Indira Gandhi University, Meerpur (Rewari)

Scheme of Examination and Syllabi

for

M.Sc.(Mathematics with Computer Science)

Ist Semester

w.e.f. session 2019-20

as per

Choice Based Credit System (CBCS)

Indira Gandhi University, Meerpur (Rewari)
Scheme of Examination
M.Sc.(Mathematics with Computer Science)
Under Choice Based Credit System
w.e.f. Session 2019-20

Semester-I

Core Courses

Course Code	Title of the Course	Theory Marks	Internal Marks	Practical Marks	Credits L:T:P	Contact hrs per week	Total Credits
MCS-101	Abstract Algebra	80	20	-	4:0:0	4	4
MCS-102	Mathematical Analysis	80	20	-	4:0:0	4	4
MCS-103	Ordinary Differential Equations	80	20	-	4:0:0	4	4
MCS-104	Complex Analysis	80	20	-	4:0:0	4	4
MCS-105	Programming in C and Data Structure	60	-	40	2:0:2	6	4
MCS-106	Operating System and Unix	60	-	40	2:0:2	6	4
MCS-107	Seminar	-	-	25	-	-	1
MCS-108	Self Study Paper	-	-	25	-	-	1

Total Credits : 26
Total Contact Hours per Week : 28
Max Marks : 650

Note: The criteria for awarding internal assessment of 20 marks for each paper shall be as under :

(i) Sessional test : 10 marks
(ii) Assignment/Presentation : 5 marks
(iii) Attendance : 5 marks
Less than 65% : 0 marks
65% and above but upto 70% : 2 marks
Above 70% but upto 75% : 3 marks
Above 75% but upto 80% : 4 marks
Above 80% : 5 marks

General Guidelines

1. Seminar

In each semester, there will be a paper on seminar presentation of 25 marks with 01 credit. In this paper, the student will be required to present a seminar of about 15-20 minutes on the theme/topic such as review of research papers/articles published in National/International Journals in his /her area of interest. The topic will be selected by the student in consultation with the teacher alloted to him/her by the department.

An internal committee of two teachers constituted by the Chairperson of the department for each student will evaluate the seminar presentation. The evaluation (Internal evaluation only) will be based on the presentation of student, depth of subject matter and answer to questions. There will be a Coordinator to be nominated by the Chairperson of the Department among the teachers of the Department.

For seminar, the topics should be chosen in the following manner:

1st Semester	Any topic (not related to the syllabi)
2nd Semester	Any Basic Research Paper/Article
3rd Semester	Any National Level Research Paper/Article
4th Semester	Any Foreign Research Paper/Article

2. Self Study Paper

In each semester, there will be a self study paper of 25 marks with 01 credit. The objective of this paper is to create habits of reading books and to develop writing skills in a manner of creativity and originality. The students will select a topic of their own interest in the given area in consulation with their teachers/incharge/mentors. After selecting a suitable title for the paper, the students will be required to prepare a hand written report of about 6-10 pages in his/her own handwritng. The students will be required to submit the report after getting it checked by the concerned teacher and will be asked to re-submit the report after making the required corrections(if any) before the commencment of the examinations of that semester. The structure of the paper will include the following:

- Introduction
- Main Body
- Conclusion

The thoughts presented in the paper must be original work of the students.

The paper will be evaluated by the panel (one external and one internal examiner) to be appointed by the Chairperson of Department from the prescribed panel of the University.

The evaluation of Self Study paper will be done as given below:

- Evaluation of the paper : 15 marks
- Viva-Voce on the paper : 10 marks
- Total : 25 marks

MCS-101: Abstract Algebra

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

Credits : 4:0:0

Note: The question paper 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.

Section-I

p-groups, Sylow p-subgroups, Sylow theorems, Applications of Sylow theorems, Description of groups 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, Upper and lower central series.
Composition series, Zassenhaus lemma, Jordan-Holder theorem.

Section-III

Modules, Cyclic modules, Simple modules, Schur lemma, Free modules, Torsion modules, Torsion free modules, Fundamental structure theorem for finitely generated free modules, Modules over principal ideal domain and its applications to finitely generated abelian groups.

Section-IV

Noetherian and Artinian modules, Noetherian and Artinian rings, Nil and nilpotent ideals in Noetherian and Artinian rings, Hilbert basis theorem.
Hom_R(R,R), Opposite rings, Wedderburn-Artin theorem, Maschke theorem.

