M. Sc. Mathematics with Computer Science
(w.e.f. Session 2016-17)
as per
Choice Based Credit System (CBCS)

Program Specific Outcomes

Student would be able to:

PSO1 Transmit mathematics and computer knowledge.

PSO2 Acquire analytical and logical thinking through various mathematical and computational techniques.

PSO3 Apply mathematical and computational skills to real life problems.

PSO4 Attain in-depth knowledge to pursue higher studies and ability to conduct research.

PSO5 Achieve targets of successfully clearing various examinations/interviews for placements in teaching, banks, software industries and various other organizations/services.

Scheme of Examination of
M.Sc. Mathematics with Computer Science
Programme Code:MMC2
Semester- I
(w.e.f. Session 2016-17)

Course Code	Title of the Course	External Marks	Internal Marks	Practical Marks	Credits (L:T:P)
Core					
16MMC21C1	Abstract Algebra	80	20	--	4:1:0
16MMC21C2	Mathematical Analysis	80	20	--	4:1:0
16MMC21C3	Ordinary Differential Equations	80	20	--	4:1:0
16MMC21C4	Complex Analysis	80	20	--	4:1:0
16MMC21C5	Programming in C and Data Structure	60	--	40	2:0:2
16MMC21C6	Operating System and Unix	60	--	40	2:0:2
			Total Credits :		**28**

Note 1 : The Criteria for awarding internal assessment of 20 marks shall be as under:

A) Class test : 10 marks.
B) Assignment & Presentation : 5 marks
C) Attendance : 5 marks
Less than 65% : 0 marks
Upto 70% : 2 marks
Upto 75% : 3 marks
Upto 80% : 4 marks
Above 80% : 5 marks

Note 2 : The syllabus of each course will be divided into **four** Sections of **two** questions each. The question paper of each course will consist of **five** Sections. Each of the sections I to IV will contain two questions and the students shall be asked to attempt **one** question from each. Section - V shall be compulsory and contain **eight** short answer type questions without any internal choice covering the entire syllabus.

16MMC21C1: Abstract Algebra

Time: 03 Hours ***Credits : 4:1:0***
Max Marks : 80

Course Outcomes

Students would be able to:

CO1 Apply group theoretic reasoning to group actions.

CO2 Learn properties and analysis of solvable & nilpotent groups, Noetherian & Artinian modules and rings.

CO3 Apply Sylow's theorems to describe the structure of some finite groups and use the concepts of isomorphism and homomorphism for groups and rings.

CO4 Use various canonical types of groups and rings- cyclic groups and groups of permutations, polynomial rings and modular rings.

CO5 Analyze and illustrate examples of composition series, normal series, subnormal series.

Section - I

Conjugates and centralizers in S_n, p-groups, Group actions, Counting orbits. Sylow subgroups, Sylow theorems, Applications of Sylow theorems, Description of group of order p^2 and pq, Survey of groups upto order 15.

Section - II

Normal and subnormal series, Solvable series, Derived series, Solvable groups, Solvability of S_n-the symmetric group of degree $n \geq 2$, Central series, Nilpotent groups and their properties, Equivalent conditions for a finite group to be nilpotent, Upperandlower central series. Composition series, Zassenhaus lemma, Jordan-Holder theorem.

Section - III

Modules, Cyclic modules, Simple and semi-simple modules, Schur lemma, Free modules, Torsion modules, Torsion free modules, Torsion part of a module, Modules over principal ideal domain and its applications to finitely generated abelian groups.

Section - IV

Noetherian and Artinian modules, Modules of finite length, Noetherian and Artinian rings, Hilbert basis theorem.

$Hom_R(R,R)$, Opposite rings, Wedderburn – Artin theorem, Maschk theorem, Equivalent statement for left Artinian rings having non-zero nilpotent ideals.

Radicals: Jacobson radical, Radical of an Artinian ring.

Note : The question paper of each course will consist of **five** Sections. Each of the sections **I to IV** will contain **two** questions and the students shall be asked to attempt **one** question from each. **Section-V** shall be **compulsory** and will contain **eight** short answer type questions without any internal choice covering the entire syllabus.

Books Recommended:

1. I.S. Luther and I.B.S.Passi, Algebra, Vol. I-Groups, Vol. III-Modules, Narosa Publishing House (Vol. I – 2013, Vol. III –2013).
2. Charles Lanski, Concepts in Abstract Algebra, American Mathematical Society, First Indian Edition, 2010.
3. VivekSahai and VikasBist, Algebra, Narosa Publishing House, 1999.
4. D.S. Malik, J.N. Mordenson, and M.K. Sen, Fundamentals of Abstract Algebra, McGraw Hill, International Edition, 1997.

5. P.B. Bhattacharya, S.K. Jain and S.R. Nagpaul, Basic Abstract Algebra (2nd Edition), Cambridge University Press, Indian Edition, 1997.
6. C. Musili, Introduction to Rings and Modules, Narosa Publication House, 1994.
7. N. Jacobson, Basic Algebra, Vol. I & II, W.H Freeman, 1980 (also published by Hindustan Publishing Company).
8. M. Artin, Algebra, Prentice-Hall of India, 1991.
9. Ian D. Macdonald, The Theory of Groups, Clarendon Press, 1968.

16MMC21C2: Mathematical Analysis

Time: 03 Hours ***Credits : 4:1:0***
Max Marks : 80

Course Outcomes

Students would be able to:

CO1 Understand Riemann Stieltjes integral, its properties and rectifiable curves.

CO2 Learn about pointwise and uniform convergence of sequence and series of functions and various tests for uniform convergence.

CO3 Find the stationary points and extreme values of implicit functions.

CO4 Be familiar with the chain rule, partial derivatives and concept of derivation in an open subset of R^n.

Section - I

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

Section - II

Sequence and series of functions, Point wise and uniform convergence, Cauchy criterion for uniform convergence, Weirstrass Mtest, Abel and Dirichlettests for uniform convergence, Uniform convergence and continuity, Uniform convergence and differentiation, Weierstrass approximation theorem.

Section - III

Power series, uniform convergence and uniqueness theorem, Abel theorem, Tauber theorem. Functions of several variables, Linear Transformations, Euclidean spaceR^n, Derivatives inanopensubsetofR^n, ChainRule, Partialderivatives, ContinuouslyDifferentiableMapping, Young and Schwarz theorems.

Section - IV

Taylor 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 multipliers method, Jacobian and its properties.

Note : The question paper of each course will consist of **five** Sections. Each of the sections **I to IV** will contain **two** questions and the students shall be asked to attempt **one** question from each. **Section-V** shall be **compulsory** and will contain **eight** short answer type questions without any internal choice covering the entire syllabus.

Books Recommended:

1. Walter Rudin, Principles of Mathematical Analysis (3rd edition) McGraw-Hill, Kogakusha, 1976, International Student Edition.
2. T. M. Apostol, Mathematical Analysis, Narosa Publishing House, New Delhi, 1974.
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, 1976.
6. R. G. Bartle, The Elements of Real Analysis, Wiley International Edition, 2011.
7. S.C. Malik and Savita Arora, Mathematical Analysis, New Age International Limited, New Delhi, 2012.

16MMC21C3: Ordinary Differential Equations

Time: 03 Hours ***Credits : 4:1:0***
Max Marks : 80

Course Outcomes

Students would be able to:

CO1 Apply differential equations to variety of problems in diversified fields of life.
CO2 Learn use of differential equations for modeling and solving real life problems.
CO3 Interpret the obtained solutions in terms of the physical quantities involved in the original problem under reference.
CO4 Use various methods of approximation to get qualitative information about the general behaviour of the solutions of various problems.

Section - I

Preliminaries, ε-approximate solution, Cauchy-Euler construction of an ε-approximate solution of an initial value problem, Equicontinuous family of functions, Ascoli-Arzela Lemma, Cauchy-Peano existence theorem.

Lipschitz condition, Picards-Lindelof existence and uniqueness theorem for $dy/dt = f(t,y)$, Solution of initial-value problems by Picards method, Dependence of solutions on initial conditions ***(Relevant topics from the books by Coddington& Levinson, and Ross)***.

Section - II

Linear systems, Matrix method for homogeneous first order system of linear differential equations, Fundamental set of solutions, Fundamental matrix of solutions, Wronskian of solutions, Basic theory of the homogeneous linear system, Abel-Liouville formula, Non-homogeneous linear system.

Strum Theory, Self-adjoint equations of the second order, Abel formula, Strum Separation theorem, Strum Fundamental comparison theorem.

(Relevant topics from chapters 7 and 11 of book by Ross)

Section - III

Nonlinear differential systems, Phase plane, Path, Critical points, Autonomous systems, Isolated critical points, Path approaching a critical point, Path entering a critical point, Types of critical points- Center, Saddle points, Spiral points, Node points, Stability of critical points, Asymptotically stable points, Unstable points, Critical points and paths of linear systems. Almost linear systems. **(Relevant topics from chapter 13 of book by Ross)**.

Section - IV

Nonlinear conservative dynamical system, Dependence on a parameter, Liapunov direct method, Limit cycles, Periodic solutions, Bendixson nonexistence criterion, Poincore-Bendixson theorem(statement only), Index of a critical point.

Strum-Liouville problems, Orthogonality of characteristic functions. **(Relevant topics from chapters 12 and 13 of the book by Ross)**.

Note : The question paper of each course will consist of **five** Sections. Each of the sections **I to IV** will contain **two** questions and the students shall be asked to attempt **one** question from each. **Section-V** shall be **compulsory** and will contain **eight** short answer type questions without any internal choice covering the entire syllabus.

Books Recommended:

1. E.A. Coddington and N. Levinson, *Theory of ordinary differential equations*, Tata McGraw Hill, 2000.
2. S.L. Ross, *Differential equations*, John Wiley and Sons Inc., New York, 1984.
3. W.E. Boyce and R.C. Diprima, E*lementary differential equations and boundary value problems*, John Wiley and Sons, Inc., New York, 4th edition, 1986.
4. G.F. Simmon, *Differential Equations*, Tata McGraw Hill, New Delhi, 1993.

16MMC21C4: Complex Analysis

Time: 03 Hours ***Credits : 4:1:0***
Max Marks : 80

Course Outcomes

Students would be able to:

CO1 Be familiar with complex numbers and their geometrical interpretations.
CO2 Understand the concept of complex numbers as an extension of the real numbers.
CO3 Represent the sum function of a power series as an analytic function.
CO4 Demonstrate the ideas of complex differentiation and integration for solving related problems and establishing theoretical results.
CO5 Understand concept of residues, evaluate contour integrals and solve polynomial equations.

Section - I

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 argz, Logz and z^a.

Section - II

Path in a region, Contour, Complex integration, Cauchy theorem, Cauchy integral formula, Extension of Cauchy integral formula for multiple connected domain, Poisson integral formula, Higher order derivatives, Complex integral as a function of its upper limit, Morera theorem, Cauchy inequality, Liouville theorem, Taylor theorem.

Section - III

Zeros of an analytic function, Laurent series, Isolated singularities, Cassorati- Weierstrass theorem, Limit point of zeros and poles. Maximum modulus principle, Schwarz lemma, Meromorphic functions, Argument principle, Rouche theorem, Fundamental theorem of algebra, Inverse function theorem.

Section - IV

Calculus of residues, Cauchy residue theorem, Evaluation of integrals of the types $\int_0^{2\pi} f(\cos\theta, \sin\theta)d\theta$, $\int_{-\infty}^{\infty} f(x)dx$, $\int_0^{\infty} f(x)\sin mx\, dx$ and $\int_0^{\infty} f(x)\cos mx\, dx$, Conformal mappings.

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

Note : The question paper of each course will consist of **five** Sections. Each of the sections **I to IV** will contain **two** questions and the students shall be asked to attempt **one** question from each. **Section-V** shall be **compulsory** and will contain **eight** short answer type questions without any internal choice covering the entire syllabus.

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, 2002.

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, 1972.
5. E.C. Titchmarsh, The Theory of Functions, Oxford University Press, London.
6. Ruel V. Churchill and James Ward Brown, Complex Variables and Applications, McGraw-Hill Publishing Company, 2009.
7. H.S. Kasana, Complex Variable Theory and Applications, PHI Learning Private Ltd, 2011.
8. Dennis G. Zill and Patrik D. Shanahan, A First Course in Complex Analysis with Applications, John Bartlett Publication, 2nd Edition, 2010.

16MMC21C5: Programming in C and Data Structure

Credits : 2:0:2

Course Outcomes

Students would be able to:

CO1 Realize the importance of programming using C language.

CO2 Implement selective structures and repetitive structures in C programs using different control statements.

CO3 To emphasize on the importance of use of pointers for efficient C programming.

CO4 Use structures and unions in a C program for handling multivariate data.

CO5 Implement stack, queues and various types of linked lists.

Part-A (Theory)

Time : 03 Hours
Max Marks :60

Section - I

An overview of programming, Programming language, Classification, Basic structure of a C Program, C language preliminaries, Operators and expressions, Decisions and loops.

Section - II

Arrays and pointers, Pointer arithmetic, Passing pointers as function arguments, Accessing array elements through pointers, Passing arrays as function arguments, Arrays of pointers, Pointers to pointers, Storage classes –fixed vs. automatic duration, Global variables, Structure and Union.

Section - III

Basic terminology, Elementary data organization, Structure operations, Linear data structure Arrays, Multi-dimensional arrays, Sequential allocation, Address calculations, Sparse arrays and its applications. Linked lists: Simple Lists, Circular linked list, Doubly linked list.

Section - IV

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

Note : The question paper of each course will consist of **five** Sections. Each of the sections **I to IV** will contain **two** questions and the students shall be asked to attempt **one** question from each. **Section-V** shall be **compulsory** and will contain **eight** short answer type questions without any internal choice covering the entire syllabus.

Books Recommended :

1. Brian W. Kernighan & Dennis M. Ritchie, The C Programme Language, Second Edition (ANSI features) , Prentice Hall 1989.
2. E. Balagurusamy, Programming in ANSI C, Third Edition, Tata McGraw-Hill Publishing Co. Ltd.
3. S. G. Byron, Theory and Problems of Programming with C, Second Edition (Schaum's Outline Series), Tata McGraw-Hill Publishing Co. Ltd.

4. K.R. Venugopal and S.R. Prasad, Programming with C, 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.

Part-B (Practical)

Time: 03 Hours
Max Marks :40

There will be a separate practical course based on the above theory course (i.e. **16MC21C5: Programming in C and Data Structure**.

16MMC21C6 : Operating System and Unix

Credits : 2:0:2

Course Outcomes

Students would be able to:

CO1 Analyze the structure of operating system and basic architectural components involved in its design.

CO2 Understand various process management concepts including scheduling, synchronization, multithreading and deadlocks.

CO3 Get familiar with concepts of memory management including virtual memory and disk management.

CO4 Have knowledge of different types of operating systems including UNIX.

CO5 Design and implement shell scripts using different commands and control structures.

Part-A (Theory)

Time : 03 Hours
Max Marks :60

Section - I

Basics of Operating Systems:Basics of Operating Systems: Definition, Generations of Operating systems, Types of Operating Systems: Mainframe, Desktop, Multiprocessor, Distributed, Clustered, Multiprogramming, Real time, Embedded and Time sharing. Operating System Components: Process Management component, Memory Management component - I/O Management component, File Management component, Protection System – Networking management component, Command interpreter. Operating System Services: Process Execution, I/O operations, File manipulations, Communications, Error detection and recovery, Resource allocation, Accounting, System Protection, System Calls and System call Execution

Section - II

Processes: Definition, Process Relationship, Process states, Process State transitions, Process Control Block, Context switching, Threads, Concept of multithreads, Benefits of threads, Types of threads. Process Scheduling: Definition, Scheduling objectives, Types of Schedulers, Scheduling criteria, CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time (Definition only), Scheduling algorithms, Preemptive and Non-preemptive, FCFS, SJF , RR, Multiprocessor scheduling – Types, Performance evaluation of the scheduling. Process Management –Process scheduling Information, Memory Management, Access control – Caches, Page allocation and De-allocation.

Interprocess Communication and Synchronization: Definition, Shared Memory System, Message passing, Critical section, Mutual Exclusion, Semaphores.

Section - III

Basic Memory Management: Definition, Logical and Physical address map, Memory allocation, Contiguous Memory allocation, Fixed and variable partition, Internal and External fragmentation and Compaction, Paging, Principle of operation, Page allocation, Hardware support for paging, Protection and sharing, Disadvantages of paging.

Virtual Memory: Basics of Virtual Memory, Hardware and control structures, Locality of reference, Page fault , Working Set , Dirty page/Dirty bit, Demand paging (Concepts only) – Page Replacement policies, Optimal (OPT) , First in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used (LRU)

Deadlocks: Definition, Deadlock characteristics, Deadlock Prevention, Deadlock Avoidance, Deadlock detection and Recovery.

Section - IV

File Management:File concept, File attributes, Name, Identifier, Type, Location, Size, Time, Date, User identification, File Operations, Directory Structure, Single level, Two level, Tree Structure, Disk space allocation methods, Contiguous, Linked, Indexed, Access Methods – Sequential, Random access, File system structure, Byte sequence, Record sequence and Tree-based, Disk formatting.

UNIX: Overview of UNIX and its architecture. UNIX commands. History of Linux, Features of Linux- Differences between UNIX and Linux, Linux Architecture, Popular Flavors of Linux

Note : The question paper of each course will consist of **five** Sections. Each of the sections **I to IV** will contain **two** questions and the students shall be asked to attempt **one** question from each. **Section-V** shall be **compulsory** and will contain **eight** short answer type questions without any internal choice covering the entire syllabus.

Reference Books:

1. Abraham Silberschatz, Operating System Concepts,Addision Wesley.
2. D.M. Dhamdhere,Operating Systems – A Concept Based Approach, TMGH
3. Pal Chaudhury, Operating system, Principals & Design, PHI Learning.
4. William stalling, Operating System, Pearson Education, New Delhi.
5. Deitel and Deitel, Operating System, Pearson Education, New Delhi.
6. Ikvinderpal Singh, Operating Systems, Khanna Pub. Co., New Delhi.
7. P.S. Gill, Operating System Concepts, Firewall Media.
8. RohitKhurana, Operating System, Vikas Publishing Ltd, New Delhi

Part-B (Practical)

Time: 03 Hours
Max Marks : 40

There will be a separate practical course based on the above theory course (i.e. **16MMC21C6 : Operating System and Unix)**.

Scheme of Examination of
M.Sc. Mathematics with Computer Science, Semester- II
(w.e.f. Session 2016-17)

Course Code	Title of the Course	External Marks	Internal Marks	Practical Marks	Credits (L:T:P)
Core					
16MMC22C1	Theory of Field Extensions	80	20	--	3:1:0
16MMC22C2	Measure and Integration Theory	80	20	--	3:1:0
16MMC22C3	Integral Equations and Calculus of Variations	80	20	--	4:1:0
16MMC22C4	Partial Differential Equations	80	20	--	4:1:0
16MMC22C5	Object Oriented Programming with C++	50	--	50	2:0:2
Discipline Specific Elective (Choose Any one)					
16MMC22D1	Data Communication and Networking	60	--	40	2:0:2
16MMC22D2	Information and Communication Technology	60	--	40	2:0:2
Foundation Elective					
To be Chosen from the pool of foundation electives provided by the university					2-3
Open Elective					
To be Chosen from the pool of foundation electives provided by the university (excluding the course prepared by the Department of Mathematics).					3

Discipline SpecificCourses for the students who will not opt for open elective.					
16MMC22SO1	Mathematics for Finance and Insurance	80	20	--	3:0:0
16MMC22SO2	Statistics through SPSS	40	--	60	1:0:2

Total Credits : 31-32

Note 1 : The Criteria for awarding internal assessment of 20 marks shall be as under:

A) Class test : 10 marks.
B) Assignment & Presentation : 5 marks
C) Attendance : 5 marks

Less than 65% : 0 marks
Upto 70% : 2 marks
Upto 75% : 3 marks
Upto 80% : 4 marks
Above 80% : 5 marks

Note 2 : The syllabus of each course will be divided into **four** Sections of **two** questions each. The question paper of each course will consist of **five** Sections. Each of the sections I to IV will contain two questions and the students shall be asked to attempt **one** question from each Section. Section - V shall be compulsory and shall contain **eight** short answer type questions without any internal choice covering the entire syllabus.

Note 3 : Elective courses can be offered subject to availability of requisite resources/ faculty.

16MMC22C1: Theory of Field Extensions

Time: 03 Hours ***Credits :3:1:0***
Max Marks : 80

Course Outcomes

Students would be able to:

CO1 Use diverse properties of field extensions in various areas.
CO2 Establish the connection between the concept of field extensions and Galois theory.
CO3 Describe the concept of automorphism, monomorphism and their linear independence in field theory.
CO4 Compute the Galois group for several classical situations.
CO5 Solve polynomial equations by radicals along with the understanding of ruler and compass constructions.

Section - I

Extension of fields: Elementary properties, Simple Extensions, Algebraic and transcendental Extensions. Factorization of polynomials, Splitting fields, Algebraically closed fields, Separable extensions, Perfect fields.

Section - II

Galios theory: Automorphism of fields, Monomorphisms and their linear independence, Fixed fields, Normal extensions, Normal closure of an extension, The fundamental theorem of Galois theory, Norms and traces.

Section - III

Normal basis, Galios fields, Cyclotomic extensions, Cyclotomic polynomials, Cyclotomic extensions of rational number field, Cyclic extension, Wedderburn theorem.

Section - IV

Ruler and compasses construction, Solutions by radicals, Extension by radicals, Generic polynomial, Algebraically independent sets, Insolvability of the general polynomial of degree $n \geq 5$ by radicals.

Note : The question paper of each course will consist of **five** Sections. Each of the sections **I to IV** will contain **two** questions and the students shall be asked to attempt **one** question from each. **Section-V** shall be **compulsory** and will contain **eight** short answer type questions without any internal choice covering the entire syllabus.

Books Recommended :

1. I.S. Luther and I.B.S.Passi, Algebra, Vol. IV-Field Theory, Narosa Publishing House, 2012.
2. Ian Stewart, Galios Theory, Chapman and Hall/CRC, 2004.
3. VivekSahai and VikasBist, Algebra, Narosa Publishing House, 1999.
4. P.B. Bhattacharya, S.K. Jain and S.R. Nagpaul, Basic Abstract Algebra (2nd Edition), Cambridge University Press, Indian Edition, 1997.
5. S. Lang, Algebra, 3rd editioin, Addison-Wesley, 1993.
6. Ian T. Adamson, Introduction to Field Theory, Cambridge University Press, 1982.
7. I.N.Herstein, Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975.

16MMC22C2: Measure and Integration Theory

Time: 03 Hours ***Credits :3:1:0***
Max Marks : 80

Course Outcomes

Students would be able to:

CO1 Describe the shortcomings of Riemann integral and benefits of Lebesgue integral.
CO2 Understand the fundamental concept of measure and Lebesgue measure.
CO3 Learn about the differentiation of monotonic function, indefinite integral, use of the fundamental theorem of calculus.

Section - I

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, Borelset, Equivalent formulation of measurable set sin terms of open, Closed, $F_\sigma$and $G_\delta$sets, Nonmeasurablesets.

Section - II

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 theorem, Lusin theorem, Convergence in measure and F. Riesztheorem.Almost uniform convergence.

Section - III

Short comings 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, FatouLemma, Monotone convergence theorem, General Lebesgue Integral, Lebesgue convergencetheorem.

Section - IV

Vitali 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.

Note : The question paper of each course will consist of **five** Sections. Each of the sections **I to IV** will contain **two** questions and the students shall be asked to attempt **one** question from each. **Section-V** shall be **compulsory** and will contain **eight** short answer type questions without any internal choice covering the entire syllabus.

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, 1976.
6. R. G. Bartle, The Elements of Real Analysis, Wiley International Edition, 2011.

16MMC22C3: Integral Equations and Calculus of Variations

Time: 03 Hours ***Credits : 4:1:0***
Max Marks : 80

Course Outcomes

Students would be able to:

CO1 Understand the methods to reduce Initial value problems associated with linear differential equations to various integral equations.

CO2 Categorise and solve different integral equations using various techniques.

CO3 Describe importance of Green's function method for solving boundary value problems associated with non-homogeneous ordinary and partial differential equations, especially the Sturm-Liouville boundary value problems.

CO4 Learn methods to solve various mathematical and physical problems using variational techniques.

Section - I

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. Laplace transfrom method for a difference kernel. Solution of a Volterra integral equation of the first kind.

Section - II

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. Fredholmresolvent kernel as a ratio of two series. Fredholm equations with separable kernels. Approximation of a kernel by a separable kernel, Fredholm Alternative, Non homonogenousFredholm equations with degenerate kernels.

Section - III

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

Section - IV

Motivating problems of calculus of variations, Shortest distance, Minimum surface of resolution, Brachistochrone problem, Isoperimetric problem, Geodesic. Fundamental lemma of calculus of variations, Euler 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 of each course will consist of **five** Sections. Each of the sections **I to IV** will contain **two** questions and the students shall be asked to attempt **one** question from each. **Section-V** shall be **compulsory** and will contain **eight** short answer type questions without any internal choice covering the entire syllabus.

Books Recommended:

1. A.J. Jerri, I*ntroduction to Integral Equations with Applications,*A Wiley-Interscience Publication, 1999.

2. R.P. Kanwal, L*inear Integral Equations*, Theory and Techniques, Academic Press, New York.
3. W.V. Lovitt, L*inear Integral Equations*, McGraw Hill, New York.
4. F.B. Hilderbrand, M*ethods of Applied Mathematics*, Dover Publications.
5. J.M. Gelfand and S.V. Fomin, C*alculus of Variations*, Prentice Hall, New Jersy, 1963.

16MMC22C4: Partial Differential Equations

Time: 03 Hours ***Credits : 4:1:0***
Max Marks : 80

Course Outcomes

Students would be able to:

CO1 Establish a fundamental familiarity with partial differential equations and their applications.
CO2 Distinguish between linear and nonlinear partial differential equations.
CO3 Solve boundary value problems related to Laplace, heat and wave equations by various methods.
CO4 Use Green's function method to solve partial differential equations.
CO5 Find complete integrals of Non-linear first order partial differential equations.

Section – I

Method of separation of variables to solve Boundary Value Problems (B.V.P.) associated with one dimensional heat equation. Steady state temperature in a rectangular plate, Circular disc, Semi-infinite plate. The heat equation in semi-infinite and infinite regions. Solution of three dimensional Laplace equations, Heat Equations, Wave Equations in cartesian, cylindrical and spherical coordinates. 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. (Relevant topics from the book by O'Neil)

Section - II

Partial differential equations: Examples of PDE classification. Transport equation – Initial value problem. Non-homogeneous equations.
Laplace equation – Fundamental solution, Mean value formula, Properties of harmonic functions, Green function.

Section - III

Heat Equation – Fundamental solution, Mean value formula, Properties of solutions, Energy methods.
Wave Equation – Solution by spherical means, Non-homogeneous equations, Energy methods.

Section - IV

Non-linear first order PDE – Complete integrals, Envelopes, Characteristics, Hamilton Jacobi equations (Calculus of variations, Hamilton ODE, Legendre transform, Hopf-Lax formula, Weak solutions, Uniqueness).

Note : The question paper of each course will consist of **five** Sections. Each of the sections **I to IV** will contain **two** questions and the students shall be asked to attempt **one** question from each. **Section-V** shall be **compulsory** and will contain **eight** short answer type questions without any internal choice covering the entire syllabus.

Books Recommended:

1. I.N. Sneddon, Elements of Partial Differential Equations, McGraw Hill, New York.
2. Peter V. O'Neil, Advanced Engineering Mathematics, ITP.
3. L.C. Evans, Partial Differential Equations: Second Edition (Graduate Studies in Mathematics) 2nd Edition, American Mathematical Society, 2010.

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.

16MMC22C5: Object Oriented Programming with C++

Credits : 2:0:2

Course Outcomes

Students would be able to:

CO1 Apply C++ features to design and implement a program.

CO2 Develop solutions to problems demonstrating usage of data abstraction, encapsulation and inheritance.

CO3 Program using C++ features such as operators overloading, polymorphism, streams, exception handling etc.

CO4 Implement practical applications and analyze issues related to object-oriented techniques in the C++ programming language.

Part-A (Theory)

Time : 03 Hours

Max Marks : 60

Section - I

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

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

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

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 of each course will consist of **five** Sections. Each of the sections **I to IV** will contain **two** questions and the students shall be asked to attempt **one** question from each. **Section-V** shall be **compulsory** and will contain **eight** short answer type questions without any internal choice covering the entire syllabus.

Books Recommended:

1. I.S. Robert Lafore, Waite 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 Outline Series, Tata Mc Graw Hill Pub. Co.
4. J.N. Barakaki, Object Oriented Programming using C++, Prentic Hall of India, 1996.

Part-B (Practical)

Time: 03 Hours
Max Marks : 40

There will be a separate practical course based on the above theory course (i.e. **16MMC22C5: Object Oriented Programming with C++)**.

16MMC22D1: Data Communication and Networking

Credits : 2:0:2

Course Outcomes

Students would be able to:

CO1 Understand the fundamental concepts of data communications and networking.
CO2 Identify the importance of the ISO 7-layer reference model.
CO3 Emphasize on the area of computer networks in terms of connectivity and mobility along with role of communication protocols.
CO4 Describe the design principles of wired and wireless communication networks.
CO5 Learn the way to model and analyze the functioning of commonly used network architectures.

Part-A (Theory)

Time : 03 Hours
Max Marks :60

Section - I

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.

Section - II

Computer networks: Definition, Need for computer networks, Advantages of networks, Hardware and software requirements. Reference models: OSI reference model, TCP/IP reference model.

Section - III

Types of network: LAN, MAN, WAN, Value added network and their features, Network topologies. Switching Techniques: Circuit switching, Message switching and Packet switching.

Section - IV

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

Note : The question paper of each course will consist of **five** Sections. Each of the sections **I to IV** will contain **two** questions and the students shall be asked to attempt **one** question from each. **Section-V** shall be **compulsory** and will contain **eight** short answer type questions without any internal choice covering the entire syllabus.

Books Recommended:

1. 1.A.F. Behrou, Data Communication & Networking, Tata Mc-Graw Hill
2. S.T. Andrew, Computer Networks,
3. Nasib S. Gill, Essentials of computer and Network Technology, Khanna Book Publishing.
4. M Jain and Satish Jain, Data Communication & Networking, BPB Pub.
5. Hemant Kapila, Data Communication & Networking, S. Dinesh & Co.

Part-B (Practical)

Time: 03 Hours
Max Marks :40

There will be a separate practical course based on the above theory course (i.e. **16MMC22D1: Data Communication and Networking)**.

16MMC22D2 :Information and Communication Technology

Credits : 2:0:2

Course Outcomes

Students would be able to:

CO1 Understand various types of computer networks and transmission Protocols.

CO2 Implement the installation, handling and safe usage of software's studied in theory.

CO3 Understand and analyze the appropriateness of methodologies and technologies for the design and implementation of ICT solutions.

CO4 Understand different type of threats, technologies, ethics and issues related to ICT.

CO5 Demonstrate ICT infrastructure and articulate the relationships and interdependencies between technologies.

Part-A (Theory)

Time : 03 Hours
Max Marks :60

Section - I

Data, Information and knowledge, ICT – definition, Scope, Importance & Nature of Information & Communication Technology, Applications.

Computer System: Classification of digital computers, System hardware, Memory units and auxiliary storage devices, Peripheral devices (Input and output devices), Software, Open source software and open standards.

Computer networks, Networking Instruments, Communication devices, Transmission media (Bound links and Unbound links) and Switches.

Section - II

World Wide Web – History, Difference between Internet and www, Search engines. Web Servers: What is a server; Server software, Services provided by servers and their types.

Website: Definition, Portal, Components of website, Building a website, Elements of website, Software to create website. Web pages: Definition, Working, Static and dynamic areas, Website vs. webpage, Web Browser: the tool bar, SSL, Names of various web browsers. Blogs- Definition of blog and bloggers, Advantages and disadvantages of blogging. URL: definition, Elements absolute and relative URL. Protocols: definition, TCP/IP, HTTP, FTP which one to use when and why, Applications and examples.

Section - III

Concept of web services, Email: Definition, Protocols used in email services, Mail account and address, Sending and receiving an email, Features like cc, Bcc, Spam and junk, Email etiquettes-proper structure and layout, Case sensitivity, disclaimer to email, Care with abbreviations and emotions, Chat : Definition, Chat room, Commonly used types of chat.

Video conferencing: definition, Areas of application, Advantages and disadvantages of videoconferencing.

e-learning: definition, Benefits, Application areas, E-learning software. e-shopping: definition, Advantages and dis-advantages, Sites available, Threats and security concerns.

e-reservation: definition, Benefits, Application areas, Reservation process, Live and non-live reservation e-group: definition, Features, Benefits. Social Networking: definition, Names of various social networking web sites, Merits and demerits, Service providers, Features available, Ethics.

Section - IV

Virus- definition, Types, Virus spread, Protection, Current threats. Worms- definition, Types, Spread, Protection, Current threats. Trojans- definition, Trojan spread, Protection. Spyware- definition, Symptoms, Prevention and protection. Malware- definition, Types, Prevention. Spams- definition, Detection and prevention. Hackers and Crackers- definition, Tools available, Types of hacking, Difference between hackersand crackers. Antivirus tools- free and paid tools, Latest tools, There style of working, Importance of regular update.

Note : The question paper of each course will consist of **five** Sections. Each of the sections **I to IV** will contain **two** questions and the students shall be asked to attempt **one** question from each. **Section-V** shall be **compulsory** and will contain **eight** short answer type questions without any internal choice covering the entire syllabus.

Books Recommended:

1. Chris Abbott, ICT: Changing Education, Routledge Falmer
2. Wong, M.L. Emily, S.C. Sandy, Tat-heung Choi, and Tsz-ngong Lee, Insights into Innovative Classroom Practices with ICT: Identifying the Impetus for Change, Education Technology & Society.
3. Ann Hatherly, ICT and the greatest Technology: A Teacher Mind, Early Childhood Folio
4. Mary Hayes, David Whitebread, ICT in the Early Years, Open University Press.

Part-B (Practical)

Time: 03 Hours
Max Marks : 40

There will be a separate practical course based on the above theory course (i.e. **16MMC22D2 :Information and Communication Technology)**.

16MMC22SO1 : Mathematics for Finance and Insurance

Time: 03 Hours ***Credits :3:0:0***
Max Marks : 80

Course Outcomes

Students would be able to:

CO1 Demonstrate knowledge of the terminology related to nature, scope, goals, risks and decisions of financial management.

CO2 Predict various types of returns and risks in investments and take necessary protective measures for minimizing the risk.

CO3 Develop ability to understand, analyse and solve problems in bonds, finance and insurance.

CO4 Build skills for computation of premium of life insurance and claims for general insurance using probability distributions.

Section - I

Financial Management – overview. Nature and scope of financial management. Goals and main decisions of financial management. Difference between risk, Speculation and gambling. Time value of Money - Interest rate and discount rate. Present value and future value-discrete case as well as continuous compounding case. Annuities and its kinds.

Section - II

Meaning of return. Return as Internal Rate of Return (IRR). Numerical methods like Newton Raphson method to calculate IRR. Measurement of returns under uncertainty situations. Meaning of risk. Difference between risk and uncertainty. Types of risks. Measurements of risk. Calculation of security and Portfolio Risk and Return-Markowitz Model. Sharpe Single Index Model- Systematic Risk and Unsystematic Risk.

Section - III

Taylor series and Bond Valuation. Calculation of Duration and Convexity of bonds.
Insurance Fundamentals – Insurance defined. Meaning of loss. Chances of loss, Peril, Hazard, proximate cause in insurance. Costs and benefits of insurance to the society and branches of insurance-life insurance and various types of general insurance. Insurable loss exposures- feature of a loss that is ideal for insurance.

Section - IV

Life Insurance Mathematics – Construction of Morality Tables. Computation of Premium of Life Insurance for a fixed duration and for the whole life. Determination of claims for General Insurance – Using Poisson Distribution and Negative Binomial Distribution –the Polya Case.
Determination of the amount of Claims of General Insurance – Compound Aggregate claim model and its properties, Claims of reinsurance. Calculation of a compound claim density function F, Recursive and approximate formulae for F.

Note : The question paper of each course will consist of **five** Sections. Each of the sections **I to IV** will contain **two** questions and the students shall be asked to attempt **one**question from each. **Section-V** shall be **compulsory** and will contain **eight** short answer type questions without any internal choice covering the entire syllabus.

Books Recommended:

1. AswathDamodaran, Corporate Finance - Theory and Practice, John Wiley & Sons, Inc.
2. John C. Hull, Options, Futures, and Other Derivatives, Prentice-Hall of India Private Limited.
3. Sheldon M. Ross, An Introduction to Mathematical Finance, Cambridge University Press.
4. Mark S. Dorfman, Introduction to Risk Management and Insurance, Prentice Hall, Englwood Cliffs, New Jersey.
5. C.D. Daykin, T. Pentikainen and M. Pesonen, Practical Risk Theory for Actuaries, Chapman & Hall.
6. Salih N. Neftci, An Introduction to the Mathematics of Financial Derivatives, Academic Press, Inc.
7. Robert J. Elliott and P. Ekkehard Kopp, Mathematics of Financial Markets, Sprigner-Verlag, New York Inc.

16MMC22SO2: Statistics through SPSS

Credits : 1:0:2

Course Outcomes

Students would be able to:

CO1 Learn basic workings of SPSS and perform a wide range of data management tasks in SPSS with the understanding of different types of data and scales of their measurement..

CO2 Plot various kinds of chart and graph for analysis of data.

CO3 Obtain descriptive statistics and basic inferential statistics for comparisons using SPSS.

CO4 Apply basic statistical parametric and non-parametric tests for the given data.

CO5 Carry out correlation, regression and factor analysis through the use of SPSS.

Part-A (Theory)

Time: 03 Hours

Max Marks: 40

Section – I

Data: Qualitative and quantitative data, Cross-sectional and time series data, Univariate and multivariate data. Scales of measurement of data. SPSS data file: Opening a data file in SPSS, SPSS Data Editor, Creating a data file, Editing and manipulating data, Missing values, Editing SPSS output, Copying SPSS output, Printing from SPSS, Importing data.

Section – II

Descriptive statistics with SPSS: Measures of central tendency, Dispersion, Skewness, Kurtosis. Charts and graphs with SPSS: Frequencies, Bar charts, Pie charts, Line graphs, Histograms, Box plots.

Section – III

Statistical tests using SPSS: Normality tests, t-tests, F-test, One way and Two way ANOVA, Non-parametric tests- Chi Square, Spearman rank, Maan Whitney U and Wilcoxon signed rank test.

Section – IV

Correlation and regression using SPSS: Linear correlation and regression, Multiple regression. Factor analysis using SPSS.

Note : The question paper of each course will consist of **five** Sections. Each of the sections **I to IV** will contain **two** questions and the students shall be asked to attempt **one** question from each. **Section-V** shall be **compulsory** and will contain **eight** short answer type questions without any internal choice covering the entire syllabus.

Books Recommended:

1. S.L. Gupta and H. Gupta, SPSS for Researchers, International Book House Pvt. Ltd.
2. A. Field, Discovering Statistics using SPSS, SAGE Publications.
3. V. Gupta, SPSS for Beginners, VJ Books Inc.
4. A. Rajathi and P. Chandran, SPSS for you, MJP Publishers

Part-B (Practical)

Time: 03 Hours
Max Marks : 60

There will be a separate practical course based on the above theory course. All practicals are required to be done using SPSS (i.e. **16MMC22DO2: Statistics through SPSS).**

Scheme of Examination of
M.Sc. Mathematics with Computer Science, Semester- III
(w.e.f. Session 2017-18)

Course Code	Title of the Course	External Marks	Internal Marks	Practical Marks	Credit (L:T:P)
Core					
17MMC23C1	Functional Analysis	80	20	--	3:1:0
17MMC23C2	Elementary Topology	80	20	--	3:1:0
17MMC23C3	Fluid Dynamics	80	20	--	3:1:0
17MMC23C4	Mathematical Statistics	80	20	--	3:1:0
Discipline Specific Elective					
Group A (Choose Any One)					
17MMC23DA1	Computer Graphics	60	--	40	2:0:2
17MMC23DA2	Multimedia Technologies	60	--	40	2:0:2
17MMC23DA3	System Analysis and Design	60	--	40	2:0:2
17MMC23DA4	Computer Security	60	--	40	2:0:2
17MMC23DA5	Mathematical Modeling	80	20	--	3:1:0
17MMC23DA6	Discrete Mathematics	80	20	--	3:1:0
Group B (Choose Any One)					
17MMC23DB1	MATLAB	60	--	40	2:0:2
17MMC23DB2	Software Engineering	60	--	40	2:0:2
17MMC23DB3	Internet Fundamentals	60	--	40	2:0:2
17MMC23DB4	Core Java	60	--	40	2:0:2
17MMC23DB5	Information Security	60	--	40	2:0:2
17MMC23DB6	Analytical Number Theory	80	20	--	3:1:0

Open Elective	
To be Chosen from the pool of open electives provided by the university (excluding the open elective prepared by the Department of Mathematics).	3

Discipline SpecificCourses for the students who will not opt for open elective. These courses also be taken as open elective by the students of other departments (Choose any one)					
17MMC23SO1	Multivariate Analysis	80	20	--	3:0:0
17MMC23SO2	Graph Theory	80	20	--	3:0:0

Total Credits : 30

Note 1 : The Criteria for awarding internal assessment of 20 marks shall be as under:

A)	Class test	:	10 marks.
B)	Assignment & Presentation	:	5 marks
C)	Attendance	:	5 marks
	Less than 65%		*: 0 marks*
	Upto 70%	*:*	*2 marks*
	Upto 75%	*:*	*3 marks*
	Upto 80%	*:*	*4 marks*
	Above 80%	*:*	*5 marks*

Note 2 : The syllabus of each course will be divided into **four** Sections of **two** questions each. The question paper of each course will consist of **five** Sections. Each of the sections I to IV will contain two questions and the students shall be asked to attempt **one** question from each Section. Section - V shall be compulsory and shall contain **eight** short answer type questions without any internal choice covering the entire syllabus.

Note 3 : Elective courses can be offered subject to availability of requisite resources/ faculty.

17MMC23C1: Functional Analysis

Time: 03 Hours ***Credits :3:1:0Max***
Marks : 80

Course Outcomes

Students would be able to:

CO1 Be familiar with the completeness in normed linear spaces.
CO2 Understand the concepts of bounded linear transformation, equivalent formulation of continuity and spaces of bounded linear transformations.
CO3 Describe the solvability of linear equations in Banach Spaces, weak and strong convergence and their equivalence in finite dimensional space.
CO4 Learn the properties of compact operators.
CO5 Understand uniform boundedness principle and its consequences.

Section - I

Normed linear spaces, Metric on normed linear spaces, Completion of a normed space, Banach spaces, subspace of a Banach space, Holder and Minkowski 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.

Section - II

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).

Section - III

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.

Section - IV

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.

Note : The question paper of each course will consist of **five** Sections. Each of the sections **I to IV** will contain **two** questions and the students shall be asked to attempt **one** question from each. **Section-V** shall be **compulsory** and will contain **eight** short answer type questions without any internal choice covering the entire syllabus.

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, Anamaya Publishers, New Delhi-2006.
5. K.C. Rao, Functional Analysis, Narosa Publishing House, Second edition.

17MMC23C2: Elementary Topology

Time: 03 Hours ***Credits :3:1:0***
Max Marks : 80

Course Outcomes

Students would be able to:

CO1 Get familiar with the concepts of topological space and continuous functions.
CO2 Generate new topologies from a given set with bases.
CO3 Describe the concept of homeomorphism and topological invariants.
CO4 Establish connectedness and compactness of topological spaces and proofs of related theorems.
CO5 Have in-depth knowledge of separation axioms and their properties.

Section - I

Definition and examples of topological spaces, Comparison of topologies on a set, Intersection and union of topologies on a set, 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, Alternative methods of defining a topology in terms of neighbourhood system and Kuratowski closure operator.

Section - II

Relative(Induced) topology, Base and subbase for a topology, Base for Neighbourhood system. Continuous functions, Open and closed functions , Homeomorphism. Connectedness and its characterization, Connected subsets and their properties, Continuity and connectedness, Components, Locally connected spaces.

Section - III

Compact spaces and subsets, Compactness in terms of finite intersection property, Continuity and compact sets, Basic properties of compactness, Closeness of compact subset and a continuous map from a compact space into a Hausdorff and its consequence. Sequentially and countably compact sets, Local compactness and one point compatification.

Section - IV

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, Lindelof theorem. T_0, T_1, T_2 (Hausdorff) separation axioms, their characterization and basic properties.

Note : The question paper of each course will consist of **five** Sections. Each of the sections **I to IV** will contain **two** questions and the students shall be asked to attempt **one** question from each. **Section-V** shall be **compulsory** and will contain **eight** short answer type questions without any internal choice covering the entire syllabus.

Books Recommended :

1. C.W.Patty, Foundation of Topology, Jones &Bertlett, 2009.

2. Fred H. Croom, Principles of Topology, Cengage Learning, 2009.
3. George F. Simmons, Introduction to Topology and Modern Analysis, McGraw-Hill Book Company, 1963.
4. J. L. Kelly, General Topology, Springer Verlag, New York, 2000.
5. J. R. Munkres, Toplogy, Pearson Education Asia, 2002.
6. K. Chandrasekhara Rao, Topology, Narosa Publishing House Delhi,2009.
7. K.D. Joshi, Introduction to General Topology, Wiley Eastern Ltd, 2006.

17MMC23C3: Fluid Dynamics

Time: 03 Hours ***Credits : 3:1:0***
Max Marks : 80

Course Outcomes

Students would be able to:

CO1 Be familiar with continuum model of fluid flow and classify fluid/flows based on physical properties of a fluid/flow along with Eularian and Lagrangian descriptions of fluid motion.

CO2 Derive and solve equation of continuity, equations of motion, vorticity equation, equation of moving boundary surface, pressure equation and equation of impulsive action for a moving inviscid fluid.

CO3 Calculate velocity fields and forces on bodies for simple steady and unsteady flow including those derived from potentials.

CO4 Understand the concepts of velocity potential, stream function and complex potential, and their use in solving two-dimensional flow problems applying complex-variable techniques.

CO5 Represent mathematically the potentials of source, sink and doublets in two-dimensions as well as three-dimensions, and study their images in impermeable surfaces.

Section - I

Kinematics - Velocity at a point of a fluid. Eulerian and Lagrangian methods. Stream lines, path lines and streak lines. Velocity potential. Irrotational and rotational motions. Vorticity and circulation. Equation of continuity. Boundary surfaces. Acceleration at a point of a fluid. Components of acceleration in cylindrical and spherical polar co-ordiantes.

Section - II

Pressure at a point of a moving fluid. Euler equation of motion. Equations of motion in cylindrical and spherical polar co-ordinates. Bernoulli equation. Impulsive motion. Kelvin circulation theorem. Vorticity equation. Energy equation for incompressible flow. Kinetic energy of irrotational flow. Kelvin minimum energy theorem. Kinetic energy of infinite fluid. Uniqueness theorems.

Section - III

Axially symmetric flows. Liquid streaming part a fixed sphere. Motion of a sphere through a liquid at rest at infinity. Equation of motion of a sphere. Kinetic energy generated by impulsive motion. Motion of two concentric spheres.

Three-dimensional sources, sinks and doublets. Images of sources, sinks and doublets in rigid impermeable infinite plane and in impermeable spherical surface.

Section - IV

Two dimensional motion; Use of cylindrical polar co-ordinates. Stream function. Axisymmetric flow. Stoke stream function. Stoke stream function of basic flows.

Irrotational motion in two-dimensions. Complex velocity potential. Milne-Thomson circle theorem. Two-dimensional sources, sinks, doublets and their images. Blasius theorem.

Note : The question paper of each course will consist of **five** Sections. Each of the sections **I to IV** will contain **two** questions and the students shall be asked to attempt **one** question from each. **Section-V** shall be **compulsory** and will contain **eight** short answer type questions without any internal choice covering the entire syllabus.

Books Recommended:

1. W.H. Besaint and A.S. Ramasey, A Treatise on Hydromechanics, Part II, CBS Publishers, Delhi, 1988.
2. F. Chorlton, Text Book of Fluid Dynamics, C.B.S. Publishers, Delhi, 1985
3. O'Neill, M.E. and Chorlton, F., Ideal and Incompressible Fluid Dynamics, Ellis Horwood Limited, 1986.
4. R.K. Rathy, An Introduction to Fluid Dynamics, Oxford and IBH Publishing Company, New Delhi, 1976.
5. G.K. Batchelor, An Introduction to Fluid Mechanics, Foundation Books, New Delhi,1994.

17MMC23C4 : Mathematical Statistics

Time: 03 Hours ***Credits :3:1:0***
Max Marks : 80

Course Outcomes

Students would be able to:

CO1 Understand the mathematical basis of probability and its applications in various fields of life.

CO2 Use and apply the concepts of probability mass/density functions for the problems involving single/bivariate random variables.

CO3 Have competence in practically applying the discrete and continuous probability distributions along with their properties.

CO4 Decide as to which test of significance is to be applied for any given large sample problem.

Section - I

Probability: Definition and various approaches of probability, Addition theorem, Boole inequality, Conditional probability and multiplication theorem, Independent events, Mutual and pairwise independence of events, Bayes theorem and its applications.

Section - II

Random variable and probability functions:Definition and properties of random variables, Discrete and continuous random variables, Probability mass and density functions, Distribution function. Concepts of bivariate random variable: joint, marginal and conditional distributions.

Mathematical expectation: Definition and its properties. Variance, Covariance, Moment generating function- Definitions and their properties.

Section - III

Discrete distributions:Uniform, Bernoulli, Binomial, Poisson and Geometric distributions with their properties.

Continuous distributions: Uniform, Exponential and Normal distributions with their properties.

Section - IV

Testing of hypothesis: Parameter and statistic, Sampling distribution and standard error of estimate, Null and alternative hypotheses, Simple and composite hypotheses, Critical region, Level of significance, One tailed and two tailed tests, Two types of errors.

Tests of significance: Large sample tests for single mean, Single proportion, Difference between two means and two proportions.

Note : The question paper of each course will consist of **five** Sections. Each of the sections **I to IV** will contain **two** questions and the students shall be asked to attempt **one** question from each. **Section-V** shall be **compulsory** and will contain **eight** short answer type questions without any internal choice covering the entire syllabus.

Books recommended :

1. V. Hogg and T. Craig, Introduction to Mathematical Statistics , 7^{th} addition, Pearson Education Limited-2014
2. A.M. Mood, F.A. Graybill, and D.C. Boes, Introduction to the Theory of Statistics, Mc Graw Hill Book Company.
3. J.E. Freund, Mathematical Statistics, Prentice Hall of India.
4. M. Speigel, Probability and Statistics, Schaum Outline Series.
5. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, S. Chand Pub., New Delhi.

17MMC23DA1: Computer Graphics

Credits : 2:0:2

Course Outcomes

Students would be able to:

CO1 Gain programming skills in language C for writing applications that produce 2D and 3D computer graphics.

CO2 Learn the principles and commonly used paradigms and techniques of computer graphics.

CO3 Write basic graphics application programs including animation.

CO4 Design and code programs for 2-D and 3-D transformations, clipping, filling area and hidden surface removal.

Part-A (Theory)

Time : 03 Hours
Max Marks : 60

Section – I

Introduction to Computer Graphics: What is Computer Graphics, Computer Graphics Applications, Two Dimensional Graphics Primitives C Graphics Introduction: Graphics Mode Initialization in C, C Graphics Functions Line drawing algorithms: DDA, Bresenham Line Drawing Algorithm. Circle drawing algorithms: Bresenham circle drawing, Midpoint circle drawing algorithm.

Section - II

Two/Three Dimensional Viewing: The 2-D Viewing Pipeline, Windows, Viewports, Window to View Port Mapping. Two dimensional transformations: Transformations, Translation, Scaling, Rotation, Reflecti*/*=on, Composite Transformation. Three dimensional transformations: Three dimensional graphics concept, Matrix representation of 3-D Transformations, Composition of 3-D transformation.

Section - III

Clipping: Point and Line Clipping - 4 Bit Code Algorithm, Sutherland-Cohen Algorithm
Polygon Clipping: Sutherland-Hodgeman Polygon Clipping Algorithm.

Section – IV

Filled area algorithms: Scanline Polygon filling algorithm, Boundary filled algorithm.
Hidden surface removal: Introduction to hidden surface removal. The Z- buffer algorithm, Scanline algorithm, Area subdivision algorithm.

Note : The question paper of each course will consist of **five** Sections. Each of the sections **I to IV** will contain **two** questions and the students shall be asked to attempt **one** question from each. **Section-V** shall be **compulsory** and will contain **eight** short answer type questions without any internal choice covering the entire syllabus.

Books Recommended:

1. Computer Graphics Principles and Practices second editionby James D. Foley, Andeies van Dam, Stevan K. FeinerandJohb F. Hughes, 2000, Addision Wesley.
2. Computer Graphics by Donald Hearn and M.Pauline Baker,2nd Edition, 1999, PHI

3. Procedural Elements for Computer Graphics – David F.Rogers, 2001, T.M.H Second Edition
4. Fundamentals of 3 Dimensional Computer Graphics by AlanWatt, 1999, Addision Wesley.
5. Computer Graphics: Secrets and Solutions by Corrign John,BPB
6. Graphics, GUI, Games & Multimedia Projects in C byPilania&Mahendra, Standard Publ.
7. Computer Graphics Secrets and solutions by Corrign John,1994, BPV
8. Introduction to Computer Graphics By N. KrishanmurthyT.M.H, 2002

Part-B (Practical)

Time: 03 Hours
Max Marks : 40

There will be a separate practical course based on the above theory course (i.e. **17MMC23DA1: Computer Graphics)**.

17MMC23DA2:Multimedia Technologies

Credits : 2:0:2

Course Outcomes

Students would be able to:

CO1 Understand the concepts of multimedia systems.

CO2 Familiar with the concepts of text, audio text and audio tools.

CO3 Understand the concepts of MIDI image and video image, synchronization accuracy specification factors.

CO4 Learn about the concepts of image and video compression.

Part-A (Theory)

Time : 03 Hours

Max Marks :60

Section - I

Introduction to Multimedia, Building blocks of Multimedia, Multimedia and Hypermedia, History of Multimedia, Features of multimedia, Applications of Multimedia system, Stages of Multimedia Application Development.

Section - II

Audio: Aims and Objectives, Power of sound, Multimedia sound system, Digital Audio, Digitization of sound, Editing Digital Recordings, Making MIDI Audio, Audio file formats, Hardware Aspects of MIDI, Structure of MIDI Messages, Software used for Audio, Quantization and Transmission of Audio.

Section - III

Images: Introduction, Digital Images, Image file formats, Graphics / Image Data types, Bitmaps, Making still images, Vectored drawing, Color Science, Color Models in Images.

Section - IV

Videos: Fundamental concepts of videos, Type of Video Signals, Analog video, Digital video, Color Models in Video, Principles of Animation, Animation techniques, File Formats, Shooting and editing video, Video Compression.

Note : The question paper of each course will consist of **five** Sections. Each of the sections **I to IV** will contain **two** questions and the students shall be asked to attempt **one** question from each. **Section-V** shall be **compulsory** and will contain **eight** short answer type questions without any internal choice covering the entire syllabus.

Books Recommended:

1.Ze-Nian Li and Mark S. Drew, Fundamentals of Multimedia, Pearson Education.
2. S. Gokul : Multimedia Magic, BPB Publication.
3. Bufford : Multimedia Systems, Addison Wesley.
4. Jeffcoate : Multimedia in Practice, Prectice-Hall.

Part-B (Practical)

Time: 03 Hours
Max Marks : 40

There will be a separate practical course based on the above theory course (i.e. **17MMC23DA2:Multimedia Technologies**).

17MMC23DA3:System Analysis and Design

Credits: 2:0:2

Course Outcomes

Students would be able to:

CO1 Carry out a feasibility analysis, create a project plan and explain project deliverables.
CO2 Explain how to determine the project resource requirements and project budget.
CO3 Analyze Data Flow diagrams, ER diagrams and Critical Path.
CO4 Define hardware and software specifications and identify the techniques for testing.
CO5 Understand systems migration plan, systems maintenance plan and the preservation of the project documentation.

Part-A (Theory)

Time : 03 Hours
Max Marks : 60

Section - I

System Concept: Definition, Characteristics, Elements of system, Physical and abstract system, Open and closed system, Man-made information systems. System Development Life Cycle: Various phases of system development, Considerations for system planning and control for system success, Role of system analyst.

Section - II

System Planning: Bases for planning in system analysis: Dimensions of Planning. Initial Investigation: Determining user's requirements and analysis, Fact finding process and techniques. Tools of structured Analysis: Data Flow diagram, Data dictionary, IPO and HIPO charts, Gantt charts, Pseudo codes, Flow charts, Decision tree, Decision tables. Feasibility study: Technical, Operational & Economic Feasibilities.

Section - III

Cost/Benefit Analysis: Data analysis cost and benefit analysis of a system. Input/ Output and Form Design, File Organization and Database design: Introduction to files and database, File structures and organization, Objectives of database design, Logical and physical view of data.

Section - IV

System testing: Introduction, Objectives of testing, Test planning, Testing techniques. Quality assurance: Goal of quality assurance, Levels of quality assurance. System implementation and software maintenance: Primary activities in maintenance, Reducing maintenance costs.

Note : The question paper of each course will consist of **five** Sections. Each of the sections **I to IV** will contain **two** questions and the students shall be asked to attempt **one** question from each. **Section-V** shall be **compulsory** and will contain **eight** short answer type questions without any internal choice covering the entire syllabus.

Books Recommended:

1. Awad M. Elias, "System Analysis and Design", Galgotia Publication.
2. Igor Hawryszkiewyez, "Introduction to System Analysis and Design", 4th edition, Prentice-Hall.

3. Jeffrey L. Whitten, And Lonnie D. Bentey, “Systems analysis and Design Methods”, 4th edition, Tata McGraw-Hill.
4. Mark Lejk, And David Deeks, “An Introduction to System Analysis Techniques”, Prentice Hall.
5. Don Yeates, Maura Shields and David Helmy, “System Analysis and Design”, Longman group limited, 1994.

Part-B (Practical)

Time: 03 Hours
Max Marks :40

There will be a separate practical course based on the above theory course (i.e. **17MMC23DA3:System Analysis and Design**).

17MMC23DA4: Computer Security

Credits: 2:0:2

Course Outcomes

Students would be able to:

CO1 Understand the concepts of computer security and vulnerabilities of IT systems.
CO2 Learn the security threats and ways to address them.
CO3 Understand the principles underlying cryptography and cryptanalysis.
CO4 Explain the key cryptographic concepts and technologies including symmetric and asymmetric encryption, hashing etc.
CO5 Design security solutions and apply techniques including cryptography and security protocols.

Part-A (Theory)

Time : 03 Hours
Max Marks : 60

Section - I

Introduction Basic concepts: threats, Vulnerabilities, Controls; Risk; Confidentiality, Integrity, Availability; Security policies, Security mechanisms; Assurance; Prevention, Detection, Deterrence.

Security as Risk Management, Aspects of Security.

Basic cryptography, Basic cryptographic terms, Historical background, Symmetric crypto primitives, Modes of operation, Cryptographic hash functions, Asymmetric crypto primitives, Properties of Ciphers.

Section - II

Program security, Flaws, Malicious code: Viruses, Trojan horses, Worms, Program flaws: Buffer overflows, Time-of-check to time-of-use flaws, Incomplete mediation. Defences, Software development controls, Testing techniques, Security in conventional operating systems, Memory, Time, File, Object protection requirements and techniques, Protection in contemporary operating systems.

Section - III

Identification and authentication, Identification goals, Authentication requirements, Human authentication, Machine authentication.

Trusted operating systems: Assurance, Trust, Design principles, Evaluation criteria, Evaluation process.

Section - IV

Database management systems security, Database integrity, Database secrecy, Inference control, Multi-level databases.

Management of security, Security policies, Risk analysis, Physical threats and controls, Legal aspects of security, Privacy and ethics.

Note : The question paper of each course will consist of **five** Sections. Each of the sections **I to IV** will contain **two** questions and the students shall be asked to attempt **one** question from each. **Section-V** shall be **compulsory** and will contain **eight** short answer type questions without any internal choice covering the entire syllabus.

Books Recommended:

1. Dieter Gollmann, "Computer Security" (3rd edition).
2. Ross Anderson, "Security Engineering".

Part-B (Practical)

Time: 03 Hours
Max Marks :40

There will be a separate practical course based on the above theory course (i.e. **17MMC23DA4: Computer Security)**.

17MMC23DA5 : Mathematical Modeling

Time: 03 Hours ***Credits :3:1:0***
Max Marks : 80

Course Outcomes

Students would be able to:

CO1 Understand the core principles of mathematical modeling.
CO2 Apply precise and logical reasoning to problem solving.
CO3 Frame quantitative problems and model them mathematically.
CO4 Analyze the importance of partial differential equations in mathematical modeling.
CO5 Formulate the observable real problem mathematically.

Section - I

Introduction and the technique of mathematical modeling, Classification and characteristics of mathematical models. Mathematical modeling through algebra, Finding the radius of the earth, Motion of planets, Motions of satellites. Linear and Non-linear growth and decay models, Population growth models. Effects of Immigration and Emigration on Population size, Decrease of temperature, Diffusion, Change of price of a commodity, Logistic law of population growth. A simple compartment model. Diffusion of glucose or a Medicine in the blood stream.

Section - II

Mathematical modelling of epidemics, A simple epidemics model, A susceptible – infected - susceptible (SIS) model, SIS model with constant number of carriers, Simple epidemic model with carriers, Model with removal, Model with removal and immigration. Mathematical modelling in economics, Domar macro model, Domar first debt model, Domar second debt model, Samuelson investment model, Stability of market equilibrium. Mathematical modelling in medicine, Arms race and battles: A model for diabetes mellitus, Richardson model for arms race, Lamechester combat model.

Section - III

Mathematical modelling through partial differential equations: Mass-balance Equations, Momentum-balance Equations, Variational principles, Probability generating function, Modelling for traffic on a highway.

Section - IV

Stochastic models of population growth, Need for stochastic models, Linear birth-death-immigration-emigration processes, Linear birth-death process, Linear birth-death-immigration process, Linear birth-death-emigration process, Non-linear birth-death process.

Note : The question paper of each course will consist of **five** Sections. Each of the sections **I to IV** will contain **two** questions and the students shall be asked to attempt **one** question from each. **Section-V** shall be **compulsory** and will contain **eight** short answer type questions without any internal choice covering the entire syllabus.

Books Recommended:

1. J.N. Kapur, Mathematical Modeling, New Age International Limited.
2. J.N. Kapur, Mathematical Models in Biology and Medicine, Affiliated East-West Press (P) Ltd.
3. Mathematical Models in the Social, Management and Life Sciences, D.N. Burghes and A.D. Wood, John Wiley & Sons.
4. Mathematical Modeling, J.G. Andrews & R.R Mclone, Butterworths (Pub.) Inc.

17MMC23DA6: DISCRETE MATHEMATICS

Time: 03 Hours ***Credits :3:1:0***
Max Marks : 80

Course Outcomes

Students would be able to:

CO1 Be familiar with fundamental mathematical concepts and terminology of discrete mathematics and discrete structures.
CO2 Express a logic sentence in terms of predicates, quantifiers and logical connectives.
CO3 Use finite-state machines to model computer operations.
CO4 Apply the rules of inference and contradiction for proofs of various results.
CO5 Evaluate boolean functions and simplify expressions using the properties of boolean algebra.

Section - I

Recurrence Relations and Generating Functions, Some number sequences, Linear homogeneous recurrence relations, Non-homogeneous recurrence relations, Generating functions, Recurrences and generating functions, Exponential generating functions.

Section - II

Statements Symbolic Representation and Tautologies, Quantifiers, Predicates and validity, Prepositional Logic.
Lattices as partially ordered sets, their properties, Lattices as Algebraic systems. Sub lattices, Direct products and Homomorphism, Some special lattices e.g. complete, Complemented and Distributive Lattices.

Section - III

Boolean Algebras as Lattices, Various Boolean Identities, The switching Algebra. Example, Subalgebras, Direct Products and Homomorphism, Joint-irreducible elements, Atoms and Minterms, Boolean forms and their equivalence, Minterm Boolean forms,
Sum of Products, Cononical forms, Minimization of Boolean functions, Applications of Boolean Algebra to Switching Theory (using AND, OR and NOT gates.) The Karnaugh method.

Section - IV

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.
Grammars and Language: Phrase-Structure Grammars, Requiting rules, Derivation, Sentential forms, Language generated by a Grammar, Regular, Context -Free and context sensitive grammars and Languages, Regular sets, Regular Expressions and the pumping Lemma.

Note : The question paper of each course will consist of **five** Sections. Each of the sections **I to IV** will contain **two** questions and the students shall be asked to attempt **one** question from each. **Section-V** shall be **compulsory** and will contain **eight** short answer type questions without any internal choice covering the entire syllabus.

Books Recommended:

1. Kenneth H. Rosen, Discrete Mathematics and Its Applications, Tata McGraw-Hill, Fourth Edition.
2. Seymour Lipschutz and Marc Lipson, Theory and Problems of Discrete Mathematics, Schaum Outline Series, McGraw-Hill Book Co, New York.
3. John A. Dossey, Otto, Spence and Vanden K. Eynden, Discrete Mathematics, Pearson, Fifth Edition.
4. J.P. Tremblay, R. Manohar, "Discrete mathematical structures with applications to computer science", Tata-McGraw Hill Education Pvt.Ltd.
5. J.E. Hopcraft and J.D.Ullman, Introduction to Automata Theory, Langauages and Computation, Narosa Publishing House.
6. M. K. Das, Discrete Mathematical Structures for Computer Scientists and Engineers, Narosa Publishing House.
7. C. L. Liu and D.P.Mohapatra, Elements of Discrete Mathematics- A Computer Oriented Approach, Tata McGraw-Hill, Fourth Edition.

17MMC23DB1: MATLAB

Credits : 2:0:2

Course Outcomes

Students would be able to:

CO1 Know the basic concepts of MATLAB software.

CO2 Understand the procedures, algorithms, and concepts required in solving specific problems.

CO3 Code solutions to problems in MATLAB, in a legible, debug' able and efficient way.

CO4 Solve different types of mathematical problems and draw various types of graphs using MATLAB.

Part-A (Theory)

Time : 03 Hours
Max Marks : 60

Section-I

Introduction to MATLAB Programming: Basics of MATLAB programming, Anatomy of a program, Variables and assignments, Data types, Operators, Working with complex numbers, Mathematical operations, Functions for input and output, Good programming style. Introduction to vectors in Matlab: Defining a Vector, Accessing elements within a vector, Basic operations on vectors

Section-II

Strings, String functions, Cell array, Creating cell array, Introduction to Matrices in Matlab: Defining Matrices, Matrix functions, Matrix operations, Vector functions. Loops: For loops, While loops, Branching (conditional statements) - if statement, If else statement, Else if statement, Executable files, Subroutines, Built in functions and user-defined functions, Function handles, Function handles in m-files, Inline functions.

Section-III

Linear Algebra: Solving a Linear System, Finding eigen values and eigenvectors, Polynomial curve fitting on fly, Curve fitting with polynomial functions, Least squares curve fitting, General nonlinear fits, Interpolation, Data Analysis and Statistics, Numerical Integration, Ordinary Differential Equations: A first order linear ODE, A second order nonlinear ODE, Ode23 versus ode45, Nonlinear Algebraic Equations, Roots of polynomials.

Section-IV

Data files: Saving and recalling data, Saving a session as text, C style read/write, Graphs and plots- Basic 2-D plots, Overlay plots, Specialized 2-D plots, 3-D plots, Interpolated surface plots, Using subplots for multiple graphs, Saving and printing graphs, Mesh, Contour, Contourf, Using built-in algorithms: Optimization and Numerical integration (areas), Root-finding.

Note : The question paper of each course will consist of **five** Sections. Each of the sections **I to IV** will contain **two** questions and the students shall be asked to attempt **one** question from each. **Section-V** shall be **compulsory** and will contain **eight** short answer type questions without any internal choice covering the entire syllabus.

Books Recommended:

1. Amos Gilat, MATLAB An Introduction With Applications 5ed, Publisher: Wiley.
2. C. F. Van Loan and K.-Y. D. Fan., Insight through Computing: A Matlab Introduction to Computational Science and Engineering, SIAM Publication, 2009.

3. Y.Kirani Singh, B.B. Chaudhari, MATLAB Programming, PHI Learning, 2007.
4. KristerAhlersten, An Introduction to Matlab, Bookboon.com.
5. RudraPratap, Getting Started with MATLAB, Oxford University Press.

Part-B (Practical)

Time: 03 Hours

Max Marks : 40

There will be a separate practical course based on the above theory course (i.e. **17MMC23DB1: MATLAB)**.

17MMC23DB2: Software Engineering

Credits: 2:0:2

Course Outcomes

Students would be able to:

CO1 Learn the phases of software life cycle.
CO2 Create and specify a software design based on the requirement specification.
CO3 Get familiar with modeling languages for analysis and design.
CO4 Make a testing plan for the software.
CO5 Develop an ability to identify, formulate, and solve software engineering problems using a well-defined process.

Part-A (Theory)

Time : 03 Hours
Max Marks : 60

Section - I

Basics of Software Engineering**:** Need for Software Engineering, Definition, Software Characteristics, Software Myths, Program versus Software Products. Software Development Life Cycle Models**:** Introduction, Waterfall Model , Prototyping model , Spiral Model, Iterative Enhancement model - RAD model , Object Oriented Model - Advantages and Disadvantages of above models , Comparison of various models. Software Requirement Analysis (SRS): Value of good SRS, Requirement Process, Requirement Specification, Components of an SRS, Structures of a requirements documents - Problems in SRS.

Section - II

Software Design**:** Definition of software design, Objectives of software design, Process of software design, Architectural design, Modular design, Structure chart, Coupling and Cohesion. CODING**:** Information Hiding, Programming style, Internal documentation, Monitoring and Control for coding, Structured programming. Software Planning: Software metrics - Definition, Types of metrics, Product and Project metrics, Function point and feature point metrics, Software project estimation , COCOMO Model.

Section - III

Software Maintenance**:** Software as an evolution entity, Software configuration management activities, Change control process, Software version control, Software configuration management, Need for maintenance, Categories of maintenance, Maintenance cost, Factors affecting the effort. Risk management **:** Definition of risk , Basics for different types of software risks , Monitoring of risks , Risk management , Risk avoidance , Risk detection , Risk control , Risk recovery , Sources of risks , Types of risks. Project scheduling **:** Introduction , Factors affecting the task set for the project , Scheduling methods , Work breakdown structure , Flow graph , Gant chart - PERT.

Section - IV

Software Testing **:** Introduction to testing , Testing principles , Testing objectives , Test Oracles - Basic terms used in testing , Fault , Error , Failure - Test cases , Black box and white box testing , Advantages and disadvantages of above testing , Methods for Block box testing strategies , Methods for white box testing strategies , Testing activities , Test plan.

Note : The question paper of each course will consist of **five** Sections. Each of the sections **I to IV** will contain **two** questions and the students shall be asked to attempt **one**

question from each. **Section-V** shall be **compulsory** and will contain **eight** short answer type questions without any internal choice covering the entire syllabus.

Books Recommended:

1. Ian Sommerville, Software Engineering, Pearson Education
2. Roger S. Pressman, Software Engineering, A practioner's Approach, McGraw-Hill International Edition
3. Pankaj Jalote, Integrated approach to Software Engineering, Narosa Publishing House.
4. N.S. Gill, Software Engineering, Khanna Pub. Co., New Delhi.
5. K.K. Aggarwal and Yogesh Singh, Software Engineering, New Age Publishers, New Delhi
6. BoriesBeizer, Software Testing techniques, Dream Tech Press

Part-B (Practical)

Time: 03 Hours
Max Marks : 40

There will be a separate practical course based on the above theory course (i.e. **17MMC23DB2: Software Engineering)**.

17MMC23DB3: Internet Fundamentals

Credits : 2:0:2

Course Outcomes

Students would be able to:

CO1 Understand the network structures.
CO2 Learn how search engines work on web.
CO3 Apply the HTML for creating animated pages.
CO4 Use the e-mails and other instant messaging services.
CO5 Establish connections- point to point, point to multi-points etc.

Part-A (Theory)

Time : 03 Hours
Max Marks :60

Section - I

Introduction Objectives, Basic of Computer Networks, Local Area Network (LAN), Wide Area Network (WAN), Internet , Concept of Internet, Applications of Internet, Connecting to the Internet, Troubleshooting, World Wide Web (WWW), Web Browsing Softwares, Popular Web Browsing Softwares, Search Engines, Popular Search Engines / Search for content, Accessing Web Browser, Using Favorites Folder, Downloading Web Pages, Printing Web Pages, Understanding URL, Surfing the web, Using e-governance website.

Section - II

HTML, Basic HTML, Document Body Text, Hyperlink, Adding more formatting, LISTS- Using Colour& images- Tables, Multimedia objects, Frames, Forms- MARQUEE.

Section - III

Basics of E-mail, What is an Electronic Mail, Email Addressing BCC, Using E-mails, Opening Email account Mailbox: Inbox and Outbox, Creating and Sending a new E-mail, Replying to an E-mail message, Forwarding an E-mail message, Sorting and Searching emails, Document collaboration, Instant Messaging and Collaboration, Using Instant messaging, Instant messaging providers, Netiquettes.

Section - IV

Host- To-Host Communication. Network Level Logical addressing-IPv4 addresses, IPv6 addresses, Internet protocol-IPv4 andIPv6, Process to Process Delivery, Connectionless and Connection Oriented Service: UDP, TCP, Congestion control, Quality of service. Client Server Programs, Name space, Domain name space, Remote logging, Electronic mail, File transfer.

Note : The question paper of each course will consist of **five** Sections. Each of the sections **I to IV** will contain **two** questions and the students shall be asked to attempt **one**question from each. **Section-V** shall be **compulsory** and will contain **eight** short answer type questions without any internal choice covering the entire syllabus.

Books Recommended:

1. Learning guide to Internet, BPB
2. Internet Complete, Sybex
3. Hatman&Eden : ASP with VBScript, SQL and HTML ProgrammingReference, IDG Books India (P), Ltd.
4. Jon Duckett,Beginning HTML, XHTML, CSS, And JavaScript.

5. Behrouz A. Forouzan, Data Communication and Networking, 4ed, Tata Mc-Graw Hill
6. Andrew S. Tanenbaum, Computer Networks.

Part-B (Practical)

Time: 03 Hours
Max Marks :40

There will be a separate practical course based on the above theory course (i.e. **17MMC23DB3: Internet Fundamentals)**.

17MMC23DB4: Core Java

Credits : 2:0:2

Course Outcomes

Students would be able to:

CO1 Understand the fundamental concepts of OOP.

CO2 Use the concepts of inheritance, polymorphism, encapsulation and method overloading.

CO3 Create java application programs using interfaces and packages.

CO4 Develop programs using the java collection API as well as the java standard class library.

CO5 Use graphical user interface in java programs.

Part-A (Theory)

Time : 03 Hours
Max Marks : 60

Section - I

Introduction to Java Programming: Overview of Java, Features of Java as programming language /Platform JDK Environment and Tools.

Java – Programming Fundaments: Data types, Variables, Operators, Keywords, Naming Conventions Structure of Java Program Flow Control- Decision, Interaction, Arrays.

Section - II

Classes and Objects: Class – Members, Access control Objects, Constructors, Use of 'this' keyword, Static, Non-static, Public, Private & protected data members.

Inheritance & Polymorphism: Super, Extends, Single, Multiple inheritance, Method overriding Abstract classes & ADT, 'Final' keyword Extending interfaces.

Section - III

Exception Handling: Exceptions and Types, Try..catch, Finally block, Throw & throws statement, User-defined exceptions.

Threading: Java thread lifecycle, Thread class & runnable interface, Thread priorities & synchronization, Usage of wait & notify.

Section - IV

Java I/O:Streams, InputStream, OutputStream, Working with Reader classes, InputStreamReader, BufferedReader, FileInputstream, FileOutputStream.

Event Programming: Java awt components (windows, Frame, Panel, Dialog, File Dialog, Label, Button, List, Check Box, Text Components, Choice, Menu Components), Layout Managers Border, Flow, Grid, Event Model Listeners / Adapters.

Note : The question paper of each course will consist of **five** Sections. Each of the sections **I to IV** will contain **two** questions and the students shall be asked to attempt **one** question from each. **Section-V** shall be **compulsory** and will contain **eight** short answer type questions without any internal choice covering the entire syllabus.

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Books Recommended:

1. Herbert Schildt, Java: A Beginner's Guide (Sixth Edition)
2. E Balgurusamy, Programming with JAVA.
3. Herbert Schildt,The Complete Reference – JAVA.

4. Michael Morgen,Java 2 for professional developers.
5. Cay. S. Horstmann, Gray Cornell, Core Java, Vol 1 and vol 2.
6. Nutshell, Java.

Part-B (Practical)

Time: 03 Hours

Max Marks : 40

There will be a separate practical course based on the above theory course (i.e. **17MMC23DB4: Core Java)**.

17MMC23DB5: Information Security

Credits: 2:0:2

Course Outcomes

Students would be able to:

CO1 Install e-mails and file security softwares and PGP.
CO2 Use efficient codes to encrypt and decrypt messages.
CO3 Develop SSL or Firewall based solutions against security threats.
CO4 Write an extensive analysis report on any existing security. product/code and investigate the strong and weak points of the product/code.
CO5 Write programs in C related to various cryptographic algorithms.

Part-A (Theory)

Time : 03 Hours
Max Marks :60

Section - I

Introduction: History of Information Security- Critical characteristics of information NSTISSC security model: Components of Information System- Securing componentsBalancing information security and access: Approaches to information security implementation – SDLC – Security System Development Life Cycle – SDLC and Sec SDLC phase summary.

Section - II

Need for security: Business needs.Threats: Definition- Categories of threats. Attacks: Definition- types of attacks. Secure software development: Software assurance – Software design principles software development security problems. Law and ethics in information security: International Laws and legal bodies – Ethics and information security- Codes of ethics and Professional organizations.

Section - III

Risk Management- Overview, Risk Identification, Asset identification, Vulnerability, Identification, Risk Assessment: Introduction-likelihood-risk determination-possible controls Risk Control Strategies: Selecting a risk control strategy - qualitative verses quantitative risk control practices, Risk management discussion points: Recommended risk control practices

Section - IV

Firewalls: Introduction- processing modes- firewall architectures – selecting the right firewall- content filters, VPN: Introduction- transport mode- tunnel mode, Intrusion Detection and Prevention Systems (IDPS): Types- IDPS detection methods. Cryptography: Introduction, Cipher methods, Cryptographic algorithms, Cryptographic tools Interception of data: Mobile and portable system, Special considerations for physical security threats.

Note : The question paper of each course will consist of **five** Sections. Each of the sections **I to IV** will contain **two** questions and the students shall be asked to attempt **one** question from each. **Section-V** shall be **compulsory** and will contain **eight** short answer type questions without any internal choice covering the entire syllabus.

Books Recommended:

1. Michael E Whitman and Herbert J Mattord, “Principles of Information Security”, Vikas Publishing House, New Delhi.

2. Micki Krause, Harold F. Tipton, " Handbook of Information Security Management", Vol 1-3 CRC Press.
3. Stuart Mc Clure, Joel Scrambray, George Kurtz, Hacking Exposed, Tata McGraw-Hill.
4. Matt Bishop, " Computer Security Art and Science", Pearson/PHI.

Part-B (Practical)

Time: 03 Hours
Max Marks : 40

There will be a separate practical course based on the above theory course (i.e. **17MMC23DB5: Information Security).**

17MMC23DB6: Analytical Number Theory

Time: 03 Hours ***Credits : 3:1:0***
Max Marks : 80

Course Outcomes

The students would be able to:

CO1 Know about the classical results related to prime numbers and get familiar with the irrationality of *e* and *Π*.
CO2 Study the algebraic properties of U_n and Q_n.
CO3 Learn about the Waring problems and their applicability.
CO4 Learn the definition, examples and simple properties of arithmetic functions and about perfect numbers.
CO5 Understand the representation of numbers by two or four squares.

Section - I

Distribution of primes, Fermat and Mersenne numbers, Farey series and some results concerning Farey series, Approximation of irrational numbers by rationals, Hurwitz theorem, Irrationality of e and π.

Section - II

The arithmetic in Z_n , The group U_n , Primitive roots and their existence, the group $U_p{}^n$ (p-odd) and $U_2{}^n$, The group of quadratic residues Q_n , Quadratic residues for prime power moduli and arbitrary moduli, The algebraic structure of U_n and Q_n .

Section - III

Riemann Zeta Function $\zeta(s)$ and its convergence, Application to prime numbers, $\zeta(s)$ as Euler product, Evaluation of $\zeta(2)$ and $\zeta(2k)$.
Diophantine equations $ax + by = c$, $x^2+y^2 = z^2$ and $x^4+y^4 = z^4$, The representation of number by two or four squares, Waring problem, Four square theorem, The numbers g(k) & G(k), Lower bounds for g(k) & G(k).

Section - IV

Arithmetic functions $\phi(n)$, $\tau(n)$, $\sigma(n)$ and $\sigma_k(n)$, U(n), N(n), I(n), Definitions and examples and simple properties, Perfect numbers, Mobius inversion formula, The Mobius function μ_n, The order and average order of the function $\phi(n)$, $\tau(n)$ and $\sigma(n)$.

Note : The question paper of each course will consist of **five** Sections. Each of the sections **I to IV** will contain **two** questions and the students shall be asked to attempt **one** question from each. **Section-V** shall be **compulsory** and will contain **eight** short answer type questions without any internal choice covering the entire syllabus.

Books Recommended:

1. G.H. Hardy and E.M. Wright, An Introduction to the Theory of Numbers.
2. D.M. Burton, Elementary Number Theory.
3. N.H. McCoy, The Theory of Number by McMillan.
4. I. Niven, I. and H.S. Zuckermann, An Introduction to the Theory of Numbers.
5. A. Gareth Jones and J Mary Jones, Elementary Number Theory, Springer Ed. 1998.

17MMC23SO1: Multivariate Analysis

Time: 03 Hours ***Credits :3:0:0***
Max Marks : 80

Course Outcomes

Students would be able to:

CO1 Perform exploratory analysis of multivariate data.
CO2 Test for multivariate normality of the data.
CO3 Apply multivariate statistical methods for testing of hypothesis and estimation.
CO4 Perform data reduction using principal component analysis.
CO5 Apply multivariate techniques to study the population structure.

Section - I

Multivariate normal distribution, Marginal and conditional distributions, Characteristic function. Distribution of linear combinations of normal vector

Section - II

Maximum likelihood estimators of mean vector and covariance matrix. Distribution of sample mean vector, Distribution of quadratic forms. Correlation coefficient of a bivariate sample, Partial and multiple correlation coefficients.

Section - III

Derivation of generalised T^2 -statistic and its distribution, Uses of T^2 -statistic. The problem of classification, Procedures of classification of one of the two populations with known probabilities.
Wishart matrix - its distribution(without proof) and properties. Generalised variance.

Section - IV

Principal components, Maximum likelihood estimators of principal components and their variances.
Canonical correlations and variates, Estimation of canonical correlations and variates.
Cluster analysis.

Note : The question paper of each course will consist of **five** Sections. Each of the sections **I to IV** will contain **two** questions and the students shall be asked to attempt **one** question from each. **Section-V** shall be **compulsory** and will contain **eight** short answer type questions without any internal choice covering the entire syllabus.

Books Recommended:

1. T.W. Anderson, An Introduction to Multivariate Statistical Analysis, John Wiley
2. C.R. Rao, Linear Statistical Inference and its Applications, John Wiley
3. R.A. Johnson and D.W. Wichern, (2001), Applied Multivariate Statistical Analysis, Prentice Hall of India
4. A.C. Rencher, (2002), Methods of Multivariate Analysis, 2nd Ed., John Wiley & Sons.

17MMC23SO2: Graph Theory

Time: 03 Hours ***Credits :3:0:0***
Max Marks : 80

Course Outcomes

Students would be able to:

CO1 Model real world problems and solve them using basic Graph Theory.
CO2 Understand graph, subgraphs, connected and disconnected graphs etc.
CO3 Differentiate between Hamiltonian and Eulerian graphs.
CO4 Solve problems involving vertex, edge connectivity, planarity and edge coloring.
CO5 Apply tree and graph algorithms to solve problems.

Section - I

Definition and types of graphs, Walks, Paths and Circuits, Connected and Disconnected graphs, Applications of graphs, operations on Graphs, Graph Representation, Isomorphism of Graphs.

Section - II

Eulerian and Hamiltonian paths, Shortest Path in a Weighted Graph, The Travelling Sales person Problem, Planar Graphs, Detection of Planarity and Kuratowski Theorem, Graph Colouring.

Section - III

Directed Graphs, Trees, Tree Terminology, Rooted Labeled Trees, Prefix Code, Binary Search Tree, Tree Traversal.

Section - IV

Spanning Trees and Cut Sets, Minimum Spanning Trees, Kruskal Algorithm, Prim Algorithm, Decision Trees, Sorting Methods.

Note : The question paper of each course will consist of **five** Sections. Each of the sections **I to IV** will contain **two** questions and the students shall be asked to attempt **one** question from each. **Section-V** shall be **compulsory** and will contain **eight** short answer type questions without any internal choice covering the entire syllabus.

Books Recommended:

1. NarsinghDeo, Graph Theory with Applications to Engineering and Computer Science, Prentice –Hall of India Pvt. Ltd, 2004.
2. F. Harary: Graph Theory, Addition Wesley, 1969.
3. G. Chartrand and P. Zhang. Introduction to Graph Theory, Tata McGraw-Hill, 2006.
4. Kenneth H. Rosen, Discrete Mathematics and Its Applications, Tata McGraw-Hill, Fourth Edition, 1999.
5. Seymour Lipschutz and Marc Lipson, Theory and Problems of Discrete Mathematics, Schaum Outline Series, McGraw-Hill Book Co, New York, 2007.
6. John A. Dossey, Otto, Spence and Vanden K. Eynden, Discrete Mathematics, Pearson, Fifth Edition, 2005.
7. C. L. Liu and D.P.Mohapatra, Elements of Discrete Mathematics- A Computer Oriented Approach, Tata McGraw-Hill, Fourth Edition.

Scheme of Examination of
M.Sc. Mathematics with Computer Science, Semester- IV
(w.e.f. Session 2017-18)

Course Code	Title of the Course	External Marks	Internal Marks	Practical Marks	Credit (L:T:P)
Core					
17MMC24C1	Inner Product Spaces and Measure Theory	80	20	--	3:1:0
17MMC24C2	Classical Mechanics	80	20	--	3:1:0
17MMC24C3	Mechanics of Solids	80	20	--	3:1:0
17MMC24C4	Operations Research Techniques	80	20	--	3:1:0
Discipline Specific Elective					
Group C (Any One)					
17MMC24DC1	Database Management System	60	--	40	2:0:2
17MMC24DC2	Cryptography	60	--	40	2:0:2
17MMC24DC3	Programming in Visual Basic	60	--	40	2:0:2
17MMC24DC4	Data and File Structure	60	--	40	2:0:2
17MMC24DC5	Network Security	60	--	40	2:0:2
17MMC24DC6	Information Theory	80	20	--	3:1:0
Group D (Any One)					
17MMC24DD1	Digital Image Processing	60	--	40	2:0:2
17MMC24DD2	Artificial Intelligence and Expert Systems	60	--	40	2:0:2
17MMC24DD3	Cyber Security	60	--	40	2:0:2
17MMC24DD4	Data Warehousing and Mining	60	--	40	2:0:2
17MMC24DD5	Algebraic Number Theory	80	20	--	3:1:0
17MMC24DD6	Coding Theory	80	20	--	3:1:0

Total Credits : 24

Note 1 : The Criteria for awarding internal assessment of 20 marks shall be as under:

A) Class test : 10 marks.
B) Assignment & Presentation : 5 marks
C) Attendance : 5 marks
Less than 65% : 0 marks
Upto 70% : 2 marks
Upto 75% : 3 marks
Upto 80% : 4 marks
Above 80% : 5 marks

Note 2 : The syllabus of each course will be divided into **four** Sections of **two** questions each. The question paper of each course will consist of **five** Sections. Each of the sections I to IV will contain two questions and the students shall be asked to attempt **one** question from each Section. Section - V shall be compulsory and shall contain **eight** short answer type questions without any internal choice covering the entire syllabus.

Note 3 : Elective courses can be offered subject to availability of requisite resources/ faculty.

17MMC24C1: Inner Product Spaces and Measure Theory

Time: 03 Hours ***Credits :3:1:0***
Max Marks : 80

Course Outcomes

Students would be able to:

CO1 To understand Hilbert spaces and some other related terms in Hilbert spaces.
CO2 To introduce the concept of projections, measure and outer measure.
CO3 To learn about Hahn, Jordan and Radon-Nikodyn decomposition theorem, Lebesgue-stieltjes integral, Baire sets and Baire measure.

Section - I

Hilbert Spaces: Inner product spaces, Hilbert spaces, Schwarz inequality, Hilbert space as normed linear space,Convex sets in Hilbert spaces, Projection theorem, Orthonormal sets,Separability, Total Orthonormal sets, Bessel inequality, Parseval identity.

Section - II

Conjugate of a Hilbert space, Riesz representation theorem in Hilbert spaces, Adjoint of an operator on a Hilbert space, Reflexivity of Hilbert space, Self-adjoint operators, Positive operators, Product of Positive Operators.

Section-III

Projection operators, Product of Projections, Sum and Difference of Projections, Normal and unitary operators, Projections on Hilbert space, Spectral theorem on finite dimensional space. Convex functions, Jensen inequalities, Measure space, Generalized Fatou lemma, Measure and outer measure, Extension of a measure, Caratheodory extension theorem.

Section - IV

Signed measure, Hahn decomposition theorem, Jordan decomposition theorem, Mutually signed measure, Radon – Nikodyn theorem,Lebesgue decomposition, Lebesgue - Stieltjes integral, Product measures, Fubini theorem, Baire sets, Baire measure, Continuous functions with compact support.

Note : The question paper of each course will consist of **five** Sections. Each of the sections **I to IV** will contain **two** questions and the students shall be asked to attempt **one** question from each. **Section-V** shall be **compulsory** and will contain **eight** short answer type questions without any internal choice covering the entire syllabus.

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, 1978.
3. S.K. Berberian, Measure and Integration, Chelsea Publishing Company, New York, 1965.
4. George F. Simmons, Introduction to Topology and Modern Analysis, McGraw-Hill Book Company, 1963
5. K.C. Rao, Functional Analysis, Narosa Publishing House, Second edition, 2006.

17MMC24C2: Classical Mechanics

Time: 03 Hours ***Credits :3:1:0***
Max Marks : 80

Course Outcomes

Students would be able to:

CO1 Be familiar with the concepts of momental ellipsoid, equimomental systems and general motion of a rigid body.

CO2 Understand ideal constrains, general equation of dynamics and Lagrange's equations for potential forces.

CO3 Describe Hamiltonian function, Poincare-Carton integral invariant and principle of least action.

CO4 Get familiar with canonical transformations, conditions of canonicity of a transformation in terms of Lagrange and Poisson brackets.

Section – I

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).

Section – II

Free & constrained systems, Constraints and their classification, Holonomic and non-holonomic systems, Degree of freedom and generalised coordinates, Virtual displacement and virtual work, Statement of principle of virtual work (PVW), Possible velocity and possible acceleration, Ideal constraints**, G**eneral equation of dynamics for ideal constraints, Lagrange equations of the first kind. D' Alembert principle, Independent coordinates and generalized forces, Lagrange equations of the second kind, Generalized velocities and accelerations. Uniqueness of solution, Variation of total energy for conservative fields. Lagrange variable and Lagrangian function $L(t, Q_i, \dot{q}_i)$, Lagrange equations for potential forces, Generalized momenta p_i.

Section - III

Hamiltonian variable and Hamiltonian function, Donkin theorem, Ignorable coordinates, Hamilton canonical equations, Routh variables and Routh function R, Routh equations, Poisson Brackets and their simple properties, Poisson identity, Jacobi – Poisson theorem.
Hamilton action and Hamilton principle, Poincare – Carton integral invariant, Whittaker equations, Jacobi equations, Lagrangian action and the principle of least action.

Section - IV

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 of each course will consist of **five** Sections. Each of the sections **I to IV** will contain **two** questions and the students shall be asked to attempt **one** question from each. **Section-V** shall be **compulsory** and will contain **eight** short answer type questions without any internal choice covering the entire syllabus.

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.
7. F. Chorlton, Textbook of Dynamics, CBS Publishers, New Delhi.

17MMC24C3: Mechanics of Solids

Time: 03 Hours ***Credits :3:1:0***
Max Marks : 80

Course Outcomes

Students would be able to:

CO1 Get familiar with Cartesian tensors, as generalization of vectors, and their properties which are used in the analysis of stress and strain to describe the phenomenon of solid mechanics.

CO2 Analyse the basic properties of stress and strain components, their transformations, extreme values, invariants and Saint-Venant principle of elasticity.

CO3 Demonstrate generalized Hooke's law for three dimensional elastic solid which provides the linear relationship between stress components and strain components.

CO4 Use different types of elastic symmetries to derive the stress-strain relationship for isotropic elastic materials for applications to architecture and engineering.

Section - I

Cartesian tensors of different orders, Contraction of a tensor, Multiplication and quotient laws for tensors, Substitution and alternate tensors, Symmetric and skew symmetric tensors, Isotropic tensors, Eigenvalues and eigenvectors of a second order symmetric tensor.

Section - II

Analysis of Stress: Stress vector, Normal stress, Shear stress, Stress components, Cauchy equations of equilibrium, Stress tensor of order two, Symmetry of stress tensor, Stress quadric of Cauchy, Principal stresses, Stress invariants, Maximum normal and shear stresses, Mohr diagram.

Section - III

Analysis of Strain: Affine transformations, Infinitesimal affine deformation, Pure deformation, Components of strain tensor and their geometrical meanings, Strain quadric of Cauchy, principal strains, Strain invariants, General infinitesimal deformation, Saint-Venant conditions of compatibility, Finite deformations.

Section - IV

Equations of Elasticity: Generalized Hook's law, Hook's law in an elastic media with one plane of symmetry, Orthotropic and transversely isotropic symmetries, Homogeneous isotropic elastic media, Elastic moduli for an isotropic media, Equilibrium and dynamical equations for an isotropic elastic media, Beltrami - Michell compatibility conditions.

Note : The question paper of each course will consist of **five** Sections. Each of the sections **I to IV** will contain **two** questions and the students shall be asked to attempt **one** question from each. **Section-V** shall be **compulsory** and will contain **eight** short answer type questions without any internal choice covering the entire syllabus.

Books Recommended:

1. I.S. Sokolnikoff, M*athematical theory of Elasticity*, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1977.

2. Teodar M. Atanackovic and ArdeshivGuran, T*heory of Elasticity for Scientists and Engineers*, Birkhausev, Boston, 2000.
3. Saada, A.S., *Elasticity-Theory and applications*, Pergamon Press, New York.
4. D.S. Chandersekhariah and L. Debnath, C*ontinuum Mechanics*, Academic Press, 1994.
5. Jeffreys, H., *Cartesian tensor*s.
6. A.K. Mal & S.J. Singh, D*eformation of Elastic Solids*, Prentice Hall, New Jersey, 1991.

17MMC24C4: Operations Research Techniques

Time: 03 Hours ***Credits :3:1:0***
Max Marks : 80

Course Outcomes

Students would be able to:

CO1 Identify and develop operations research model describing a real life problem.

CO2 Understand the mathematical tools that are needed to solve various optimization problems.

CO3 Solve various linear programming, transportation, assignment, queuing, inventory and game problems related to real life.

Section - I

Operations Research: Origin, Definition and scope. Linear Programming: Formulation and solution of linear programming problems by graphical and simplex methods, Big - M and two-phase methods, Degeneracy, Duality in linear programming.

Section - II

Transportation Problems: Basic feasible solutions, Optimum solution by stepping stone and modified distribution methods, Unbalanced and degenerate problems, Transhipment problem. Assignment problems: Hungarian method, Unbalanced problem, Case of maximization, Travelling salesman and crew assignment problems.

Section - III

Concepts of stochastic processes, Poisson process, Birth-death process, Queuing models: Basic components of a queuing system, 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)

Section - IV

Inventory control models: Economic order quantity(EOQ) model with uniform demand, EOQ when shortages are allowed, EOQ with uniform replenishment, Inventory control with price breaks.

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.

Note : The question paper of each course will consist of **five** Sections. Each of the sections **I to IV** will contain **two** questions and the students shall be asked to attempt **one**question from each. **Section-V** shall be **compulsory** and will contain **eight** short answer type questions without any internal choice covering the entire syllabus.

Books recommended :

1. H.A. Taha, Operation Research-An introducton, Printice Hall of India.
2. P.K. Gupta and D.S. Hira, Operations Research, S. Chand & Co.
3. S.D. Sharma, Operation Research, KedarNath Ram Nath Publications.
4. J.K. Sharma, Mathematical Model in Operation Research, Tata McGraw Hill.

17MMC24DA1: Database Management System

Credits : 2:0:2

Course Outcomes

Students would be able to:

CO1 Have a broad understanding of database concepts and DBMS software.

CO2 Understand major DBMS components and their functioning.

CO3 Model an application's data requirements using conceptual modeling tools like ER diagrams and design database schemas.

CO4 Write SQL commands for manipulation of data related to relational algebra and calculus.

Part-A (Theory)

Time : 03 Hours
Max Marks : 60

Section - I

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

Three levels of the architecture: External level, Conceptual level and Internal level, Mappings and Schemas, Client/Server architecture, Distributed processing.

Section - III

Data model, Relational data model, Hierarchical data model, Network data model. Relational model, Basic structure, Terminology.
Normalization, First Normal Form, Second Normal Form, Third Normal Form, BCNF, Relational algebra and Relational Calculus

Section - IV

PL/SQL Blocks, Data types, PL/SQL functions, Cursors, Error handling inPL/SQL, Package functions, Package procedures.
Database Triggers: Use & type of database Triggers, DatabaseTriggers Vs. Declarative Integrity Constraints, Creatinga Trigger, BEFORE vs AFTER Trigger Combinations, Dropping a Trigger.

Note : The question paper of each course will consist of **five** Sections. Each of the sections **I to IV** will contain **two** questions and the students shall be asked to attempt **one** question from each. **Section-V** shall be **compulsory** and will contain **eight** short answer type questions without any internal choice covering the entire syllabus.

Books Recommended

1. C.J. Date, Sixth Ed., An Introduction to Database System, Addison-Wesley Publishing Co.
2. Ullman, D.Jeffery, Principles of Database System, Computer Science Press.

3. James Martin, Principles of Database Management System, Prentice Hall of India Pvt. Ltd.
4. Desai, C.Bipin, Introduction to Data base Systems, Galgotia Publ.
5. R.P. Whittington, Data Base Systems Engineering, Clavendon Press.
6. D.M.Kroenke, Database Processing : Fundamental Design, Implementation, 2nd Edn. Galgotia Publ. Pvt. Ltd.
7. Wiederhold, Database Design, McGraw Hill Book Comp.

Part-B (Practical)

Time: 03 Hours
Max Marks : 40

There will be a separate practical course based on the above theory course (i.e. **17MMC24DA1: Database Management System)**.

17MMC24DA2: Cryptography

Credits : 2:0:2

Course Outcomes

Students would be able to:

CO1 Compare and contrast a range of different cryptosystems from an application's viewpoint.

CO2 List and elaborate the differences between secret key and public key cryptosystems.

CO3 Identify the different approaches to quantify secrecy.

CO4 Explain the role of authentication in security.

Part-A (Theory)

Time : 03 Hours

Max Marks :60

Section - I

Introduction: Security, Attacks, Attack Types, Viruses, Worms, Trojan Horses, Classical Cryptography.

Basics of Modern Cryptography: Plaintext, Ciphertext, Keys, Simple ciphers, Public key cryptography, Digital signatures.

Section - II

Conventional Encryption / Secret Key Cryptography: Cryptography, Cryptanalysis, Cipher Structure, Encryption Algorithms, Data Enncryption Standard (DES), International Data Encryption Algorithm (IDEA), Advanced Encryption Standard (AES)

Modes of Operation, Symmetric Block Ciphers, Cipher Block Chaining (CBC), Multiple Encryption DES.

Section - III

Public Key Cryptography: Basic Number Theory, Factorization, Diffie-Hellman Key Exchange, Public Key Cryptography Algorithms, RSA.

Digital Signatures: One-time signatures, Digital Signature Standard (DSS).

Section - IV

Authentication and Public Key Infrastructure (PKI): Overview of Authentication Systems (Password, Address, Cryptographic), Security Handshake Pitfalls, Authentication Standards, Kerberos, PKI Trust Models.

Note : The question paper of each course will consist of **five** Sections. Each of the sections **I to IV** will contain **two** questions and the students shall be asked to attempt **one** question from each. **Section-V** shall be **compulsory** and will contain **eight** short answer type questions without any internal choice covering the entire syllabus.

Books Recommended:

1. D. R. Stinson.Cryptography: Theory and Practice.CRC Press.
2. William Stallings, Network Security Essentials-Applications &Standards , Pearson.
3. Charlie Kaufman, Radia Perlman, Mike Speciner, Nework Security PrivateCommunication in a Public World , Second Edition, 2004,Pearson.
4. Matt Bishop,Computer Security, Art and Science, Pearson.
5. Bruce Schneier, Applied Cryptography, Pearson.
6. Alfred J. Meneze, Handbook of Applied Cryptography, CRC Press.

Part-B (Practical)

Time: 03 Hours
Max Marks :40

There will be a separate practical course based on the above theory course (i.e. **17MMC24DA2: Cryptography)**.

17MMC24DA3: Programming in Visual Basic

Credits : 2:0:2

Course Outcomes

Students would be able to:

CO1 Differentiate between sequential and event driven programming.

CO2 Get familiar with the concepts of objects, methods, and events pertaining to the programming.

CO3 Create attractive program interfaces using different controls on forms and applying different events.

CO4 Develop programs employing simple animations.

CO5 Understand database programming and reporting.

Part-A (Theory)

Time : 03 Hours
Max Marks : 60

Section - I

Visual Basic: Introduction, Analyzing, Data types, Variables, Constants, Controls and Properties.

Control Structures: Conditional Statements, Loop Statements, Exit statement, Stop statement Arrays

Section - II

Text Boxes, Command Buttons, Labels, Additional Controls – List Box, ComboBox, Difference between ListBox and Combo Box, Option Buttons, Check Boxes, Frames, Scroll Bars, Timer Control

Control Arrays, Procedures and Functions, SDI and MDI Applications

Section - III

Menus: Menu Editor, Menu controls, Submenus, Popup Menus

Common Dialog Controls: Color Dialog Box, Font Dialog Box, Open and Save as Dialog Box, Print Dialog Box, Help Dialog Box.

Database Programming: Data Access Object, Data Binding, Data Control and Data Bound Controls, Database Object, Recordset Object, Field Object.

Section - IV

Crystal Reports:Introduction to Reports, Crystal Reports, Creating and Using a Report in VB

Library Functions: Conversion functions, String functions, Numeric functions, Date and Time Functions.

Note : The question paper of each course will consist of **five** Sections. Each of the sections **I to IV** will contain **two** questions and the students shall be asked to attempt **one** question from each. **Section-V** shall be **compulsory** and will contain **eight** short answer type questions without any internal choice covering the entire syllabus.

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.

Part-B (Practical)

Time: 03 Hours
Max Marks :40

There will be a separate practical course based on the above theory course (i.e. **17MMC24DA3: Programming in Visual Basic)**.

17MMC24DA4: Data and File Structure

Credits : 2:0:2

Course Outcomes

Students would be able to:

CO1 Access how the choices of data structure & algorithmic methods impact the performance of program.

CO2 Choose an appropriate data structure depending upon the type of problem.

CO3 Have knowledge about the concepts of functions, arrays and link-lists.

CO4 Understand the working of several fundamental algorithms particularly those that can be implemented with stacks, queues, trees and sorting algorithms.

CO5 Design the new algorithms or modify existing ones for new applications.

Part-A (Theory)

Time : 03 Hours
Max Marks :60

Section - I

Basic terminology, Elementary data organization, Data structure operations, Algorithm Complexity and Time-Space trade-off (Definitions only), Linear data structure: Arrays, Linked List, Stack and Queue.

Section - II

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

Section - III

Graphs: Terminology & Representations, Graphs & Multi-graphs, Directed Graphs, Weighted graphs, Sequential Representations of Graphs, Adjacency Matrices, Traversal, Connected Component and Spanning Trees, Minimum Cost Spanning Trees.

Section - IV

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, Searching and merging techniques.

Note : The question paper of each course will consist of **five** Sections. Each of the sections **I to IV** will contain **two** questions and the students shall be asked to attempt **one** question from each. **Section-V** shall be **compulsory** and will contain **eight** short answer type questions without any internal choice covering the entire syllabus.

Books Recommended:

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. E. Balagurusamy, Programming in ANSI C, Third Edition, Tata McGraw-Hill Publishing Co. Ltd.
4. S.G. Byron, 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.

Part-B (Practical)

Time: 03 Hours
Max Marks :40

There will be a separate practical course based on the above theory course (i.e. **17MMC24DA4: Data and File Structure)**.

17MMC24DA5: Network Security

Credits : 2:0:2

Course Outcomes

Students would be able to:

CO1 Identify factors for the requirement of the network security.
CO2 Describe specific examples of network attacks.
CO3 Explain the terms vulnerability, threats and attacks.
CO4 Identify physical points of vulnerability in wide area networks.
CO5 Locate spam in e-mails and learn to get rid of them.

Part-A (Theory)

Time : 03 Hours
Max Marks :60

Section - I

Networking Devices(Layer1,2,3)- Different types of network layer attacks, Firewall (ACL, Packet Filtering, DMZ, Alerts and Audit Trials), IDS, IPS and its types (Signature based, Anomaly based, Policy based, Honeypot based).

Section - II

VPN and its types, Tunneling Protocols, Tunnel and Transport Mode, Authentication Header-Encapsulation Security Payload (ESP), IPSEC Protocol Suite, IKE PHASE 1, II, Generic Routing Encapsulation(GRE).

Section - III

WAN Topologies, Standard IP based Switching; CEF based Multi-Layer switching-MPLS Characteristics, Frame Mode MPLS Operation, MPLS VPN.

Section - IV

Security Services for E-mail-attacks possible through E-mail, Establishing keys privacy, Authentication of the source, Message Integrity, Non-repudiation, Pretty Good Privacy, S/MIME. SSL/TLS Basic Protocol, Computing the keys, Client authentication, Secure Electronic Transaction (SET), Kerberos.

Note : The question paper of each course will consist of **five** Sections. Each of the sections **I to IV** will contain **two** questions and the students shall be asked to attempt **one** question from each. **Section-V** shall be **compulsory** and will contain **eight** short answer type questions without any internal choice covering the entire syllabus.

Reference Books:

1. Charlie Kaufman, Radia Perlman, Mike Speciner, “Network Security”, Prentice Hall
2. Charles Pfleeger, ”Security in Computing”, Prentice Hall.
3. Ulysess Black, “Internet Security Protocols: Protecting IP Traffic”, Prentice Hall PTR.
4. Amir Ranjbar, “CCNP ONT Official Exam Certification Guide”, Cisco Press .
5. Luc De Ghein, “MPLS Fundamentals”, 1st Ed. Ed., Cisco Press .

6. William Stallings, “Cryptography and Network Security”, Pearson Education.

Part-B (Practical)

Time: 03 Hours
Max Marks :40

There will be a separate practical course based on the above theory course (i.e. **17MMC24DA5: Network Security)**.

17MMC24DA6: Information Theory

Time: 03 Hours ***Credits :3:1:0***
Max Marks : 80

Course Outcomes

Students would be able to:

CO1 Understand various measures of information with proofs of important properties of information measures.

CO2 Learn the basic concepts of noiseless coding, channel and channel capacity and relation among them.

CO3 Compare different codes and construct optimal codes.

CO4 Explain important discrete memoryless channels and continuous channels.

CO5 Analyse information processed by the channels and obtain channel capacity.

Section -I

Measure of Information – Axioms for a measure of uncertainty. The Shannon entropy and its properties. Joint and conditional entropies. Trans-information and its properties. Axiomatic characterization of the Shannon entropy due to Shannon and Fadeev.

Section -II

Noiseless coding- Ingredients of noiseless coding problem, Uniquely decipherable codes. Necessary and sufficient condition for the existence of instantaneous codes. Construction of optimal codes.

Section -III

Discrete Memoryless Channel - Classification of channels, Information processed by a channel. Calculation of channel capacity, Decoding schemes, The ideal observer. The fundamental theorem of Information Theory.

Section -IV

Continuous Channels - The time-discrete Gaussian channel, Uncertainty of an absolutely continuous random variable. The converse to the coding theorem for time-discrete Gaussian channel. The time-continuous Gaussian channel, Band-limited channels.

Note : The question paper of each course will consist of **five** Sections. Each of the sections **I to IV** will contain **two** questions and the students shall be asked to attempt **one** question from each. **Section-V** shall be **compulsory** and will contain **eight** short answer type questions without any internal choice covering the entire syllabus.

Books Recommended:

1. R. Ash, Information Theory, Interscience Publishers, New York, 1965.
2. F.M. Reza, An Introduction to Information Theory, MacGraw-Hill Book Company Inc., 1961.
3. J. Aczeladn Z. Daroczy, On Measures of Information and their Characterizations, Academic Press, New York.

17MMC24DB1: Digital Image Processing

Credits : 2:0:2

Course Outcomes

Students would be able to:

CO1 Understand the mathematical foundations for digital image representation, image acquisition, image transformation, and image enhancement.

CO2 Understand the mathematical principles of image restoration, image compression, and image segmentation.

CO3 Develop a theoretical foundation of fundamental concepts of digital image processing.

CO4 Use MATLAB software for various digital image processing applications.

Part-A (Theory)

Time : 03 Hours
Max Marks : 60

Section - I

Introduction: What is Digital Image Processing, Origin ofDigital Image Processing Fundamental to Digital Image Processing, Fundamental steps in Digital ImageProcessing, Components of Digital Image Processing System, Image sensing and acquisition, Image sampling, Quantization and representation, Basic relationship between pixels.

Section - II

Image Enhancement in the Spatial Domain: Background, Basic gray leveltransformation, Histogram processing, Basics of spatial filtering, Smoothing and Sharpening Spatial filters Frequency domain and Image Enhancement:Introduction to Fourier Transform and the Frequency Domain, Discrete Fourier Transform, Smoothing andSharpening Frequency-Domain filters.

Section - III

Image Restoration: Image Degradation/Restoration Process, Noise models, Restoration in presence of noise Filters: Inverse Filtering, Minimum Mean Square Filtering, Geometric mean filter, Geometric transformations.

Section - IV

Color Image Processing:Color Fundamentals, Color models, Basis of full color imageprocessing, Color transformations. Image Compression: Fundamentals, Image compression models, Error free compression, Lossy compression.

Note : The question paper of each course will consist of **five** Sections. Each of the sections **I to IV** will contain **two** questions and the students shall be asked to attempt **one** question from each. **Section-V** shall be **compulsory** and will contain **eight** short answer type questions without any internal choice covering the entire syllabus.

Books Recommended:

1. Rafael C.Gonzalez& Richard E. Woods,Digital Image Processing, 2002, Pearson Education
2. A.K. Jain,Digital Image Processing, 1995,-PHI
3. Abhishek Yadav and Poonam Yadav,Digital Image Processing, University SciencePress
4. Shashi Kumar Singh, Digital Image Processing, University Science Press
5. Alasdair McAndrew, Introduction to Digital Image Processing withMatlab, Thomson Course Technology
6. Rafeal C.Gonzalez, Richard E.Woods, Steven L. Eddins, Digital Image Processing using Matlab, Pearson Education.

Part-B (Practical)

Time: 03 Hours

Max Marks :40

There will be a separate practical course based on the above theory course (i.e. **17MMC24DB1: Digital Image Processing)**.

17MMC24DB2: Artificial Intelligence and Expert Systems

Credits : 2:0:2

Course Outcomes

Students would be able to:

CO1 Understand the history, development and various applications of artificial intelligence.

CO2 Be familiar with propositional and predicate logic and their roles in logic programming.

CO3 Learn the concept of knowledge representation and reasoning techniques.

CO4 Understand expert systems, neural networks and reasoning processes based on fuzzy logic.

Part-A (Theory)

Time : 03 Hours
Max Marks :60

Section - I

Introduction and applications of artificial intelligence, Problem solving: Defining the problem as StateSpace search, Production system, Problem characteristics, Problem system characteristics, Problem spaces and searches. Blind Searchtechniques:Breadth first Search, Depth first search, Heuristic search techniques: Hill climbing, Best first, A * algorithm, AO* algorithm, Game Playing:Game Tree, Min Max Algorithms, Game Playing Alpha Beta Pruning, Problem Reduction

Section - II

Knowledge representation: Level of representation, Knowledge representation schemes, Formal logic, Inference Engine, Semantic net, Frame, Scripts.
Predicate logic:Skolemzing Queries, Unification, Modus Pones, Resolution, Dependency Directed Back Tracking.

Section - III

Expert system: Definition, Role of knowledge in expert system, Architecture of expert system. Expert system development life cycle: Problem selection, Prototype construction, Formalization, Implementation, Evaluation, Knowledge acquisition: Knowledge engineer, Cognitive behavior, Acquisition techniques.

Section - IV

Neural networks: Introduction, Comparison ofartificial neural networks with biological neural networks, Learning in neural networks, Perceptrons, Back propagation networks, Application of neural networks.
Fuzzy logic: Definition, Difference betweenBoolean and Fuzzy logic, Fuzzy subset, Fuzzy membership function, Fuzzy expert system, Inferenceprocess for fuzzy expert system, Fuzzy controller.

Note : The question paper of each course will consist of **five** Sections. Each of the sections **I to IV** will contain **two** questions and the students shall be asked to attempt **one** question from each. **Section-V** shall be **compulsory** and will contain **eight** short answer type questions without any internal choice covering the entire syllabus.

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Books Recommended:

1. David W. Rolston: Principles of Artificial Intelligence and Expert System Development, Mc-GrawHill Book Company.
2. Elaine Rich, Kevin Knight: Artificial Intelligence, Tata McGraw Hill.
3. Carl Townsend: Introduction to Turbo Prolog, BPB
4. Stamations V. Kartalopous: Understanding Neural Networks and Fuzzy Logic, PHI

Part-B (Practical)

Time: 03 Hours

Max Marks : 40There will be a separate practical course based on the above theory course (i.e. **17MMC24DB2: Artificial Intelligence and Expert Systems)**.

17MMC24DB3:Cyber Security

Credits : 2:0:2

Course Outcomes

Students would be able to:

CO1 Analyze and understand the working of network security devices such as Firewalls, IDS/IPS, NAT and proxies.

CO2 Install and configure network devices for network monitoring tasks.

CO3 Identify abnormalities within the network caused by worms, viruses, bots and network related security threats.

CO4 Have knowledge of concepts of packet capturing and its working.

CO5 Learn about the format of protocols of traffic analysis.

Part-A (Theory)

Time : 03 Hours
Max Marks : 60

Section - I

Why require a security, Picking a Security Policy, Strategies for a Secure Network, The Ethics of Computer Security, Security Threats and levels, Security Plan (RFC 2196). Classes of Attack: Stealing Passwords, Social Engineering, Bugs and Backdoors, Authentication Failures, Protocol Failures, Information Leakage, Exponential Attacks, Viruses and Worms, Denial of Service Attacks, Botnets, Active Attacks.

Section - II

IP security: Overview, Architecture, Authentication Header, Encapsulating Security Payload, Key management, Web security: Web security considerations, Secure Socket Layer and Transport Layer Security, Secure electronic transaction, Web issues. E-MAIL Security: Store and forward, Security services for e-mail, Establishing keys , Privacy, Authentication of the Source, Message Integrity, Non-repudiation, Proof of submission and delivery, Pretty Good Privacy, Secure/ Multipurpose Internet Mail Extension.

Section - III

Wireless Device security issues, CDPD security (Cellular Digital Packet Data), GPRS security (General Packet Radio Service), GSM (Global System for Mobile Communication) security.

Section - IV

Kinds of Firewalls, Packet Filters, Application, Level Filtering, Circuit, Level Gateways, Dynamic Packet Filters, Distributed Firewalls, What Firewalls Cannot Do, Filtering Services, Reasonable Services to Filter, Digging for Worms, Packet Filtering, Implementing policies (Default allow, Default Deny) on proxy.

Note : The question paper of each course will consist of **five** Sections. Each of the sections **I to IV** will contain **two** questions and the students shall be asked to attempt **one** question from each. **Section-V** shall be **compulsory** and will contain **eight** short answer type questions without any internal choice covering the entire syllabus.

Reference Books:

1. Charles P. Fleeger, "Security in Computing", Prentice Hall, New Delhi.
2. Behrouz A.Forouzan, "Cryptography & Network Security", Tata McGraw Hill, India, New Delhi.
3. William Stallings, "Cryptography and Network Security, Prentice Hall, New Delhi.
4. Bruce Schneier, "Applied Cryptography", John Wiley & Sons, New York.
5. Nichols and Lekka, "Wireless Security-Models, Threats and Solutions", Tata McGraw-Hill, New Delhi.
6. Merritt Maxim and David Pollino, "Wireless Security", Osborne/McGraw Hill, New Delhi.

Part-B (Practical)

Time: 03 Hours
Max Marks : 40

There will be a separate practical course based on the above theory course (i.e. **17MMC24DB3:Cyber Security)**.

17MMC24DB4: Data Warehousing and Mining

Credits: 2:0:2

Course Outcomes

Students would be able to:

CO1 Explain the fundamental concepts, benefits and problem-areas associated with data warehousing.

CO2 Describe various architectures and main components of a data warehouse.

CO3 Design a data warehouse and address the issues that arise when implementing data warehousing.

CO4 Compare and contrast OLAP and data mining as techniques for extracting knowledge from a data warehouse.

CO5 Explain various techniques used for data association and classification.

Part-A (Theory)

Time : 03 Hours
Max Marks : 60

Section - I

Need for data warehouse, Definition, Goals of data warehouse, Data Mart, Data warehouse, Architecture, Extract and load process, Clean and transform data, Star, Snowflake and galaxy schemas for multidimensional databases.

Fact and dimension data, Designing fact tables, Partitioning, Partitioning strategy, Horizontal partitioning, Vertical partitioning.

Section - II

Data warehouse and OLAP technology, Multidimensional data models and different OLAP operations, OLAP Server : ROLAP, MOLAP and HOLAP.

Section - III

Data preprocessing, Data integration and transformation, Data reduction, Discretization and concept Hierarchy Generation, Data mining primitives, Types of Data Mining, Data Mining query language, Architectures of data mining.

Data generation & Summarization based characterization, Analytical characterization, Mining class comparisons, Mining descriptive statistical measures in large databases.

Section - IV

Mining Association Rules in large databases: Association rule mining, Single dimensional Bookan association rules from Transactional DBS, Multi level association rules from transaction DBS, Multidimensional association rules from relational DBS and DWS, Correlation analysis, Constraint based association mining.

Classification: Classification by decision tree induction, Back propagation, Bayesian classification, Classification based on association rules, Temporal and spatial data mining.

Note : The question paper of each course will consist of **five** Sections. Each of the sections **I to IV** will contain **two** questions and the students shall be asked to attempt **one** question from each. **Section-V** shall be **compulsory** and will contain **eight** short answer type questions without any internal choice covering the entire syllabus.

Books Recommended:

1. 1.W.H.Inmon : Building Data Ware House, John Wiley & Sons.
2. S. Anahory and D. Murray : Data Warehousing, Pearson Education, ASIA.
3. Jiawei Han &MichelineKamber : Data Mining - Concepts & Techniques, Harcourt India Pvt. Ltd. (Morgan Kaufmann Publishers).
4. Michall Corey, M. Abbey, IAzramson& Ben Taub : Oracle 8i Building Data Ware Housing, TMH.
5. I.H. Whiffen : Data Mining, Practical Machine Cearing tools & techniques with Java (Morgan Kanffmen)
6. SimaYazdanri&Shirky& S. Wong : Data Ware Housing with oracle.
7. A.K. Pujari : Data Mining Techniques, University Press.
8. IBM An Introduction to Building the Data Warehouse, PHI, Publication.
9. Pieter AdriaansDolfZantinge : Data Mining, Addition Wesley.
10. David Hand, HeikkiMannila and PadhraicSmyth : Principles of Data mining, PHI, Publication.
11. Anahory S., Murray D. : Data Warehousing in the Real World,Addision Wesley.

Part-B (Practical)

Time: 03 Hours
Max Marks :40

There will be a separate practical course based on the above theory course (i.e. **17MMC24DB4: Data Warehousing and Mining)**.

17MMC24DB5: Algebraic Number Theory

Time: 03 Hours ***Credits :3:1:0***
Max Marks : 80

Course Outcomes

Students would be able to:

CO1 Understand the arithmetic of algebraic number fields.
CO2 Prove theorems about integral bases, and about unique factorization into ideals.
CO3 Factorize an algebraic integer into irreducibles.
CO4 Find the ideals of an algebraic number ring.
CO5 Understand ramified and unramified extensions and their related results.

Section - I

Algebraic Number and Integers : Gaussian integers and its properties, Primes and fundamental theorem in the ring of Gaussian integers, Integers and fundamental theorem in $Q(\omega)$ where $\omega^3 = 1$, Algebraic fields, Primitive polynomials, The general quadratic field $Q(\sqrt{m})$, Units of $Q(\sqrt{2})$, Fields in which fundamental theorem is false, Real and complex Euclidean fields, Fermat theorem in the ring of Gaussian integers, Primes of $Q(\sqrt{2})$ and $Q(\sqrt{5})$.

Section - II

Countability of set of algebraic numbers, Liouville theorem and generalizations, Transcendental numbers, Algebraic number fields, Liouville theorem of primitive elements, Ring of algebraic integers, Theorem of primitive elements.

Section - III

Norm and trace of an algebraic number, Non degeneracy of bilinear pairing, Existence of an integral basis, Discriminant of an algebraic number field, Ideals in the ring of algebraic integers, Explicit construction of integral basis, Sign of the discriminant, Cyclotomic fields, Calculation for quadratic and cubic cases.

Section - IV

Integral closure, Noetherian ring, Characterizing Dedekind domains, Fractional ideals and unique factorization, G.C.D. and L.C.M. of ideals, Chinese remainder theorem, Dedekind theorem, Ramified and unramified extensions, Different of an algebraic number field, Factorization in the ring of algebraic integers.

Note : The question paper of each course will consist of **five** Sections. Each of the sections **I to IV** will contain **two** questions and the students shall be asked to attempt **one** question from each. **Section-V** shall be **compulsory** and will contain **eight** short answer type questions without any internal choice covering the entire syllabus.

Books Recommended:

1. Esmonde and M Ram Murty, Problems in Algebraic Number Theory, GTM Vol. 190, Springer Verlag, 1999.
2. G.H. Hardy and E.M. Wright, An Introduction to the Theory of Numbers
3. W.J. Leveque, Topics in Number Theory – Vols. I, III Addition Wesley.
4. H. Pollard, The Theory of Algebraic Number, CarusMonogrpah No. 9, Mathematical Association of America.
5. P. Riebenboim, Algebraic Numbers – Wiley Inter-science.
6. E. Weiss, Algebraic Number Theory, McGraw Hill.

17MMC24DB6: Coding Theory

Time: 03 Hours ***Credits :3:1:0***
Max Marks : 80

Course Outcomes

Students would be able to:

CO1 Design new algorithms for coding.

CO2 Calculate the parameters of given codes and their dual codes using standard matrix and polynomial operations.

CO3 Compare the error-detecting/correcting facilities of given codes for a given binary symmetric channel.

CO4 Understand and explain the basic concepts of Hamming codes, perfect and quasi-perfect codes, Golay codes, Hamming sphere and bounds for various codes.

CO5 Describe the real life applications of codes.

Section - I

The communication channel, The coding problem, Types of codes, Block codes, Types of codes such as repetition codes, Parity check codes and their error-detection and correction capabilities. Hamming metric, Relationship of error detection/correction with hamming distance, Maximum likelihood decoding procedure, Decoding by syndrome decoding and Coset leaders, Standard array.

Section - II

Linear codes(Binary and non binary), Minimum distance, Dimension, Modular representation of linear codes, Description of linear codes by matrices, Polynomial codes, Generator and parity check polynomials and matrices.

Section - III

Dual codes, Self duality, Weight distribution of dual of binary linear codes, Macwilliam identity(binary case) extending, Expurgating and augmenting a code, Lee metric, Convolutional codes, Description using matrices and polynomials, Encoding using (4,3,2) encoder.

Section - IV

Hamming codes (Binary and non-binary) and their properties, Perfect and quasi-perfect codes. Golaycodes as perfect codes, Bounds on minimum distance for block codes,Plotkin bound, Hamming sphere.

Note : The question paper of each course will consist of **five** Sections. Each of the sections **I to IV** will contain **two** questions and the students shall be asked to attempt **one** question from each. **Section-V** shall be **compulsory** and will contain **eight** short answer type questions without any internal choice covering the entire syllabus.

Books Recommended

1. Ryamond Hill, A First Course in Coding Theory, Oxford University Press, 1986.
2. Man Young Rhee, Error Correcting Coding Theory, McGraw Hill Inc., 1989.

3. W.W. Peterson and E.J. Weldon, Jr., Error-Correcting Codes. M.I.T. Press, Cambridge Massachuetts, 1972.
4. E.R. Berlekamp, Algebraic Coding Theory, McGraw Hill Inc., 1968.
5. F.J. Macwilliams and N.J.A. Sloane, Theory of Error Correcting Codes, North-Holand Publishing Company.
6. J.H. Van Lint, Introduction to Coding Theory, Graduate Texts in Mathematics, 86, Springer, 1998.
7. L.R. Vermani, Elements of Algebraic Coding Theory, Chapman and Hall, 1996.