MAHARSHI DAYANAND UNIVERSITY, ROHTAK
DEPARTMENT OF MATHEMATICS

Scheme of Examination-Semester System
for
M.Sc. Mathematics with Computer Science

(*w.e.f. Session 2008-09*)

SEMESTER-I

Paper No.	Title of the Paper	Hours/ week	Internal Assess-ment	Theory	Practi-cals	Total
MMCS-101	Advanced Abstract Algebra-I	4	20	80	-	100
MMCS-102	Real Analysis-I	4	20	80	-	100
MMCS-103	Topology-I	4	20	80	-	100
MMCS-104	Integral Equations and Calculus of Variations	4	20	80	-	100
MMCS-105	Programming in C (ANSI Features)	4	20	80	-	100
MMCS-106	Operating Systems and UNIX	4	20	80	-	100
MMCS-107	Practicals	4 hours per week per student in a group of 15 students	20	-	80	100

Note 1: The marks of internal assessment of each paper shall be splited as under :

A) One class test of 10 marks. The class test will be held in the middle of the semester.

B) Assignment & Presentation : 5 marks

C) Attendance : 5 marks

65% but upto 75%	:	1 marks
More than 75% but upto 85%	:	2 marks
More than 85% but upto 90%	:	3 marks
More than 90% but upto 95%	:	4 marks
Above 95%	:	5 marks

Note 2: The syllabus of each paper will be divided into **four** units of **two** questions each. The question paper will consist of **five** units. Each of the first four units will contain two questions and the students shall be asked to attempt **one** question from each unit. Unit five of each question paper shall contain **eight to ten** short answer type questions without any internal choice and it shall be covering the entire syllabus. As such unit five shall be **compulsory**.

Note 3: As per UGC recommendations, the teaching program shall be supplemented by tutorials and problem solving sessions for each theory paper. For this purpose, tutorial classes shall be held for each theory paper in groups of 8 students for half-hour per week.

Syllabus- 1st SEMESTER

MMCS 101 : Advanced Abstract Algebra-I

Max. Marks : 80
Time : 3 hours

Unit - I (2 Questions)

Groups : Zassenhaus lemma, Normal and subnormal series, Composition series, Jordan-Holder theorem, Solvable series, Derived series, Solvable groups, Solvability of S_n – the symmetric group of degree $n \geq 2$.

Unit - II (2 Questions)

Nilpotent group: Central series, Nilpotent groups and their properties, Equivalent conditions for a finite group to be nilpotent, Upper and lower central series, Sylow-p sub groups, Sylow theorems with simple applications. Description of group of order p^2 and pq, where p and q are distinct primes(In general survey of groups upto order 15).

Unit - III (2 Questions)

Field theory, Extension of fields, algebraic and transcendental extensions. Splitting fields, Separable and inseparable extensions, Algebraically closed fields, Perfect fields.

Unit - IV (2 Questions)

Finite fields, Automorphism of extensions, Fixed fields, Galois extensions, Normal extensions and their properties, Fundamental theorem of Galois theory, Insolvability of the general polynomial of degree $n \geq 5$ by radicals.

Note : The question paper will consist of **five** units. Each of the first four units will contain **two** questions from unit **I , II , III , IV** respectively and the students shall be asked to attempt **one** question from each unit. Unit five will contain **eight to ten** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory**.

Books Recommended :

1. I.N.Herstein, Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975.
2. P.B. Bhattacharya, S.K. Jain and S.R. Nagpaul, Basic Abstract Algebra (2nd Edition), Cambridge University Press, Indian Edition, 1997.
3. P.M. Cohn, Algebra, Vols. I, II & III, John Wiley & Sons, 1982, 1989, 1991.
4. N. Jacobson, Basic Algebra, Vol. I & II, W.H Freeman, 1980 (also published by Hindustan Publishing Company).
5. S. Lang, Algebra, 3rd Editioin, Addison-Wesley, 1993.

6. I.S. Luther and I.B.S.Passi, Algebra, Vol. I-Groups, Vol. II-Rings, Narosa Publishing House (Vol. I – 1996, Vol. II –1990).
7. D.S. Malik, J.N. Mordenson, and M.K. Sen, Fundamentals of Abstract Algebra, McGraw Hill, International Edition, 1997.
8. Vivek Sahai and Vikas Bist, Algebra, Narosa Publishing House, 1999.

MMCS 102 : Real Analysis -I

Max. Marks : 80
Time : 3 hours

Unit - I (2 Questions)

Riemann-Stieltjes integral, its existence and properties, Integration and differentiation, The fundamental theorem of calculus, Integration of vector-valued functions, Rectifiable curves.

Unit - II (2 Questions)

Set functions, Intuitive idea of measure, Elementary properties of measure, Measurable sets and their fundamental properties. Lebesgue measure of a set of real numbers, Algebra of measurable sets, Borel set, Equivalent formulation of measurable sets in terms of open, Closed, F_σ and G_δ sets, Non measurable sets.

Unit - III (2 Questions)

Measurable functions and their equivalent formulations. Properties of measurable functions. Approximation of a measurable function by a sequence of simple functions, Measurable functions as nearly continuous functions, Egoroff's theorem, Lusin's theorem, Convergence in measure and F. Riesz theorem. Almost uniform convergence.

Unit - IV (2 Questions)

Shortcomings of Riemann Integral, Lebesgue Integral of a bounded function over a set of finite measure and its properties. Lebesgue integral as a generalization of Riemann integral, Bounded convergence theorem, Lebesgue theorem regarding points of discontinuities of Riemann integrable functions, Integral of non-negative functions, Fatou's Lemma, Monotone convergence theorem, General Lebesgue Integral, Lebesgue convergence theorem.

Note : The question paper will consist of **five** units. Each of the first four units will contain **two** questions from unit **I , II , III , IV** respectively and the students shall be asked to attempt **one** question from each unit. Unit five will contain **eight to ten** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory**.

Books Recommended :

1. Walter Rudin, Principles of Mathematical Analysis (3rd edition) McGraw-Hill, Kogakusha, 1976, International Student Edition.
2. H.L. Royden, Real Analysis, Macmillan Pub. Co., Inc. 4th Edition, New York, 1993.
3. P. K. Jain and V. P. Gupta, Lebesgue Measure and Integration, New Age International (P) Limited Published, New Delhi, 1986.
4. G.De Barra, Measure Theory and Integration, Wiley Eastern Ltd., 1981.
5. R.R. Goldberg, Methods of Real Analysis, Oxford & IBH Pub. Co. Pvt. Ltd.
6. R. G. Bartle, The Elements of Real Analysis, Wiley International Edition.

MMCS 103 : Topology - I

Max. Marks : 80
Time : 3 hours

Unit - I (2 Questions)

Statements only of (Axiom of choice, Zorn's lemma, Well ordering theorem and Continnum hypothesis).

Definition and examples of topological spaces, Neighbourhoods, Interior point and interior of a set , Closed set as a complement of an open set , Adherent point and limit point of a set, Closure of a set, Derived set, Properties of Closure operator, Boundary of a set , Dense subsets, Interior, Exterior and boundary operators.

Base and subbase for a topology, Neighbourhood system of a point and its properties, Base for Neighbourhood system.

Relative(Induced) topology, Alternative methods of defining a topology in terms of neighbourhood system and Kuratowski closure operator.

Comparison of topologies on a set, Intersection and union of topologies on a set.

Unit - II (2 Questions)

Continuous functions, Open and closed functions , Homeomorphism.

Tychonoff product topology, Projection maps, Characterization of Product topology as smallest topology, Continuity of a function from a space into a product of spaces.

Connectedness and its characterization, Connected subsets and their properties, Continuity and connectedness, Connectedness and product spaces, Components, Locally connected spaces, Locally connected and product spaces.

Unit - III (2 Questions)

First countable, second countable and separable spaces, hereditary and topological property, Countability of a collection of disjoint open sets in separable and second countable spaces, Product space as first axiom space, Lindelof theorem. T_0, T_1, T_2 (Hausdorff) separation axioms, their characterization and basic properties.

Unit - IV (2 Questions)

Compact spaces and subsets, Compactness in terms of finite intersection property, Continuity and compact sets, Basic properties of compactness, Closedness of compact subset and a continuous map from a compact space into a Hausdorff and its consequence. Sequentially and countably compact sets, Local compactness, Compactness and product space, Tychonoff product theorem and one point compactification. Quotient topology, Continuity of function with domain- a space having quotient topology, Hausdorffness of quotient space.

Note : The question paper will consist of **five** units. Each of the first four units will contain **two** questions from unit **I , II , III , IV** respectively and the students shall be asked to attempt **one** question from each unit. Unit five will contain **eight to ten** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory**.

Books Recommended :

1. George F. Simmons, Introduction to Topology and Modern Analysis, McGraw-Hill Book Company, 1963.
2. K.D. Joshi, Introduction to General Topology, Wiley Eastern Ltd.
3. J. L. Kelly, General Topology, Affiliated East West Press Pvt. Ltd., New Delhi.
4. J. R. Munkres, Toplogy, Pearson Education Asia, 2002.
5. W.J. Pervin, Foundations of General Topology, Academic Press Inc. New York, 1964.

MMCS 104 : Integral Equations and Calculus of Variations

Max. Marks : 80
Time : 3 hours

Unit - I (2 Questions)

Linear integral equations, Some basic identities, Initial value problems reduced to Volterra integral equations, Methods of successive substitution and successive approximation to solve Volterra integral equations of second kind, Iterated kernels and Neumann series for Volterra equations. Resolvent kernel as a series in λ, Laplace transform method for a difference kernel, Solution of a Volterra integral equation of the first kind.

Unit - II (2 Questions)

Boundary value problems reduced to Fredholm integral equations, Methods of successive approximation and successive substitution to solve Fredholm equations of second kind, Iterated kernels and Neumann series for Fredholm equations. Resolvent kernel as a sum of series. Fredholm resolvent kernel as a ratio of two series. Fredholm equations with separable kernels, Approximation of a kernel by a separable kernel, Fredholm Alternative, Non homogenous Fredholm equations with degenerate kernels.

Unit - III (2 Questions)

Green's function, Use of method of variation of parameters to construct the Green's function for a nonhomogeneous linear second order boundary value problem, Basic four properties of the Green's function, Orthogonal series representation of Green's function, Alternate procedure for construction of the Green's function by using its basic four properties. Reduction of a boundary value problem to a Fredholm integral equation with kernel as Green's function. Hilbert-Schmidt theory for symmetric kernels.

Unit - IV (2 Questions)

Motivating problems of calculus of variations, Shortest distance, Minimum surface of revolution, Branchistochrone problem, Isoperimetric problem,
Geodesic. Fundamental lemma of calculus of variations, Euler's equation for one dependant function and its generalization to 'n' dependant functions and to higher

order derivatives, Conditional extremum under geometric constraints and under integral constraints.

Note : The question paper will consist of **five** units. Each of the first four units will contain **two** questions from unit **I , II , III , IV** respectively and the students shall be asked to attempt **one** question from each unit. Unit five will contain **eight to ten** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory**.

Books Recommended :

1. Jerri, A.J., Introduction to Integral Equations with Applications, A Wiley-Interscience Pub.
2. Kanwal, R.P., Linear Integral Equations, Theory and Techniques, Academic Press, New York.
3. Gelfand, J.M. and Fomin, S.V., Calculus of Variations, Prentice Hall, New Jersy, 1963.
4. Weinstock , Calculus of Variations, McGraw Hall.
5. Abdul-Majid wazwaz, A first course in Integral Equations, World Scientific Pub.
6. David, P. and David, S.G. Stirling, Integral Equations, Cambridge University Press.
7. Tricomi, F.G., Integral Equations, Dover Pub., New York.

MMCS 105 : Programming in C (ANSI Features)

Max. Marks : 60
Time : 3 hours

Unit - I (2 Questions)

An overview of Programming, Programming Language, Classification. Basic structure of a C Program, C language preliminaries.

Operators and Expressions, Two's compliment notation, Bit - Manipulation Operators, Bitwise Assignment Operators, Memory Operators.

Unit - II (2 Questions)

Arrays and Pointers, Encryption and Decryption. Pointer Arithmetic, Passing Pointers as Function Arguments, Accessing Array Elements through Pointers, Passing Arrays as Function Arguments. Multidimensional Arrays. Arrays of Pointers, Pointers to Pointers.

Unit - III (2 Questions)

Storage Classes –Fixed vs. Automatic Duration. Scope. Global Variables. Definitions and Allusions. The register Specifier. ANSI rules for the Syntax and Semantics of the Storage-Class Keywords. Dynamic Memory Allocation.

Structures and Unions. *enum* declarations. Passing Arguments to a Function, Declarations and Calls, Automatic Argument Conversions, Prototyping. Pointers to Functions.

Unit - IV (2 Questions)

The C Preprocessors, Macro Substitution. Include Facility. Conditional Compilation. Line Control.

Input and Output -Streams. Buffering. Error Handling. Opening and Closing a File. Reading and Writing Data. Selecting an I/O Method. Unbuffered I/O. Random Access. The Standard Library for I/O.

Note : The question paper will consist of **five** units. Each of the first four units will contain **two** questions from unit **I , II , III , IV** respectively and the students shall be asked to attempt **one** question from each unit. Unit five will contain **eight to ten** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory**.

Books Recommended :

1. Peter A. Darnell and Philip E. Margolis, C : A Software Engineering Approach, Narosa Publishing House (Springer International Student Edition) 1993.
2. Samuel P. Harkison and Gly L. Steele Jr., C : A Reference Manual, Second Edition, Prentice Hall, 1984.
3. Brian W. Kernighan & Dennis M. Ritchie, The C Programme Language, Second Edition (ANSI features) , Prentice Hall 1989.
4. Balagurusamy E : Programming in ANSI C, Third Edition, Tata McGraw-Hill Publishing Co. Ltd.
5. Byron, S. Gottfried : Theory and Problems of Programming with C, Second Edition (Schaum's Outline Series), Tata McGraw-Hill Publishing Co. Ltd.
6. Venugopal K. R. and Prasad S. R.: Programming with C , Tata McGraw-Hill Publishing Co. Ltd.

MMCS-106 : Operating System and Unix

Max Marks : 80
Time : 3 Hours

Unit I (2 Questions)

Operating systems overview : Operating systems as an extended machine and resource manager, Operating systems classification; Operating systems and system calls; Operating systems architecture.

Process management functions : Process model, Hierarchies and implementation; Process states and transitions; Multi-programming, Multi-tasking, Multi-threading; Level of schedulers and scheduling algorithms.

Unit II (2 Questions)

Memory management function : Memory management of single user operating systems partition, Swapping, Paging, Segmentation, Virtual memory.

Device management function : I/O devices and controllers, Interrupt handlers, Device independent I/O software, User-space I/O software.

Unit III (2 Questions)

File management functions: File naming structure, Types, Access mechanisms, Attributes and operations, Hierarchical directory systems, Directory structures and directory operations, File space allocations, File sharing, File locking, Symbolic links, File protection and security.

Current programming : Sequential and concurrent process, Bernsteins condition; Time-dependency and critical code unit, Mutual exclusion problem, Classical process co-ordination problems, Deadlock handling, Inter-process communication.

Unit IV (2 Questions)

UNIX Operating System: Overview of UNIX operating system. Implementation of basic functions and commands in UNIX operating system.

Note : The question paper will consist of **five** units. Each of the first four units will contain **two** questions from unit **I , II , III , IV** respectively and the students shall be asked to attempt **one** question from each unit. Unit five will contain **eight to ten** short answer

type questions without any internal choice covering the entire syllabus and shall be **compulsory**.

Books Recommended :

1. Milan Milankovic, Operating System, McGraw Hill.
2. Peterson and Solserchatz, Operating System Concepts, Addison Wesley.
3. Achyut S. Godbole, Operating System, Tata McGraw Hill.
4. H.M.I. Deitel, An Introduction to Operating Systems, Addison Wesley.
5. Ritchie. Operating System, BPB Publication.
6. Steven, Advanced Programming in UNIX Environment, Addison Wesley.

MMCS-107 : Practicals

Max. Marks : 80
Time 4 hours

The practical examination will be based upon Papers MMCS-105 and MMCS-106.

i) Viva-voce and practical record : 30 marks

ii) Written practical work : 50 marks

The examiner shall set a question paper consisting of **four** questions and the students will be required to attempt any **two** questions. They will write these programs in Answer-books, run the same on computers and take printouts.

SEMESTER-II

Paper No.	Title of the Paper	Hours/ week	Internal Assess-ment	Theory	Practi-cals	Total
MMCS-201	Advanced Abstract Algebra-II	4	20	80	-	100
MMCS-202	Real Analysis-II	4	20	80	-	100
MMCS-203	Topology-II	4	20	80	-	100
MMCS-204	Ordinary Differential Equations	4	20	80	-	100
MMCS-205	Data and File Structure	4	20	80	-	100
MMCS-206	Data Communication, Networking and Internet	4	20	80	-	100
MMCS-207	Practicals	4 hours per week per student in a group of 15 students	20	-	80	100

Note 1: The marks of internal assessment of each paper shall be split as under :

A) One class test of 10 marks. The class test will be held in the middle of the semester.

B) Assignment & Presentation : 5 marks

C) Attendance : 5 marks

65% but upto 75% : 1 marks

More than 75% but upto 85% : 2 marks

More than 85% but upto 90% : 3 marks

More than 90% but upto 95% : 4 marks

Above 95% : 5 marks

Note 2: The syllabus of each paper will be divided into **four** units of **two** questions each. The question paper will consist of **five** units. Each of the first four units will contain two questions and the students shall be asked to attempt **one** question from each unit. Unit five of each question paper shall contain **eight to ten** short answer type questions without any internal choice and it shall be covering the entire syllabus. As such unit five shall be **compulsory**.

Note 3: As per UGC recommendations, the teaching program shall be supplemented by tutorials and problem solving sessions for each theory paper. For this purpose, tutorial classes shall be held for each theory paper in groups of 8 students for half-hour per week.

Syllabus- 2nd SEMESTER

MMCS 201 : Advanced Abstract Algebra-II

Max. Marks : 80
Time : 3 hours

Unit - I (2 Questions)

Neotherian and Artinian modules and rings with simple properties and examples, Nil and Nilpotent ideals in Neotherian and Artinian rings, Hilbert Basis theorem.

Unit - II (2 Questions)

$Hom_R(R,R)$, Opposite rings, Wedderburn – Artin theorem, Maschk's theorem, Equivalent statement for left Artinian rings having non-zero nilpotent ideals, Uniform modules, Primary modules and Neother- Lasker theorem.

Unit - III (2 Questions)

Cyclic modules, Simple and semi-simple modules, Schur's lemma, Free modules, Fundamental structure theorem of finitely generated modules over principal ideal domain and its applications to finitely generated abelian groups.

Unit - IV (2 Questions)

Canonical forms : Similarity of linear transformations, Invariant subspaces, Reduction to triangular form, Nilpotent transformations, Index of nilpotency, Invariants of nilpotent transformations, The primary decomposition theorem, Rational canonical forms, Jordan blocks and Jordan forms.

Note : The question paper will consist of **five** units. Each of the first four units will contain **two** questions from unit **I , II , III , IV** respectively and the students shall be asked to attempt **one** question from each unit. Unit five contain **eight to ten** short answer type questions without any internal choice covering the entire syllabus and shall be compulsory.

Books Recommended :

1. I.N.Herstein, Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975.
2. P.B. Bhattacharya, S.K. Jain and S.R. Nagpaul, Basic Abstract Algebra (2nd Edition), Cambridge University Press, Indian Edition, 1997.
3. M. Artin, Algebra, Prentice-Hall of India, 1991.
4. P.M. Cohn, Algebra, Vols. I, II & III, John Wiley & Sons, 1982, 1989, 1991.
5. I.S. Luther and I.B.S.Passi, Algebra, Vol. I-Groups, Vol. II-Rings, Narosa Publishing House (Vol. I – 1996, Vol. II –1990).

6. D.S. Malik, J.N. Mordenson, and M.K. Sen, Fundamentals of Abstract Algebra, McGraw Hill, International Edition, 1997.
7. K.B. Datta, Matrix and Linear Algebra, Prentice Hall of India Pvt., New Dlehi, 2000.
8. Vivek Sahai and Vikas Bist, Algebra, Narosa Publishing House, 1999.
9. T.Y Lam, Lectures on Modules and Rings, GTM Vol. 189, Springer-Verlag, 1999.

MMCS 202 : Real Analysis -II

Max. Marks : 80
Time : 3 hours

Unit - I (2 Questions)

Rearrangements of terms of a series, Riemann's theorem. Sequence and series of functions, Pointwise and uniform convergence, Cauchy criterion for uniform convergence, Weirstrass's M test, Abel's and Dirichlet's tests for uniform convergence, Uniform convergence and continuity, Uniform convergence and differentiation, Weierstrass approximation theorem.

Unit - II (2 Questions)

Power series, its uniform convergence and uniqueness theorem, Abel's theorem, Tauber's theorem.

Functions of several variables, Linear Transformations, Euclidean space R^n, Open balls and open sets in R^n, Derivatives in an open subset of R^n, Chain Rule, Partial derivatives, Continuously Differentiable Mapping, Young's and Schwarz's theorems.

Unit - III (2 Questions)

Taylor's theorem. Higher order differentials, Explicit and implicit functions. Implicit function theorem, Inverse function theorem. Change of variables, Extreme values of explicit functions, Stationary values of implicit functions. Lagrange's multipliers method. Jacobian and its properties, Differential forms, Stoke's Theorem.

Unit - IV (2 Questions)

Vitali's covering lemma, Differentiation of monotonic functions, Function of bounded variation and its representation as difference of monotonic functions, Differentiation of indefinite integral, Fundamental theorem of calculus, Absolutely continuous functions and their properties.

L^p spaces, Convex functions, Jensen's inequalities, Measure space, Generalized Fatou's lemma, Measure and outer measure, Extension of a measure, Caratheodory extension theorem.

Note : The question paper will consist of **five** units. Each of the first four units will contain **two** questions from unit **I , II , III , IV** respectively and the students shall be asked to attempt **one** question from each unit. Unit five will contain **eight to ten** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory**.

Books Recommended :

1. S.C. Malik and Savita Arora, Mathematical Analysis, New Age International Limited, New Delhi.
2. T. M. Apostol, Mathematical Analysis, Narosa Publishing House, New Delhi.
3. H.L. Royden, Real Analysis, Macmillan Pub. Co., Inc. 4th Edition, New York, 1993.
4. G. De Barra, Measure Theory and Integration, Wiley Eastern Limited, 1981.
5. R.R. Goldberg, Methods of Real Analysis, Oxford & IBH Pub. Co. Pvt. Ltd.
6. R. G. Bartle, The Elements of Real Analysis, Wiley International Edition.

MMCS 203 : Topology -II

Max. Marks : 80
Time : 3 hours

Unit - I (2 Questions)

Regular, Normal, T_3 and T_4 separation axioms, their characterization and basic properties, Urysohn's lemma and Tietze extension theorem, Regularity and normality of a compact Hausdorff space, Complete regularity, Complete normality, $T_{3\frac{1}{2}}$ and T_5 spaces, their characterization and basic properties.

Unit - II (2 Questions)

Nets : Nets in topological spaces, Convergence of nets, Hausdorffness and nets, Subnet and cluster points, Compactness and nets,

Filters : Definition and examples, Collection of all filters on a set as a poset, Finer filter, Methods of generating filters and finer filters, ultra filter and its characterizations, Ultra filter principle, Image of filter under a function, Limit point and limit of a filter, Continuity in terms of convergence of filters, Hausdorffness and filters, Convergence of filter in a product space, Compactness and filter

convergence, Canonical way of converting nets to filters and vice versa, Stone-Cech compactification.

Unit - III (2 Questions)

Covering of a space, Local finiteness, Paracompact spaces, Michaell theorem on characterization of paracompactness in regular spaces, Paracompactness as normal space, A. H. Stone theorem, Nagata- Smirnov Metrization theorem.

Unit - IV (2 Questions)

Embedding and metrization : Embedding lemma and Tychonoff embedding theorem, Metrizable spaces, Urysohn's metrization theorem.

Homotopy and Equivalence of paths, Fundamental groups, Simply connected spaces, Covering spaces, Fundamental group of circle and fundamental theorem of algebra.

Note : The question paper will consist of **five** units. Each of the first four units will contain **two** questions from unit **I , II , III , IV** respectively and the students shall be asked to attempt **one** question from each unit. Unit five will contain **eight to ten** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory**.

Books Recommended :

1. George F. Simmons, Introduction to Topology and Modern Analysis, McGraw-Hill Book Company, 1963.
2. K.D. Joshi, Introduction to General Topology, Wiley Eastern Ltd.
3. J. L. Kelly, General Topology, Springer Verlag, New York, 1991.
4. J. R. Munkres, Toplogy, Pearson Education Asia, 2002.
5. W.J. Pervin, Foundations of General Topology, Academic Press Inc. New York, 1964.

MMCS 204 : Ordinary Differential Equations

Max. Marks : 80
Time : 3 hours

Unit - I (2 Questions)

Preliminaries : Initial value problem and equivalent integral equation.

ε-approximate solution, Cauchy-Euler construction of an ε-approximate solution, Equicontinuous family of functions, Ascoli-Arzela lemma, Cauchy-Peano existence theorem.

Uniqueness of solutions, Lipschitz condition, Picard-Lindelof existence and uniqueness theorem for $\frac{dy}{dt}$ = f(t,y), Dependence of solutions on initial conditions and parameters, Solution of initial-value problems by Picard method.

Unit - II (2 Questions)

Sturm-Liouville BVPs, Sturms separation and comparison theorems, Lagrange's identity and Green's formula for second order differential equations, Properties of eigenvalues and eigenfunctions, Pruffer transformation, Adjoint systems, Self-adjoint equations of second order.

Linear systems, Matrix method for homogeneous first order system of linear differential equations, Fundamental set and fundamental matrix, Wronskian of a system, Method of variation of constants for a nonhomogeneous system with constant coefficients, nth order differential equation equivalent to a first order system.

Unit - III (2 Questions)

Nonlinear differential system, Plane autonomous systems and critical points, Classification of critical points – rotation points, foci, nodes, saddle points. Stability, Asymptotical stability and unstability of critical points,

Unit - IV (2 Questions)

Almost linear systems, Liapunov function and Liapunov's method to determine stability for nonlinear systems, Periodic solutions and Floquet theory for periodic systems, Limit cycles, Bendixson non-existence theorem, Poincare-Bendixson theorem (Statement only), Index of a critical point.

Note : The question paper will consist of **five** units. Each of the first four units will contain **two** questions from unit **I , II , III , IV** respectively and the students shall be asked to attempt **one** question from each unit. Unit five will contain **eight to ten** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory**.

Books Recommended :

1. Coddington, E.A. and Levinson, N.,, Theory of Ordinary Differential Equations, Tata McGraw Hill, 2000.
2. Ross, S.L., Differential Equations, John Wiley and Sons Inc., New York, 1984.

3. Deo, S.G., Lakshmikantham, V. and Raghavendra, V., Textbook of Ordinary Differential Equations, Tata McGraw Hill, 2006.
4. Boyce, W.E. and Diprima, R.C., Elementary Differential Equations and Boundary Value Problems, John Wiley and Sons, Inc., New York, 1986, 4th edition.
5. Goldberg, J. and Potter, M.C., Differential Equations – A System Approach, Prentice Hall, 1998
6. Simmons, G.F., Differential Equations, Tata McGraw Hill, New Delhi, 1993.
7. Hartman, P., Ordinary Differential Equations, John Wiley & Sons, 1978.
8. Somsundram, D., Ordinary Differential Equations, A First Course, Narosa Pub. Co., 2001.

MMCS-205 : Data and File Structure

Max. Marks : 80
Time : 3 hours

Unit I (2 Questions)

Linear data structure. Arrays, Multi-dimensional arrays, Sequential allocation, Address calculations, Sparse arrays and its applications.

Linked lists: Simple Lists, Circular lists, Doubly linked lists.

Unit II (2 Questions)

Stacks, Operations on stacks, Applications of stacks.

Queues, Operations on queue. Applications of queue, Circular queue, Deque, Priority queue.

Unit III (2 Questions)

Trees : Tree terminology, Binary tree, Memory representation of binary tree, Tree traversal algorithms, Binary search tree(BST), AVL tree, Threaded tree, B-Tree and B+ tree.

Graph : Graph terminology, Representation of graphs, Graph traversal, Weighted graph

Unit IV (2 Questions)

File structures : Concepts of fields, Records and files.

File organization : Serial and sequential file organizations, Direct/Random file organization, Indexed sequential file organization. Inverted-lists and multi-lists organization. Hashing functions and collision handling methods.

Sorting : Internal and external sorting. Search and merging techniques.

Note : The question paper will consist of **five** units. Each of the first four units will contain **two** questions from unit **I , II , III , IV** respectively and the students shall be asked to attempt **one** question from each unit. Unit five will contain **eight to ten** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory**.

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1. Samuel P. Harkison and Gly L. Steele Jr., C : A Reference Manual, Second Edition, Prentice Hall, 1984.
2. Brian W. Kernighan & Dennis M. Ritchie, The C Programme Language, Second Edition (ANSI features) , Prentice Hall 1989.
3. Balagurusamy E : Programming in ANSI C, Third Edition, Tata McGraw-Hill Publishing Co. Ltd.
4. Byron, S. Gottfried : Theory and Problems of Programming with C, Second Edition (Schaum's Outline Series), Tata McGraw-Hill Publishing Co. Ltd.
5. Loomis, Data Structure and File Management, Prentice Hall India Ltd.
6. Schaume's Outline Series, Data Structures, Tata McGraw Hill.
7. Tannenbaum, Data Structure Using C, Tata McGraw-Hill.

MMCS-206 : Data Communication, Networking and Internet

Max. Marks : 80
Time : 3 hours

Unit I (2 Questions)

Data communication : Concept of data , Signal, Channel, Band-width, Bit rate and band rate; Analog and digital communications; Asynchronous and synchronous transmission; Data encoding techniques; Modulation techniques, Multiplexing.

Unit II (2 Questions)

Computer networks : Definition, Need for computer networks, Advantages of networks, Hardware and software requirements.

Reference models : OSI reference model, TCP/IP reference model

Unit III (2 Questions)

Types of network : LAN, MAN, WAN, Value added network and their features, Network topologies.

Switching techniques: Circuit switching, Message switching and Packet switching.

Transmission media : Magnetic media, Twisted pair, Co-axial cable, Radio transmission, Line of sight transmission, Communication satellite, Wireless transmission.

Unit IV (2 Questions)

Internetworking : Internet architecture, Bridges, Switches, Routers and Gateways.

E-mail architecture, User agent (UA), MTA, Message format, Message transfer, e-mail privacy, FTP, Newsgroups, Remote logins, Chat groups, Search engines.

Note : The question paper will consist of **five** units. Each of the first four units will contain **two** questions from unit **I , II , III , IV** respectively and the students shall be asked to attempt **one** question from each unit. Unit five will contain **eight to ten** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory**.

Books Recommended :

1. Behrou A. Forouan, Data Communication & Networking, Tata Mc-Graw Hill
2. Andrew S. Tanenbaum, Computer Networks,
3. Nasib S. Gill, Essentials of computer and Network Technology, Khanna Book Publishing.
4. Dr. M Jain & Satish Jain, Data Communication & Networking, BPB Pub.
5. Hemant Kapila, Data Communication & Networking, S. Dinesh & Co.
6. Learning guide to Internet, BPB
7. Internet Complete, Sybex

MMCS-207 : Practicals

Max. Marks : 80
Time 4 hours

The practical examination will be based upon Papers MMCS-205 and MMCS-206.

i) Viva-voce and practical record : 30 marks

ii) Written practical work : 50 marks

The examiner shall set a question paper consisting of **four** questions and the students will be required to attempt any **two** questions. They will write these programs in Answer-books, run the same on computers and take printouts.

SEMESTER-III

Paper Code	Title of the Paper	Internal-Assessment Marks	Theory Marks	Practicals Marks	Total Marks
MMCS- 301	Functional Analysis-I	20	80	-	100
MMCS- 302	Partial Differential Equations and Mechanics	20	80	-	100
MMCS- 303	Complex Analysis-I	20	80	-	100
MMCS- 304	(i) Mathematical Statistics (ii) Advanced Discrete Mathematics-I	20	80	-	100
MMCS- 305	Object Oriented Programming with C++	20	80	-	100
MMCS- 306	Database Management System	20	80	-	100
MMCS- 307	Practicals	20	-	80	100
Total Marks Semester-III					700
Total Marks Semester-II					700
Total Marks Semester-I					700
GRAND TOTAL					2100

Note 1: The marks of internal assessment of each paper shall be split as under :

A) One class test of 10 marks. The class test will be held in the middle of the semester.

B) Assignment & Presentation : 5 marks

C) Attendance : 5 marks

65% but upto 75% : 1 marks

More than 75% but upto 85% : 2 marks

More than 85% but upto 90% : 3 marks

More than 90% but upto 95% : 4 marks

Above 95% : 5 marks

Note 2: The syllabus of each paper will be divided into **four** units of **two** questions each. The question paper will consist of **five** units. Each of the first four units will contain two questions and the students shall be asked to attempt **one** question

from each unit. Unit five of each question paper shall contain **eight to ten** short answer type questions without any internal choice and it shall be covering the entire syllabus. As such unit five shall be **compulsory**.

Note 3: As per UGC recommendations, the teaching program shall be supplemented by tutorials and problem solving sessions for each theory paper. For this purpose, tutorial classes shall be held for each theory paper in groups of 8 students for half-hour per week.

Note 4: Optional papers can be offered subject to availability of requisite resources/ faculty.

Syllabus - 3rd SEMESTER

MMCS 301 : Functional Analysis-I

Max. Marks : 80 **Time : 3 Hours**

Unit -I (2 Questions)

Normed linear spaces, Metric on normed linear spaces, Completion of a normed space, Banach spaces, subspace of a Banach space, Holder's and Minkowski's inequality, Completeness of quotient spaces of normed linear spaces. Completeness of l_p, L^p, R^n, C^n and C[a,b]. Incomplete normed spaces.

Unit -II (2 Questions)

Finite dimensional normed linear spaces and Subspaces, Bounded linear transformation, Equivalent formulation of continuity, Spaces of bounded linear transformations, Continuous linear functional, Conjugate spaces, Hahn-Banach extension theorem (Real and Complex form).

Unit -III (2 Questions)

Riesz Representation theorem for bounded linear functionals on L^p and C[a,b]. Second conjugate spaces, Reflexive space, Uniform boundedness principle and its consequences, Open mapping theorem and its application projections, Closed Graph theorem.

Unit -IV (2 Questions)

Equivalent norms, Weak and Strong convergence, their equivalence in finite dimensional spaces. Weak sequential compactness, Solvability of linear equations in Banach spaces.

Compact operator and its relation with continuous operator. Compactness of linear transformation on a finite dimensional space, properties of compact operators, compactness of the limit of the sequence of compact operators, the closed range theorem.

Note : The question paper will consist of **five** units. Each of the first four units will contain **two** questions from unit **I , II , III , IV** respectively and the students shall be asked to attempt **one** question from each unit. Unit five will contain **eight to ten** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory**.

Books Recommended

1. H.L. Royden, Real Analysis, MacMillan Publishing Co., Inc., New York, 4th Edition, 1993.
2. E. Kreyszig, Introductory Functional Analysis with Applications, John Wiley.
3. George F. Simmons, Introduction to Topology and Modern Analysis, McGraw-Hill Book Company, 1963.
4. A. H. Siddiqi, Khalil Ahmad and P. Manchanda, Introduction to Functional Analysis with Applications.

MMCS 302 : Partial Differential Equations and Mechanics

Max. Marks : 80 **Time : 3 Hours**

Unit – I(2 Questions)

Method of separation of variables to solve B.V.P. associated with one dimensional heat equation. Solution of two dimensional heat equation and two dimensional Laplace equation. Steady state temperature in a rectangular plate, in the circular disc, in a semi-infinite plate. The head equation in semi-infinite and infinite regions. Temperature distribution in square plate and infinite cylinder. Solution of three dimensional Laplace equation in Cartesian, cylindrical and spherical coordinates. Dirichlets problem for a solid sphere. (Relevant topics from the books by O'Neil)

Unit -II(2 Questions)

Method of separation of variables to solve B.V.P. associated with motion of a vibrating string. Solution of wave equation for Semi-infinite and infinite strings. Solution of wave equation in two dimensions. Solution of three dimensional wave

equation in Cartesian, cylindrical and spherical coordinates. Laplace transform solution of P.V.P.. Fourier transform solution of B.V.P. (Relevant topics from the books by O'Neil)

Unit-III(2 Questions)

Kinematics of a rigid body rotating about a fixed point, Euler's theorem, general rigid body motion as a screw motion, moving coordinate system - rectilinear moving frame, rotating frame of reference, rotating earth. Two-dimensional rigid body dynamics – problems illustrating the laws of motion and impulsive motion. (Relevant topics from the book of Chorlton).

Unit -IV(2 Questions)

Moments and products of inertia, angular momentum of a rigid body, principal axes and principal moment of inertia of a rigid body, kinetic energy of a rigid body rotating about a fixed point, momental ellipsoid and equimomental systems, coplanar mass distributions, general motion of a rigid body. (Relevant topics from the book of Chorlton).

Note : The question paper will consist of **five** units. Each of the first four units will contain **two** questions from unit **I , II , III , IV** respectively and the students shall be asked to attempt **one** question from each unit. Unit five will contain **eight to ten** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory**.

Books Recommended

1. Sneddon, I.N. — Elements of Partial Differential Equations, McGraw Hill, New York.
2. O'Neil, Peter V. — Advanced Engineering Mathematics, ITP.
3. F. Chorlton — Textbook of Dynamics, CBS Publishers, New Delhi.
4. H.F. Weinberger — A First Course in Partial Differential Equations, John Wiley & Sons, 1965.
5. M.D. Raisinghania — Advanced Differential equations, S. Chand & Co.

MMCS 303 : Complex Analysis-I

Max. Marks : 80 **Time : 3 hours**

Unit -I(2 Questions)

Function of a complex variable, continuity, differentiability. Analytic functions and their properties, Cauchy-Riemann equations in Cartesian and polar coordinates. Power series, Radius of convergence, Differentiability of sum function of a power series. Branches of many valued functions with special reference to arg z, log z and z^a.

Unit -II(2 Questions)

Path in a region, Contour, Simply and multiply connected regions, Complex integration. Cauchy theorem. Cauchy's integral formula. Poisson's integral formula. Higher order derivatives. Complex integral as a function of its upper limit, Morera's theorem. Cauchy's inequality. Liouville's theorem. The fundamental theorem of algebra. Taylor's theorem.

Unit -III(2 Questions)

Zeros of an analytic function, Laurent's series. Isolated singularities. Cassorati- Weierstrass theorem, Limit point of zeros and poles.

Maximum modulus principle, Minimum modulus principle. Schwarz lemma. Meromorphic functions. The argument principle. Rouche's theorem, Inverse function theorem.

Unit - IV(2 Questions)

Calculus of residues. Cauchy's residue theorem. Evaluation of integrals.

Bilinear transformations, their properties and classifications. Definitions and examples of Conformal mappings.

Space of analytic functions and their completeness, Hurwitz's theorem. Montel's theorem. Riemann mapping theorem.

Note : The question paper will consist of **five** units. Each of the first four units will contain **two** questions from unit **I , II , III , IV** respectively and the students shall be asked to attempt **one** question from each unit. Unit five will contain **eight to ten** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory**.

Books Recommended

1. H.A. Priestly, Introduction to Complex Analysis, Clarendon Press, Oxford, 1990.
2. J.B. Conway, Functions of one Complex variable, Springer-Verlag, International student-Edition, Narosa Publishing House, 1980.
3. Liang-shin Hann & Bernand Epstein, Classical Complex Analysis, Jones and Bartlett Publishers International, London, 1996.
4. E.T. Copson, An Introduction to the Theory of Functions of a Complex Variable, Oxford University Press, London.
5. E.C. Titchmarsh, The Theory of Functions, Oxford University Press, London.
6. L.V. Ahlfors, Complex Analysis, McGraw Hill, 1979.
7. S. Lang, Complex Analysis, Addison Wesley, 1977.
8. Mark J. Ablowitz and A.S. Fokas, Complex Variables : Introduction and Applications, Cambridge University Press, South Asian Edition, 1998.
8. S. Ponnusamy, Foundations of Complex Analysis, Narosa Publishing House, 1997.
9. Ruel V. Churchill and James Ward Brown, Complex Variables and Applications, McGraw-Hill Publishing Company.

MMCS 304 (Option (i)) : Mathematical Statistics

Max. Marks : 80 **Time :3 Hours**

Unit - I(2 Questions)

Measures of central tendency, measures of dispersion, moments, skewness, kurtosis.

Probability: Introduction, rules of probability, conditional probability, independent events, Bayes's Theorem.

Unit -II (2 Questions)

Distribution function, probability mass function, probability density function, two dimensional probability mass function, two-dimensional distribution function, marginal and conditional distribution functions, joint density function, marginal and conditional density functions, stochastic independence.

Expected value of a random variable, properties of expectation. moment generating function; Chebychev's inequality, convergence in probability and in distribution, weak and strong laws of large numbers (statements only).

Unit -III (2 Questions)

Discrete probability distributions: Bernoulli distribution, Binomial distribution, Poisson distribution, Hypergeometric distribution, Geometric distribution,

Continuous probability distributions: Uniform distribution, Exponential distribution, Normal distribution, Beta and Gamma distributions, Cauchy distribution.

Central Limit Theorem (statements only)

Unit -IV (2 Questions)

Parameter and statistic, sampling distribution of a statistic, standard error. Null and alternative hypotheses, two types of error, critical region and level of significance, one-tailed and two-tailed tests, procedure for testing of hypothesis.

Tests of significance for large samples – for single proportion, difference of proportions, single mean, difference of means and difference of standard deviations. Goodness of fit test, test of independence of attributes, t-test for single mean, t-test for difference of means (paired and unpaired), F-test for equality of two population variances.

Note : The question paper will consist of **five** units. Each of the first four units will contain **two** questions from unit **I , II , III , IV** respectively and the students shall be asked to attempt **one** question from each unit. Unit five will contain **eight to ten** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory**.

Books Recommended

1. Baisnab and Jas, M, : Elements of Probability and Statistics, Tata McGraw Hill
2. Goon, A.M., Gupta M.K. and Dasgupta, B, : An Outline of Statistical Theory, World Press

3. Gupta, S.C. and Kapoor V.K. : Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi

4. Freund, J.E.: Mathematical Statistics, Prentice Hall of India
5. Mood A.M., Graybill : Introduction to Theory of Statistics
F.A. and Boes, D.D.

MMCS 304 (Option (ii)) : Advanced Discrete Mathematics –I

Max. Marks : 80 **Time :3 Hours**

Unit - I(2 Questions)

Graph Theory – Definitions and basic concepts, special graphs, Sub graphs, isomorphism of graphs, Walks, Paths and Circuits, Eulerian Paths and Circuits, Hamiltonian Circuits, matrix representation of graphs, Planar graphs, Colouring of Graph.

Unit -II (2 Questions)

Directed Graphs, Trees, Isomorphism of Trees, Representation of Algebraic Expressions by Binary Trees, Spanning Tree of a Graph, Shortest Path Problem, Minimal spanning Trees, Cut Sets, Tree Searching..

Unit -III (2 Questions)

Introductory Computability Theory - Finite state machines and their transition table diagrams, equivalence of finite state machines, reduced machines, homomorphism, finite automata acceptors, non-deterministic finite automata and equivalence of its power to that of deterministic finite automata Moore and Mealy machines.

Unit -IV (2 Questions)

Grammars and Languages – Phrase-structure grammar rewriting rules, derivations, sentential forms, Language generated by a grammar, regular, context-free and context sensitive grammars and languages, regular sets, regular expressions and pumping lemma, Kleene's theorem.

Note : The question paper will consist of **five** units. Each of the first four units will contain **two** questions from unit **I , II , III , IV** respectively and the students shall be asked to attempt **one** question from each unit. Unit five will contain **eight to ten** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory**.

Books Recommended

1. J.P. Tremblay & R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, McGraw-Hill Book Co., 1997.
2. J.L. Gersting, Mathematical Structures for Computer Science, (3rd edition), Computer Science Press, New York.
3. Seymour Lipschutz, Finite Mathematics (International edition 1983), McGraw-Hill Book Company, New York.
4. C.L. Liu, Elements of Discrete Mathematics, McGraw-Hilll Book Co.
5. Babu Ram, Discrete Mathematics, Vinayak Publishers and Distributors, Delhi, 2004.

MMCS 305 : Object Oriented Programming with C++

Max. Marks : 80 **Time :3 Hours**

Section I (2 Questions)

Basic concepts of Object-Oriented Programming (OOP). Advantages and applications of OOP. Object-oriented languages. Introduction to C++. Structure of a C++ program. Creating the source files. Compiling and linking.

C++ programming basics: Input/Output, Data types, Operators, Expressions, Control structures, Library functions.

Section II (2 Questions)

Functions in C++ : Passing arguments to and returning values from functions, Inline functions, Default arguments, Function overloading.

Classes and objects : Specifying and using class and object, Arrays within a class, Arrays of objects, Object as a function arguments, Friendly functions, Pointers to members.

Section III (2 Questions)

Constructors and destructors. Operator overloading and type conversions.

Inheritance : Derived class and their constructs, Overriding member functions, class hierarchies, Public and private inheritance levels.

Polymorphism, Pointers to objects, this pointer, Pointers to derived classes, virtual functions.

Section IV (2 Questions)

Streams, stream classes, Unformatted Input/Output operations, Formatted console Input/Output operations, Managing output with manipulators.

Classes for file stream operations, Opening and Closing a file. File pointers and their manipulations, Random access. Error handling during file operations, Command-line arguments. Exceptional handling.

Note : The question paper will consist of **five** units. Each of the first four units will contain **two** questions from unit **I , II , III , IV** respectively and the students shall be asked to attempt **one** question from each unit. Unit five will contain **eight to ten** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory**.

Books Recommended :

1. I.S. Robert Lafore, Waite's Group Object Oriented Programming using C++, Galgotia Pub.
2. E. Balagrusamy, Object Oriented Programming with C++, 2nd Edition, Tata Mc Graw Hill Pub. Co.
3. Byron, S. Gottfried, Object Oriented Programming using C++, Schaum's Outline Series, Tata Mc Graw Hill Pub. Co.
4. J.N. Barakaki, Object Oriented Programming using C++, Prentic Hall of India, 1996.

MMCS 306 : Database Management System

Max. Marks : 80 **Time :3 Hours**

Section I (2 Questions)

Terminologies of database, Drawbacks of conventional file systems, Data administrator (Role and functions), characteristics of databases. Data redundancy, data integrity, data independence. DBMS and its functions. Advantages and disadvantages of database.

Section II (2 Questions)

Three levels of the architecture: External level, conceptual level and internal level, Mappings and schemas, Client/Server architecture, Distributed processing.

Section III (2 Questions)

Data model, Relational data model, Hierarchical data model, Network data model. Relational model, Basic structure, terminology.

Section IV (2 Questions)

Normalization, First Normal Form, Second Normal Form, Third Normal Form, BCNF, Relational algebra and Relational Calculus, The SQL language.
Use of DBMS Package ORACLE/MS-ACCESS.

Note : The question paper will consist of **five** units. Each of the first four units will contain **two** questions from unit **I , II , III , IV** respectively and the students shall be asked to attempt **one** question from each unit. Unit five will contain **eight to ten** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory**.

Books Recommended

1. C.J. Date, Sixth Ed., An Introduction to Database System, Addison-Wesley Publishing Co.
2. Ullman, Jeffery D., Principles of Database System, Computer Science Press.
3. James Martin, Principles of Database Management System, Prentice Hall of India Pvt. Ltd.
4. Desai, Bipin C., Introduction to Data base Systems, Galgotia Publ.
5. Whittington, R.P., Data Base Systems Engineering, Clavendon Press.
6. Kroenke, D.M., Database Processing : Fundamental Design, Implementation, 2nd Edn. Galgotia Publ. Pvt. Ltd.
7. Wiederhold, Database Design, McGraw Hill Book Comp.

MMCS 307 : Practicals

Max. Marks : 80
Time : 4 Hours

The practical will be based on the Papers MMCS-305 and MMCS-306

i) Viva-voce and practical record : 30 marks

ii) Written practical work : 50 marks

The examiner shall set a question paper consisting of 4 questions and the examinees will be required to attempt any two. They will write the programs in Answer-books and will run the same on computers and they will take printouts of programs and output.

SEMESTER-IV

Paper Code	Title of the Paper	Internal-Assessment Marks	Theory Marks	Practicals Marks	Total Marks
MMCS-401	Functional Analysis-II	20	80	-	100
MMCS-402	Classical Mechanics	20	80	-	100
MMCS-403	Complex Analysis-II	20	80	-	100
MMCS-404	(i) Operations Research (ii) Advanced Discrete Mathematics-II	20	80	-	100
MMCS-405	Programming in Visual Basic	20	80	-	100
MMCS-406	Software Engineering	20	80	-	100
MMCS-407	Practicals	20	-	80	100
Total Marks Semester-IV					700
Total Marks Semester-III					700
Total Marks Semester-II					700
Total Marks Semester-I					700
GRAND TOTAL					2800

Note 1: The marks of internal assessment of each paper shall be split as under :

A) One class test of 10 marks. The class test will be held in the middle of the semester.

B) Assignment & Presentation : 5 marks

C) Attendance : 5 marks

65% but upto 75% : 1 marks

More than 75% but upto 85% : 2 marks

More than 85% but upto 90% : 3 marks

More than 90% but upto 95% : 4 marks

Above 95% : 5 marks

Note 2: The syllabus of each paper will be divided into **four** units of **two** questions each. The question paper will consist of **five** units. Each of the first four units will contain two questions and the students shall be asked to attempt **one** question from each unit. Unit five of each question paper shall contain **eight to ten** short

answer type questions without any internal choice and it shall be covering the entire syllabus. As such unit five shall be **compulsory**.

Note 3: As per UGC recommendations, the teaching program shall be supplemented by tutorials and problem solving sessions for each theory paper. For this purpose, tutorial classes shall be held for each theory paper in groups of 8 students for half-hour per week.

Note 4: Optional papers can be offered subject to availability of requisite resources/ faculty.

Syllabus - 4th SEMESTER

MMCS 401 : Functional Analysis –II

Max. Marks : 80 **Time : 3 Hours**

Unit-I (2 Questions)

Signed measure, Hahn decomposition theorem, Jordan decomposition theorem, Mutually signed measure, Radon – Nikodyn theorem Lebesgue decomposition, Lebesgue - Stieltjes integral, Product measures, Fubini's theorem.

Unit-II (2 Questions)

Baire sets, Baire measure, continuous functions with compact support, Regularity of measures on locally compact spaces, Riesz-Markoff theorem.

Hilbert Spaces: Inner product spaces, Hilbert spaces, Schwarz's inequality, Hilbert space as normed linear space.

Unit-III (2 Questions)

Convex sets in Hilbert spaces, Projection theorem. Orthonormal sets, Bessel's inequality, Parseval's identity, conjugate of a Hilbert space, Riesz representation theorem in Hilbert spaces.

Unit-IV (2 Questions)

Adjoint of an operator on a Hilbert space, Reflexivity of Hilbert space, Self-adjoint operators, Positive and projection operators, Normal and unitary operators, Projections on Hilbert space, Spectral theorem on finite dimensional space.

Note : The question paper will consist of **five** units. Each of the first four units will contain **two** questions from unit **I , II , III , IV** respectively and the students shall be asked to attempt **one** question from each unit. Unit five will contain **eight to ten** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory**.

Books Recommended

1. H.L. Royden, Real Analysis, MacMillan Publishing Co., Inc., New York, 4th Edition, 1993.
2. E. Kreyszig, Introductory Functional Analysis with Applications, John Wiley.
3. S.K. Berberian, Measure and Integration, Chelsea Publishing Company, New York, 1965.
4. G. Bachman and L. Narici, Functional Analysis, Academic Press, 1966.
5. George F. Simmons, Introduction to Topology and Modern Analysis, McGraw-Hill Book Company, 1963.

MMCS 402 : Classical Mechanics

Max. Marks : 80 **Time : 3 hours**

Unit –I(2 Question)

Free & constrained systems, constraints and their classification, holonomic and non-holonomic systems, degree of freedom and generalized coordinates, virtual displacement and virtual work, statement of principle of virtual work (PVW), possible velocity and possible acceleration, D' Alembert's principle,

Lagrangian Formulation : Ideal constraints**,** general equation of dynamics for ideal constraints, Lagrange's equations of the first kind.

Unit –II(2 Question)

Independent coordinates and generalized forces, Lagrange's equations of the second kind, generalized velocities and accelerations. Uniqueness of solution, variation of total energy for conservative fields.

Lagrange's variable and Lagrangian function $L(t, q_i, \dot{q}_i)$, Lagrange's equations for potential forces, generalized momenta p_i , Hamiltonian variable and Hamiltonian function $H(t, q_i, p_i)$, Donkin's theorem, ignorable coordinates.

Unit -III(2 Question)

Hamilton canonical equations, Routh variables and Routh function R, Routh's equations, Poisson Brackets and their simple properties, Poisson's identity, Jacobi – Poisson theorem.

Hamilton action and Hamilton's principle, Poincare – Carton integral invariant, Whittaker's equations, Jacobi's equations, Lagrangian action and the principle of least action.

Unit -IV(2 Question)

Canonical transformation, necessary and sufficient condition for a canonical transformation, univalent Canonical transformation, free canonical transformation, Hamilton-Jacobi equation, Jacobi theorem, method of separation of variables in HJ equation, Lagrange brackets, necessary and sufficient conditions of canonical character of a transformation in terms of Lagrange brackets, Jacobian matrix of a canonical transformation, conditions of canonicity of a transformation in terms of Poison brackets, invariance of Poisson Brackets under canonical transformation.

Note : The question paper will consist of **five** units. Each of the first four units will contain **two** questions from unit **I , II , III , IV** respectively and the students shall be asked to attempt **one** question from each unit. Unit five will contain **eight to ten** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory**.

Books Recommended

1. F. Gantmacher — Lectures in Analytic Mechanics, MIR Publishers, Moscow, 1975.
2. P.V. Panat — Classical Mechanics, Narosa Publishing House, New Delhi, 2005.
3. N.C. Rana and P.S. Joag — Classical Mechanics, Tata McGraw-Hill, New Delhi, 1991.
4. Louis N. Hand and Janet D. Finch — Analytical Mechanics, CUP, 1998.

5. K. Sankra Rao — Classical Mechanics, Prentice Hall of India, 2005.
6. M.R. Speigal — Theoretical Mechanics, Schaum Outline Series.

MMCS 403 : Complex Analysis-II

Max. Marks : 80 **Time : 3 hours**

Unit - I(2 Question)

Integral Functions. Factorization of an integral function. Weierstrass' factorisation theorem. Factorization of sine function. Gamma function and its properties. Stirling formula. Integral version of gamma function. Riemann Zeta function. Riemann's functional equation. Runge's theorem. Mittag-Leffler's theorem.

Unit - II(2 Question)

Analytic Continuation. Natural Boundary. Uniqueness of direct analytic continuation. Uniqueness of analytic continuation along a curve. Power series method of analytic continuation. Schwarz Reflection principle. Germ of an analytic function.

Monodromy theorem and its consequences. Harmonic functions on a disk. Poisson kernel. The Dirichlet problem for a unit disc.

Unit - III(2 Question)

Harnack's inequality. Harnack's theorem. Dirichlet's region. Green's function. Canonical product. Jensen's formula. Poisson-Jensen formula. Hadamard's three circles theorem. Growth and order of an entire function. An estimate of number of zeros. Exponent of Convergence. Borel's theorem. Hadamard's factorization theorem.

Unit -IV(2 Question)

The range of an analytic function. Bloch's theorem. Schottky's theorem. Little Picard theorem. Montel Caratheodory theorem. Great Picard theorem. Univalent functions. Bieberbach's conjecture(Statement only) and the "1/4 theorem" .

Note : The question paper will consist of **five** units. Each of the first four units will contain **two** questions from unit **I , II , III , IV** respectively and the students shall be asked to attempt **one** question from each unit. Unit five will contain **eight to ten** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory**.

Books Recommended

1. H.A. Priestly, Introduction to Complex Analysis, Clarendon Press, Oxford, 1990.
2. J.B. Conway, Functions of one Complex variable, Springer-Verlag, International student-Edition, Narosa Publishing House, 1980.
3. Liang-shin Hann & Bernand Epstein, Classical Complex Analysis, Jones and Bartlett Publishers International, London, 1996.
4. E.T. Copson, An Introduction to the Theory of Functions of a Complex Variable, Oxford University Press, London.
5. E.C. Titchmarsh, The Theory of Functions, Oxford University Press, London.
6. L.V. Ahlfors, Complex Analysis, McGraw Hill, 1979.
7. S. Lang, Complex Analysis, Addison Wesley, 1977.
8. Mark J. Ablowitz and A.S. Fokas, Complex Variables : Introduction and Applications, Cambridge University Press, South Asian Edition, 1998.
9. S. Ponnusamy, Foundations of Complex Analysis, Narosa Publishing House, 1997.

MMCS 404 (Option (i)) : Operations Research Techniques

Max. Marks : 80 **Time : 3 hours**

Unit - I (2 Questions)

Origin, definition and scope of Operations Research. Linear Programming: Formulation and solution of linear programming problems by graphical and simplex methods, Big - M and two phase methods, Duality in linear programming. Non-linear Programming: Convex and concave functions, Kuhn-Tucker conditions for constrained optimization, solution of quadratic programming problems.

Unit - II (2 Questions)

Transportation Problems: Basic feasible solutions, optimum solution by stepping stone and modified distribution methods, unbalanced and degenerate problems, transhipment problem. Assignment problems: Solution by Hungarian method, unbalanced problem, case of maximization, travelling salesman and crew assignment problems.

Unit - III (2 Questions)

Queuing methods: Basic components of a queuing system, General birth-death equations, steady-state solution of Markovian queuing models with single and multiple servers (M/M/1. M/M/C, M/M/1/k, M/MC/k)

Inventory control models: Economic order quantity(EOQ) model with uniform demand and with different rates of demands in different cycles, EOQ when shortage are allowed, EOQ with uniform replenishment, Inventory control with price breaks.

Unit - IV (2 Questions)

Game Theory : Two person zero sum game, Game with saddle points, the rule of dominance; Algebric, graphical and linear programming methods for solving mixed strategy games. Replacement problems: Replacement of items whose running cost increases with time, Replacement policies for the items that fail completely - Individual and the Group Replacement policies. Sequencing problems: Processing of n jobs through 2 machines, n jobs through 3 machines, 2 jobs through m machines, n jobs through m machines.

Note : The question paper will consist of **five** units. Each of the first four units will contain **two** questions from unit **I , II , III , IV** respectively and the students shall be asked to attempt **one** question from each unit. Unit five will contain **eight to ten** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory**.

Books recommended :

1. Taha, H.A., Operation Research-An introducton, Printice Hall of India.
2. Dipak Chatterjee, Linear programming and Game Theory, Prentice Hall India.
3. Gupta, P.K. and Hira, D.S., Operations Research, S. Chand & Co.
4. Sharma, S.D., Operation Research, Kedar Nath Ram Nath Publications.
5. Sharma, J.K., Mathematical Model in Operation Research, Tata McGraw Hill.
6. Kapoor, V.K., Operations Research, Sultan Chand & Sons.

MMCS 404 (Option (ii)) : Advanced Discrete Mathematics -II

Max. Marks : 80 **Time :3 Hours**

Unit- I (2 Questions)

Formal Logic – Statements. Symbolic Representation and Tautologies. Quantifier, Predicates and Validity. Propositional Logic.

Unit -II (2 Questions)

Semigroups & Monoids-Definitions and Examples of Semigroups and Monoids (including those pertaining to concatenation operation).

Homomorphism of semigroups and monoids. Congruence relation and Quotient Semigroups. Subsemigroup and submonoids. Direct products. Basic Homomorphism Theorem. Pigeonhole principle, principle of inclusion and exclusion, derangements.

Unit -III (2 Questions)

Lattices- Lattices as partially ordered sets. Their properties. Lattices as Algebraic systems. Sublattices, Direct products, and Homomorphisms. Some Special Lattices e.g., Complete. Complemented and Distributive Lattices. Join-irreducible elements. Atoms and Minterms.

Unit -IV (2 Questions)

Boolean Algebras – Boolean Algebras as Lattices. Various Boolean Identities. The switching Algebra example. Subalgebras, Direct Products and Homomorphisms. Boolean Forms and Their Equivalence. Minterm Boolean Forms, Sum of Products Canonical Forms. Minimization of Boolean Functions. Applications of Boolean Algebra to Switching Theory (using AND, OR & NOT gates). The Karnaugh Map method.

Note : The question paper will consist of **five** units. Each of the first four units will contain **two** questions from unit **I , II , III , IV** respectively and the students shall be asked to attempt **one** question from each unit. Unit five will contain **eight to ten** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory**.

Books Recommended

1. J.P. Tremblay & R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, McGraw-Hill Book Co., 1997.
2. J.L. Gersting, Mathematical Structures for Computer Science, (3rd edition), Computer Science Press, New York.
3. Seymour Lipschutz, Finite Mathematics (International edition 1983), McGraw-Hill Book Company, New York.
4. C.L. Liu, Elements of Discrete Mathematics, McGraw-Hilll Book Co.
5. Babu Ram, Discrete Mathematics, Vinayak Publishers and Distributors, Delhi, 2004.

MMCS 405 : Programming in Visual Basic

Max. Marks : 80 **Time :3 Hours**

Section I (2 Questions)

Visual Basic : Introduction, Analyzing, Controls and Properties, Coding, Control structures : Decision & Loops, Control Array, Arrays

Section II (2 Questions)

Text Boxes, Command Buttons, Additional Controls – List Box, Option Buttons, Frames, Check Boxes, Scroll Bars, Timer Control,

Section III (2 Questions)

Menus: Menu Editor, Menu controls, Dialog Boxes, Procedures and Functions, Using Debugging Windows, Database Programming,

Section IV (2 Questions)

Crystal Reports. Simple Active X controls. Library Functions: String, Numeric, Time-related & Misc. Functions

Note : The question paper will consist of **five** units. Each of the first four units will contain **two** questions from unit **I , II , III , IV** respectively and the students shall be asked to attempt **one** question from each unit. Unit five will contain **eight to ten** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory**.

Books Recommended

1. Reselman & Other, Using Visual Basic 6, Prentice Hall of India.
2. Donald & Oancea, Visual Basic 6 from Scratch, Prentice- Hall of India.
3. Noel Jerke, Visual Basic 6, Tata Mc-Graw Hill
4. Days Maver, Teach Yourself More VB in 21 days, Techmedia.

MMCS 406 : Software Engineering

Max. Marks : 80 **Time :3 Hours**

Section I (2 Questions)

Introduction : The Software crisis, Software Engineering Problem, Software Engineering Approach, software process & its characteristics, Goals of software engineering, Software metrics and their importance,

Software Development Process: A Process Step Specification, Waterfall model, Prototyping, Iterative Enhancement, Spiral model and their comparisons.

Section II (2 Questions)

Software Requirements Analysis and Specifications, Planning a Software Project: Cost Estimation, COCOMO Model, Project Scheduling, Quality assurance Plans, Project Monitoring Plans, Risk Management

Section III (2 Questions)

Software Design : Function oriented design - principles, modeule level concepts, Design notation, structured design methodologies, Object-Oriented Design – concept, notations, methodologies. Detailed Design

Section IV (2 Questions)

Coding, Testing techniques- Testing fundamental, test case design, functional testing, Structural testing, Test Plans, Unit Testing, Integration Testing, System Testing, Acceptance Testing.

Note : The question paper will consist of **five** units. Each of the first four units will contain **two** questions from unit **I , II , III , IV** respectively and the students shall be asked to attempt **one** question from each unit. Unit five will contain **eight to ten** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory**.

Books Recommended :

1. S. Roser Pressman, Software Engineering, A Practitioners Approach, Mc-Graw Hill Book Co.
2. N.S. Gill, Software Engineering, Khanna Pub. Co., New Delhi.
3. Pankaj Jalote, An Integrated Approach to Software Engineering, Narosa Pub.
4. K.K. Aggarwal and Yogesh Singh, Software Engineering, New Age Publishers, New Delhi.
5. M.L. Shooman, Software Engineering, Tata McGraw Hill.

MMCS-407 : Practicals

Max. Marks : 80
Time : 4 Hours

The practical will be based on the Paper MMCS-405

i) Viva-voce and practical record : 30 marks

ii) Written practical work : 50 marks

The examiner shall set a question paper consisting of 4 questions and the examinees will be required to attempt any two. They will write the programs in Answer-books and will run the same on computers and they will take printouts of programs and output.