SHIVAJI UNIVERSITY, KOLHAPUR

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Accredited by NAAC: A++ Grade with CGPA 3.52

Choice Based Credit System with Multiple Entry and Multiple Exit Option (NEP-2020)

Syllabus For

M.Sc. Tech (Industrial Mathematics with Computer Applications) Part -I

Semester I and II

(Syllabus to be implemented from the Academic Year2022-23)

Choice Based Credit System with Multiple Entry and Multiple Exit Option (NEP-2020)
M.Sc. Tech (Industrial Mathematics with Computer Applications)Programme Structure
M.Sc. Tech (Industrial Mathematics with Computer Applications) Part – I

SEMESTER-I (Duration- Six Month)												
	Sr. No.	Course Code	Teaching Scheme			Examination Scheme					
			Theory and Practical			University Assessment (UA)			Internal Assessment (IA)		
			Lectures (Per week)	Hours (Per week)	Credit	Maximum Marks	Minimum Marks	Exam. Hours	Maximum Marks	Minimum Marks	Exam. Hours
CGPA	1	CC-101	Lectures (Per week)	Hours (Per week)	4	80	32	3	20	8	1
	2	CC-102	4	--	4	80	32	3	20	8	1
	3	CC-103	4	--	4	80	32	3	20	8	1
	4	CC-104	4	--	4	80	32	3	20	8	1
	5	CC-105	4	--	4	80	32	3	20	8	1
	6	CCPR-106	--	8	4	80	32	3	20	8	--
Total (A)			**--**	**--**	**24**	**480**	**--**	**--**	**120**	**--**	**--**
Non-CGPA	1	AEC-107	2	2	2	--	--	--	50	20	2
SEMESTER-II (Duration- Six Month)											
CGPA	1	CC-201	Lectures (Per week)	Hours (Per week)	4	80	32	3	20	8	1
	2	CC-202	4	-	4	80	32	3	20	8	1
	3	CC-203	4	-	4	80	32	3	20	8	1
	4	CC-204	4	-	4	80	32	3	20	8	1
	5	CC-205	4	-	4	80	32	3	20	8	1
	6	CCPR-206	-	8	4	80	32	3	20	8	--
Total (B)			**--**	**--**	**24**	**480**	**--**	**--**	**120**	**--**	**--**
Non-CGPA	1	SEC-207	2	2	2	--	--	--	50	20	2
Total (A+B)					**48**	**960**	**--**	**--**	**240**	**--**	**--**

<table>
<tr><td>• Student contact hours per week : 30 Hours</td><td>• Total Marks for M.Sc Tech.-I : 1200</td></tr>
<tr><td>• Theory Lectures : 60 Minutes Each
• Practical : 8 Hours per week</td><td>• Total Credits for M.Sc Tech.-I (Semester I & II) : 48</td></tr>
<tr><td>• CC-Core Course
• CCPR-Core Course Practical
• AEC-Mandatory Non-CGPA compulsory Ability Enhancement Course
• SEC- Mandatory Non-CGPA compulsory Skill Enhancement Course</td><td>• Separate passing is mandatory for Theory and Internal Examinations</td></tr>
<tr><td colspan="2">• Requirement for Entry at M.Sc Tech(Industrial Mathematics with Computer Applications) Part-I:
1) Completed the Bachelor’s degree with principal / major subject Mathematics
or
2) Completed the Bachelor’s degree with Mathematics courses upto Second Year of Bachelor’s degree.
or
3) Completed the Bachelor’s degree (Level 7) with principal / major subject Mathematics.
or
Completed the Bachelor’s degree (Level 7) with Mathematics courses upto undergraduate Diploma (Level 6)</td></tr>
<tr><td colspan="2">• Exit Option at M.Sc Tech (Industrial Mathematics with Computer Applications)Part-I :
Students can exit after completion of M.Sc Tech Part-I with Certificate Course in M.Sc Tech(Industrial Mathematics with Computer Applications)</td></tr>
<tr><td colspan="2"></td></tr>
</table>

Choice Based Credit System with Multiple Entry and Multiple Exit Option (NEP-2020)
M.Sc. Tech (Industrial Mathematics with Computer Applications) Programme Structure
M.Sc. Tech (Industrial Mathematics with Computer Applications)Part – II

SEMESTER-III (Duration- Six Month)												
	Sr. No.	Course Code	Teaching Scheme			Examination Scheme					
			Theory and Practical			University Assessment (UA)			Internal Assessment (IA)		
			Lectures (Per week)	Hours (Per week)	Credit	Maximum Marks	Minimum Marks	Exam. Hours	Maximum Marks	Minimum Marks	Exam. Hours
CGPA	1	CC-301	4	-	4	80	32	3	20	8	1
	2	CC-302	4	-	4	80	32	3	20	8	1
	3	CC -303	4	-	4	80	32	3	20	8	1
	4	CC -304	4	-	4	80	32	3	20	8	1
	5	DSE -305	4	-	4	80	32	3	20	8	1
	6	CCPR-306	--	8	4	80	32	3	20	8	--
Total (C)			**--**	**--**	**24**	**480**	**--**	**--**	**120**	**--**	**--**
Non-CGPA	1	AEC-307	2	2	2	--	--	--	50	20	2
	2	EC (SWM MOOC)-308/ OE-308	Number of lectures and credit shall be as specified on SWAYAM- MOOC or as specified on OE								
SEMESTER-IV (Duration- Six Month)											
CGPA	1	CC-401	4	--	4	80	32	3	20	8	1
	2	CC-402	4	--	4	80	32	3	20	8	1
	3	CC -403	4	--	4	80	32	3	20	8	1
	4	CC -404	4	--	4	80	32	3	20	8	1
	5	DSE -405	4	--	4	80	32	3	20	8	1
	6	CCPR-406	--	8	4	80	32	3	20	8	--
Total (D)			**--**	**--**	**24**	**480**	**--**	**--**	**120**	**--**	**--**
Non-CGPA	1	SEC-407	2	2	2	--	--	--	50	20	2
	1	GE-408	2	2	2	--	--	--	50	20	2
Total (C+D)					**48**	**960**	**--**	**--**	**240**	**--**	**--**

<table>
<tr><td>• Student contact hours per week : 30 Hours</td><td>• Total Marks for M.Sc Tech.-II : 1200</td></tr>
<tr><td>• Theory Lectures : 60 Minutes Each
• Practical : 8 Hours per week</td><td>• Total Credits for M.Sc Tech.-II (Semester III & IV) : 48</td></tr>
<tr><td>• CC-Core Course
• CCPR-Core Course Practical
• DSE-Discipline Specific Elective
• AEC-Mandatory Non-CGPA compulsory Ability Enhancement Course
• SEC- Mandatory Non-CGPA compulsory Skill Enhancement Course
• EC (SWM MOOC) - Non-CGPA Elective Course
• GE-Generic Elective
• OE- Open Elective</td><td>• Separate passing is mandatory for Theory and Internal Examination</td></tr>
<tr><td colspan="2">• Requirement for Entry at M.Sc Tech (Industrial Mathematics with Computer Applications)Part-II :
1) Students of Shivaji University Kolhapur who have completed learning of M.Sc Tech (Industrial Mathematics with Computer Applications)Part-I .
or
2) Students who have completed M.Sc Tech (Industrial Mathematics with Computer Applications)Part-I .</td></tr>
<tr><td colspan="2">• Exit Option at M.Sc Tech (Industrial Mathematics with Computer Applications)Part-II:
PG Diploma Course in M.Sc Tech(Industrial Mathematics with Computer Applications)</td></tr>
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Choice Based Credit System with Multiple Entry and Multiple Exit Option (NEP-2020)
M.Sc. Tech (Industrial Mathematics with Computer Applications) Programme Structure
M.Sc. Tech (Industrial Mathematics with Computer Applications)Part – III

SEMESTER-V (Duration- Six Month)												
	Sr. No.	Course Code	Teaching Scheme			Examination Scheme					
			Theory and Practical			University Assessment (UA)			Internal Assessment (IA)		
			Lectures (Per week)	Hours (Per week)	Credit	Maximum Marks	Minimum Marks	Exam. Hours	Maximum Marks	Minimum Marks	Exam. Hours
CGPA	1	CC-501	4	-	4	80	32	3	20	8	1
	2	CC-502	4	-	4	80	32	3	20	8	1
	3	CC -503	4	-	4	80	32	3	20	8	1
	4	DSE -504	4	-	4	80	32	3	20	8	1
	5	CCS -505	4	-	4	80	32	3	20	8	1
	6	CCPR-506	--	8	4	100	40	*	--	--	--
Total (E)			**--**	**--**	**24**	**500**	**--**	**--**	**100**	**--**	**--**
SEMESTER-VI (Duration- Six Month)											
CGPA	1	CC-601	--	--	1	100	40	3	--	--	--
	2	CCPR-602	--	--	24	300	120	*	200	80	*
Total (F)			**--**	**--**	**25**	**400**	**--**	**--**	**200**	**--**	**--**
Total (E+F)					**49**	**900**	**--**	**--**	**300**	**--**	**--**

• Student contact hours per week : **30** Hours	• Total Marks for M.Sc Tech.-III : **1200**
• Theory Lectures : **60** Minutes Each • Industrial Project Minimum 14 weeks	• Total Credits for M.Sc Tech.-III (Semester V & VI) : **49**
• CC-Core Course • CCS- Core Course Specialization • CCPR-Core Course Practical • DSE-Discipline Specific Elective	• ***Separate passing is mandatory for Theory and Internal Examination***
• **Requirement for Entry at M.Sc Tech (Industrial Mathematics with Computer Applications)Part-III :** **1) Students who have completed M.Sc Tech (Industrial Mathematics with Computer Applications)Part-I and students of Shivaji University Kolhapur who have completed learning of M.Sc Tech (Industrial Mathematics with Computer Applications)Part-II .** **or** **2) Students who have completed M.Sc Tech (Industrial Mathematics with Computer Applications)Part-I and M.Sc Tech (Industrial Mathematics with Computer Applications)Part-II.**	

	M.Sc. Tech-I	**M.Sc. Tech-II**	**M.Sc. Tech-III**	**Total**
Marks	**1200**	**1200**	**1200**	**3600**
Credits	**48**	**48**	**49**	**145**

I. CGPA course:

1. There shall be 22 Core Courses (CC) of 85 credits per programme.
2. There shall be 01 Core Course Specialization (CCS) of 4 credits per programme.
3. There shall be 03 Discipline Specific Elective (DSE) courses of 12 credits per programme
4. There shall be 05 Core Courses Practical (CCPR) of 20 credits per programme.
5. There shall be Industrial Project(CCPR-602) of 24 credits per programme.
6. Total credits for CGPA courses shall be of 145 credits per programme

II. Mandatory Non-CGPA Courses:

1. There shall be 01 Mandatory Non-CGPA compulsory Ability Enhancement Courses (AEC) of 02 credits each per programme.
2. There shall be 01 Mandatory Non-CGPA compulsory Skill Enhancement Course (SEC) of 02 credits per programme.
3. There shall be one Elective Course (EC) (SWAYAM -MOOC). The credits of this course shall be as specified on EC/ SWAYAM-MOOC.
4. There shall be one Generic Elective (GE) course of 02 credits per programme. Each student has to take generic elective from the department other than parent department.
5. The total credits for Non-CGPA course shall be of 04 credits + at least 02 credits of EC/ SWAYAM -MOOC.
6. The credits assigned to the course and the programmes are to be earned by the students and shall not have any relevance with the work load of the teacher.

M.Sc. Tech. (Industrial Mathematics with Computer Applications) (Part-I) (Semester I)

Course Code	Title of Course
CC-101	Advanced Calculus
CC-102	Linear Algebra
CC-103	Discrete Mathematical Structures -I
CC-104	Computer Architecture
CC-105	Object Oriented Programming
CCPR-106	Lab Course I
AEC-107	Communicative English-I

M.Sc. Tech. (Industrial Mathematics with Computer Applications) (Part-I) (Semester II)

Course Code	Title of Course
CC-201	Numerical Analysis
CC-202	Algebra
CC-203	Discrete Mathematical Structures -II
CC-204	Data Structures
CC-205	Database Management System
CCPR-206	Lab Course II
SEC-207	Fundamentals of Information Technology (FIT)-I

M. Sc. Tech (Industrial Mathematics with Computer Applications)
(Part I) (Semester I)

M. Sc. Tech (Industrial Mathematics with Computer Applications) (Part I) (Semester I)
(NEP-2020)
(Introduced from Academic Year 2022-23)

Course Code : CC-101

Title of Course: Advanced Calculus

Course Outcomes : Upon successful completion of this course, the student will be able to:

1. Analyze convergence of sequences and series, double sequences and double series
2. Analyze convergence of sequences and series of functions
3. check differentiability of functions of several variables
4. Apply inverse and implicit function theorems for functions of several variables

Unit I : **15 Lectures**

Sequences and series of functions: Pointwise convergence of sequences of functions, Examples of sequences of real valued functions, Definition of uniform convergence, Uniform convergence and continuity, Cauchy condition for uniform convergence, Uniform convergence and Riemann integration, Uniform convergence and differentiation

Unit II: **15 Lectures**

Rearrangement of series, subseries, Double sequences, Double series, rearrangement of double series, sufficient condition for equality of iterated series, multiplication of series, Cesarosummability, sufficient conditions for uniform convergence of series, uniform convergence and double sequences, mean convergence, Taylor series generated by a function, Bernstein's theorem, binomial series.

Unit III: **15 Lectures**

Multivariable differential Calculus: The Directional derivatives, directional derivatives and continuity, total derivative, total derivatives expressed in terms of partial derivatives, The matrix of linear function, mean value theorem for differentiable functions, A sufficient condition for differentiability, sufficient condition for equality of mixed partial derivatives, Taylor's formula for functions from R^n to R^1.

Unit IV: **15 Lectures**

Implicit functions: Functions of several variables, Linear transformations, Differentiation, Contraction principle, The inverse function theorem, The implicit function theorem and their applications.

Recommended books :

1. Mathematical Analysis, Apostal, Second Edition, Narosa Publishing House.1974

Reference books:

1.Principles of mathematical Analysis, Walter Rudin, third Edition, McGraw Hill book company
2. Calculus Vol. I ,Vol II, Tom M. Apostol, Second EditionWiley India Pvt. Ltd.
3. W.Fleming, Functions of several Variables,2nd Edition ,Springer Verlag, 1977.

M. Sc. Tech (Industrial Mathematics with Computer Applications) (Part I) (Semester I)
(NEP-2020)
(Introduced from Academic Year 2022-23)

Course Code : CC-102

Title of Course: Linear Algebra

Course Outcomes: Upon successful completion of this course, the student will be able to:

1. understand basic notions in Linear Algebra and use the results in developing advanced mathematics.
2. study the properties of Vector Spaces, Linear Transformations, Algebra of Linear Transformations and Inner product space in some details.
3. construct Canonical forms and Bilinear forms.
4. apply knowledge of Vector space, Linear Transformations, Canonical Forms and Bilinear Transformations.

Unit I: **15 Lectures**

Elementary Basic concepts, Linear Independence and Bases, Dual Spaces, Annihilator of a subspace, Quotient Spaces. **Inner product spaces**, **Linear Transformations :** The Algebra of Linear transformations.

Unit II: **15 Lectures**

Characteristic Roots, Matrices, Eigen values and eigenvectors of a linear transformation, **Canonical Forms:** Similarity of linear transformations, Triangular form.

Unit III: **15 Lectures**

Canonical Forms: Nilpotent transformations, A Decomposition V: Jordan Form, Rational Canonical Form, Trace and transpose.

Unit IV: **15 Lectures**

Determinants, Hermitian, Unitary and Normal linear transformations, **Bilinear Forms:** Bilinear Forms, Symmetric Bilinear Forms, Skew Symmetric Bilinear Forms.

Recommended Book(s):

1. Herstein I. N. : Topics in Algebra, 2nd Edition, Willey Eastern Limited.
2. Hoffman, Kenneth and Kunze R: Linear Algebra, Prentice Hill of India Private Limited., 1984.

Reference Books:

1. A. R. Rao and P. Bhimashankaran, Linear Algebra, Hidustan Book Agency.
2. Surjit Singh, Linear Algebra, Vikas publishing House (1997).
3. Gilbert Strang: Introduction to Linear Algebra, Wellesley-Cambridge Press

M. Sc. Tech (Industrial Mathematics with Computer Applications) (Part I) (Semester I)
(NEP-2020)
(Introduced from Academic Year 2022-23)

Course Code : CC-103

Title of Course: Discrete Mathematical Structures -I

Course Outcomes: Upon successful completion of this course, the student will able to

1. learn formal logic as a theoretical foundation and its application to topics in discrete mathematics and computer science.
2. study Binomial theorem and used to solve various combinatorial problems.
3. understand some basic properties of graphs and related discrete structures.
4. simplify the graphs using matrix.
5. apply different algorithms to solve Travelling salesman problem.

Unit I: **15 Lectures**

Logic: Propositions, Logical Connectives, Conditionals and Biconditionals, Tautologies, Logical equivalences, Theory of inference for statement calculus, Validity using truth tables, Rules of inference, Consistency of Premises, quantifiers, Valid formula and Equivalences, Methods of Proofs, Counting: The Rules of Sum and Product, Permutations and Combinations.

Unit II: **15 Lectures**

Binomial Theorem, Pigeonhole Principle, Extended Pigeonhole Principle, Inclusion -Exclusion Principle and Applications of Inclusion-Exclusion, Recurrence Relations, Linear Recurrence Relations with constant coefficients, Homogeneous solutions, Particular solution and total solution, Solution of recurrence relation by using generating functions.

Unit III: **15 Lectures**

Graph: Definition, examples, vertex degrees, Subgraphs, Operations on graphs, paths and cycles. Matrix Representation, Fusion, Trees and Connectivity: Definitions and simple properties, Bridges, Spanning trees, Shortest Path problem, cut vertices and connectivity, Euler Tours and Hamiltonian Cycles: Euler Tours, The Chinese Postman Problem (CPP).

Unit IV: **15 Lectures**

Hamiltonian Graphs, Travelling Salesman Problem, Matchings, Marriage problem, personal assignment problem, optimal assignment problem, Planar Graphs: Plane and Planar Graphs, Euler's Formula, Kuratowski's Theorem, Directed Graphs: Definitions, Indegree and Outdegree.

Recommended Books:

1. C. L. Liu, D. P. Mohopatra, Elements of Discrete Mathematics (TATA McGraw-HILL) 2013.
2. John Clark and Allan Holton, A First Look at Graph Theory (Allied Publishers LTD) 1991.

Reference Books:

1. Kolman, Busby, Ross, Discrete Mathematical Structures (PHI) 6th Edition.
2. K. H. Rosen, Discrete Mathematics and its Applications (TATA McGraw-HILL)
3. N. Deo, Graph Theory with Applications to Comp. Sc. and Engineering. PHI Publication.

M. Sc. Tech (Industrial Mathematics with Computer Applications) (Part I) (Semester I)
(NEP-2020)
(Introduced from Academic Year 2022-23)

Course Code : CC-104

Title of Course: Computer Architecture

Course Outcomes: Upon successful completion of this course, the student will be able to:

1. Identify the addressing mode of instructions
2. Determine which hardware blocks and control lines are used for specific instructions
3. Demonstrate how to add and multiply integers and floating-point numbers using two's complement and IEEE floating point representation
4. Detect pipeline hazards and identify possible solutions to those hazards
5. Map a virtual address into a physical address

Unit I: **15 Lectures**

Data Representation: Introduction to Digital Computer, Number Systems- Binary, Octal and Hexadecimal, Inter-conversion between number systems, **Digital Logic Circuits :** K-map Multiplexers, Logic Gates, Combinational Logic – Adder, Subtractors, multiplexers, Demultiplexers. **Sequential logic –** SR Flip flop, D Flip flop, JK Flip flop, **Registers** – 4-bit register, 4-bit register with parallel load, **Shift Registers** - 4-bit register shift register, **Counters** - Ripple Counters, Synchronous counters, Asynchronous counters.

Unit II: **15 Lectures**

Memory Organization: Memory Hierarchy, Main memory – RAM and ROM chips, memory address map, memory connection to CPU. hardware organization of Auxiliary memory, hardware organization of Associative Memory, Cache memory. Virtual memory – Address and memory space, address mapping using pages, Direct Memory Access (DMA)

Unit III: **15 Lectures**

Pipeline and Vector Processing: **P**arallel processing, pipelining general considerations, Arithmetic pipeline, instruction pipeline, data dependency, handling of branch instructions, RISC pipeline, delayed load, delayed branch, Vector processing, vector operation, matrix multiplication, Memory interleaving.

Unit IV: **15Lectures**

Multiprocessors : Characteristics of multiprocessors Interconnection structures – time sharing common bus, multiport memory, crossbar switch, multistage switch network, hypercube interconnection. Interprocessor communication and synchronization.

Recommended Books :

1. Computer System Architecture – M. Moris Mano
2. H.S. Stone, Introduction to Computer Architecture, Galgotia.
3. J.P. Hayes, Computer Architecture and Organization, McGraw-Hill.

Reference Books:

1. K. Hwang & F.A. Briggs, Computer Architecture & Parallel Processing, McGraw-Hill.
2. P.M. Kogge, The Architecture of Pipelined Computers, McGraw-Hill.
3. J.L. Hennessy & D.A. Patterson, Computer Architecture : A Quantitative Approach, Morgan Kauffmann.

M. Sc. Tech (Industrial Mathematics with Computer Applications) (Part I) (Semester I)
(NEP-2020)
(Introduced from Academic Year 2022-23)

Course Code : CC-105

Title of Course: Object Oriented Programming

Course Outcomes: Upon successful completion of this course, the student will be able to:

1. compare the procedural and object-oriented paradigm with concepts of streams, classes, functions, data, and object
2. design, implement, test, debug, and document programs in C++
3. classify inheritance with the understanding of early and late binding
4. demonstrate exception handling, generic programming

Unit I: **15 Lectures**

Introduction to Object Oriented Paradigms: An overview of programming & Programming languages, Basic terminology and features, Variables, Keywords and Constants, Data Types, **Operators:** Arithmetic, Relational, Logical, Assignment, Conditional, Bitwise **Decision control structures:** If-else Statements, Switch Case. **Loop control structures:** while loop, for loop, do-while loop, **Functions:** Call by Value, Call by Reference, **Arrays:** Concepts and Declarations of an Array, Initializing Arrays,1D and 2D array

Unit II: **15 Lectures**

Class and Object: Creating and Using Classes and members, member Initialization list, member wise assignment, efficiency considerations. Types of constructor, (Default, Parameterized, Copy), Multiple constructors in a class, destructors. **Constant objects** and member functions, **Static** data members and functions, **Friend** Function, friend class, non member functions, this pointer, Nested classes

Unit III: **15 Lecture**

Operator overloading and user defined conversions: function overloading, operator overloading fundamentals, Restrictions, overloading unary & binary operators

Inheritance- defining a class hierarchy, types of inheritance, Base class member access, Base and Derived class constructor, Direct base classes & indirect base classes, Function overriding **Virtual functions and Polymorphism:** early and late binding, virtual table, virtual pointer, pure virtual functions, virtual base class, virtual inheritance, Run Time Type Identification.

Unit IV: **15 Lectures**

Generic Programming: overview, Function templates, Class templates, member templates, introduction to Namespace, overview of Standard Template Library **Exception handling**- keywords, basics of c++ exceptions, catching an exception, re-throwing an exception **File Input / Output:** File Operations, File opening Modes.

Recommended Books:

1. Object Oriented Programming with C++ - E Balagurusamy
2. Bajarne Stroustrup - "The C++ programming language"(Addison Wesley)

Reference Books:

1. Object Oriented Programming in C++ - R. Subburaj (Vikas Publication)
2. Rambaugh et.al. - "Object Oriented Modeling and Designing"
3. Grady Booch -"Object Orient Analysis and Design with applications"

M. Sc. Tech (Industrial Mathematics with Computer Applications) (Part I) (Semester I)
(NEP-2020)
(Introduced from Academic Year 2022-23)

Course Code: CCPR-106

Title of Course: Lab Course-I

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

1. Implement dynamic memory management techniques using pointers, constructors, destructors
2. Understand and employ file management
3. Demonstrate how to control errors with exception handling
4. Implement Object Oriented Programs using templates and exceptional handling concepts

The programs related to Object Oriented Programming.

Minimum 4 practicals based on the syllabus of each unit of Object Oriented Programming course.

M. Sc. Tech (Industrial Mathematics with Computer Applications)
(Part I) (Semester II)

M. Sc. Tech (Industrial Mathematics with Computer Applications) (Part I) (Semester II)
(NEP-2020)
(Introduced from Academic Year 2022-23)

Course Code : CC-201

Title of Course: Numerical Analysis

Course Outcomes: Upon successful completion of this course, the student will be able to:

1. apply the methods to solve linear and nonlinear equations.
2. find numerical integration and analyze error in computation.
3. solve differential equations using various numerical methods.
4. determine eigen values and eigen vectors of a square matrix.
5. construct LU decomposition of a square matrix.

Unit I: **15 Lectures**

Transcendental & polynomial equations: Bisection method, Iteration methods based on First degree equation (Secant method, Regula-Falsi method and Newton-Raphson method). Rate of Convergence, Iterative methods (Birge-Vieta method and Bairstow method).

Unit II: **15 Lectures**

System of linear algebraic equations and eigen value problems: Matrix factorization methods (Doolittle's method, Crout's method), Iteration methods (Jacobi iteration method, Gauss-Seidel iteration method), convergence analysis of iterative methods, Eigen values and eigenvectors, Gerschgorin theorem, Brauer theorem, Jacobi method for symmetric matrices, Householder's method for symmetric matrices, Power method.

Unit III: **15 Lectures**

Interpolation, differentiation and integration: Lagrange and Newton interpolations, Truncation error bounds, Newtons divided difference interpolation, finite difference operators, numerical differentiation, methods based on interpolation, numerical integration, methods based on interpolation, error analysis, Newton-Cotes methods, Error estimates for trapezoidal and Simpson's rule.

Unit IV: **15 Lectures**

Numerical solution of differential equations: Euler method, analysis of Euler method, Backward Euler method, mid-point method, order of a method, Taylor series method, Explicit Runge-Kutta methods of order two and four, convergence and stability of numerical methods, Truncation error, error analysis.

Recommended Books:

1. M. K. Jain, S. R. K. Iyengar, R. K. Jain, Numerical methods for scientific and Engineering Computation (Fifth Edition), New Age International Publishers 2007.

Reference Books:

1. S. S. Sastry, Introductory methods of Numerical Analysis (Fifth Edition), PHI learning Private Limited, New Delhi 2012.
2. D. Kincaid, W. Cheney, Numerical Analysis Mathematics of Scientific Computing (Third Edition), American Mathematical Society.
3. J.C. Butcher, Numerical methods for ordinary differential equations (Second Edition), John Wiley & Sons Ltd, 2008.
4. Kendall E. Atkinson, An Introduction to Numerical Analysis (Second Edition), John Wiley & Sons 1988.

M. Sc. Tech (Industrial Mathematics with Computer Applications) (Part I) (Semester II)
(NEP-2020)
(Introduced from Academic Year 2022-23)

Course Code : CC-202

Title of Course: Algebra

Course Outcomes: Upon successful completion of this course, the student will be able to:

1. study group theory and ring theory in some details.
2. introduce and discuss module structure over a ring.
3. apply Sylow theorems.
4. use homomorphism and isomorphism theorems.
5. check irreducibility of polynomials over Q using Eisenstein criteria.

Unit I: **15 Lectures**

Permutations: Groups of permutations, Examples, The Alternating Groups, Simple groups, simplicity of A_n ($n > 4$), Applications, **Series of Groups**: Subnormal and Normal Series, Jordan-Holder Theorem, The Center and the Ascending Central Series, **Isomorphism Theorems**: Isomorphism Theorems.

Unit II: **15 Lectures**

The Zassenhaus (Butterfly) Lemma, Schreier Theorem, **Group action on a set**: The Notion of Group Action, fixed sets and isotropy subgroups, Orbits, **Applications of G-Sets to Counting**: Burnside theorem, **Sylow Theorems:** p-groups, The Sylow Theorems.

Unit III: **15 Lectures**

Applications of the Sylow Theory: Applications to p-Groups and the Class equation, Further Applications, **Rings of Polynomials**: Polynomial in an Indeterminate, The evaluation Homomorphisms, The New Approach. **Factorization of Polynomials over Fields:** The Division Algorithm in F[x], Irreducible Polynomials, Eisenstein criteria, Ideal Structure in F[x], Uniqueness of Factorization in F[x].

Unit IV: **15 Lectures**

Unique Factorization Domains: Principal Ideal Domain (PID), Uniqueness of Factorization Domain(UFD), Gauss lemma, **Euclidean Domains:** Introduction and Definition, Arithmetic in Euclidean Domains. **Modules:** Definitions and Examples, Direct Sums, Free Modules, sub-modules, Quotient Modules, Homomorphism, Simple Modules, Modules over PID, Schur's Lemma.

Recommended Books:

3. John B. Fraleigh , A first course in Abstract Algebra (Third Edition), Narosa publishing house, New Delhi.
4. C. Musili, Introduction to Rings and Modules (Second Revised Edition), Narosa Publishing house, New Delhi.

Reference Books:

1. Joseph A. Gallian, Contemporary Abstract Algebra (Fourth Edition), Narosa Publishing house, New Delhi.
2. Bhattacharya, Jain and Nagpal, Basic Abstract Algebra, 2nd edition, Narosa Publishing House, New Delhi.
3. I. N. Herstein, Topics in Algebra, Vikas Publishing House.
4. N. Jacobson, Basic Algebra, Hind Publishing Corporation, 1984.

M. Sc. Tech (Industrial Mathematics with Computer Applications) (Part I) (Semester II)
(NEP-2020)
(Introduced from Academic Year 2022-23)

Course Code : CC-203

Title of Course: Discrete Mathematical Structures -II

Course Outcomes: Upon successful completion of this course, the student will able to

1. learn applications of discrete mathematics including lattices and Boolean Algebra.
2. Simplify the Boolean identities and its application to switching circuits.
3. Locate and use the information on discrete mathematics and its applications.
4. understand the terminology, operations, and symbols of finite state automata.
5. understand the terminology, operations, and symbols of Context-free Grammars.

Unit I: **15 Lectures**

Lattices: Partially ordered sets and Lattices, lattices as algebraic systems, sub-lattices, direct product, Ideals, Types of ideals, Quotient lattice, Homomorphisms, complete lattices. Modular lattices, distributive lattices, the complemented lattices, convex sub lattices, Congruence relations in lattices.

Unit II: **15 Lectures**

Conversion of Boolean Algebra in to Boolean rings and vice versa. Boolean Algebras-Boolean Algebras as Lattices. Various Boolean identities. The Switching algebra. Sub algebras, Direct Products and Homomorphism. Join irreducible elements, Atoms and Minterms. Boolean Forms, Applications of Boolean algebra to Switching Theory.

Unit III: **15 Lectures**

Finite Automata and Regular Expressions: Finite State System, Basic Definitions, Nondeterministic Finite Automata, Finite Automata with ε - Moves, Regular Expressions, Applications of Finite Automata. Properties of Regular Sets: The Pumping lemma for regular sets, Closure property of regular sets, Decision Algorithm for regular sets, The Myhill-Nerode theorem and minimization of Finite Automata.

Unit IV: **15 Lectures**

Context-free Grammars: Motivation and Introduction, Context-free Grammars, Derivation Trees, Simplification of Context-free Grammars, Chomsky normal form, Greibach normal form. Pushdown Automata: Informal description, Definitions, Pushdown Automata and Context-free Languages.

Recommended Books :

1. G. Gartzer, General Lattice theory, Academic Press, INC.,1978.
2. J. E. Hopcroft, J. D. Ullman, Introduction to Automata Theory, Languages and Computation, Narosa Publishing House,1987 (Ninth Reprint).

Reference Books:

1. J. P. Tremblay & R. Manohar, Discrete Mathematics Structure with Applications to computer Science, McGraw-Hill Book Co.
2. Garrett Birkhoff, Lattice Theory, AMS.
3. Kolman, Busby, Ross, Discrete Mathematical Structures (PHI) 6th Edition.

M. Sc. Tech (Industrial Mathematics with Computer Applications) (Part I) (Semester II)
(NEP-2020)
(Introduced from Academic Year 2022-23)

Course Code : CC-204

Title of Course: Data Structures

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

1. Describe and simulate various linear data structures like stacks, queues, linked lists using static and dynamic allocation and use them in solving problems.
2. Simulate nonlinear data structures like binary search tree and threaded binary trees and use them in designing applications like sorting, expression trees etc.
3. Explain the various algorithms for sorting and searching
4. Demonstrate the indexing techniques in data structures

UNIT I: **15 Lectures**

Introduction to data structure: Data, Data Types, abstract Data type, Arrays as abstract data types (1D, 2D, Multidimensional) **Linked lists:** Concepts, Operations: Insert, Delete, Traversal, Static implementation using arrays, Dynamic implementation, doubly linked lists, Circular lists, Linked lists applications, Polynomial representation.

UNIT II: **15 Lectures**

Stack: Characteristics of Stack, push and pop operations, Stack implementation using C, Stacks as linked lists, Stack Applications, conversion of infix expression to postfix and prefix expressions, Expression evaluation, Recursion. **Queues:** Characteristics of Queue, insert, and delete operations, Queue implementation using C, queues as linked lists, Queue Applications: priority queues.

UNIT III: **15 Lectures**

Trees: Terminology and concepts, Binary trees representation, Static implementation using arrays Linked representation, binary search tree, Operation inserts and Delete, Tree traversals, Creation of a tree using preorder, inorder, and postorder traversals, Representing trees as binary Trees, Height balanced trees (AVL tree), B Trees.

UNIT IV: **15 Lectures**

Graphs: Graph representations, Breadth first and Depth first search, Topological sort, Single source Shortest path, Minimum Spanning tree. **Sorting:** Concepts and needs, Bubbles, Quick, Selection, Insertion, Tree (Heap), Merge, Radix sort.

Recommended Books:

1. Data Structures using C and C++ - Tanenbaum.
2. Classic data Structures, Samantha PHI, 2002

Reference Books:

1. Data Structures: A Pseudocode Approach with C, Richard Gilberg, Behrouz Forouzan, Cengage Learning, 2004.
2. Data structures and algorithms, Aho, Hop craft and Ulman. (Addision - Wesley)
3. Data Structures and Program design (PHI-96), R.L.Kruse.

M. Sc. Tech (Industrial Mathematics with Computer Applications) (Part I) (Semester II)
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Course Code : CC-205

Title of Course: Database Management System

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

1. classify database management system concepts and different data models.
2. describe fundamental elements of relational data models and master the basics of SQL.
3. understand the concepts of integrity, security and normalization approach.
4. develop skills for query processing and optimization.

Unit I: **15 Lectures**

Introduction to DBMS: Concept and architecture of DBMS, Levels of Abstraction in a DBMS, **The Three Great Data Models:** The Relational Data Model, The Network Data Model, The Hierarchical Data Model, Comparison of the Models Database Design and the E-R Model: **Overview of the design process, E-R Model, E-R diagrams**

Unit II: **15 Lectures**

Relational model : Concept , Relational Algebra and Tuple and Domain Calculus**.**
Introduction to RDBMS: History, Generations and characteristics, difference between DBMS and RDBMS. **Relational database design :**Functional dependencies , Normal Forms, join and decomposition

Unit III: **15 Lectures**

SQL functions: MAX, MIN SORT, COUNT, AVERAGE, Numeric, String, Date Functions, Type conversion functions. **SQL:** Data Definition Language (DDL), Data Manipulation Language (DML), Data Control Language (DCL),Transaction Control (TCL).
Transactions and Concurrency Control: Transaction concept, ACID Properties of transaction, transaction state, concurrent execution , Serializability.

Unit IV: **15 Lectures**

Security & Protection: Role of DBA, Backup and Recovery system. **PL/SQL:** Overview, structure of block, Basic Statements, cursor, exception handling, subprograms,database triggers.

Recommended Books :

1. Korth and Silderschutz - "Database systems concepts" (TMH)
2. Database management system - Pearson publication

Reference Books:

1. C.J.Date - "Introduction to database systems" (Narosa)
2. Ulman J.D. - "Principles of database systems" (Galgotia)
3. Ivan Bayross – SQL and PL/SQL programming (PHI)

M. Sc. Tech (Industrial Mathematics with Computer Applications) (Part I) (Semester II)
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Course Code : CCPR-206

Title of Course: Lab Course-II

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

1. Implement the various algorithms for sorting and searching
2. Demonstrate the indexing techniques in data structures
3. Define the terminology, features, classifications, and characteristics embodied in database systems.
4. Use an SQL interface of a multi-user relational DBMS package to create, secure, populate, maintain, and query a database.

The programs related to Data Structures and Database Management System.

Minimum 4 practicals based on Unit I and II of Data Structures course and minimum 4 practicals based on Unit II, III and IV of Database Management System course.

1. Nature of the Theory Question Papers:

1. There shall be 7 questions each carrying 16 marks
2. Question No.1 is compulsory. It consists of objective type questions.
3. Students have to attempt any four questions from Question No.2 to Question No.7.
4. Question No.2 to Question No.7 shall consist of short/ descriptive-answer type sub-questions.

2. Nature of the Lab Course Question Papers:

Lab Course-I:

1. Practical Examinations will be conducted at the end of semester.
2. Exam will be of 3 hrs duration.
3. There shall be 6 questions each of 20 marks, of which a student has to attempt any 4 questions.
4. There shall be 20 marks for practical assignments.

Lab Course-II:

1. In Practical Examination there shall be 2 sections.
2. In section 1 there shall be 3 questions each of 20 marks, of which a student has to attempt any 2 questions.
3. In section 2 there shall be 10 questions each of 4 marks.
4. There shall be 10 marks for practical viva and 10 marks for practical assignments.

3. There shall be 1 internal examiner and 1 external examiner to conduct practical examination.