements

Branching: if-else statement, Nested if-else, Looping: While statement, Do-while statement, For statement, Switch statement, Break statement, Goto statement. [8 Lectures]

Unit 7: Functions

Overview of functions, Library functions, User defined functions, Defining a function, Accessing a function, Function prototypes, Local and global variables, Passing arguments to a function, Call-by-value, Call-by-reference, Recursion. [12 Lectures]

Unit 8: Arrays and Pointers

Defining an array, Processing an array, One-dimensional array, Multi-dimensional array, Matrix operations, Arrays and strings, Introduction to pointers , The & and * operator, Pointer declarations, Passing pointers to a function, Pointers and one-dimensional arrays, Dynamic memory allocation, Operations on pointers, Pointers and multi-dimensional Arrays, Array of pointers. [18 Lectures]

Unit 9: Structures and Unions:

Defining a structure, Processing a structure, User defined data type (Typedef), Structures and Pointers, Passing structures to functions, Structure within structure (Nested/ self-referential Structure), Unions.

[10 Lectures]

Unit 10: File Handling

Concepts of file, Opening and closing of file, Modes, Input/ output function, Creating a file, Processing a file. [8 Lectures]

Laboratory works 50 Hrs.

This course requires a lot of programming practices. Each topic must be followed by a practical session. Practical sessions for each unit should be conducted and should include writing programs for mathematical problems as much as possible. The sample lab sessions could be as following descriptions;

- The lab sessions should include writing programs for basic mathematical operations like addition, subtraction, multiplication, division, average etc.

- The instructor should encourage the students to write the programs for finding factorials, computing GCD, primality testing, Fibonacci numbers, sum of natural numbers, generation of series of numbers, finding quadratic roots, generation of random numbers, computing area, volume etc.

- Students should write programs for matrix computation including addition of matrices, multiplication of matrices using the Arrays. The students should also be able to represent adjacency graphs using arrays.

- The students should write programs for creating user defined data types using Structures and Unions.

- The students should also practice handling files. They should write programs for reading and writing from/to the files.

Text books

1. Byron S. Gottefried, " *Theory and Problems of Programming with C*", Mc-Graw Hill.
2. Brian W. Kernighan & Dennis M. Ritchie, "*The C programming Language*", PHI.
3. E. Balagurusamy, "*Programming in ANSI C*", Tata Mc-Graw Hill.

Reference books

4. Yashavant Kanetkar: "*Let us C*", BPB Publications.
5. Stephen G. Kochan, "*Programming in C*", CBS Publishers & Distributors.
6. Efraim Turban, R. Kelly Rainer, Jr. Richard E. Potter, "*Introduction to Information Technology",* John Wiley & Sons (Asia) Pvt. Ltd.

Alexis Leon, Mathews Leon, "*Fundamentals of Information Technology*", Le

Tribhuvan University

Institute of Science and Technology
Course of Study for Four Year Mathematics

Course Title: Real Analysis **Full Marks:** 75
Course No. : MAT 302 **Pass Mark:** 26.25
Level : B.Sc. **Year:** III
Nature of Course: Theory **Period per week:** 9 Lecture Hrs.

Course description

This course is designed for third year of Four years B.Sc. program. The main aim of this course is to provide elementary knowledge of real analysis.

Course objectives

The general objectives of this course is

a) To acquire basic knowledge and understanding of the language of mathematical terms, symbols, statements formulae, definitions, logic etc.
b) To develop basic knowledge and analytical skill in the emerging areas of Real Analysis.
c) To prepare a base for higher studies in Mathematical Analysis.

Course Contents

Unit 1. Basic Concepts

Elementary logic: Connectives, Quantifiers, Basic laws of logic, Techniques of proof.
Sets and functions: Sets and set operations, Relations and functions, One-to-one and onto functions, One-to-one correspondence, Images and inverse images, Composition, Inverse functions. [22 Lectures]

Unit 2. Real Number System

Peano's axioms, Field axioms, Order axioms, Bounded and unbounded sets, Supremum and infimum, Completeness axioms, Archimedean property, Well ordering principle, Rational density, Countable and uncountable sets, Cardinality. [25 Lectures]

Unit 3. Point-Set Topology of the Real Line

Neighbourhood, Interior points and limit points of a set, Open and closed sets and their properties, Bolzano-Weierstrass theorem, Closure of a set, Derived sets, Perfect sets. [15 Lectures]

Unit 4. Sequences of Real Numbers

Sequences and subsequences, Convergent sequences, Bolzano-Weierstrass theorem for sequences, Cauchy sequences, Convergence criteria, Operations on convergent sequences, Monotonic sequence and convergence, Nested intervals theorem. [16 Lectures]

Unit 5 **Series of Real Numbers**

Series and sequences, Convergence and divergence, Cauchy's criteria for convergence, Different tests for convergence, Alternating series, Absolute and conditional convergence. [17 Lectures]

Unit 6. Limits and Continuity

Limits, Sequential criterion for limits, One-sided limits, Properties of limits, Continuity of functions, Sequential criterion for continuity, Discontinuities, Continuity and inverse images, Functions continuous on closed intervals, Sign preserving property, Intermediate value theorem, Bolzano's theorem, Uniform continuity, Lipschitz condition. [13 Lectures]

Unit 7. Differentiation

Derivative of a real-valued function of a single variable, Differentiability at a point and in an interval, Sequential criterion for derivatives, Differentiability and continuity, Monotonic functions, Rules of differentiation, Rolle's theorem, Lagrange's mean value theorem, Cauchy's mean value theorem and their geometric interpretations, Higher order derivatives, Taylor's theorem, Maclaurin's theorem and their infinite series form, Applications of Taylor's theorem in extreme values problems, Indeterminate forms, L'Hospital rule. [16 Lectures]

Unit 8. Riemann Integration

Partitions and refinement of partitions, upper and lower integrals, Riemann integrable functions and Riemann integrals, Condition of integrability, Properties of Riemann integrals, Alternative approach: Step function approach to Riemann integration. [14 Lectures]

Unit 9. Fundamental Theorems of Calculus

Primitives, Fundamental theorem of calculus, First mean value theorem, Generalized first mean value theorem, Integration by parts, Change of variable in an integral, Second mean value theorem (particular case). [12 Lectures]

Text books

1 Bartle, Robert G. & Sherbert, Donald R.: *Introduction to Real Analysis*, John Wiley and Sons Inc., Singapore.
2 Bajracharya, P.M.: *Real Analysis – An Introduction to Proof*, Buddha Academic Publishers & Distributors Pvt.Ltd., Kathmandu, Nepal
3 Shrestha, R.M. and Pahari,N.P.: *Fundamentals of Mathematical Analysis*, Sukunda Pustak Bhawan, Kathmandu, Nepal.

Reference books

4 Maskey, S.M.: *Principles of Real Analysis*, Bhundipuran Prakashan, Kathmandu, Nepal.

5 Malik, S.C.& Arora, Savita: *Mathematical Analysis*, Wiley Eastern Limited, New Delhi.

Tribhuvan University

Institute of Science and Technology

Course of Study for Four Years Mathematics

Course Title: Numerical Methods (Elective) **Full Marks:** 50
Course No. : MAT 303 **Pass Mark:** 17.5
Level : B.Sc. **Year:** III
Nature of Course: Theory (3 Theory + 2 Practical) **Period per week:** 5 Lecture Hrs.

Course Description

This course is designed for third year of Four years B.Sc. program as an elective subject. The main aim of this course is to provide the basic knowledge of Numerical Methods.

Course Objectives: The objective of this course is to acquaint students with the basic concepts of Numerical Methods. It aims at enabling students to build foundation of Numerical Methods.

Examination: Theory 35 + Practical 15 = 50 Marks. The practical examination will be conducted by the concerned department of the college and the marks must be sent to the controller of the examination. A student must pass separately in theory and practical exam. Pass Marks for Theory is 12.25 and for practical 5.25.

Unit 1: Introduction to MatLab, Process of Numerical Computing, Characteristics of Numerical Computing, Introduction to Approximations, Errors in Computation and Their Analysis, Significant Digits, Floating Point Representation, Accuracy and precision. [10 Lectures]

Unit 2: Nonlinear Equations: Bisection method, False position method, Newton- Raphson method, Secant method, Fixed Point Iteration Method: Derivation, Algorithm, Comparison between Them, Rate of convergence, Error Computation and Implementation. [15 Lectures]

Unit 3: Discrete Solution of Linear Equations: Basic Gauss Elimination Method, Gauss Elimination with pivoting, Triangular Factorization (Decomposition) Methods, Gauss Jordan Method, Matrix Inversion: Derivation of the Methods, Their Algorithms and Implementation. Jacobi and Gauss Seidel Iteration Methods: Derivation of the Methods, Algorithms, Rate of Convergence, Comparison between Them and Implementation. [15 Lectures]

Unit 4: Interpolation and Curve Fitting: Interpolation by Lagrange, Interpolation by Newton, Divided Differences, Forward and Backward Difference Operators, Chebyshev Polynomial: Derivation, Algorithm and Implementation. Least Squares Method: Fitting a Straight Line, Derivation, Algorithm, and Implementation. [15 Lectures]

Unit 5: Numerical Differentiation and Integrations, Solutions of ODEs: Difference approximation of first derivative, Difference Approximation for Second Order Derivative, Newton Cotes Methods, Trapezoidal Rule, Simpson's 1/3 and 3/8 rule, Romberg integration Method, Solutions of ODEs with Picard , Taylor, Euler, Modified Euler, Runge - Kutta Method of order four: Derivation, Algorithm, Error Computation, Comparison to Each other and Implementation. [20 Lectures]

Text books

1. Wan Young Yang, Wenwu Cao, Tae-Sang Chung and John Morris *Applied Numerical Analysis with Mat Lab*., John Wieley and Sons. INC., Publication.
2. B. S. Grewal, Khanna ; *Numerical Methods in Engineering and Science*, Publishers India, 2013.

3. Burden, R.L. and Faires, J.D., *Numerical Analysis, Theory and Techniques*, Cengage Learning, India Edition, 2010.

Reference books

4. Curtis F. Gerald, Patrick O; *Applied Numerical Analysis,*. Wheately, Pearson.
5. Bansal, R.K, Goel, A.K and Sharma, M.K., MATLAB Its Applications on Engineering. Delhi, Pearson Education Inc.
6. Interactive MatLab Course (Hand Out).
7. Ajay Wadhwa, Numerical Analysis with Algorithms and Computer Programs in C++; PHI Learning Pvt. Ltd. New Delhi, 2012.

Tribhuvan University

Institute of Science and Technology
Course of Study for Four Year Mathematics

Course Title: Discrete Mathematics (Elective) **Full Marks:** 50
Course No. : MAT 304 **Pass Mark:** 17.5
Level : B.Sc. **Year:** III
Nature of Course: Theory **Period per week:** 5 Lecture Hrs.

Course Objectives: This course is designed for third year of Four years B.Sc. program as an elective subject. The course aims to familiarize students with the knowledge of graph theory. The basic purpose of this course is to enable students to understand and apply basic discrete mathematics techniques based on graph theory.

Course Description: This course deals with discrete mathematics basically focused to graph theory for undergraduate students as an elective course.

Course Contents

Unit 1. Fundamentals: Sets, Set Operations, Functions, Sequences and Summations, Cardinality of Sets, Matrices, Algorithms, Complexity of Algorithms. [15 Lectures]

Unit 2. Relations: Relations and Their Properties, *n*-ary Relations and Their Applications, Representing Relations, Closures of Relations, Equivalence Relations , Partial Orderings. [15 Lectures]

Unit 3. Graphs: Graphs and Graph Models, Graph Terminology and Special Types of Graphs, Representing Graphs and Graph Isomorphism, Connectivity, Euler and Hamilton Paths, Shortest-Path Problems, Planar Graph. [15 Lectures]

Unit 4. Trees: Introduction to Trees, Applications of Trees, Tree Traversal, Spanning Trees [15 Lectures]

Unit 5. Network Flows:
Graphs as models of flow, Folws, Maximal Flows and Minimum Cuts, Maximum Flow-Min Cut Theorem. [15 Lectures]

Text/References books

1. Kenneth H. Rosen, *Discrete Mathematics and its Applications*, Tata McGraw-Hill Publishing company Limited, 7th Edition
2. Joe L. Mott, Abraham Kandel and Theodore P. Baker, *Discrete Mathematics for Computer Scientists and Mathematicians*, Prentice-Hall of India, 2nd Edition