Books recommended

1. I. S. Luther and I.B.S. Passi, Algebra, Vol. I-Groups, Narosa Publishing House, 2013.
2. I. S. Luther and I.B.S. Passi, Algebra, Vol. III-Modules, Narosa Publishing House, 2013.
3. Charles Lanski, Concepts in Abstract Algebra, American Mathematical Society, First Indian Edition, 2010.
4. Vivek Sahai and Vikas Bist, Algebra, Narosa Publishing House, 1999.
5. D. S. Malik, J. N. Mordenson and M. K. Sen, Fundamentals of Abstract Algebra, McGraw-Hill International Edition, 1997.
6. P. B. Bhattacharya, S. K. Jain and S. R. Nagpaul, Basic Abstract Algebra (2nd Edition), Cambridge University Press, Indian Edition, 1997.
7. C. Musili, Introduction to Rings and Modules, Narosa Publication House, 1994.
8. N. Jacobson, Basic Algebra, Vol. I and II, W.H Freeman, 1980.
9. M. Artin, Algebra, Prentice-Hall of India, 1991.
10. Ian D. Macdonald, The Theory of Groups, Clarendon Press, 1968.

MCS-102: Mathematical Analysis

Time : 3 hours **Max. Marks : 80**
Credits : 4:0:0

Note: The question paper 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.

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, Pointwise and uniform convergence, Cauchy criterion for uniform convergence, M_n-test for uniform convergence, Weierstrass M-test, Abel's and Dirichlet's tests for uniform convergence, Uniform convergence and continuity, Uniform convergence and Integration, Uniform convergence and differentiation, Weierstrass approximation theorem.

Section-III

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

Functions of several variables, Linear Transformations, Euclidean space R^n, Derivatives in an open subset of R^n, Chain Rule, Partial derivatives, Continuously Differentiable Mapping, 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.

Books recommended

1. Walter Rudin, Principles of Mathematical Analysis (3rd edition) McGraw-Hill, International Student Edition, 1976.
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. R. R. Goldberg, Methods of Real Analysis, Oxford and IBH Pub. Co. Pvt. Ltd, 1976.
5. R. G. Bartle, The Elements of Real Analysis, Wiley International Edition, 2011.
6. S. C. Malik and Savita Arora, Mathematical Analysis, New Age International Limited, New Delhi, 2012.

MCS-103: Ordinary Differential Equations

Time : 3 hours **Max. Marks : 80**
Credits : 4:0:0

Note: The question paper 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.

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, Picard-Lindelof existence and uniqueness theorem for $\frac{dy}{dt} = f(t, y)$, Solution of initial-value problems by Picard's method, Dependence of solutions on initial conditions.
(Relevant topics from the books by Coddington and Levinson, and Ross).

Section-II

Linear systems, Matrix method for homogeneous first order system of linear differential equations, Basic theory of the homogeneous linear system, Fundamental set of solutions, Fundamental matrix of solutions, Wronskian of solutions, Abel-Liouville formula, Non-homogeneous linear system.
Strum Theory: Self-adjoint equations of the second order, Some basic results of Sturm theory, Abel's formula, Strum Separation theorem, Strum's 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 point, 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, Stable critical points, Asymptotically stable critical points, Unstable critical points, Critical points and paths of linear systems.
(Relevant topics from chapter 13 of book by Ross).

Section-IV

Almost linear systems, Critical points and paths of almost linear systems, Nonlinear conservative dynamical systems, Dependence on a parameter, Liapunov's direct method.
Limit Cycles and Periodic solutions: Limit cycles, Periodic solutions, Existence and nonexistence of limit cycles, Bendixson's nonexistence criterion, Poincare-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).

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, Elementary 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.

MCS-104: Complex Analysis

Time : 3 hours **Max. Marks : 80**
Credits : 4:0:0

Note: The question paper 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.

Section-I

Functions of a complex variable, Continuity, Differentiability, Analytic functions and their properties, Cauchy-Riemann equations in Cartesian and polar coordinates.

Power series, Radius of convergence, Differentiability of sum function of a power series, Branches of many valued functions with special reference to arg$z$, Log$z$ and z^a.

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

$$\int_0^{2\pi} f(\cos\theta, \sin\theta)d\theta, \ \int_{-\infty}^{\infty} f(x)dx, \ \int_0^{\infty} f(x)\sin mx\ dx \ \text{ and } \int_0^{\infty} f(x)\cos mx\ dx.$$

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

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. Ruel V. Churchill and James Ward Brown, Complex Variables and Applications, McGraw-Hill Publishing Company, 2009.
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. H. S. Kasana, Complex Variables: Theory and Applications, PHI Learning Private Ltd, 2013.

7. Dennis G. Zill and P. D. Shanahan, A First Course in Complex Analysis with Applications, John Bartlett Publication, 2nd Edition, 2010.

MCS-105: Programming in C and Data Structure

Credits : 2:0:2

Part-A (Theory)

Time : 3 hours **Max. Marks : 60**

Note: The question paper 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.

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.

Books recommended

1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Second Edition, Prentice Hall 1988.
2. E. Balagurusamy, Programming in ANSI C, Tata McGraw-Hill Education, 2008.
3. G. Byron, Programming with C, Schaum's Outline Series, Tata McGraw-Hill Education, 1996.
4. K. R. Venugopal and S.R. Prasad, Programming with C, Tata McGraw-Hill, New Delhi, 1997.
5. Loomis, Mary E. S., Data Management and File Structures, Prentice Hall, 1989.
6. Seymour Lipschutz, Data Structures with C, Schaum's Outline Series, Tata McGraw Hill.
7. Aaron M. Tenenbaum, Data Structures Using C, Pearson Education India, 1990.

Part-B (Practical)

Time : 3 hours **Max. Marks : 40**

There will be a separate practical course based on the above theory course.

MCS-106: Operating System and Unix

Credits : 2:0:2

Part-A (Theory)

Time : 3 hours **Max. Marks : 60**

Note: The question paper 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.

Section-I

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 multi threads, 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

Books recommended

1. Abraham Silberschatz, Greg Gagne and Peter B. Galvin, Operating System Concepts, Wiley, 2013.
2. D.M. Dhamdhere, Operating Systems: A Concept-Based Approach, McGraw-Hill, 2007.
3. Pabitra Pal Choudhury, Operating Systems- Principles and Design, PHI Learning Private Limited, 2009.
4. William Stallings, Operating Systems, Pearson Education, New Delhi.
5. Deitel, Deitel and Choffnes, Operating Systems, Pearson Prentice Hall, 2004.
6. Ikvinderpal Singh, Network Operating Systems, Khanna Publishing Co., New Delhi.
7. P.S. Gill, Operating System Concepts, Firewall Media, New Delhi, 2006.
8. Rohit Khurana, Operating System, Vikas Publishing House Pvt. Ltd, New Delhi

Part-B (Practical)

Time : 3 hours **Max. Marks : 40**

There will be a separate practical course based on the above theory course.

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2nd Semester

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Semester-II

Core Courses

Course Code	Title of the Course	Theory Marks	Internal Marks	Practical Marks	Credits L:T:P	Contact hrs per week	Total Credits
MCS-201	Field Extensions and Galois Theory	80	20	-	4:0:0	4	4
MCS-202	Measure and Integration Theory	80	20	-	4:0:0	4	4
MCS-203	Integral Equations and Calculus of Variations	80	20	-	4:0:0	4	4
MCS-204	General Topology	80	20	-	4:0:0	4	4
MCS-205	Object Oriented Programming with C++	60	-	40	2:0:2	6	4
MCS-206	Seminar	-	-	25	-	-	1
MCS-207	Self Study Paper	-	-	25	-	-	1

Discipline Centric Elective Courses (Any one)

Course Code	Title of the Course	Theory Marks	Internal Marks	Practical Marks	Credits L:T:P	Contact hrs per week	Total Credits
MCS-208	Data Communication and Networking	60	-	40	2:0:2	6	4
MCS-209	Information and Communication Technology	60	-	40	2:0:2	6	4

Foundation Elective Courses (Any one)

Course Code	Title of the Course	Theory Marks	Internal Marks	Practical Marks	Credits L:T:P	Contact hrs per week	Total Credits
MCS-210	Value Education	40	10	-	2:0:0	2	2
MCS-211	Communication Skills and Personality Development	40	10	-	2:0:0	2	2

Total Credits : 28
Total Contact Hours per Week : 30
Max Marks : 700

General Guidelines

1. Seminar

In each semester, there will be a paper on seminar presentation of 25 marks with 01 credit. In this paper, the student will be required to present a seminar of about 15-20 minutes on the theme/topic such as review of research papers/articles published in National/International Journals in his /her area of interest. The topic will be selected by the student in consultation with the teacher alloted to him/her by the department.

An internal committee of two teachers constituted by the Chairperson of the department for each student will evaluate the seminar presentation. The evaluation (Internal evaluation only) will be based on the presentation of student, depth of subject matter and answer to questions. There will be a Coordinator to be nominated by the Chairperson of the Department among the teachers of the Department.

For seminar, the topics should be chosen in the following manner:

1st Semester	Any topic (not related to the syllabi)
2nd Semester	Any Basic Research Paper/Article
3rd Semester	Any National Level Research Paper/Article
4th Semester	Any Foreign Research Paper/Article

2. Self Study Paper

In each semester, there will be a self study paper of 25 marks with 01 credit. The objective of this paper is to create habits of reading books and to develop writing skills in a manner of creativity and originality. The students will select a topic of their own interest in the given area in consulation with their teachers/incharge/mentors. After selecting a suitable title for the paper, the students will be required to prepare a hand written report of about 6-10 pages in his/her own handwritng. The students will be required to submit the report after getting it checked by the concerned teacher and will be asked to re-submit the report after making the required corrections(if any) before the commencment of the examinations of that semester. The structure of the paper will include the following:

- Introduction
- Main Body
- Conclusion

The thoughts presented in the paper must be original work of the students.

The paper will be evaluated by the panel (one external and one internal examiner) to be appointed by the Chairperson of Department from the prescribed panel of the University.

The evaluation of Self Study paper will be done as given below:

- Evaluation of the paper : 15 marks
- Viva-Voce on the paper : 10 marks
- Total : 25 marks

MCS-201: Field Extensions and Galois Theory

Time : 3 hours **Max. Marks : 80**
Credits : 4:0:0

Note: The question paper 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.

Section-I

Fields, Prime fields, Finite field extensions, Degree of field extensions, Simple Extensions, Algebraic extensions, Splitting fields, Algebraically closed fields.

Section-II

Separable and inseparable extensions, Perfect fields.

Monomorphisms and their linear independence, Automorphism of fields, Fixed fields, Normal extensions, The fundamental theorem of Galois theory.

Section-III

Finite fields, Existence of GF(p^n), Construction of finite fields, Primitive elements, Langrage's theorem on primitive elements, Roots of unity, Cyclotomic polynomials, Cyclotomic extensions of rational number field.

Section-IV

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

Books recommended

1. I. S. Luther and I.B.S.Passi, Algebra, Vol. IV-Field Theory, Narosa Publishing House, 2012.
2. Ian Stewart, Galois Theory, Chapman and Hall/CRC, 2004.
3. Vivek Sahai and Vikas Bist, 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 edition, 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.

MCS-202: Measure and Integration Theory

Time : 3 hours **Max. Marks : 80**
Credits : 4:0:0

Note: The question paper 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.

Section-I

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

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's theorem, Lusin's theorem, Convergence in measure and F. Riesz theorem for convergence in measure, Almost uniform convergence.

Section-III

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

Section-IV

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

Books recommended

1. H. L. Royden, Real Analysis, Macmillan Pub. Co., Inc. 4th Edition, New York, 1993.
2. P. K. Jain and V. P. Gupta, Lebesgue Measure and Integration, New Age International (P) Limited Published, New Delhi, 1986.
3. G. De Barra, Measure Theory and Integration, Wiley Eastern Ltd., 1981.
4. Walter Rudin, Principles of Mathematical Analysis (3rd edition) McGraw-Hill, Kogakusha, 1976, International Student Edition.
5. R. R. Goldberg, Methods of Real Analysis, Oxford and IBH Pub. Co. Pvt. Ltd, 1976.
6. R. G. Bartle, The Elements of Real Analysis, Wiley International Edition, 2011.

MCS-203: Integral Equations and Calculus of Variations

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

Credits : 4:0:0

Note: The question paper 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.

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 transform 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, Fredholm resolvent kernel as a ratio of two series, Fredholm equations with separable kernels, Approximation of a kernel by a separable kernel, Fredholm Alternative, Non homogeneous Fredholm equations with degenerate kernels.

Section-III

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

Section-IV

Motivating problems of calculus of variations, Shortest distance, Minimum surface of resolution, Brachistochrone problem, Isoperimetric problem, Geodesics, Fundamental lemma of calculus of variations, Euler's equation for one dependant function and its generalization to 'n' dependant functions and to higher order derivatives, Conditional extremum under geometric constraints and under integral constraints.

Books recommended

1. A. J. Jerri, Introduction to Integral Equations with Applications, A Wiley Interscience Publication, 1999.
2. R. P. Kanwal, Linear Integral Equations, Theory and Techniques, Academic Press, New York.
3. J. M. Gelfand and S.V. Fomin, Calculus of Variations, Prentice Hall, New Jersy, 1963.
4. W. V. Lovitt, Linear Integral Equations, McGraw Hill, New York.
5. F. B. Hilderbrand, Methods of Applied Mathematics, Dover Publications.

MCS-204: General Topology

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

Credits : 4:0:0

Note: The question paper 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.

Section-I

Definition and examples of topological spaces, Comparison of topologies on a set, Intersection and union of topologies on a set, Limit point of a set, Derived set, Closed set, Closure of a set, Kuratowski closure axioms, Closure operator, Dense sets, Interior point and Interior of a set, Interior axioms, Exterior of a set, Exterior axioms, Boundary of a set, Interior, exterior and boundary operators, Neighborhoods, Alternative methods of defining a topology in terms of neighborhood system and Kuratowski closure operator.

Section-II

Relative (Induced) topology, Base and subbase for a topology, Base for neighbourhood system.

Continuous functions, Composition of continuous functions, Pasting lemma, Open and closed functions, Homeomorphisms, Topological properties.

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

Section-III

Separation axioms: T_0, T_1, T_2-spaces, their characterization and basic properties, T_2-spaces and sequences.

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, Lindelöf theorem.

Section-IV

Compact spaces and subsets, Compactness in terms of finite intersection property, Continuity and compact sets, Basic properties of compactness, Closedness of compact subset of a Hausdorff space and of a continuous map from a compact space into a Hausdorff and its consequence. Sequentially and Countably compact spaces, Locally compact spaces and One point compactification.

Books recommended

1. W. J. Pervin, Foundations of General Topology, Academic Press Inc. New York, 1964.
2. C. W. Patty, Foundation of Topology, Jones and Bartlett, 2009.
3. Fred H. Croom, Principles of Topology, Cengage Learning, 2009.
4. K. D. Joshi, Introduction to General Topology, New Age International, 1983.
5. J. L. Kelly, General Topology, Springer Verlag, New York, 2000.
6. K. Chandrasekhra Rao, Topology, Alpha Science International, 2009.
7. J. R. Munkres, Topology, Pearson Education Asia, 2002.

MCS-205: Object Oriented Programming with C++

Credits : 2:0:2

Part-A (Theory)

Time : 3 hours **Max. Marks : 60**

Note: The question paper 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.

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.

Books recommended

1. Robert Lafore, Object Oriented Programming in C++, Sams, 2001.
2. E. Balagurusamy, Object Oriented Programming with C++, Tata McGraw Hill Pub. Co.
3. Byron, Gottfried, Object Oriented Programming using C++, Schaum's Outline Series, Tata McGraw Hill Pub. Co.

Part-B (Practical)

Time : 3 hours **Max. Marks : 40**

There will be a separate practical course based on the above theory course.

MCS-208: Data Communication and Networking

Credits : 2:0:2

Part-A(Theory)

Time : 3 hours **Max. Marks : 60**

Note: The question paper 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.

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

Section-IV

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

Books recommended

1. Behrouz A. Forouzan, Data Communications and Networking, Mc-Graw Hill.
2. Andrew S. Tanenbaum, Computer Networks, Prentice Hall PTR, 2003.
3. Nasib S. Gill, Essentials of Computer and Network Technology, Khanna Book Publishing Co.(P) Ltd., 2000.
4. M. Jain and Satish Jain, Data Communication and Networking, BPB Publications, 2003.
5. Hemant Kapila, Data Communications and Computer Networks, S. Dinesh and Company.
6. Jon Duckett,Beginning HTML, XHTML, CSS, And JavaScript.
7. Ivan Bayross, HTML, JavaScript, DHTML and PHP, BPB Publications, 4th Edition, 2009.

Part-B (Practical)

Time : 3 hours **Max. Marks : 40**

There will be a separate practical course based on the above theory course.

MCS-209: Information and Communication Technology

Credits : 2:0:2

Part-A(Theory)

Time : 3 hours **Max. Marks : 60**

Note: The question paper 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.

Section-I

Data, Information and knowledge, ICT - Definition, scope, importance and nature of Information and 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

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

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 hackers and crackers.
Antivirus tools- free and paid tools, Latest tools, their style of working, Importance of regular update.

Books recommended

1. Chris Abbott, ICT: Changing Education, Routledge, 2001.

2. Mary Hayes, David Whitebread, ICT in the Early Years, Open University Press.

3. ITL Education Solutions Ltd., Introduction to Information Technology, Pearson Education.

4. Ann Hatherly, ICT and the greatest Technology: A Teacher Mind, