

First year of Five Years Integrated M.Sc. (Common to Physics/Mathematics/Chemistry)**Teaching Scheme:****First year of Five Years Integrated M.Sc. (Physics/Chemistry/Mathematics)****M.Sc. – I, Semester-I**

Sr. No.	Course	Code	Teaching Scheme Hours per Week			Credit	Examination Scheme			Total Marks
			L	T u.	Pr.		Theory	Tutorial	Practical	
1	Chemistry-I	MC 101	3	1	2	5	100	25	50	175
2	Physics-I	MP 101	3	1	2	5	100	25	50	175
3	Mathematics-I	MM 101	3	2	0	5	100	50	00	150
4	Environmental Science	MN 101	2	1	0	3	100	25	00	125
5	English-I	MG 101	2	1	0	3	100	25	00	125
			13	6	4		500	150	100	750
Total Contact hours per week = 23			Total Credit = 21				Total Marks = 750			

First year of Five Years Integrated M.Sc. (Physics/Chemistry/Mathematics)**M.Sc. – I, Semester-II**

Sr. No.	Course	Code	Teaching Scheme Hours per Week			Credit	Examination Scheme			Total Marks
			L	T u.	Pr.		Theory	Tutorial	Practical	
1	Chemistry-II	MC 102	3	1	2	5	100	25	50	175
2	Physics-II	MP 102	3	1	2	5	100	25	50	175
3	Mathematics-II	MM 102	3	2	0	5	100	50	00	150
4	Introduction to Computers	MG 104	2	1	0	3	100	25	00	125
5	English-II	MG 102	2	1	0	3	100	25	00	125
			13	6	4		500	150	100	750
Total Contact hours per week = 23			Total Credit = 21				Total Marks = 750			

First year of Five Years integrated M. Sc. (Physics / Chemistry / Mathematics)**M.Sc. - I, Semester – I****L T P C****MC 101 : Chemistry – I****3 1 2 5**

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- **ATOMIC STRUCTURE AND CHEMICAL BONDING (13 Hours)**
Heisenberg's Uncertainty principle, postulates of quantum mechanics, Schrödinger wave equation: Derivation, significance of ψ^2 , Schrödinger wave equation for H - atom and particle in 1-D box, angular and radial wave function, atomic orbitals and shape of s and p orbitals, Valence bond theory, Hybridization, Resonance, VSEPR, Molecular orbital theory, molecular orbitals, bonding and energy level diagram for homonuclear and heteronuclear diatomic molecules, ionic solids, Born-Haber cycle, covalent bonds, coordinate bond, hydrogen bond, dipole moment, geometry and shape of simple molecules, Molecular structure and different kind of intermolecular forces and interactions like hydrogen bonding, hydrophobicity, π - π interaction, π -cation interaction, and properties such as melting and boiling points, dipole moment, acidity and basicity.
 - **PERIODIC TABLE AND ATOMIC PROPERTIES (03Hours)**
Electronic configuration, periodicity in properties: ionization potential, electron affinity, ionic radii and electronegativity
 - **CHEMICAL KINETICS (04Hours)**
Rate of reaction, order of reaction, enzyme catalyzed reaction, fast reactions, homogeneous and heterogeneous catalysis, general characteristics of catalytic reactions.
 - **THERMODYNAMICS (07 Hours)**
First law of thermodynamics, entropy, second and third laws of thermodynamics, Gibbs free energy, Helmholtz energy, chemical equilibria, Clausius Clapeyron equation
 - **ELECTROCHEMISTRY (08 Hours)**
Single electrode potential, Hydrogen electrode, Galvanic cell, EMF series, Nernst equation, Reversible electrodes, metal-metal ion electrodes, Calomel electrode, Oxidation-Reduction electrodes, Potentiometric titration, Application of electrochemistry in Corrosion control by cathodic protection, batteries, and related devices.
 - **CHEMISTRY OF WATER (07 Hours)**
Structure of water, properties, types of water (raw water, cooling water, boiler water), role of water in life sciences, Water-treatment- primary treatment and secondary treatment, types of water treatment for use in industries.

(Total Contact Time (Theory): 42 Hours)

BOOKS RECOMMENDED:

1. Atkins P. W. and Paula D.: "Atkin's Physical Chemistry", Oxford University Press/Gopsons Paper Ltd, Noida, 8th Edn., 2006.
2. Alberty R. A. and Silbey R. J. "Physical Chemistry", 1st Edn., John Wiley & Sons (Asia), Singapore, 1995.
3. Levine I. R., "Quantum Chemistry", Prentice Hall India (Ltd), 1995.
4. Lee J. D., "Concise Inorganic Chemistry", 4th Edn., ELBS, 1991.
5. Cotton F. A., Wilkinson G., Gans P. G., "Basic Inorganic Chemistry", 2nd Edn., John Wiley & Sons, 1987.

First year of Five Years integrated M.Sc. (Physics / Chemistry / Mathematics)**M.Sc. - I, Semester – I**

	L	T	P	C
MP 101 : Physics – I	3	1	2	5

- **VECTORS FUNDAMENTALS AND DIFFERENT CO-ORDINATE SYSTEM (08 Hours)**
Unit Vectors, Vector Operations, Tripple Products, Vector Algebra in component form, Differential Calculus, Cartesian Coordinate System, Spherical Coordinate System, Cylindrical Coordinate System.
- **NEWTON'S LAWS OF MOTION, CONSERVATION LAWS, MOMENTS OF INERTIA. (10 Hours)**
Mechanics of the particle, Equation of motion, Different conservation laws, Moments of inertia, Motion in central force field
- **RIGID BODY MOTION (06 Hours)**
Euler's theorem, Angular momentum and kinetic energy, Euler's equation of motion, Euler's angles
- **ELASTICITY & HYDRODYNAMICS (08 Hours)**
Stress and Strain, Young's modulus, Shear modulus and Bulk Modulus, Buoyancy, Types of fluid flow, Bernoulli's equations. Viscosity, Terminal Velocity
- **SIMPLE HARMONIC MOTION (04 Hours)**
Restoring force, Elastic potential energy, Period and frequency, Energy, Pendulums, Applications of SHM
- **OSCILLATIONS (08 Hours)**
Damped oscillations, forced oscillations, coupled oscillations & resonance

(Total Contact Time (Theory) : 44 Hours)

BOOKS RECOMMENDED:

1. Mathur D. S., "*Mechanics*", S. Chand & Company, 2000.
2. Takwale R. G. & Puranik P.S. "*Introduction to Classical Mechanics*", TMH., 1997.
3. Feymann R. P., Lighton R. B. and Sands M.: "*The Feymann Lectures in Physics*" Vol. I Narosa Publishers, 2008.
4. Verma H. C., "*Concepts of Physics*", Vol. 1 & 2, Bharati Bhavan, 2007.
5. Landau L. D. & Lifshitz E M, "*Course on Theoretical Physics*", Vol. 1: *Mechanics*, Addison-Wesley, 2002

First year of Five Years integrated M. Sc. (Physics / Chemistry / Mathematics)**M.Sc. - I, Semester – I**

	L	T	P	C
MM 101 : Mathematics – I	3	2	0	5

- **CALCULUS** (07 Hours)
Reorientation of calculus, Differentiation of Hyperbolic and Inverse Hyperbolic functions. Successive Differentiation, standard forms, Leibnitz's theorem and applications, Power series, Expansion of functions, Taylor's and Maclaurin's series
- **APPLICATIONS OF DERIVATIVES** (08 Hours)
Curvature, Radius of curvature, Cartesian, polar parametric curve with application in Engineering problems. Indeterminate forms, L'Hospital's rules.
- **ORDINARY DIFFERENTIAL EQUATION** (08 Hours)
Reorientation of differential equation, Exact differential equation and Integrating factors, First order and higher degree ode, solvable for p, y and x, Modeling of Real world problems particularly Engg. System, spread of epidemic, spread of new technological innovations, RC and RL network
- **CURVE TRACING** (05 Hours)
Cartesian, polar and parametric form of standard curves
- **BETA AND GAMMA FUNCTION** (04 Hours)
Beta and Gamma function with their properties and duplications formula without proof
- **APPLICATION OF DEFINITE INTEGRATION** (05 Hours)
Area, arc length, surface area by revolving curve, volume by revolving area bounded by curve for Cartesian, polar and parametric curves
- **MATRICES** (07 Hours)
Elementary row and column transformation rank of matrix, Linear dependence, consistency of linear system of equations, characteristic equation, Caley-Hemilton theorem, Eigen value, Eigen vector

(Total Contact Time (Theory) : 44 Hours)

BOOKS RECOMMENDED:

1. Steward James De, "*Calculus*", Thomson Asia, Singapore, 2003.
2. Bali and Iyengar., "*Engg. Mathematics*", Laxmi Publications, New Delhi, 1997.
3. Peter O'Neil., "*Advanced Engg. Mathematics*", Thompson, Singapore, Ind. Ed. 2002.
4. Kapur J. N. , "*Mathematical Models in Biology and Medicine*", East west Press, New Delhi 1985.
5. Hilderband F. B., "*Methods of Applied Mathematics*", McGraw Hill, New York, 1968.

First year of Five Years integrated M. Sc. (Physics / Chemistry / Mathematics)**M.Sc. - I, Semester – I**

	L	T	P	C
MN 101 : Environmental Science	2	1	0	3

- **FUNDAMENTAL OF ENVIRONMENTAL SCIENCE** (05 Hours)
 - Definition
 - Principle and scope of environmental science
 - Composition and structure of atmosphere
- **NATURAL RESOURCES** (05 Hours)
 - Water
 - Land
 - Minerals
 - Forests
- **ENVIRONMENTAL POLLUTION** (05 Hours)
 - Water pollution
 - Air pollution
 - Land pollution
 - Sources, effects & control of pollution
- **ENERGY RESOURCES** (05 Hours)
 - Solar energy
 - Nuclear energy
 - Wind energy
 - Hydro energy
 - Wave energy
- **RADIATION POLLUTION** (05 Hours)
 - Sources
 - Effects
 - Control
- **THERMAL AND NOISE POLLUTION** (05 Hours)
 - Sources
 - Effects
 - Control of thermal and noise pollution

(Total Contact Time (Theory) : 30 Hours)

BOOKS RECOMMENDED:

1. Wright R.T., “*Environment Science*”, 9th edition, Prentice – Hall of India Private Limited, New Delhi 2007.
2. Cunningham W. P. & Cunningham M. A., “*Principles of Environment Science*”, *Inquiry and Application*, Tata McGraw Hill, 1999.
3. Bharucha E., “*Textbook of Environmental Studies for Undergraduate Course*”, University Grant Commission, University Press, 2001.
4. Anandan P., Kumaravelan R., “*Environment Science & Engineering*”, Scitech Publications (India) Pvt. Ltd. Fourth Reprint – July 2007.
5. Dhaujeja S. K., “*Environmental Engineering and Management*”, S. K. Kataria & Sons Publishers & Distributors, 2004 .

First year of Five Years integrated M. Sc. (Physics / Chemistry / Mathematics)**M.Sc. - I, Semester – I**

	L	T	P	C
MG 101 : English-I	2	1	0	3

- **BASIC** (12 Hours)
Articles, Prepositions, Degrees of comparison, Tenses; Kinds and Uses, Active and Passive Voice, Phrases Clauses and Sentences, Kinds of sentences, Reported Speech
- **BASIC COMPOSITION** (07 Hours)
Paragraph Writing,, Business Correspondence, Official Reports
- **BASIC PHONETICS** (08 Hours)
The Production of Speech, The Sounds of English, Phonetic Transcription, Syllable and Stress, Intonation
- **BASIC CONVERSATION** (03 Hours)
English in use, English for routine communicative functions, Speech practice

(Total Contact Time (Theory) : 30 Hours)

BOOKS RECOMMENDED:

1. Murphy R., “*Intermediate English Grammar: Reference and Practice for South Asian Students*”, Cambridge University Press, 2001.
2. Thaker P.K., Desai S. and Purani T.J. (eds), “*Developing English Skills : A Composite Course for Intermediate Students*”, Oxford University Press, 1997.
3. Mohan K. and Banerji M., “*Developing Communication Skills*”, Mc.Millan Co. Publication 1990.
4. Krishnaswami N and Sriram T., “*Creative English for Communication*”, Mc.Millan Co.Publication 1992.
5. Board of Editors, “*Written and Spoken Communication in English*”, University Press Private Limited,2007.

	L	T	P	C
MC 102: Chemistry – II	3	1	2	5

- **SURFACE CHEMISTRY** (05 Hours)
Types of adsorption, adsorption isotherms-Freundlich and Langmuir; Colloids and colloids state, application of colloids, surfactants, micelles, critical micelle concentration, Basics of surface characterization by X-Ray and DLS.
- **POLYMERS** (04 Hours)
Methods of polymerization, Characterization by TGA, DTA, Molecular weight and its determination, amorphous and crystalline polymers, biopolymers, structure-property relation in polymers.
- **CARBOHYDRATES** (04 Hours)
Introduction, Basic structural features and types of carbohydrates, Reactions and conversions, role in biological systems
- **METALLURGY** (03 Hours)
Basic principles and applications; purification of elements and metals, metallurgical aspects of corrosion and its control
- **INORGANIC CHEMISTRY** (08 Hours)
Transition metal ions and complexes; coordination chemistry, magneto chemistry, organometallic compounds, catalysis, some relevant uses of transition elements, role of metal ions in biological process; trends in properties of s-and p-block elements, silicones; silicates; zeolites; alkoxides, solgel process, O₂ activation; N₂ fixation
- **ORGANIC MOLECULES** (08 Hours)
Structure, properties and mechanism of organic reactions: Relationship between shapes and properties of organic molecules. Electrophiles and nucleophiles, reactive intermediates-free radical, carbonium ion and carbanion, carbene, arynes. Types of organic reactions- Stepwise, ionic and free radical mechanisms, single step concerted mechanism, addition, substitution, elimination and rearrangement, emphasizing mechanisms, basic features of pericyclic reactions. Linear free energy relationships, Hammett equation
- **STEREOCHEMISTRY OF ORGANIC COMPOUNDS** (08 Hours)
Conformations of alkanes and cycloalkanes; configurations, Enantiomers, molecular chirality, diastereomers, threo and erythro diastereomers, meso compounds, resolution of enantiomers, retention and racemization. Relative and absolute configuration, sequence rules, D and L systems of nomenclature and R and S systems of nomenclature, Geometric isomerism – determination of configuration of geometric isomers E and Z systems of nomenclature, geometric isomers of oximes and alicyclic compounds. Linear and cyclic conjugation, benzene, aromaticity, properties of conjugated systems
- **NEW DEVELOPMENTS IN CHEMICAL SCIENCES** (02 Hours)
Environmentally benign chemistry, nanochemistry, smart materials, and their applications, Interface of chemical sciences with other disciplines, particularly in technology and medical sciences and engineering.

(Total Contact Time (Theory) : 42 Hours)

BOOKS RECOMMENDED:

1. Chawla S., "Text Book of Engg. Chemistry", Dhanpat Rai & Co. Pvt. Ltd., Delhi, 2003.
2. Adamson A. W., "Physical Chemistry of Surfaces", 3rd Edn., John Wiley, 1976.
3. Morrison R. T. and Boyd R.N., "Organic Chemistry", 6th Edn., Prentice Hall, 1992.
4. Solomons T. W. G., "Fundamentals of Organic Chemistry", 5th Edn., John Wiley, 1992.
5. Streitwieser, Jr. A. and Heathcock C. H., "Introduction to organic chemistry" 2nd Edn, MacMillan, New York, 1998

	L	T	P	C
MP 102 : Physics – II Kinetic theory, Thermodynamics & Statistical Physics	3	1	2	5

- **KINETIC THEORY OF GASES** (04 Hours)
Postulates of kinetic theory of gases, velocity of gas molecules, Molecular energy, Kinetic molecular model of an ideal-gas, kinetic interpretation of temperature, Degree of freedom of gas molecules, Maxwell's law of equipartition of energy.
- **INTERMOLECULAR FORCES & TRANSPORT PHENOMENA** (04 Hours)
Viscosity of a gas, Thermal conductivity of gases, Van der Waals's equation of state, Brownian motion
- **LAWS OF THERMODYNAMICS** (12 Hours)
Zeroth law of Thermodynamics, Ist and IInd laws of Thermodynamics, concepts of Temperature, internal energy and entropy, calculations of change of internal energy, and Entropy in various thermodynamic processes
- **THERMODYNAMICS POTENTIALS, HELMHOLTZ & GIBBS FUNCTIONS, MAXWELL RELATIONS** (12 Hours)
Gibbs and Helmholtz energy, Gibbs paradox, Enthalpy, and Maxwell's thermodynamic relations
- **ELEMENTS OF STATISTICAL PHYSICS** (08 Hours)
Fermi Dirac, Maxwell Boltzmann, & Bose Einstein distributions
- **THERMODYNAMICS OF BLACK BODIES (04 Hours)**
Black body and characteristics, radiation principles like Rayleigh Jeans, Weins and Planck's law of black body radiation

(Total Contact Time (Theory) : 44 Hours)

BOOKS RECOMMENDED :

1. Sears F.W. & Salinger, "*Thermodynamics, Kinetic theory and Statical Thermodynamics*" 3rd Ed. Addison- Wesley/Pearson, 1975.
2. Young & Freedman, "*Sears and Zemansky's University Physics* : Pearson Education", Singapore. 2004.
3. Feynman R. P., Leighton R. B. and Sands M.: "*The Feynman Lectures in Physics*" Vol. 1 Narosa Publishers, 2008.
4. Zemansky M. W., "*Heat and Thermodynamics*" (McGraw Hill), 1957
5. Carter A., "*Classical and Statistical Thermodynamics*", Pearson Education, 1999.

First year of Five Years integrated M. Sc. (Physics / Chemistry / Mathematics)**M.Sc. –I, Semester.-II**

	L	T	P	C
MM 102: Mathematics II	3	2	0	5

- **DIFFERENTIAL CALCULUS** (07 Hours)
Partial differentiation, Euler's theorem for homogeneous function, Modified Euler's theorem, Taylor's and Maclaurin's series for two variables
- **APPLICATIONS OF PARTIAL DIFFERENTIATION** (08 Hours)
Tangent plane and Normal line Error and Approximation, Jacobians with properties, Extreme values of function of two variables, Lagrange's methods of undetermined multipliers.
- **DIFFERENTIAL EQUATION OF HIGHER ORDER** (08 Hours)
Solution of homogeneous equations, complementary functions, Particular Integrals, Linear differential equation with variable coefficient, Cauchy's Euler and Legendre's equation with variable coefficient, Method of variation of parameters.
- **MATHEMATICAL MODELS** (07 Hours)
Electrical network models, Detection of diabetes model and Bending beam models
- **SERIES SOLUTION AND SPECIAL FUNCTIONS** (07 Hours)
Regular point, Singular point, series solution of ODE of 2nd order with variable coefficient with special emphasis to differential equation of Legendre's and Bessel's for different cases of roots of indicial equations.
- **LAPLACE TRANSFORM** (07 Hours)
Laplace transform, Existence theorem, Laplace transform of derivatives and integrals, Inverse Laplace transform, Unit step functions, Dirac – delta functions, Laplace transform of periodic functions, Convolutions theorem, Application to solve simple linear and simultaneous differential equations.

(Total Contact Time (Theory): 44 Hours)

BOOKS RECOMMENDED:

1. Kreyszig E. : “*Advanced Engg. Mathematics*”. 8th Ed, John Wiley & Sons., New York, 1995.
2. Jain and Iyenger , “*Advanced Engg. Mathematics*”, Narosa Publications, New Delhi, 1997.
3. De J. S., “*Calculus*”, Thomson Asia, Singapore, 2003.
4. Kapur J. N. , “*Mathematical Models in Biology and Medicine*”, East west press, 1998.
5. Hilderbrand F. B., “*Methods of Applied Mathematics*”, McGraw Hill, New York, 1968.

First year of Five Years integrated M. Sc. (Physics / Chemistry / Mathematics)**M.Sc. –I, Semester.-II**

	L	T	P	C
MM 104: Introduction to Computers	2	1	0	3

- **Introduction to Computer** (09 Hours)
Introduction to computer, History of computer, Parts of computer, Computer Terminology, Start up of a computer, Disc drives, Disc utilities, Starting and stopping computer, use of the mouse, Installing and uninstalling software, Maintenance of computer, Purchasing a computer, Types of computers.
- **Hardware of computer** (08 Hours)
Input and output devices, Central processing unit (CPU), Keyboard, Monitor, Mouse, Printers, Modems, Scanners, Digital cameras, Different cards (sound, colour and video), Different drives (floppy, hard, CD, DVD).
- **System Software and Programming** (08 Hours)
System software-Function, Types and Utilities.
Computer Programming-Languages-Machine and assembly languages, Fortran, Cobol, Basic, C, C++, Java etc.
- **Applications of Computer** (07 Hours)
Desktop publishing, Spread sheet, Database, Graphics, Presentation, Communication, Browser, Web pages, Email, Project management, Integrated and suits.

(Total Contact Time (Theory): 32 Hours)

BOOKS RECOMMENDED:

1. Kingsley Idiagbor, “*Basic Computer Science for Beginners*”, 2002.
2. Walton, S., “*Computer Fundamentals*”, 1997.
3. Horowitz P. and Hill W., “*The Art of Electronics*”, Cambridge University Press, 1989.
4. Shelly C. V., “*Discovering Computers*”, Web Enhanced, Complete Edition, 2005.
5. Marjorie H. and Michael H., “*Microsoft Office 2003*”, Brief Edition

First year of Five Years integrated M. Sc. (Physics / Chemistry / Mathematics)**M.Sc. - I, Semester – II**

	L	T	P	C
MG 102 : English-II	2	1	0	3

- **Grammar in Use** (10 Hours)
The Verb Phrase; Be, have and do; Modal Verbs; Infinitive Gerund and Participles.
- **Concepts in Grammar** (10 Hours)
Questions and Auxiliary Verbs; Conditionals and ‘wish’; ‘ – ing’ and the infinitive; Articles and Nouns; Pronouns and Determiners; Adjectives and Adverbs; Conjunctions and Preposition.
- **A Course in Listening and Speaking** (10 Hours)
Pronunciation and Neutralization of Accent

(Total Contact Time (Theory): 30 Hours)

BOOKS RECOMMENDED:

1. Murphy, Raymond, “*Intermediate English Grammar*”, 2nd edition, Cambridge University Press, New Delhi, 2007.
2. Murthy, J. D., “*Contemporary English Grammar*”, Book Palace Publication 1998.
3. Sasikumar, V., Dutt, P. K. & Rajeevan, G., “*A Course in Listening and Speaking-I*”, Foundation Books, Cambridge Uni. Press India Pvt.Ltd., 2005.
4. Monippally, M. M., “*Business Communication Strategies*”, Tata McGraw-Hill Publishing Com. Ltd., New Delhi Publication, 2001
5. Eastwood, J., “*Oxford Guide to English Grammar*”, Oxford Uni. Press, New Delhi, 2008.

Second year of Five Years Integrated M.Sc. (Mathematics)
M.Sc. – II, Semester-III

Sr. No.	Course	Code	Teaching Scheme Hours per Week			Credit	Examination Scheme			Total Marks
			L	T u.	Pr.		Theory	Tutorial	Practical	
1	Fundamentals of Computer Programming	MM 210	3	1	2	5	100	25	50	175
2	Calculus	MM 203	3	2	0	5	100	50	00	150
3	Electromagnetic	MP 201	3	1	2	5	100	25	50	175
4	Communication Skills-I	MG 201	2	1	0	3	100	25	00	125
5	Basic Science Elective (BSE)*	MS 2XX	3	0	0	3	100	00	00	100
			14	5	4		500	125	100	725
Total Contact hours per week = 23			Total Credit = 21				Total Marks = 725			

Elect any one

***MS2XX:MS201, MS 203, MS 205, MS 207, MS 209, MS 211**

List of Basic Science Electives:

Sr. No.	Course	Code
1	Fundamentals of Classical Mechanics	MS 201
2	Modern Physics	MS 203
3	Basics of Astronomy and Astrophysics	MS 205
4	Chemistry of Environment	MS 207
5	Chemical Analysis by Instrumental Methods	MS 209
6	Heterocyclic Compounds	MS 211

Second year of Five Years Integrated M.Sc. (Mathematics)
M.Sc. –II, Semester-IV

Sr. No.	Course	Code	Teaching Scheme Hours per Week			Credit	Examination Scheme			Total Marks
			L	T u.	Pr.		Theory	Tutorial	Practical	
1	Principle of Scientific Computing	MM 202	3	2	0	5	100	50	00	150
2	Linear Algebra	MM 204	3	2	0	5	100	50	00	150
3	Organic Chemistry-I	MC 202	3	1	2	5	100	25	50	175
4	Communication Skills-II	MG 202	2	1	0	3	100	25	00	125
5	Data Structure and Algorithms	CO 206	3	0	2	5	100	00	50	150
			13	6	4		500	150	100	750
Total Contact hours per week = 23			Total Credit = 23				Total Marks = 750			

MM 210: FUNDAMENTALS OF COMPUTER PROGRAMMING	3	1	2	5
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- COMPUTER FUNDAMENTALS**
(07 Hours)

Preliminary Concepts of Algorithms, Flow charts and their execution traces, a simplified model of computer, Bit, byte, nibble, word, structure of computer (Von Neumann), I/O unit, ALU, CPU, CU, MU, different types of I/O devices.

- DIGITAL TECHNIQUES**
(08 Hours)

Number system: Decimal, binary, octal, hexa decimal, Conversion, BCD, EBCD, ASCII code, Arithmetic operations on binary numbers: addition, subtraction using 1's and 2's complement, multiplication, division.

- LOGIC GATES**
(05 Hours)

AND, OR, NOT, NAND, NOR, XOR gate, truth tables.

- PROGRAMMING IN C**
(22 Hours)

Basics
VARIABLES – CONSTANTS – EXPRESSIONS – Operators and their precedence and associativity, Basic input and output statements, Control structures, Simple programs in C using all the operators and control structures.

Functions
Concepts of Function – Parameters and how they are passed – Auto variables – Recursion – Scope and extent of variables, Writing programs using recursive and non-recursive functions.

Arrays and Strings
Single and Multi dimensional arrays – Character Array as a string, Functions on strings, Writing C Programs using arrays and for String manipulation.

Structures
Declaring and using structures, Operations on structures – Arrays of structures, User defined data types, Pointers to using files.

Files
Introduction - File Structure, File handling functions, File types, Error handling C programming examples for using files.

(Total Contact Hours(Theory): 42 Hours)

PRACTICALS:

1. Write program to read x, y coordinates of 3 points and then calculate the area of a triangle formed by them and print the coordinates of the three points and the area of the triangle. What will be the output from your program if the three given points are on a straight line?
2. Write a program which generates 100 random integers in the range of 1 to 100. Store them in an array and then print the array. Write 3 versions of the program using different loop constructs e.g. for, while, do while
3. Write a set of string manipulation functions e.g. for getting a sub string from a given position. Copying one string to another, reversing a string, adding one to another.
4. Write a program which determines the largest and the smallest number that can be stored in different data types like short, long, float and double. What happens when you add 1 to the largest possible integer number that can be stored?
5. Write a program which generates 100 random numbers in the range of 10.0 to 20.0 and sort them in descending order.
6. Write a function for transposing a square matrix in place i.e. do not use full temporary matrix.
7. First use an editor to create file with some integer numbers. Now write a program to read these numbers from the file to compute their mean and standard deviation.
8. Given two points on the surface of a sphere, write a program to determine the smallest arc length between them.

BOOKS RECOMMENDED:

1. **Rajaraman V.**, "*Programming in C*", PHI, 1994.
2. **Gottfried B. S.**, "*Theory and Problems of Programming with C*", Schaum Publishing Company, New York, 1995.
3. **Sinha P K**, "*Computer Fundamentals*", BPB Publications, 2004.
4. **Mano M. Morris**, "*Computer Engineering: Hardware Design*", Prentice Hall, US edition, 1988.
5. **Balagurusamy E.**, "*Programming in ANSI C*", 3rd Ed., TMH, New Delhi, 2004.

Second year of M.Sc. (Mathematics)**M.Sc.-II, Semester-III**

	L	T	P	C
MM 203: CALCULUS	3	2	0	5

- **LIMIT AND CONTINUITY** (07 Hours)
Limit continuity & derivative of function of several variables, directional derivative, total differential, Mean value theorem, Approximation, Chain rule, implicit differentiation.
- **MULTIPLE INTEGRAL** (08 Hours)
Reorientation of concepts of integrals, Double and Triple integrals. Evaluation techniques. Change of order of Integration, change of variable. Application of double and triple integrals for evaluation of area, volume and mass.
- **BASIC CONCEPTS OF VECTOR CALCULUS** (08 Hours)
Scalar and vector point function, differential operator, gradient, directional derivative, physical meaning of gradient, divergence, curl and Laplacian with their properties Line Integrals, Surface Integral, Volume integral, Green's, Gauss and Stoke's theorem without proof & application.
- **SEQUENCES AND SERIES OF NUMBERS** (10 Hours)
Convergence of Real sequence, Monotone sequence, Cauchy's criterion, subsequence, convergence of some special sequence, Infinite series, series of positive terms, Comparison test, Ratio test, Root test, Abel's test, Dirichlet's test, Integral test, Rearrangement of terms of a series, Alternating series, Absolute convergence, Power series of complex numbers, Radius of convergence, Multiplication of series.
- **COMPLEX NUMBERS:** (09 Hours)
De Moivre's theorem & its applications, nth roots of complex numbers, Graphical representation of Complex numbers, function of complex variable: exponential, logarithmic, rational, trigonometric, hyperbolic function.

(Total Contact Hours: 42 Hours)

BOOKS RECOMMENDED:

1. **Apostol T. M.**, "*Mathematical Analysis*", Narosa Publishing House, New Delhi, 1985.
2. **Malik S.C., and Arora S.**, "*Mathematical Analysis*", Wiley Eastern Ltd., New Delhi, 2001.
3. **Spiegel M.R.**, "*Vector Analysis*", Schaum Publishing Company, New York, 1998.
4. **Thomas G. B. and Finney R. L.**, "*Calculus and Analytic Geometry*", 9th Ed., Addison-Wesley, 1998.
5. **Kreyszig E.**, "*Advanced Engg. Mathematics*", 8th Ed, John Wiley & Sons., New York, 1995.

Second year of M.Sc. (Mathematics)**M.Sc.-II, Semester-III**

	L	T	P	C
MP 210: ELECTROMAGNETICS	3	1	2	5

- **VECTOR CALCULUS** (04 Hours)
Vector Algebra, Differential calculus, Integral calculus.
- **ELECTROSTATICS** (06 Hours)
Electric field, Divergence and curl of electrostatic field, Electric potential, Work and energy in electrostatics, conductors.
- **LAPLACE EQUATIONS, UNIQUENESS THEOREM & METHOD OF IMAGES** (08 Hours)
Laplace equation in one-,two-, and three- dimensions, 1st and 2nd uniqueness theorem, Classic image problem, Induced surface charge, Force and energy, Other image problems, Separation of variables, Multipole expansion.
- **ELECTRIC FIELDS IN MATTER** (06 Hours)
Polarization, The field of polarized object, The electric displacement, Linear dielectrics.
- **MAGNETOSTATICS** (06 Hours)
The Lorentz Force Law, Biot-Savart's law, the divergence and curl of B, Magnetic vector potential
- **MAGNETIC FIELDS IN MATTER** (06 Hours)
Magnetization, The fields of a magnetized object, The auxiliary field H, Linear and non-linear media.
- **ELECTRON OPTICS &APPLICATIONS** (08 Hours)

(Total Contact Hours: 44 Hours)

BOOKS RECOMMENDED:

1. **Griffiths. D. J.**, "*Introduction to the Electrodynamics*", 3rd Ed. Prentice – Hall of India Private Limited 1999.
2. **Edminister J. A.**, "*Schaum's Outline series, Theory and Problems of Electromagnetics*", McGraw Hill, 1993.
3. **Sadiku M. N. O.**, "*Elements of Electromagnetics*", 3rd Ed., Oxford Uni. Press, 2003..
4. **Stewart J. V.**, "*Intermediate Electromagnetic Theory*", Allied Publishers (with World Scientific), 2005.
5. **Jackson J.D.**, "*Classical Electrodynamics*", Wiley Eastern, 2005.

Second year of M.Sc. (Mathematics)

M.Sc.-II, Semester-III

L T P C

MG210: COMMUNICATION SKILLS -1

2 1 0 3

Section – 1

• SPEAKING AND LISTENING SKILLS

(15

Hours)

‘TIGER’S EYE’

1. Welcome to India
2. Starting Work
3. The Missing Bass
4. Tiger’s Eye
5. The Conference
6. Revision
7. The Inspector Calls
8. Strictly Confidential
9. The Box of Books
10. Bad News, Good News
11. A Surprise Present
12. Revision
13. A Case Full of Books
14. Deep Water
15. Tyger, Tyger

Section - 2

• SPEAKING, LISTENING AND WRITING SKILLS

(15 Hours)

1. EFFECTIVE PRESENTATION STRATEGIES

- Defining purpose
- Analyzing Audience & Locale
- Organizing Contents
- Preparing an outline
- Visual aids
- Understanding Nuances of Delivery
- Kinesics
- Proxemics
- Paralinguistics
- Chronemics

2. INTERVIEWS :

- Types of interviews
- Answering Strategies
- Job Interviews
- Preinterview preparation

3. GROUP COMMUNICATION

- Group Discussion Strategies
- Group Interaction Strategies
- Organizational Group Discussion
- Group Discussion as part of a selection process.

4. MEETING :

- Purpose
- Procedure
- Participation
- Physical Arrangement.

5. SEMINAR & CONFERENCES

- Types of Discussion Groups
- Regulating Speech
- Conducting Seminars
- Organizing Conferences
- Evaluating Oral Presentation

(Total Contact Hours: 30 Hours)

BOOKS RECOMMENDED:

1. **Raymond V. L. and Flatley M. E.**, “*Basic Business Communication skills for Empowering the Internet generation*” Tata McGraw Hill publishing company limited. New Delhi 2005.
2. **Daniel G. R. and Steven E. P.**, “*Technical Report Writing Today*,” Biz tantra. New Delhi. 2006.
3. **Rizvi M. A.** “*Effective Technical Communication*” The McGraw Hill New Delhi, 2005
4. **Meenakshi R. and Sharma S.**, “*Technical Communication Principles and Practices*“, Oxford University Press, New Delhi, 2008.
5. **Sudan A. S. and Kumar N.**, “*Business Communication*”, Anmol Publications Pvt. Ltd. New Delhi, 2003.

Second year of M.Sc. (Mathematics)

M.Sc.-II, Semester-III

	L	T	P	C
MS 201: (BASIC SCIENCE ELECTIVE)	3	0	0	3

FUNDAMENTALS OF CLASSICAL MECHANICS

- **MECHANICS OF A PARTICLE AND SYSTEM OF PARTICLES** (10 Hours)
Equation of motion, Different conservation laws, Constrained motion, Constraints, Degree of Freedom, Generalized coordinates.
- **VARIATIONAL PRINCIPLE AND LAGRANGIAN FORMULATIONS** (10 Hours)
Calculus of variations, Variational technique for many independent variables, Euler Lagrangian differential equation
- **HAMILTONIAN FORMULATION OF MECHANICS** (10 Hours)
Phase space and motion of the system, Hamilton's canonical equation of motion, Physical significance of H, Advantage of Hamilton approach.
- **SPECIAL THEORY OF RELATIVITY** (06 Hours)
Frame of Reference, Postulates, Time dilation, Length contraction, Mass-Energy Relation, Lorentz' transformation.
- **GENERAL THEORY OF RELATIVITY** (08 Hours)
Space-time Fabric, Principle of equivalence, Euclidean and non-Euclidean continuum.

(Total Contact Hours: 44 Hours)

BOOKS RECOMMENDED:

1. **Mathur D. S.**, "*Mechanics*", S. Chand & Company, 2000.
2. **Takwale R. G. & Puranik P.S.** "*Introduction to Classical Mechanics*", TMH., 1997.
3. **Feymann R. P., Lighton R. B. and Sands M.**, "*The Feymann Lectures in Physics*", Vol. 1, Narosa Publishers, 2008.
4. **Verma H. C.**, "*Concepts of Physics*", Vol. 1 & 2, Bharati Bhavan, 2007.
5. **Landau L. D. & Lifshitz E. M.**, "*Course on Theoretical Physics*", Vol. 1: Mechanics, Addison-Wesley, 2002

Second year of M.Sc. (Mathematics)

M.Sc.-II, Semester-III

	L	T	P	C
MS 203: (BASIC SCIENCE ELECTIVE)	3	0	0	3

MODERN PHYSICS

- **LIMITATIONS OF CLASSICAL PHYSICS AND RISE OF QUANTUM PHYSICS (08 Hours)**
Classical physics as an approximate of quantum physics, limitations of classical physics at microscopic levels
- **BASICS OF QUANTUM PHYSICS AND QUANTUM MECHANICS (10 Hours)**
Black body radiation, Wein's, Rayleigh-Jeans, Plank's laws, Dual nature, Atomic models, Exclusion principle and quantum numbers, The wave equation.
- **PHOTOELECTRIC EFFECT AND COMPTON EFFECT (06 Hours)**
Photo electric effect and Einstein's explanation, Compton effect and equation of wavelength
- **X – RAY (08 Hours)**
Production and characteristics of X-rays, X-ray diffraction and Bragg's law.
- **LASERS ,FIBRE OPTICS & APPLICATIONS (12 Hours)**
Laser fundamentals, types of lasers, Basics of Fibre optics, types of fibres.

(Total Contact Hours: 44 Hours)

BOOKS RECOMMENDED:

1. **Beiser A.**, "*Concept of the Modern Physics*", TMH, 2008.
2. **Ghatak A.**, "*Optics*", Tata McGraw Hill, 2005.
3. **Wehr M. R., Richards J. A. and Adair T. W.**, "*Physics of the Atom*", Addison – Wesley, 1984.
4. **Harris R.**, "*Modern Physics*", Addison-Wesley/ Pearson, 2/E, 2007
5. **Born M. and Wolf E.**, "*Principles of Optics*", Cambridge Uni. Press, 2000.

Second year of M.Sc. (Mathematics)

M.Sc.-II, Semester-III

	L	T	P	C
MS 205: (BASIC SCIENCE ELECTIVE)	3	0	0	3

BASICS OF ASTRONOMY AND ASTROPHYSICS

- **UNIVERSE AND CELESTIAL BODIES** (18 Hours)
Matter vs Radiation Dominated universe, The early universe, structure formation Galaxies, Nebulae, Stars, Classification of celestial bodies, other celestial bodies.
- **SOLAR SYSTEM** (10 Hours)
Birth, Life and Death of a star, H-R diagram, Solar system and its members
- **EARTH AND ITS ATMOSPHERE** (07 Hours)
Formation and structure of earth, different surface features of the earth, earth's atmosphere and its different parts, radio window, ozone depletions.
- **SPACE EXPLORATIONS** (07Hours)
Radiation in the universe, its effect on human and other non living mechanics, types of space vehicles, manned space explorations

(Total Contact Hours: 44 Hours)

BOOKS RECOMMENDED:

1. **Degaonkar S. S.**, "*Space Science*", Gujarat University Press, 1968
2. **Patrick M.**, "*Atlas of the Universe*", Cambridge University Press, 2000
3. **Beiser A.**, "*Concept of the Modern Physics*", TMH, 2008
4. **Mukhanov, M.**, "*Physical Foundations of Cosmology*", CUP, 2005.
5. **Islam, J. N.**, "*An Introduction to Mathematical Cosmology*", CUP, 2004.

CHEMISTRY OF ENVIRONMENT

- **INTRODUCTION** (02 Hours)
Environmental Science-objectives and guiding principles, Troposphere hydrosphere, atmosphere and lithosphere, Environmental chemistry and its scope.
- **TYPES OF POLLUTION AND POLLUTANTS** (06 Hours)
Air pollution and pollutants and their limits, Long distance movements of Pollutants and their control and monitoring, Water pollution and pollutants and their effects, Soil pollution and pollutants and their effects.
- **AIR POLLUTION** (09 Hours)
Air Pollutants CO, CO₂, Cl₂, NO_x, SO_x, H₂S, Ozone, CH₄ and H₂O and their sources, Atmospheric photochemistry, effect of NO_x, and CFCs on Ozone layer, Particulates and their sources, toxic effect of particulates, Smog, Photochemical smog & mechanism of its formation, acid rain, green house effect, global warming.
- **WATER POLLUTION** (09 Hours)
Aerobic and anaerobic oxidation, BOD, COD, Sewage and other oxygen demanding waste, Plant nutrients, fertilizers, Exotic organic chemicals, inorganic material and chemical compounds, Pollution due to surfactants and oil spills, Treatment of domestic waste water, Industrial waste water and treatments.
- **SOIL POLLUTION** (09 Hours)
Haloorganics and Pesticides, Insecticides, Fungicides, Herbicides and their chemical analysis, biodegradation of pesticides, effect of pesticides on environment, alternative method of pest control. Autocide technique, use of sex-attractants, use of juvenile hormones and its causes.
- **THERMAL POLLUTION** (04 Hours)
Introduction, sources- nuclear, coal fired, hydroelectric power plants, Industrial effluents and domestic sewage, effects and control of thermal pollution.
- **NOISE POLLUTION** (02 Hours)
Characteristics of sound, sources- industrial, transport and neighbourhood, effect of noise pollution, measurement of noise. control of noise pollution.
- **GREEN CHEMISTRY** (01 Hours)
12 Principles

(Total Contact Hours: 42 Hours)

BOOKS RECOMMENDED:

1. Puri B. K., Sharma L. R. and Falia K. C., "Principles of inorganic chemistry", Shobanal Nagin Chand & Co., Jalandhar, 1998.
2. Chawla S., "A text book of engineering chemistry", 3rd Ed, Dhanpat Rai & Co (P) Ltd, Delhi, 2003.
3. Sharma B. K., "Engineering Chemistry", 3rd Ed, Krishna Prakashan Media, 2001.
4. Bailey R. A., Clark H. M., Krause S. and Strong R. L., "Chemistry of the environment", 2nd Ed, Academic Press- An Imprint of Elsevier, 2002.
5. Wright R. T. "Environmental Science", 9th Ed, Prentice-Hall of India, New Delhi, 2005.

CHEMICAL ANALYSIS BY INSTRUMENTAL METHODS

- **EVALUATION OF ANALYTICAL DATA** (07 Hours)

Calculation in analytical chemistry, calculation of stoichiometry-titrimetry, errors, determinate errors, correction of determinate errors, indeterminate errors, mean, median, standard deviation, variance, accuracy, precision, comparison of means, rejection of result- quotient test, least square method. Component, phase, degree of freedom, phase rule and its derivation. One component and two component systems.
- **SEPARATION METHODS** (07 Hours)

Gravimetric analysis – precipitation method, mechanism of precipitation, desirable properties of gravimetric precipitate, adverse ion effect, co precipitation, post precipitation, digestion, drying and ignition, errors in gravimetric analysis, inorganic and organic precipitating agents, organic reagents in inorganic reaction.
- **VOLUMETRIC METHODS** (07 Hours)

Primary standards, acid base pH-metric and conductometric titrations, theory of acid base indicators, potentiometric redox titration, complexometric and precipitation titration, caution in volumetric titrimetry, correction for unavoidable error.
- **CHROMATOGRAPHY** (07 Hours)

Terminology, classification, mechanisms, chromatographic performance, thin layer chromatography, column chromatography, paper chromatography, gas chromatography, ion exchange chromatography, High pressure liquid chromatography, retention factors, qualitative and quantitative analysis by chromatography.
- **ELECTROMAGNETIC SPECTRUM – UV-VIS ABSORPTION SPECTROSCOPY** (07 Hours)

Interaction of radiation with matter, absorption of radiation by molecules, UV-Vis absorption spectroscopy- Beer-lambert's law, molar absorptivity, presentation and analysis of UV spectra, types of electronic transitions, effect of conjugation, concept of chromophore and auxochrome, bathochromic, hypsochromic, hyperchromic and hypochromic shift, UV conjugated enes and enones.
- **VOLTAMETRY** (07 Hours)

Polarography at DME (DC polarography), DME advantages limitation, half wave potential, Ilkovic equation, different currents in polarography, applications in inorganic and organic analysis. Coulometry- Principles of electrolysis, electrolysis at constant potential, electrolysis at constant current, coulometric methods of analysis, applications of coulometry potentiostatic and amperostatic, coulometric titration.

(Total Contact Hours: 42 Hours)

BOOKS RECOMMENDED:

1. Dean J. A., "Chemical Separation Methods", Van Nostrand Reinhold, 1970.
2. Ewing G. W., "Instrumental Methods in Chemical Analysis", 5th Ed., McGraw-Hill, 1985.
3. Willard H. H., Merrett L. L., Dean J. A. and Settle F. A., "Instrumental Methods of Analysis", 6th Ed., Van Nostrand Reinhold, 1980.
4. Vogel A. I. "A text book of quantitative chemical analysis", ELBS UK, 5th Ed, 1996.
5. Banwell C. N., "Fundamentals of Molecular Spectroscopy", Tata McGraw Hill, 1983.

HETEROCYCLIC COMPOUNDS

- **NOMENCLATURE OF HETEROCYCLES** (04 Hours)
Replacement and systematic nomenclature (Hantzsch-Widman system) for monocyclic fused and bridged heterocycles.
- **AROMATIC HETEROCYCLES** (05 Hours)
General chemical behaviour of aromatic heterocycles, classification (structural type), criteria of aromaticity (bond lengths, ring current and chemical shift in ^1H NMR spectra, empirical resonance energy, delocalization energy and Dewar resonance energy, diamagnetic susceptibility exaltations). Heteroaromatic reactivity and tautomerism in aromatic heterocycles.
- **NON-AROMATIC HETEROCYCLES** (06 Hours)
Strain bond angle and torsional strain and their consequences in small ring heterocycles, Conformation of six membered heterocycles with reference to molecular geometry, barrier to ring inversion, pyramidal inversion and 1,3-diaxial interaction, stereo-electronic effects, anneromeric and related effects. Attractive interactions- H-bonding and intermolecular nucleophilic – electrophilic interactions.
- **HETEROCYCLIC SYNTHESIS** (04 Hours)
Principles of heterocyclic synthesis involving cyclization reactions and cycloaddition reactions.
- **SMALL RING HETEROCYCLES** (05 Hours)
Three membered and four membered heterocycles- synthesis and reactions of aziridines, oxiranes, thirienes, azetidines, oxitanes and thietanes.
- **BENZO-FUSED FIVE MEMBERED HETEROCYCLES** (05 Hours)
Synthesis and reactions including medicinal applications of benzo pyrroles, benzo furans and benzo thiophenes.
- **MESOIONIC HETEROCYCLES** (05 Hours)
General classification, chemistry of some important mesoionic heterocycles of type A & B and their applications.
- **SIX-MEMBERED HETEROCYCLES** (08 Hours)
Synthesis and reactions of Pyrrilium salts and pyrrones and their comparison with pyridinium and thio pyrrilium salts and pyridones. Synthesis and reactions of quinolizium and benzopyrrilium salts, caumarins and chromones, diazines, triazines, tetrazines and thiazines.

(Total Contact Hours: 42 Hours)

BOOKS RECOMMENDED:

1. Gupta R. R., Kumar M. and Gupta V., “Heterocyclic Chemistry” Vol 1-3, Springer Verlag, 1998.
2. Eiche T. and Hauptmann S., “The Chemistry of Heterocycles”, 2002.
3. Joule J. A., Mills K. and Smith G. F., “Heterocyclic Chemistry”, Chapman and Hall, 3rd Ed. 1995.
4. Acheson R. M., “An introduction to the Heterocyclic compounds”, John Wiley, 3rd Ed, 1976.
5. Gilchrist T. L., “Heterocyclic chemistry”, Longman scientific technical, 1987.

	L	T	P	C
MM 202: PRINCIPLE OF SCIENTIFIC COMPUTING	3	2	0	5

- **INTRODUCTION TO COMPUTING** (05 Hours)
Errors & approximation, finite differences, difference operators & relations between them. Interpolation: Newton's forward & backward, Lagrange, divided differences.
- **NUMERICAL SOLUTIONS OF TRANSCENDENTAL EQUATIONS** (05 Hours)
Bisection, Secant, Regular-Falsi, Newton-Raphson, Iteration method.
- **NUMERICAL DIFFERENTIATION & INTEGRATION** (06 Hours)
Trapezoidal & Simpson's rule, Gauss Legendre quadrature, Newton Cote's formula.
- **NUMERICAL SOLUTION OF SYSTEM OF LINEAR EQUATIONS** (07 Hours)
Direct (Gauss elimination, LU decomposition), Iterative (Jacobi & Gauss-Seidel). Eigen values problem: Jacobi's and power method.
- **NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATION** (07 Hours)
Taylor series method, Picard's method, Euler's method, Modified Euler's method, Runge-Kutta method.
- **APPROXIMATION** (06 Hours)
Least square polynomial approximation, polynomial approximation using orthogonal polynomials, Chebychev polynomials.
- **MATLAB** (08 Hours)
Exposure to MATLAB and implementation of numerical algorithms.

(Total Contact Hours: 44 Hours)

BOOKS RECOMMENDED:

1. **Atkinson. K. E.**, "*An introduction to Numerical Analysis*", Wiley, 1989.
2. **Jain. M. K., Iyenger. S. R. K., Jain. R. K.**, "*Numerical Methods for Scientific and Engineering Computation*", New Age International Pvt. Ltd., 1996.
3. **Conte. S. D. and de Boor. C.**, "*Elementary Numerical Analysis-An Algorithmic Approach*", McGraw-Hill, 1981.
4. **Golub. G. H. and Ortega. J. M.**, "*Scientific Computing and differential equations: An introduction to Numerical Methods*", Academic Press, 1992.
5. **Pratap R.**, "*Getting Started with MATLAB 7*", OUP, 2006.

Second year of M.Sc. (Mathematics)

M.Sc.-II, Semester-IV

	L	T	P	C
MM 204: LINEAR ALGEBRA	3	2	0	5

- **SYSTEM OF LINEAR EQUATIONS** (08 Hours)
Matrices and elementary row operations, Gaussian elimination, LU decomposition.
- **VECTOR SPACES** (06 Hours)
Subspaces, Basis and dimension, co-ordinates.
- **LINEAR TRANSFORMATION** (08 Hours)
Representation of linear transformation by Matrices, rank-nullity theorem, duality and transpose, Determinant.
- **EIGEN VALUES & EIGEN VECTORS** (10 Hours)
Minimal & characteristic polynomials, diagonalisations, Schur's theorem, Cayley Hamilton theorem, Jordon canonical form.
- **INNER PRODUCT SPACES** (10 Hours)
Gram-Schmidt process of orthonormalization, QR decomposition. Least squares problems, adjoint of an operators, positive (semi) definite matrices, minimum principles and Rayleigh quotients, matrix norms, condition numbers.

(Total Contact Hours: 42 Hours)

BOOKS RECOMMENDED:

1. **Lang. S.**, "*Introduction to Linear Algebra*" (Undergraduate text in Mathematics), Springer, 1986.
2. **Krishnamurthy. V, Mainra. V. P. and Arora. J. L.**, "*An Introduction to Linear Algebra*", Affiliated East-West, 1976.
3. **Hoffman. K. and Kunze. R.**, "*Linear Algebra*", PHI, 1991.
4. **Strang. G.**, "*Linear Algebra & Its Applications*", 4th edition, Thomson Brooks/Cole, 2006.
5. **Noble. B. and Daniel. J. W.**, "*Applied linear Algebra*", Prentice-Hall, 1977.

	L	T	P	C
MC 202: ORGANIC CHEMISTRY – I	3	1	2	5

- **CYCLOALKANES AND DIENES** (04 Hours)
Cycloalkanes: Nomenclature, methods of formation, chemical reactions, Baeyer's strain theory and its limitations, theory of strainless ring. Dienes: Nomenclature, classification, methods of formation of butadiene, chemical reactions, 1,2 and 1,4 additions, Diel's – Alder reaction.
- **BENZENE AND ITS HOMOLOGUES** (06 Hours)
Aromaticity, Mobius and Huckel polyenes, Huckel rule, annulene, mechanism of substitution reactions, directive effects of substituents, o, p and m-directing groups, effect of substituents on reactivity, theory of activity and deactivity effects. Fused ring compounds: Chemistry of naphthalene, anthracene and phenanthrene.
- **UNIT PROCESSES** (06 Hours)
Sulphonation: Definition, methods, sulphonating agents, sulphonation of benzene with the help of SO₃, H₂SO₄, oleum and ClSO₃H Nitration: Definition, methods, nitrating agents, factors affecting nitration, nitration of benzene, naphthalene, importance of nitration in manufacture of artificial perfume.
- **HETEROCYCLIC COMPOUNDS** (07 Hours)
Nomenclature, aromaticity, synthesis, properties, uses and canonical structures of pyrrole, furan and thiophene.
- **CARBOHYDRATES** (05 Hours)
Introduction to disaccharides, glycosidic bond, structure determination of sucrose, lactose, maltose and cellobiose.
- **PHOTOCHEMISTRY** (06 Hours)
Laws of photochemistry, nature of electronically excited states, geometry, dipole moment, acid base properties, internal conversion, intersystem crossing, phosphorescence, fluorescence, quantum yield, examples of low and high quantum yield, actinometry, rate of photochemical reactions, photochemical reactions of >C=C<, >C=O, benzene ring, and nitrogen containing compounds, photooxygenations, photochemistry of air and air pollution, chemi- and bioluminescence.
- **COMPOUND CONTAINING ACTIVE METHYLENE GROUP** (02 Hours)
Malonic ester and acetoacetic ester: preparation and its synthetic applications.
- **PETROCHEMICALS** (06 Hours)
Petrochemicals obtained from C1 cut of petroleum, manufacture and applications of ammonia, formaldehyde, hexamethylene tetramine, chlorinated methane. Petrochemicals obtained from C2 cut of petroleum, manufacture and applications of chemicals obtained from ethanol, acetaldehyde (Wacker Cheime Process), ethylene dioxide, ethylene glycol.

(Total Contact Time (Theory): 42 Hours)

BOOKS RECOMMENDED:

1. **Morrison R. T. and Boyd R.N.**, 'Organic Chemistry', 6th Edn., Prentice Hall, 1992.
2. **Bahl A. and Bahl B. S.**, 'A Textbook of organic Chemistry', 2nd Edn., S. Chand, 2005.
3. **Kumar S.**, 'Introduction to Petrochemicals'. 6th Edn, Oxford & IBH, 2000.
4. **March J.**, 'Inorganic Chemistry', 5th Edn., S. Chand, 2001.
5. **Finar I. L.**, 'Organic Chemistry' volume 1 &2 6th edition Longman, London 2006.

Section 1.

WRITING AND READING SKILLS

(15 Hours)

• **TECHNICAL COMMUNICATION PRINCIPLES AND PRACTICES.**

1. Technical Proposal

- Definition & Purposes
- Key factors
- Types
- Elements & Structure
- Style & Layout
- Evaluation.

2. Note Making

- Mechanics of Note making
- Reading Strategy
- Note- Writing Techniques
- Topical sing
- Schematizing
- Reducing Devices
- Organization Techniques

3. Research Papers / Articles / Dissertation / Thesis

- Research paper
 - Characteristics components
- Articles
 - Nature and Significance of Technical Articles
 - Types of Technical Articles, Journal Articles & Conference papers
 - Elements of Technical Articles
 - Writing Strategies
- Dissertation
 - Essential feature,
 - Action plan,
 - Choosing the subject,
 - Structure

- Thesis
 - Outline
 - Organization
 - Time Table
 - Iteration
 - Style
 - Presentation
 - Structure

Section 2.

DISCOURSE ANALYSIS: A LITERARY PIECE OF WORK

(15 Hours)

TUGHLAQ by Girish Karnard

(Total Contact Hours: 30 Hours)

BOOKS RECOMMENDED:

1. **Raymond V. L. and Flatley M. E.**, “*Basic Business Communication skills for Empowering the Internet generation*”, Tata McGraw Hill publishing company limited. New Delhi 2005
2. **Daniel G. R. and Steven E. P.**, “*Technical Report Writing Today*,” Biz tantra. New Delhi. 2006.
3. **Rizvi M. A.**, “*Effective Technical Communication*” The McGraw Hill New Delhi, 2005
4. **Meenakshi R. and Sharma S.**, “*Technical Communication Principles and Practices* “, Oxford University Press, New Delhi, 2008.
5. **Sudan A. S. and Kumar N.**, “*Business Communication.*” Anmol Publications Pvt. Ltd. New Delhi, 2003.

Third year of Five Years Integrated M.Sc. (Mathematics)

M.Sc.-III, Semester-V

Sr. No.	Course	Code	Teaching Scheme Hours per Week			credit	Examination Scheme			Total Marks
			L	Tu.	Pr.		Theory	Tutorial	Practical	
1	Real Analysis	MM 301	3	2	0	5	100	50	00	150
2	Classical Mechanics	MM 303	3	2	0	5	100	50	00	150
3	Ordinary Differential Equation	MM 305	3	2	0	5	100	50	00	150
4	Computer Architecture and Organization	CO 319	3	1	0	4	100	25	00	125
5	Theoretical Computer Science	CO 321	3	1	0	4	100	25	00	125
			15	8	0		500	200	00	700
Total Contact hours per week = 23			Total Credit = 23				Total Marks = 700			

Third year of Five Years Integrated M.Sc. (Mathematics)

M.Sc.-III, Semester-VI

Sr. No.	Course	Code	Teaching Scheme Hours per Week			credit	Examination Scheme			Total Marks
			L	Tu.	Pr.		Theory	Tutorial	Practical	
1	Complex Analysis	MM 302	3	2	0	5	100	50	00	150
2	Discrete Mathematics	MM 304	3	2	0	5	100	50	00	150
3	Departmental Elective	*MM 3X0	3	1	0	4	100	25	00	125
4	Operating System	CO302	3	1	2	5	100	25	50	175
5	System software	CO304	3	1	2	5	100	25	50	175
			15	7	4		500	175	100	775
Total Contact hours per week = 26			Total Credit = 24				Total Marks = 775			

Elect any one

*MM3X0: MM310 and MM320.

Sr. No.	Course	Code
1	Fuzzy Set Theory	MM 310
2	Integral Transforms	MM 320

	L	T	P	C
MM 301: REAL ANALYSIS	3	2	0	5

- **FUNCTION OF BOUNDED VARIATION** (07 Hours)
Function of bounded variation and its simple properties. Total variation and its additive property. Variation function and its properties. Necessary and sufficient conditions for a function to be bounded variation.
- **METRIC SPACES** (07 Hours)
Compact set, Connected set, Convergent of Sequence in metric space, Cauchy sequence, complete metric space, Limit and Continuity, Differentiation, Fourier series, R-S integrals. Sequence and series of function, Uniform Convergence.
- **MEASURABLE SETS** (05 Hours)
Concept of Lebesgue measure. Inner and outer measure. Its simple properties. Set of measure zero. Cantor set.
- **MEASURABLE FUNCTION** (07 Hours)
Definition. Modulus of measurable function is measurable. Every continuous function is measurable. Sum. Difference. product and quotient of measurable functions are measurable. Statements of Lusin and Egoroff's Theorems.
- **LEBESGUE INTEGRAL** (09 Hours)
Definition. Basic simple properties. Relation between Lebesgue integral and Riemann integral. Lebesgue integral of a bounded function over a set A of finite measure. Simple properties. Lebesgue integral for unbounded functions. Bounded convergence theorem for a sequence of function. Fatou's lemma. Classical Lebesgue dominated convergence theorem. Monotone convergence theorem.
- **FOURIER SERIES** (03 Hours)
- **L^p SPACES AND FOURIER TRANSFORM.** (06 Hours)

(Total Contact Hours: 44 Hours)

BOOKS RECOMMENDED:

1. Apostol T., "Mathematical Analysis", 2nd ed., Narosa Publishers, 2002.
2. Rudin W., "Principles of Mathematical Analysis", 3rd ed., McGraw-Hill, 1983
3. Royden H. L., "Real Analysis" (3rd Edition), Macmilan Publishing Co. Inc., New York, 4th Ed., 1993.
4. Malik S.C. and Arora S., "Mathematical Analysis", Wiley Eastern Ltd., New Delhi.
5. Rana I. K., "An introduction to measure and Integration", Narosa Publishing House, Delhi, 1997.

	L	T	P	C
MM 303: CLASSICAL MECHANICS	3	2	0	5

- **INTRODUCTION TO DYNAMICS** (12 Hours)
Analytical conditions of equilibrium of coplanar forces, virtual work, Simple harmonic motion, elastic strings, velocities and acceleration along radial and cross radial direction, velocities and acceleration along tangential and normal direction, motion on smooth & rough plane curves, motion in resisting medium, motion of particles of varying mass, central orbits.
- **RIGID DYNAMICS** (08 Hours)
Euler's dynamical equations for the motion a rigid body, motion of rigid body about fixed axis, motion of rigid body about rotating axis, Coriolis acceleration, Kepler's law of motion.
- **REVIEW OF TENSORS, ANALYSIS OF STRESS** (06 Hours)
Cauchy strain principle, stress vector tensor relation ship, strain quadric of Cauchy principle stress, strain ellipsoid, Mohr's circle.
- **DEFORMATION AND STRAIN** (06 Hours)
Langragian and Eulerian description, Finite strain tensor, Small deformation theory, Rotation tensor, Strain invariant, principal strains, Cubical dilation
- **MOTION OF FLOW** (04 Hours)
Material derivatives, Pathline and stream lines, Rate of deformation, Vorticity vector.
- **CONTINUUM MECHANICS** (08 Hours)
Equation of continuity, Motion, principle of angular momentum, conservation of energy, Clausius-Dirhem inequality, Dissipatipation Function

(Total Contact Hours: 44 Hours)

BOOKS RECOMMENDED:

1. **Rana N. C. and Joag P. C.**, "*Classical Mechanics*", Tata McGraw-Hill, 1991.
2. **Takwale R. G. and Puranik P. S.**, "*Introduction to Classical Mechanics*", Tata McGraw-Hill, 2000.
3. **Pant P. V.**, "*Classical Mechanics*", Alpha Science International, 2004.
4. **Synge J. L. and Griffith B. A.**, "*Principle of Mechanics*", Tata McGraw Hill, New Delhi.
5. **Beer F., Johnson J. E. R., Eisenberg E. and Cornwell D.**, "*Vector Mechanics for Engineers: Statics and Dynamics*", Vol -I and II, , Tata McGraw Hill, 1996

	L	T	P	C
MM 305: ORDINARY DIFFERENTIAL EQUATION	3	2	0	5

- **EXISTENCE AND UNIQUENESS OF INITIAL VALUE PROBLEMS** (12 Hours)
Picard's and Peano's Theorems, Gronwall's inequality, continuation of solutions and maximal interval of existence, continuous dependence.
- **HIGHER ORDER LINEAR EQUATIONS AND LINEAR SYSTEMS** (10 Hours)
Fundamental solutions, Wronskian, variation of constants, matrix exponential solution, behaviour of solutions.
- **TWO DIMENSIONAL AUTONOMOUS SYSTEMS AND PHASE SPACE ANALYSIS** (08 Hours)
Critical points, proper and improper nodes, spiral points and saddle points.
- **ASYMPTOTIC BEHAVIOUR** (04 Hours)
Stability (linearized stability and Lyapunov methods).
- **BOUNDARY VALUE PROBLEMS FOR SECOND ORDER EQUATIONS** (10 Hours)
Green's function, Sturm comparison theorems and oscillations, eigenvalue problems.

(Total Contact Hours: 44 Hours)

BOOKS RECOMMENDED:

1. **Hirsch M., Smale S. and Devaney R.**, “*Differential Equations, Dynamical Systems and Introduction to Chaos*”, Academic Press, 2004
2. **Perko L.**, “*Differential Equations and Dynamical Systems*”, Texts in Applied Mathematics, Vol. 7, 2nd ed., Springer Verlag, New York, 1998.
3. **Rao M. R. M.**, “*Ordinary Differential Equations: Theory and Applications*”, Affiliated East- West Press Pvt. Ltd., New Delhi, 1980.
4. **Sanchez D. A.**, “*Ordinary Differential Equations and Stability Theory: An Introduction*”, Dover Publ. Inc., New York, 1968.
5. **Codington E.A. and Levinson N.**, “*Theory of Ordinary Differential Equations*”, Tata McGraw Hill, New Delhi, 1990.

	L	T	P	C
CO 319: COMPUTER ARCHITECHTURE & ORGANIZATION	3	1	0	4

- **BASIC COMPUTER ORGANIZATION AND DESIGN (04 Hours)**
Introduction, Instruction code, Design of computer instructions, Timing and Control Design, Instruction execution, Input-Output Instruction, Interrupt, Design of Basic Computer.
- **CENTRAL PROCESSOR ORGANIZATION (06 Hours)**
Processor bus organization, Arithmetic Logic Unit, Stack Organization, General Instruction Format, Addressing Modes in instruction set, Data transfer instructions, Data Manipulations instructions, Program Control instructions, Microprocessor/Micro computer organization.
- **MICRO PROGRAM CONTROL ORGANIZATION (10 Hours)**
Conventional control/Micro Prog. control, Control memory, Address sequencing, Microprogram sequencer, Micro instruction format, Advantages & Applications.
- **ARITHMETIC PROCESSOR DESIGN (06 Hours)**
Introduction. Algorithm for Addition, subtraction, Multiplication, Division for – Unsigned number, Signed magnitude numbers, 1's Complement numbers, 2's complement numbers, Floating point numbers, Decimal numbers, Processor configuration and design for different types of number representation, Design a micro programmed calculator.
- **INPUT OUTPUT ORGANIZATION (06 Hours)**
Peripheral devices, I/O interfaces, Synchronous data transfer, Asynchronous data transfer, software/hardware approach for data transfer, Direct memory access, Priority interrupt, I/O processor, Multiprocessor system organization.
- **MEMORY ORGANIZATION (06 Hours)**
Auxality memory, Microcomputer memory, Memory hirerchy, Associative memory, Virtual memory, semiconductor memories, cache memory, memory management hardware.
- **PARELLAL PROCESSING (04 Hours)**
Introduction to parallel processing, multiprogramming, time sharing, Pipeline processing, parallel processing with multiple CPUs and Functional units, Race conditions, Semaphores in process, Synchronization, Memory interleaving , RISC processor, SISC processors etc.

(Total Contact Hours: 42 Hours)

BOOKS RECOMMENDED:

1. **Mano M.**, “*Computer Systems Architecture*”, 3rd Ed, PHI, 1997.
2. **Tanenbaum A. S.**, “*Structured Computer Organization*”, 5th Ed, PHI, 2005.
3. **Stallings W.**, “*Computer Organization & Architecture: Designing For Performance*”, Pearson, 7th Ed, 2006.
4. **Hamacher C.**, “*Computer Organization*”, 5th Ed, McGraw-Hill, 2008.
5. **Hannessy J. L. and Patterson D. A.**, “*Computer organization and Design*”, 3rd Ed, reprint -2003.

	L	T	P	C
CO 321: THEORETICAL COMPUTER SCIENCE	3	1	0	4

- **INTRODUCTION (02 Hours)**
Basic Mathematical Objects: Sets, Logic, Functions, Relations, Strings, Alphabets, Languages; Mathematical Induction: Inductive proofs, Principles; Recursive Definitions; Set Notation.
- **FINITE AUTOMATA AND REGULAR EXPRESSIONS (12 Hours)**
Finite State systems, Regular Languages & Regular Expressions, Deterministic Finite Automata; Nondeterministic Finite Automata, Kleene's Theorem; Two-way Finite Automata, Finite Automata with output, Properties of Regular Sets: The Pumping Lemma for Regular sets, Closure properties, Decision properties of regular languages, Equivalence and minimization of Automata.
- **CONTEXT FREE GRAMMARS (14 Hours)**
Definition, Derivation trees & Ambiguity, Inherent ambiguity, Parse tree, Application of CFG, Simplification of CFG, Normal form of CFG, Chomsky Normal form and Chomsky Hierarchy, Unrestricted grammars, Context-sensitive languages, Relations between classes of languages, Properties of Context Free Languages: The Pumping Lemma, Closure properties, Decision properties of CFL.
- **PUSHDOWN AUTOMATA (04 Hours)**
Definitions, Languages of PDA, Equivalence of PDA and CFG, Deterministic PDA.
- **TURING MACHINES (06 Hours)**
Turing Machine Model, Language of a Turing Machine, Programming techniques of the TM, Variations of TM (Multiple TM, One-tape and Multi-tape TM etc), Deterministic and Non deterministic TM, Universal TM, Church's thesis, Recursively Enumerable Languages.
- **COMPUTATIONAL COMPLEXITY (04 Hours)**
Time and Space Complexity, Growth Rate, Complexity classes, Tractable and Non tractable Problems: P and NP, Cook's theorem.

(Total Contact Hours: 42 Hours)

BOOKS RECOMMENDED:

1. **Hopcroft J. E., Motwani R. & Ullman J.**, "Introduction to Automata theory, languages computation", 2nd Ed, Pearson India, Last Indian, Reprint 2005.
2. **Martin J. C.**, "Introduction to Languages & the Theory of Computation", McGraw-Hill International Ed, 2002
3. **Cohen D. A.**, "Introduction to Computer Theory", John Wiley & Sons, 1990 Ed, Reprint 1994
4. **Natrajan A. M. and Tamilarasi A.**, "Theory of computation", New Age Publication, 1st Ed, 2003.
5. **Azad S. K.**, "Theory of Computation, An introduction to automata, Formal Languages and Computability", Dhanpat Ray & Co., New Delhi, 2005.

	L	T	P	C
MM 302: COMPLEX ANALYSIS	3	2	0	5

- **FUNCTIONS OF COMPLEX VARIABLE** (12 Hours)
Limit, continuity, differentiability. Analytic function. Cauchy-Riemann equation. Construction of analytic function. Harmonic function.
- **COMPLEX INTEGRATION** (12 Hours)
Cauchy's theorem, Cauchy's integral formula, Cauchy's inequalities, Morera's theorem, Liouville's theorem. Taylor's and Laurent's series Maximum modulus principle. Singularities: Isolated, essential and removable. Zeroes and poles
- **RESIDUES** (10 Hours)
Residue at pole, residue at infinity, Cauchy's residue theorem, number of poles and zeroes of an analytic function. Rouché's theorem. Contour integration: evaluation of integrals
- **CONFORMAL MAPPING** (10 Hours)
Möbius transformation, translation, rotation, inversion, cross-ratio, critical value of a transformation.

(Total Contact Hours: 44 Hours)

BOOKS RECOMMENDED:

1. **Conway J. B.**, "*Functions of one Complex variable*", Springer, International Student Edition, Narosa, 1980.
2. **Ablowitz M. J. & Fokas A. S.**, "*Complex Variables: Introduction and Application*", CUP, South Asian Edition, 1998.
3. **Shastri A. R.**, "*An Introduction to Complex Analysis*", Macmillan India, New Delhi, 1999.
4. **Ponnusamy S.**, "*Foundations of Complex Analysis*", Narosa, 1997.
5. **Lang S.**, "*Complex Analysis*", Addison Wesley, 1977.

	L	T	P	C
MM 304: DISCRETE MATHEMATICS	3	2	0	5

- **MATHEMATICAL LOGIC AND PROGRAM VERIFICATION (10 Hours)**
Propositions, logical operators & propositional algebra, Predicates & quantifiers, Interaction of quantifier's with logical operators, Logical interference & proof techniques, Formal verification of computer programs (elements of Hoare logic).
- **GRAPH THEORY (08 Hours)**
Graphs, Definition & basic concepts of finite & infinite graph, Incidence & Degree, Isomorphism, Sub graph, walk, path & circuits operations on graphs, connected graph, Disconnected graph & components, Complete graph Regular graph, Bipartite graph, Euler's graph, Hamiltonian paths & Circuits, Weighted graphs, Applications, Directed & Undirected graphs, Connectivity of graphs.
- **TREES (06 Hours)**
Definition & properties of trees, Pendent vertices in a tree, Distance between two vertices Centre, Radius & diameter of a tree, Rooted & binary trees, Representation of Algebraic structure by Binary trees, Binary search trees, Spanning trees & fundamental circuits.
- **RELATION & LATTICES (08 Hours)**
Definition & Basic properties, Graphs of relation, Matrices of relation, Equivalence relation, Equivalence lasses, Partition, Partial ordered relation, Posets, Hasse diagram, Upper bounds, Lower bound, GLB & LUB ofsets, Definition & properties of Lattice, Sub lattice, Distributive & modular lattices, complemented & Bounded Lattices, complete lattices & Boolean algebra.
- **GROUP THEORY (08 Hours)**
Basic properties of Group, Groupoid, semi group & mon oid, Abelian group, Subgroup, Cosets, Normal subgroup, Lagrange's theorem, Cyclic group, Permutation group, Homomorphism & Isomorphism of groups.
- **ASYMPTOTIC ANALYSIS (04 Hours)**
Complexity analysis, Time and Storage analysis, Big-oh, Big-Omega, Big -Theta notation, Illustration and Application to Real Problems.

(Total Contact Hours: 44 Hours)

BOOKS RECOMMENDED:

1. **Rosen K. H.**, "*Discrete Mathematics and Its Applications*", 6th Ed, McGraw-Hill, 2006.
2. **Kolman B., Busby. R.C. & Ross. S.**, "*Discrete Mathematical Structure*", Prentice Hall Inc., 5th Ed, 2003.
3. **Tremblay. J. P. & Manohar. R.**, "*Discrete Mathematical structure with applications to computer science*", McGraw Hill Book Co. (1999).
4. **Deo N.**, "*Graph theory with applications to Engineering & Computer Science*", Prentice Hall of India Pvt. Ltd., 2000.
5. **Stanat D. F. and McAllister. D. F.** "*Discrete Mathematics in Computer Science*", Prentice-Hall, Englewood Cliffs, New Jersey, 1977.

	L	T	P	C
MM 310: (DEPARTMENT ELECTIVE)	3	1	0	4
FUZZY SETS THEORY				

- **INTRODUCTION** **(14 Hours)**
 Definition of Fuzzy sets. Alpha-set. Normality Extension Principle. Basic Operations like inclusion. Completion, Union and intersection, Difference Fuzzy numbers. Addition, Subtraction, Multiplication and Division, Triangular and trapezoid fuzzy numbers.
- **FUZZY LOGIC IN LPP** **(30 Hours)**
 Linear Programming Problems with fuzzy resources,
 (i) Vendegay's approach
 (ii) Werner's approach
 L.P.P. with fuzzy resources and objective : Zimmermann's approach.
 L.P.P. with fuzzy parameters in the objective function. Definition of Fuzzy multiobjective linear programming problems. A brief survey of the methodology of solving fuzzy M.O.L.P. and fuzzy goal programming

(Total Contact Hours: 44 Hours)

BOOKS RECOMMENDED:

1. **Zimmerman H. J.**, "*Fuzzy set theory and its applications*", 3rd Ed, Kluwer Academic Publishers, Boston, MA, 1996
2. **Ganesh M.**, "*Introduction to Fuzzy Sets and Fuzzy Logic*", PHI, New Delhi, 2006.
3. **Dubois D. and Prade H.**, "*Fuzzy Sets and Systems: Theory and Applications*", Academic Press, Cambridge, MA, 1980.
4. **Ross T. J.**, "*Fuzzy Logic with Engineering Applications*", McGraw-Hill, Hightstown, NJ, 1995.
5. **Klir G. J., St. Clair U. H. & Yuan B.**, "*Fuzzy set Theory Foundations and Applications*", PHI Inc. USA, 1997

	L	T	P	C
MM 320: (DEPARTMENT ELECTIVE) MATHEMATICAL METHODS	3	1	0	4

- **INTRODUCTION TO LAPLACE TRANSFORM & FOURIER TRANSFORM** (08 Hours)
- **HANKEL TRANSFORM** (08 Hours)
Hankel transform, Inversion formula of Hankel transform, Parseval relation, Finite Hankel transform, Application to Partial differential equations
- **MELLIN'S TRANSFORM** (08 Hours)
Properties of Mellin's transform. Inversion theorem, Convolution theorem, Application of Mellin's transform.
- **INTEGRAL EQUATION** (12 Hours)
Formulation of integral equations, Integral equations of Fredholm and Volterra type, solution by successive substitutions and successive approximations. Resolvent Kernel Method. Integral equations with degenerate kernels. Abel's integral equation, Integral equations of convolution type and their solutions by Laplace transform Fredholm's theorems. Integral equations with symmetric kernel, Eigenvalue and eigenfunction of integral equation and their simple properties. Fredholm alternative.
- **GENERALISED FUNCTION** (08 Hours)
Good function and Fairly good function and their properties, Regular Sequences, Generalised functions, Properties of generalised function, Dirac's delta function, Heaviside unit function and Signum function, Derivative of generalised function, Fourier transform of generalized functions.

(Total Contact Hours: 44 Hours)

BOOKS RECOMMENDED:

1. **Debnath L.**, "*Integral Transform & their Applications*", CRC press, New York, 2006.
2. **Sneddon I. N.**, "*Special Functions of Mathematical Physics & Chemistry*", Longman.
3. **Zemanian A. H.**, "*Generalized Integral Transformations*", John Wiley & Sons, New York.
4. **Andrews L. C. & Shivamoggi B. K.**, "*Integral Transforms for Engineers*", SPIE Press, Bellingham, 1999.
5. **Andrews L. C. & Phillips. R. L.**, "*Mathematical Techniques for Engineers & Scientists*", PHI, New Delhi, 2006.

	L	T	P	C
CO 302: OPERATING SYSTEMS	3	1	2	5

- **INTRODUCTION (04 Hours)**
Operating Systems (OS) Objectives, Formal Definition, Evolution, Types, DMA & Multiprogramming - OS Interfaces - The Command-less command interpreter systems - Device drivers – Examples.
- **PROCESSES, THREADS, SCHEDULING (06 Hours)**
Process Management: The process concept - Programs, Processes & Threads – Process Control Block – PCB as a data structure in contemporary operating systems - Process Hierarchy - System Calls - CPU Scheduling & algorithms. Metrics – Examples.
- **INTERPROCESS SYNCHRONIZATION & COMMUNICATION (10 Hours)**
Concurrent processes - The Critical Section & Mutual Exclusion problem - Algorithms - Semaphores, Critical Region, Conditional Critical Region, Monitors, Messages - Examples in Contemporary OS - Classical Process Co-ordination Problems. Deadlocks: Characterization - Prevention - Avoidance - Detection - Recovery - Combined Approach to Deadlock handling & Deadlock Handling in contemporary OS.
- **MEMORY MANAGEMENT (06 Hours)**
Memory Hierarchy, Static and Dynamic Memory Allocation, Overview of Swapping, Multiple Partitions Contiguous and Non-Contiguous Memory Allocation, Concepts of Paging, Segmentation.
- **VIRTUAL MEMORY (06 Hours)**
Virtual Memory Concepts - Demand paging - Performance - Fragmentation & Compaction. Page replacement and Allocation algorithms -Memory Protection - System Calls – Linux/Windows Virtual Memory Techniques.
- **DEVICE MANAGEMENT (06 Hours)**
Terminals & Capability Databases - Emulators - Virtual Terminals - Disk Devices - Device Independence - Free space management - Performance and Reliability - Storage hierarchy.
- **FILE SYSTEMS AND PROTECTION MECHANISMS (04 Hours)**
Levels - File Systems in Disk Partitions - File-naming & File Access - Allocation strategies - Directory systems & their implementations - File Systems to device drivers - File Systems Reliability – Examples of fsck() and fsdb() utilities - File protection - Implementation issues.

(Total Contact Hours: 42 Hours)

PRACTICALS:

1. Shell programming exercises (a) without using any of the filters (b) using filters like **sed, awk, grep, find**.
2. Implementation of the Classical Process Coordination & Synchronization Problems like Bounded Buffer Producer-Consumer, Readers-Writers etc using System V IPC constructs.
3. Implementation of the Classical Process Coordination & Synchronization Problems as above using Java's concurrent programming support

BOOKS RECOMMENDED:

1. **Silberschatz A. Galvin P. B. & Gagne G.**, “*Operating System Concepts*”, 7th Ed, John Wiley & Sons, 2004.
2. **Stallings W.**, “*Operating Systems: Internals and Design Principles*”, 6th Ed, Pearson Pub., 2008.
3. **S Tanenbaum A.**, “*Operating Systems - Design and Implementation*”, 3rd Ed, PHI EEE, 2006.
4. **Crowley J.**, “*Operating Systems - An Object oriented Approach*”, 1st Ed, McGraw Hill, 1998.
5. **Kernighan B. W. & Pike R.**, “*UNIX programming Environment*”, 2nd Ed, PHI-EEE, 2001.

	L	T	P	C
CO 304: SYSTEMS SOFTWARE	3	1	2	5

- **INTRODUCTION** (02 Hours)
Introduction System software, Utility Software, systems programming.
- **ASSEMBLER** (03 Hours)
Introduction, Cross Assembler, Micro Assembler, Meta Assembler, Single pass Assembler, Two Pass Assembler, Design of Operation code table, Symbol table, Literal table.
- **MACRO PROCESSOR** (04 Hours)
Introduction of Macros, Macro processor design, Forward reference, Backward reference, positional parameters, keyword parameters, conditional assembly, Macro calls within Macros, Implementation of macros within Assembler. Designing Macro name table, Macro Definition table, Key word parameter table, Actual parameter table, Expansion time variable storage.
- **COMPILER STRUCTURE** (02 Hours)
Analysis-synthesis model of compilation, various phases of a compiler, tool based approach to compiler construction.
- **LEXICAL AND SYNTAX ANALYSIS** (18 Hours)
Interface with input, parser and symbol table, token, lexeme and patterns, difficulties in lexical analysis, error reporting, and implementation. Regular definition, Transition diagrams. context free grammars, ambiguity, associativity, precedence, top down parsing, recursive descent parsing, transformation on the grammars, predictive parsing, Bottom up parsing, operator precedence parsing, LR parsers.
- **INTERMEDIATE CODE GENERATION** (07 Hours)
Intermediate representations, Code generation & instruction selection issues, basic blocks & flow graphs, register allocation, optimization of basic blocks, loops, global dataflow analysis.
- **RUN TIME ENVIRONMENT** (06 Hours)
Absolute loader, Relocation - Relocating loader, Dynamic loader, Bootstrap loader, Linking-loader, Program relocatability, Design of Absolute Loader, Design of direct-linking editor, other Loader scheme e.g. (Binders, Linking Loaders, Overlays, Dynamic Binders.

(Total Contact Hours: 42 Hours)

PRACTICALS:

1. Implement a symbol table routine to determine whether an identifier lexeme has previously seen & store a new lexeme into symbol table
2. Implement a lexical analyzer that reads the input one character at a time and returns to the parser the token it has found.
3. Implement recursive descent, predictive, operator precedence & LR parsers.

BOOKS RECOMMENDED:

1. Aho. A.V., Sethi. R. & Ullman. J. D., “Compilers-Principles, Techniques and Tools”. Pearson, 2006
2. Leland L. B.,”System Software -An Introduction to System Programming”, 3rd Ed, Addison Wesley, reprint 2003
3. Loudon, K. C., ”Compiler Construction-Principles and Practice”, 1st Ed, Thomson, 1997
4. Dhamdhare. D. M., “System Programming and Operating System”, 2nd Ed, TMH, 1999
5. Houlb A. I., “Compiler Design in C”, PHI, EEE, 1995

Fourth year of Five Years Integrated M.Sc. (Mathematics)

M.Sc.-IV, Semester-VII

Sr. No.	Course	Code	Teaching Scheme			credit	Examination Scheme			Total Marks
			Hours per Week				Theory	Tutorial	Practical	
			L	Tu.	Pr.					
1	Elements of Algebra	MM 401	3	2	0	5	100	50	00	150
2	Topology	MM 403	3	2	0	5	100	50	00	150
3	Fluid Dynamics	MM 405	3	2	0	5	100	50	00	150
4	Optimization Techniques	MM 407	3	2	0	5	100	50	00	150
5	Software Engineering	CO 421	3	1	0	4	100	25	00	125
			15	9	0		500	225	00	725
Total Contact hrs per week = 24			Total Credit = 24			Total Marks = 725				

Fourth year of Five Years Integrated M.Sc. (Mathematics)

M.Sc.-IV, Semester-VIII

Sr. No.	Course	Code	Teaching Scheme			credit	Examination Scheme			Total Marks
			Hours per Week				Theory	Tutorial	Practical	
			L	Tu.	Pr.					
1	Functional Analysis	MM 402	3	2	0	5	100	50	00	150
2	Partial Differential Equations and their Applications	MM 404	3	2	0	5	100	50	00	150
3	Higher Transcendental Functions	MM 406	3	2	0	5	100	50	00	150
4	Calculus of Variations & Integral Equations	MM 408	3	2	0	5	100	50	00	150
5	Computer Networks	CO 430	3	1	0	4	100	25	00	125
			15	9	0		500	225	00	725
Total Contact hrs per week = 24			Total Credit = 24			Total Marks = 725				

	L	T	P	C
MM 401: ELEMENTS OF ALGEBRA	3	2	0	5

- **GROUP THEORY** **(15 Hours)**
 Elementary Groups, different types of groups, definition of subgroups, types of subgroups, Lagrange's theorem, Morphism of groups, Quotient Groups, Fundamental theorem on homomorphism of groups, Isomorphism, Automorphism.
 Solvable groups and theorem of them, Direct product, Conjugacy, Conjugate classes, Theorems on finite groups, Cauchy's theorem, Sylow's theorem.
- **RING THEORY** **(15 Hours)**
 Rings, Quotient rings, subring, Homomorphism, Monomorphism, Isomorphism, Ideals (Prime and Maximal).
 Integral domain, Principal ideal
- **FIELD THEORY** **(12 Hours)**
 Fields, division ring, Skew fields, finite fields, field extensions, splitting fields and Normal Extensions, Separable extensions, Galois Theory, Norms and traces.

(Total Contact Time (Theory): 42 Hours)

BOOKS RECOMMENDED:

1. **Artin M.:** "Algebra", Prentice-Hall of India, 1991.
2. **Chon P.M.:** "Algebra", Vols. I, II & III, John Wiley & Sons, 1992, 1989, 1991.
3. **Fraleigh J.B.:** "First Course in Abstract Algebra", A. Third Edition, Narosa Publishing House New Delhi 2003.
4. **Herstein I.N.:** "Topics in Algebra", Wiley Eastern Ltd., New Delhi, 1975.
5. **Malik D.S., Mordeson J.N., and Sen M.K.:** "Fundamentals of Abstract Algebra", McGraw-Hill, International Edition, 1997.

Fourth year of Five Years Integrated M.Sc. (Mathematics)**M.Sc.-IV, Semester-VII****MM 403: TOPOLOGY****L T P C****3 2 0 5**

- **INTRODUCTION (15 Hours)**
Open sets, Closed sets, neighborhoods, limit points, interiors, closures, Topological Spaces, Examples of topological spaces, subspace topology, product topology, metric topology, order topology, Quotient Topology, bases, sub bases, continuous function, Homeomorphism, Topological manifold.
- **SEPARATION AXIOMS (10 Hours)**
Separability i.e. T_0 , T_1 , T_2 spaces, Regularity, Completed regularity, Normality, Urysohn Lemma, Tychonoff embedding and Urysohn Metrization Theorem, Tietze Extension Theorem.
- **COMPACTNESS (05 Hours)**
Compact Spaces, Heine-Borel Theorem, Local compactness, one point compactification, Tychonoff Theorem.
- **CONNECTEDNESS**
Connected Spaces, connected subspaces of the real line, components and local connectedness.
- **CHARACTERIZATION (07 Hours)**
Complete metric spaces and function spaces, Characterization of compact metric spaces, Ascoli-Arzelà Theorem, Baire Category Theorem and its applications:

(Total Contact Time (Theory): 42 Hours)**BOOKS RECOMMENDED:**

1. **Armstrong M.A.:** "Basic Topology", Springer(India), 2004.
2. **Joshi K.D.:** "Introduction to General Topology", New Age International, New Delhi, 2000.
3. **Kelley J.L.:** "General Topology", Van Nostrand, Princeton, 1955.
4. **Munkres J.R.:** "Topology", 2nd ED., Pearson Education (India), 2001.
5. **Simmons G.F.:** "Introduction to Topology and Modern Analysis", McGraw-Hill, New York, 1963.

	L	T	P	C
MM 405: FLUID DYNAMICS	3	2	0	5

- GENERAL INTRODUCTION (06 Hours)**
 Introduction to fluid dynamics, Normal and shear stress, The concept of a fluid, Kinds of fluids, Characteristics of fluid; Density, Pressure, Viscosity, Surface tension and compressibility, Different types of flows, Visualization of flows.
- FLUID KINEMATICS (04 Hours)**
 Lagrangian and Eulerian description of fluid motion, Stream lines and path lines, Differentiation following the motion of fluid, Vorticity equation, Vortex sheets, filaments.
- GOVERNING EQUATIONS OF FLUID DYNAMICS (12 Hours)**
 Equation of continuity in Cartesian and general vector form, Expression in cylindrical and spherical coordinates, Euler's equations of motion in general vector form. Bernoulli's equation its application to orifice, pitot tube, venturimeter. Navier Stokes equation : General theory of stress and rate of strains. Transformation of rates of strain. Derivation of the Navier-stokes equation. Derivation of Euler's equations as a special case of Navier – Stokes equation.
- POTENTIAL FLOW (08 Hours)**
 Velocity potential and irrotational flow, circulation and Kelvin's theorem, theorem of Blasius. Stream function in two dimensions, Complex velocity potential, Flow net, Superposition of simple flows, Rankine's method for construction of stream lines, Boundary value problems. Indication of the use of complex analysis and conformal transformation in flow problems.
- INCOMPRESSIBLE VISCOUS FLOW (04 Hours)**
 Flow between parallel plates – Couette flow and plane Poiseuille flow. Hagen – Poiseuille flow through pipes.
- LAMINAR FLOW OF VISCOUS INCOMPRESSIBLE FLUIDS (08 Hours)**
 Similarity of flow - Reynold's and Froude number. Flow between parallel plates – Couette flow and plane Poiseuille flow. Hagen – Poiseuille flow through pipes, Turbulent flow & its characteristics.

(Total Contact Hours: 42 Hours)

BOOKS RECOMMENDED:

1. **Bachelor G.K.:** "An introduction to fluid dynamics", Publisher, Cambridge University Press, 2000.
2. **Hermann Schlichting, Klaus Gersten, Krause E., Jr. Oertel H., Mayes C.:** "Boundary-Layer Theory", 8th edition Springer 2004.
3. **Kundu, Pijush K., and Cohen Ira M.:** "Fluid Mechanics", 3rd ed. Burlington, MA: Elsevier, 2004.
4. **O'Neill M.E. and Chorlton F.:** "Ideal and Incompressible fluid dynamics", Publisher: John Wiley & Sons, 1986.
5. **Yuan S.W.:** "Foundation of fluid Mechanics", Publisher: Prentice – Hall International, 1970.

	L	T	P	C
MM 407: OPTIMIZATION TECHNIQUES	3	2	0	5

- **LINEAR PROGRAMMING PROBLEM** (10 Hours)
Introduction, structure of L.P.P., Formulation of L.P.P., Graphical method of solution of L.P.P., Standard form of L.P.P., Simplex Algorithm, Simplex Tableau, Two phase method, Big-M method, Types of Linear programming solutions, Duality.
- **REVISED SIMPLEX METHOD** (05 Hours)
Revised Simplex method(with and without artificial variable), bounded variable technique, Dual simplex method, Modified dual simplex method.
- **SENSITIVITY ANALYSIS** (04 Hours)
Change in the objective function, Change in the requirement vector, Addition of variable, Addition of constraint, Parametric analysis of cost and requirement vector.
- **INTEGER PROGRAMMING PROBLEMS** (04 Hours)
Gomory's cutting plane algorithm, Gomory's mixed integer problem algorithm, A branch and bound algorithm.
- **TRANSPORTATION PROBLEMS** (04 Hours)
Mathematical model for Transportation Problem, North-West Corner Method, Least Cost Method, Vogel's Approximation Method, Test for optimality, Degeneracy in Transportation problem, Variations in Transportation problem.
- **ASSIGNMENT PROBLEMS** (04 Hours)
Mathematical model for Assignment Problem, Solution method for Assignment Problem, Variations in Assignment problem, Travelling Salesman problem
- **SEQUENCING PROBLEMS** (03 Hours)
Processing of Jobs through machines, Problems with n jobs two machines, n jobs three machines and n jobs m machines.
- **PERT AND CPM** (05 Hours)
Introduction, Basic difference between PERT and CPM, Steps of PERT/CPM Techniques, PERT/CPM Network components and precedence relationships, Critical path analysis, Probability in PERT analysis, Project Time-Cost, Trade-off, Updating of the project, Resource allocation- resource smoothing and resource levelling.
- **GAME THEORY** (05 Hours)
Graphical Method and Bilinear Programming methods for Rectangular Games.

(Total Contact Time: 44 Hours)

BOOKS RECOMMENDED:

1. **Beale, E.M.L. and Mackley, L.:** "Introduction to Optimization", John Wiley, 1988.
2. **Joshi, M.C. and Moudgalya, K. :** "Optimization: Theory and Practice", Narosa, New Delhi, 2004
3. **Kanti Swarup, Gupta, P.K. and Man Mohan:** "Operation Research" Sultan Chand & Sons, New Delhi, 1980.
4. **Rao, S.S.:** "Optimization Theory and Applications". 2nd Ed. Willey Eastern Ltd. New Delhi, 1985
5. **Taha, H.A.:** "Operations Research: An Introduction", 8th Ed., Prentice Hall, 2006.

Fourth year of Five Years Integrated M.Sc. (Mathematics)**M.Sc.-IV, Semester -VII****CO 421: SOFTWARE ENGINEERING****L T P C****3 1 0 4**

- **INTRODUCTION (02 Hours)**
Software Process- Software Engineering Development Life Cycle – Software Qualities – Problems with Software Production- Brooke's No Silver Bullet.
- **SOFTWARE LIFE-CYCLE MODELS (03 Hours)**
Builds-and – Fix, Waterfall, Rapid Prototyping, Incremental, Spiral, Comparison, ISO 9000-CMM levels - Comparing ISO 9000 and CM.
- **SOFTWARE REQUIREMENTS AND ANALYSIS (08 Hours)**
Techniques – Feasibility Analysis- Requirements Elicitation – Validation- Rapid Prototyping- OO Paradigms vs. Structured Paradigm – OO Analysis- CASE tools.
- **SOFTWARE SPECIFICATIONS (10 Hours)**
Specification Document – Specification Qualities, Uses, Classification – Operational Behavioral- DFD, UML, Petri nets - Descriptive Specifications – ER Diagrams, Logic, Algebraic Specs – Comparison of various techniques and CASE tools.
- **INTRODUCTION TO FORMAL APPROACH (04 Hours)**
Formal Specifications, Software Verification & Validation, Cleanroom Engineering, - Formal approaches, Model Checking – SPIN Tool for Distributed Software.
- **CASE TOOLS, ISO AND CAPABILITY MATURITY MODEL (04 Hours)**
CASE Tools - Stepwise Refinement – Cost – Benefit Analysis – Scope of CASE – Versions control – ISO and CMM.
- **SOFTWARE TESTING PRINCIPLES (08 Hours)**
Non-execution & Execution based testing –Automated Static Analysis- Test-case selection- Black- Box and Glass-Box Testing- Testing Objects- Testing vs. Correctness Proof
- **MAINTENANCE PHASE (01 Hours)**
- Tutorials will based on the coverage of the above topics separately. **(14 Hours)**

(Total Contact Time: 42 Hours)**BOOKS RECOMMENDED:**

1. **Ghezzi, Jazayeri, Mandrioli:** "Fundamentals of Software Engineering", 2/E, Pearson Education, 2002
2. **Pankaj Jalote:** "An Intergrated approach to SE", Narosa, 3/E, 2005
3. **Roger S Pressman:** "Software Engineering – A Practitioner's Approach", McGraw-Hill 6/E, 2005
4. **Sommerville:** "Software Engineering, 2006 ed., Pearson Education, 6/E, 2006
5. **Stephen R Schach:** "Software Engineering with JAVA", TMH, 1999

	L	T	P	C
MM402: FUNCTIONAL ANALYSIS	3	2	0	5

- **FUNDAMENTALS OF NORMED LINEAR SPACES** (07 Hours)
Normed Linear Spaces, Fixed point theorem, Riesz lemma, finite dimensional spaces.
- **BOUNDED LINEAR MAPS ON NORMED LINEAR SPACES** (08 Hours)
Examples, linear maps on finite dimensional spaces, operator norm, Banach Spaces, Hahn-Banach theorems and its applications, Open mapping and Closed Graph theorems, Uniform Boundedness Principle, Divergence of Fourier series.
- **DUAL SPACES AND ADJOINT OF AN OPERATOR** (06 Hours)
Duals of classical spaces, weak and weak * convergence, Banach Alaoglu theorem, Adjoint of an operator.
- **HILBERT SPACES** (07 Hours)
Inner product spaces, orthonormal sets, Gram-Schmidt orthogonalization, Bessel's inequality, orthonormal basis, Separable Hilbert spaces, projection and Riesz representation theorem.
- **BOUNDED OPERATORS ON HILBERT SPACE** (07 Hours)
Adjoint operator, normal, unitary, self adjoint operator, compact operator, eigen value, eigen vectors, Banach algebras.
- **SPECTRAL THEOREM** (07 Hours)
Spectral theorem for compact self adjoint operators, spectral theorem for bounded self adjoint operators, Self adjoint, normal and unitary operators.

(Total Contact Time: 42 Hours)

BOOKS RECOMMENDED:

1. **Conway J.B.** : "A Course in Functional Analysis", Springer-Verlag, New York, 1990.
2. **Goffman C. and Pedrick G.**: "First course in Functional Analysis, Prentice Hall of India, New Delhi, 1987.
3. **Simmons G.F.**: "Topology and Modern Analysis", Mc Graw-Hill, New York, 1963.
4. **Taylor A. E.**: "Introduction to Functional Analysis", John Wiley & Sons, New York, 1958
5. **W.Rudin**: "Functional Analysis", Mc Graw-Hill, New York, 1991.

MM404: PARTIAL DIFFERENTIAL EQUATIONS AND THEIR APPLICATIONS

- **INTRODUCTION TO PDE** **(04 Hours)**
Formation of PDE, order and degree of PDE, Types of PDE, Initial and Boundary conditions, Types of solution.
- **SOLUTION OF PDE**
 - (i.) PDE of 1st order, The method of characteristics, the existence and uniqueness theorem, Cauchy problems, Lagrange's and Charpit's method, some special types of equations which can be solved easily by methods other than the general methods. **(12 Hours)**
 - (ii.) PDE of second and higher orders with constant coefficients, Classification of linear PDE of second order, Reduction to canonical form of PDE. **(06 Hours)**
 - (iii.) The Sturm-Liouville problem, Adjoint and self adjoint operator, Green's functions and integral representations **(08 Hours)**
- **METHOD OF SEPARATION OF VARIABLES** **(06 Hours)**
Solution of heat, wave equation in one dimension and Laplace equation.
- **INTEGRAL TRANSFORM METHOD TO SOLVE PDE** **(06 Hours)**
Laplace and Fourier method to solve heat, wave equation in one dimension and Laplace equation.

(Total Contact Time: 42 Hours)

BOOKS RECOMMENDED:

1. **Amarnath T.:** "An Elementary Course in Partial Differential Equations", (2nd edition), Narosa Publishing House, 1997.
2. **Evans L.C.:** "Partial Differential Equations, Graduate studies in Mathematics", Vol 19, AMS, 1998.
3. **John F.:** "Partial Differential Equations", 3rd ed. Narosa Publ. Co., New Delhi, 1979.
4. **Prasad Phoolan, Ravindran, Renuka:** "Partial Differential Equations", New Age International Publication, New Delhi, 2009.
5. **Sneddon Ian N.:** "Elements of Partial Differential Equations", McGraw-Hill Company, New York, 1957.

MM406: HIGHER TRANSCENDENTAL FUNCTIONS

- **HYPERGEOMETRIC FUNCTIONS (10 Hours)**
Hyper geometric equation, series solution near zero, one and infinity, Hyper geometric function, Integral representation, Differentiation of Hyper geometric function, Confluent Hyper geometric function and its integral representation.
- **THEORY OF GENERATING FUNCTIONS (12 Hours)**
Generating functions of the form $G(2xt-t^2)$, $e^t\phi(t)$, $A(t)\exp[-xt/(1-t)](1-t)^{-q} \otimes [4xt/(1-t)]$, Boas and Buck type, Pure recurrence relations, Appell, Sheffer and 0-type characterizations of polynomial sets
- **ORTHOGONAL POLYNOMIALS (10 Hours)**
Introduction, The moment functional, and orthogonality, Existence of OPS, The fundamental recurrence formula, Zeros, Gauss quadrature, Kernel polynomials, Symmetric moment functional, certain related recurrence relations.
- **BASIC HYPERGEOMETRIC SERIES & THEIR APPLICATIONS (10 Hours)**
Introduction to Basic Hyper geometric series, q-analogue of orthogonal polynomials, q-Gamma and q-Beta functions.

(Total Contact Time: 42 Hours)

BOOKS RECOMMENDED:

1. **Andrews, G.E., R. Askey and R. Roy:** "Special Functions", Cambridge Univ. Press, 1990.
2. **Bailey W.N.:** "Generalized Hyper geometric series" Stechert-Hafner Service Agency, New York and London, 1964.
3. **Copson E.T.:** "introduction to the theory of functions of a complex variable", The English Language Book Society, London, 1978.
4. **Chihara, T.S.:** "Introduction to orthogonal polynomials", Gordon and Breach Science Publishers Inc., New York, 1978.
5. **Saxena R.K., Mathai A.M., Hans J. Haubold:** "The H- functions, Theory and Applications", Springer, 2010.

MM408: CALCULUS OF VARIATIONS & INTEGRAL EQUATIONS

- **INTRODUCTION OF CALCULUS OF VARIATIONS (10 Hours)**
Maxima and minima, boundary conditions and transition conditions, Variational notation, constraints and Lagrange multipliers, Variable and points, Strum-Liouville Problems, Hamilton's principle, Lagrange's equations, Generalized dynamical entitites, constraints in dynamical systems, small vibrations about equilibrium, normal coordinates.
- **VARIATIONAL PROBLEMS (08 Hours)**
Variational problems of deformable bodies, useful transformations, Variational problem for Elastic plate, Rayleigh-Ritz method, semi direct method.
- **INTRODUCTION TO INTEGRA EQUATIONS (08 Hours)**
Relations between differential and integral equations, The Green's function, Linear Equations in cause and effect, the influence function, Fredholm equations with separable kernels, Hilbert-Schmidt theory, Iterative methods for solving equations of the second kind, The Neumann series, Fredholm theory, Singular Integral Equations, special devices.
- **METHODS TO SOLVE INTEGRAL EQUATIONS (08 Hours)**
Iterative approximations to characteristic functions, Approximations of Fredholm equations by sets of algebraic equations, Approximate method of undermined coefficients, The method of collocation, The method of weighting functions, The method of least squares, Approximation of the kernel
- **INTRODUCTION TO DISTRIBUTION THOERY (08 Hours)**
Some introductory definitions, Test functions, Linear functional and Schwartz-Sobolev theory of distributions, Algebraic operations on distributions, Analytic operations on distributions, The support and singular support of a distributions

(Total Contact Time: 42 Hours)

BOOKS RECOMMENDED:

1. **Hilderbrand F. B.:** "Methods of Applied Mathematics", Prentice Hall Inc., 2nd Edition, 1965.
2. **Kanwal R.P.:** "Generalized Functions: Theory and Technique", Academic Press, New York, 1983.
3. **Lovitt W.V.:** "Linear integral equation", Dover Pub., 1st Ed. 1950.
4. **Mikhlin S.G.:** "Linear integral equation(translated from Russian)", Hindustan Book Agency, 1960.
5. **Sneddon I.N.:** "Mixed boundary value problems in potential theory", North Holland, 1966.

CO 430: COMPUTER NETWORKS

- **INTRODUCTION (03 Hours)**
Overview of network and data communication, Data communications, Computer Networking, Protocols and Standards, types of Network, Network Topology, Protocol hierarchies and design issues of layers, Interfaces and services, Reference Model: The OSI reference model, TCP/IP reference model, network standards.
- **PHYSICAL LAYER (06 Hours)**
Data and transmission techniques, Multiplexing, Transmission media, Asynchronous Communication, Wireless transmission, ISDN, ATM, Cellular Radio, Switching techniques issues.
- **DATA LINK LAYER (08 Hours)**
Layer design issues, services provided to network layers, Framing, Error control and Flow control, Data link control and protocols- Simplex protocol, Sliding window protocol.
- **MEDIUM ACCESS SUBLAYER (08 Hours)**
Channel Allocations, Multiple Access protocols- ALOHA, CSMA, CSMA/CD protocols, Collision free protocols, Limited contention protocols, LAN architectures, IEEE 802 and OSI, Ethernet(CSMA/CD), Bus, Token Ring, DQDB, FDDI, Bridges and recent developments.
- **NETWORK LAYER (08 Hours)**
Network Layer design issue, Routing algorithms and protocols, Congestion Control Algorithms, Internetworking, Addressing, N/W Layer Protocols and recent developments.
- **TRANSPORT LAYER (06 Hours)**
Transport services, Design issues, transport layer protocols, Congestion Control, QOS and its improvement.
- **APPLICATION LAYER (03 Hours)**
Client Server Model, DNS, SMTP, FTP, HTTP, WWW and recent development.
- Tutorial will be based on the coverage of the above topics separately (14 Hours)

(Total Contact Time: 42 Hours + 14 Hours = 56 Hours)

BOOKS RECOMMENDED:

1. **Comer Douglas E.:** "Internetworking with TCP/IP", Volume – I, 3/E Pub. PHI, 1991.
2. **Forouzan B.:** "Data Communication and Networking", 5/E, TMH, 1997.
3. **Stevens W. Richard:** "TCP/IP Illustrated", Volume – I, Pub. Addison Wesley, 1994.
4. **Tanenbaum:** "Computer Network", 4/E, PHI, 1996.
5. **William Stalling:** "Data and Computer Communication", 8/E, Prentice Hall, 2006.

Fifth year of Five Years Integrated M.Sc. (Mathematics)
M.Sc.-V, Semester-IX

Sr. No.	Course	Code	Teaching Scheme Hours per Week			credit	Examination Scheme			Total Marks
			L	Tu.	Pr.		Theory	Tutorial	Practical	
1	Elements of Statistics	MM 501	3	2	0	5	100	50	00	150
2	Differential Geometry	MM 503	3	2	0	5	100	50	00	150
3	Elementary Number Theory	MM 505	3	1	0	4	100	25	00	125
4	Mathematical Modeling & Simulation	MM 507	3	1	0	4	100	25	00	125
5	Elective – I	MM 5X0	3	1	0	4	100	25	00	125
			15	7	0	22	500	175	00	675
Total Contact hours per week = 22			Total Credit = 22				Total Marks = 675			

Elect any one from each of Elective-I (Minimum five students)

Sr. No.	Code	Elective –I
1	MM 511	Advanced Operations Research
2	MM 513	Advanced Fluid Mechanics
3	MM 515	Approximation Theory
4	MM 517	Advanced Numerical Techniques
5	MM 519	Biomathematics
6	MM 521	Sobolev Space

Fifth year of Five Years Integrated M.Sc. (Mathematics)
M.Sc.-V, Semester-X

Sr. No.	Course	Code	Teaching Scheme Hours per Week			credit	Examination Scheme			Total Marks
			L	Tu.	Pr.		Theory	Tutorial	Practical	
1	Project Work and Dissertation	MM 520	0	0	24	16	0	0	500	500
Total Contact hours per week = 24			Total Credit = 16				Total Marks = 500			

MM 501: ELEMENTS OF STATISTICS

- **INTRODUCTION (06 Hours)**
Reorientation of Axiomatic, Definition of Probability, Independent events and Independent random variables, Bayes Theorem.
- **BASIC DISTRIBUTION (08 Hours)**
Discrete random variable distribution: Binomial, Poisson, geometric, Negative binomial, hypergeometric.
Continuous random variable distribution: normal, uniform, gamma, Weibull, Chi Square, t and F (univariate and multivariate); Expectations and moments, moment generating function, marginal and conditional distribution in case of multivariate, covariance matrix, Coefficients of skewness & kurtosis.
- **CORRELATION & REGRESSION (08 Hours)**
Correlation between two variables partial correlation, Karl Pearson's method, Spearman's rank coefficient of correlation, Repeated rank, Concurrent deviation method, Regression, coefficients of regression, their properties, multiple regression and its applications.
- **ESTIMATION (10 Hours)**
Least square approach, maximum likelihood method, moment estimation, Test of significance for large sample, Null hypothesis, Alternative hypothesis, Test of hypothesis, Types of errors, Reliability of sample, confidence limits, Small sample, Chi Square Test, t-test, F-test and their applications.
- **TIME SERIES ANALYSIS (10 Hours)**
Analysis of time series, Elementary methods of its analysis, trend, Method of moving average, Method of least square, Short term fluctuation, Random fluctuations.

(Total Contact Time (Theory): 42 Hours)

BOOKS RECOMMENDED:

1. **Blake I:** "An introduction to Applied Probability", John Wiley & Sons, 1979.
2. **Catttergee, S and Price, P:** "Regression analysis by examples", Second edition, John Wiley & Sons, 1991.
3. **David Stirzaker:** "Elementary Probability", Cambridge University Press, 1994.
4. **Des Raj and Chandak:** "Sampling theory", Narosa Publishing, 1998.
5. **Murphy M. N.:** "Sampling theory and methods", Statistical Publishing Society, Calcutta, 1995.

MM 503: DIFFERENTIAL GEOMETRY

- **THEORY OF CURVES (15 Hours)**
Curves in \mathbb{R}^3 , Torsion, Frenet-Serret formulae, Representation of a curve by its curvature, Fundamental, Existence and Uniqueness theorem for space curves, Surfaces, Tangent vectors to surface, The First fundamental form and arc length, Normal curvature, Geodesic curvature, Gauss's formulas, Geodesics. Parallel vector fields along a curve and parallelism, The second fundamental form and the Weingarten map, Principal, Gaussian, Mean and normal curvatures.
- **THEORY OF SURFACES (12 Hours)**
Riemannian curvature and Gauss's theorem, Eggregium, Isometries and Fundamental theorem of surfaces, Surfaces of constant curvature, Fenchel's Theorem, The Fary-Milnor Theorem, Simple curvature results for surfaces, Geodesic Coordinate patches, Orientability and angular variation of surfaces, The Gauss-Bonnet Formula, The Gauss-Bonnet Theorem, Euler Characteristics.
- **THEORY OF MANIFOLDS (15 Hours)**
Definition and examples of topological manifolds, Differentiable manifolds, Differentiable functions, Rank of a mapping, Immersions, Sub manifolds, Lie Groups, Tangent vectors and the Tangent space. Vector fields, The Lie Algebra of Vector Fields on a Manifold, Frobenius theorem, An application of Frobenius Theorem.

(Total Contact Time (Theory): 42 Hours)

BOOKS RECOMMENDED:

1. **Boothby W.M.:** "An introduction to differentiable manifolds and Riemannian Geometry", (Revised Second Edition), Academic Press.
2. **Millman R.S. and Parker G.D.:** "Elements of Differential Geometry", Prentice-Hall Inc.
3. **Pressley:** "Elementary Differential Geometry", Springer Undergraduate Text Series, Springer Publications.
4. **Thorpe J.A.:** "Introduction to Differential Geometry", Springer –Verlag.
5. **Tu L.W.:** "An introduction to Manifolds", Springer Publications.

MM 505: ELEMENTARY NUMBER THEORY

- **INTRODUCTION (06 Hours)**
Divisibility, Greatest Common Divisor(gcd), Euclidean Algorithm, Primes and their elementary properties, Fundamental theorem of Arithmetic.
- **CONGRUENCE RELATION (12 Hours)**
Congruence and their Basic properties, Chinese Remainder Theorem, Euler's phi-function, Fermat's Little Theorem, Wilson's Theorem, Euler's theorem and its application in Cryptography.
- **ARITHMETIC FUNCTIONS (12 Hours)**
Greatest integer function, Arithmetic functions, Mobius inversion formula, Fibonacci numbers, Representation of an integer as sum of two and four squares, Diophantine Equations: $ax + by = c$, $x^2 + y^2 = z^2$ and $x^4 + y^4 = z^4$.
- **RESIDUES (12 Hours)**
Residue classes and Residued residue classes, Quadratic residues, Legendre symbol, Gauss's Lemma about Legendre symbol, law of quadratic reciprocity, Jacobi symbol, primitive roots and indices.

(Total Contact Time (Theory): 42 Hours)

BOOKS RECOMMENDED:

1. **Apostol T.:** "Introduction to Analytic Number theory", Springer-Verlag, 1976.
2. **Baker A.:** "A Concise Introduction to the Theory of Numbers", Cambridge University Press, 1990.
3. **Burton D.M.:** "Elementary Number Theory", 6th Edition, McGraw Hill, 2007.
4. **Hardy G.H. and Wright E.M.:** "An Introduction to the Theory of Numbers", 4th Edition, OUP, 1975.
5. **Niven I., Zuckerman H.S. and Montgomery L.:** "An Introduction to the Theory of Numbers", 6th Ed., Wiley, New York, 2003.

MM 507: MATHEMATICAL MODELING & SIMULATION

- **MATHEMATICAL MODELING**

INTRODUCTION: (08 Hours)

Introduction to mathematical modeling, types of models, characteristics of MM, framework of MM, validation of Mathematical Model.

SOME CASE STUDIES: (12 Hours)

Models based on system of algebraic equations, Models based on ordinary differential equations, Models based on system of 1st order ordinary differential equations.

- **SIMULATION**

INTRODUCTION: (12 Hours)

Introduction to simulation, types of simulation, simulation methodology, random number generation, Monte-Carlo simulation, simulation of continuous system, discrete event simulation, Design of experiments, Validation.

SOME CASE STUDIES: (10 Hours)

Simulation of queuing system, water reservoir system, inventory control and forecasting, PERT network, regression analysis.

(Total Contact Time (Theory): 42 Hours)

BOOKS RECOMMENDED:

1. **Caldwell J., Douglas K.S. Ng, Caldwell Jim:** "Mathematical Modeling: Case Studies and Projects (Texts in the Mathematical Sciences)", Springer Netherlands, 2004.
2. **Deo Narsingh:** "System Simulation with Digital Computer", PHI New Delhi, 2006.
3. **Frank L. Severance:** "System Modeling and Simulation: An Introduction", John Wiley, 2001.
4. **Gordon Geoffrey:** "System Simulation", PHI, India, 2007.
5. **Kapoor J.N.:** "Mathematical Modeling", New Age International(p) Limited, 1998.
6. **Kapoor J.N.:** "Mathematical Models in Biology and Medicine", East-West Press, New Delhi, 2000.

MM 511: ADVANCED OPERATIONS RESEARCH

- **INTRODUCTION** (03 Hours)
Nature and scope of Operation Research, Convex sets and convex functions and their properties.
- **NON-LINEAR PROGRAMMING** (12 Hours)
Kuhn-Tucker conditions, Lagrange's theory, Duality theory, Search techniques = one variable and several variables, Pontryagin's maximum principle and its applications.
- **DYNAMIC PROGRAMMING AND ITS APPLICATIONS** (05 Hours)
Introduction, Nature of dynamic programming, Deterministic processes, Non Sequential discrete optimization, Allocation problems, Assortment problems, Sequential discrete optimization, Long-term planning problem, Multi-stage decision process, Application of Dynamic Programming in production scheduling and routing problems.
- **QUEUEING THEORY** (07Hours)
Basic Structures of queueing models, Poisson queues- M/M/1, M/M/C for finite and infinite queue length, Non-Poisson queue-M/G/1, Machine Maintenance (steady state).
- **INVENTORY MODELS** (07 Hours)
Inventory control- Deterministic including price breaks and Multi-item with constraints, Probabilistic (with and without lead time).
- **GOAL PROGRAMMING** (05 Hours)
Introduction, Difference between LP and GP approach, Concept of Goal Programming, Graphical solution- method of Goal Programming, Modified simplex method of Goal Programming.
- **GEOMETRIC PROGRAMMING** (05 Hours)
Geometric programming (both unconstrained and constrained).

(Total Contact Time : 44 Hours)

BOOKS RECOMMENDED:

1. **Beale, E.M.L. and Mackley, L.:** "Introduction to Optimization", John Wiley, 1988.
2. **Hiller, F.S. and Lieberman:** "Introduction to Operation Research", 6th Ed., McGraw-Hill International Edition, Industrial Engineering Series, 1995.
3. **Rao, S.S.:** "Optimization Theory and Applications", 2nd Ed., Wiley Eastern Ltd., New Delhi, 1985.
4. **Taha, H.A.:** "Operation Research: An Introduction", 8th Ed. Prentice.

MM 513: ADVANCED FLUID MECHANICS

- **REVIEW OF FUNDAMENTAL EQUATIONS (06 Hours)**
Equation of Continuity, Euler's equation of motion, Bernoulli's equation, Momentum equation, Nature of stresses in fluids, viscosity, Navier-Stokes equations, The equation of motion expressed in Cylindrical and Spherical polar coordinates, Equation of state for gases.
- **VISCOUS FLOW PHENOMENA (12 Hours)**
Laminar and turbulent motion, Flow between two coaxial rotating cylinders, Unsteady flows with plane boundary, Plane Couette flow with porous wall, Steady flow caused by a rotating plane, Reynolds and Froude's numbers, Flow at low Reynolds number, Dimensionless form of the Stokes's equation, uniqueness theorem for Stokes flow, Minimum-dissipation-of-energy theorem, The Lorentz Reciprocal theorem, Boundary conditions at a Fluid- Fluid Interface, Liquid droplet falling under gravity.
- **VISCOUS FLOW AT HIGH REYNOLD'S NUMBER (08 Hours)**
Observed character of the flow: Boundary Layers, Flow past a Semi-infinite flat plate, Flow in the wake of a Flat Plate, Boundary layer equations for a curved wall, Similarity solutions, Approximate solutions, Basics of Jet flow.
- **COMPRESSIBLE FLUID FLOW (08 Hours)**
Internal energy of a gas, Specific Heats of a substance: Case of a Perfect Gas, Functions of State: Entropy and other Thermodynamics Notions, Compressibility Effects in real Fluids, The speed of a sound in a gas, Equations of motion of an Inviscid Gas.
- **WATER WAVES (08 Hours)**
Occurrence of waves, The mathematical description of Wave motion, Gravity waves, Wave energy, Effect of Surface Tension, Standing Waves, Waves in a canal, Waves on the surface of a uniform stream.

(Total Contact Time : 44 Hours)

BOOKS RECOMMENDED:

1. **Fay, James A.:** "Introduction to Fluid Mechanics", Cambridge, MA: MIT Press, 1994.
2. **Kundu, Pijush K., and Cohen Ira M.:** "Fluid Mechanics" 3rd Ed. Burlington, MA: Elsevier, 2004.
3. **O'Neill M.E. and Chorlton F.:** "Ideal and Incompressible Fluid Dynamics", Publisher: John Wiley & Sons, 1986.
4. **O'Neill M.E. and Chorlton F.:** "Viscous and compressible fluid dynamics", Publisher: John Wiley & Sons, 1986.
5. **Tritton D.:** "Physical Fluid Dynamics", 2nd Ed., New York, Oxford University Press, 1988.

MM 515: APPROXIMATION THEORY

- **INTRODUCTION AND PRELIMINARY OBSERVATION** **(08 Hours)**
Concept of best approximation in a Normed linear space, Existence of best Approximation, Uniqueness problem, Uniform convexity, strict convexity, continuity of best approximation operator.
- **WEIERSTRASS THEOREM AND BERNSTEIN POLYNOMIAL** **(05 Hours)**
The Weierstrass Theorem, Bernstein polynomials, Bernstein Constructive proof of convergence.
- **OPERATORS & TOOLS** **(07 Hours)**
Monotone operators, Korovkin theorems, Modulus of Continuity and its properties, Lipschitz class & their properties.
- **BEST UNIFORM APPROXIMATION** **(10 Hours)**
Sufficient condition for Uniqueness of the Best Approximation, Characterization of the Best Approximation in the Uniform Norm, Jackson Theorems and its applications, characterization theorem, Haar conditions, Alternation theorem.
- **MORE THEOREMS ON APPROXIMATION** **(12 Hours)**
Markoff systems, Theorem of De La Valle Poussin, Strong Unicity theorem, Haar's theorem, The convergence of Jackson Theorems, Bernstein inequality, Bernstein theorems, Zygmund theorem.

(Total Contact Time : 42 Hours)

BOOKS RECOMMENDED:

1. **Korovkin P.P.:** "Linear Operators and Approximation Theory", Hindustan Publishing Corporation, 1960.
2. **Lorentz G.G.:** "Bernstein polynomials", Univ. of Toronto Presss, Toronto, 1953.
3. **Mhaskar H.N., Pai D.V.:** "Fundamental of Approximation theory", Narosa Publishing House, Delhi, 2000.
4. **Natanson I.P.:** "Constructive Function Theory", Vol.-1: Uniform Approximation, NY: Frederick Ungar, 1st Ed., 1964.
5. **Powell M.J.D.:** "Approximation Theory & Methods", Cambridge Univ.Press, 1981.

MM 517: ADVANCED NUMERICAL TECHNIQUES

- **SYSTEM OF LINEAR EQUATIONS (05 Hours)**
Condition number and Ill condition systems, Matrix and Vector norms, Error Bounds, Wilkinson's algorithm for ill-conditioned systems, Tridiagonal and pentagonal system of equations.
- **COMPUTING OF EIGEN VALUES AND EIGEN VECTORS (05 Hours)**
Given's, Householder, Q-R and Inverse Method, Stability Analysis.
- **NUMERICAL SOLUTION OF ODE (06 Hours)**
Initial Value Problems for Ordinary Differential Equations: multi-step methods, predictor and corrector scheme, stability and convergence analysis.
- **FINITE DIFFERENCE METHOD TO SOLVE ODE (06 Hours)**
Difference approximation to derivatives, Shooting methods, Difference schemes, Boundary conditions of different kind, Convergence of difference scheme.
- **FINITE DIFFERENCE METHOD TO SOLVE PARABOLIC PDE (06 Hours)**
Explicit and Implicit Difference schemes in one and two space dimensions, Consistency, Stability and convergence if different scheme.
- **FINITE DIFFERENCE METHOD TO SOLVE ELLIPTIC PDE (06 Hours)**
Dirichlet, Neumann and mixed problems, Direct factorization methods and successive over-relaxation (S.O.R.), ADI and conjugate gradient methods.
- **FINITE DIFFERENCE METHOD TO SOLVE HYPERBOLIC PDE (08 Hours)**
First order hyperbolic systems in one and two space dimensions-stability and convergence, Second order equations in one and two space dimensions, Stability: matrix method, Von-Neumann and energy methods, Lax-Richtmyer equivalence theorem, Consistency and convergence results

(Total Contact Time : 42 Hours)

BOOKS RECOMMENDED:

1. **Atkinson K.E.:** "An Introduction to Numerical Analysis", Wiley, 1989.
2. **Jain M. K., Iyenger S.R.K., Jain R.K.:** "Numerical Method for Scientific and Engineering Computation", New Age Publication, New Delhi, 2009.
3. **Jain R.K.:** "Numerical Solution of Differential Equations", New Age Publication, New Delhi, 2008.
4. **Mitchell R. and Griffiths S. D. F.:** "The Finite Difference Method in Partial Differential Equations" Wiley and Sons, NY, 1980.
5. **Smith G.D.:** "Numerical Solutions of Partial Differential Equations", 3rd Ed., Calerndorn Press, Oxford, 1985.

MM 519: BIO-MATHEMATICS

- **MATHEMATICAL EPIDEMICS (09 Hours)**
Epidemic models, Deterministic models with and without removal, General Deterministic Models with removal and Immigration, Control of and Epidemic, Stochastic Epidemic Model without removal.
- **MODELLING GENETICS (09 Hours)**
Models in Genetics, Basic models for Inheritance, Further discussion of Basic Model for Inheritance of Genetic Characteristics, Models for Genetic Improvements: Selection and Mutation, Models for Genetic Inbreeding.
- **MODELLING BIODIFFUSION (07 Hours)**
Pharmaco-Kinetics, Compartmental Models in terms of system of Differential Equations, Bio-Diffusion, Diffusion of Drugs, Trans-Capillary Exchange, Oxygenating of Blood, Cardio Vascular Flow Patterns, Temperature regulation in Human subjects.
- **BIOLOGICAL DATA ANALYSIS (08 Hours)**
Curve Fitting and Biological Modeling, Fitting curves to Data, The Method of Least Squares, Polynomial curve fitting.

(Total Contact Time : 42 Hours)

BOOKS RECOMMENDED:

1. **Allman Elizabeth S. and Rhodes John A.:** "Mathematical Models in Biology: An Introduction", 2004.
2. **Cullen:** "Linear Models in Biology (Pharmacy)", Cambridge University Press, December, 2004.
3. **Fung F. C.:** "Fluid Mechanics", TataMcGraw-Hill, 2005.
4. **Kapur J.N.:** "Mathematical Models in Biology and Medicine", New Delhi, East-West Press, 1981.
5. **Kleinstreuer Clement:** "Bio-Fluid Dynamics", CRC Taylor and Francis, 2006.

MM 521: SOBOLEV SPACE

- **DISTRIBUTION** (04 Hours)
Test function spaces and distributions, Convergence distribution derivatives.
- **FOURIER TRANSFORM** (06 Hours)
 L^1 - Fourier Transform, Fourier transforms of a Gaussian, L^2 - Fourier transform, Inversion formula, L^p -Fourier transforms, Convolutions.
- **SOBOLEV SPACES** (08 Hours)
The Spaces $W_{\infty}^{l,p}(\Omega)$ and $W^{l,p}(\Omega)$, their simple characteristic properties, density results, Min and Max of $W^{l,p}$ -Functions, The space $H^1(\Omega)$ and its properties, density results, Dual Spaces, Fractional Order Sobolev Spaces, Trace spaces and Trace Theory.
- **IMBEDDING THEOREM** (06 Hours)
Continuous and compact imbedding of Sobolev spaces into Lebesgue Spaces, Sobolev imbedding theorem, Rellich-Kondrasov theorem.
- **WEIGHTED SPACES** (08 Hours)
Definition, motivation, examples of practical importance, Special weights of power type, General Weights, Weighted Lebesgue space $P(\Omega, \sigma)$ weighted Sobolev spaces, $W^{k,p}(\Omega, \sigma)$, $W_0^{k,p}(\Omega, \sigma)$ and their properties.
- **INEQUALITIES** (10 Hours)
Methods of local co-ordinates, the classes C^0 , $C^{0,k}$, Holder's condition, Partition of unity, the class $K(x_0)$ including cone property, Hardy inequality, Jensen's inequality, Young's inequality, Hardy – Littlewood – Sobolev inequality, Sobolev inequality and its various versions.

(Total Contact Time : 42 Hours)

BOOKS RECOMMENDED:

1. **Adams R. A.:** "Sobolev Spaces", Academic Press Inc., 1975.
2. **Kesavan S.:** "Topics in Functional Analysis and /Applications", Wiley Eastern Limited, 1989.
3. **Kufner A.:** "Weighted Sobolev Spaces", John Wiley & Sons Ltd., 1985.
4. **Lieb E. H. and Loss M.:** "Analysis", Narosa Publishing House, 1997.
5. **Pathak R. S.:** "A Course in Distribution Theory and Applications", Narosa Publishing House, 2001.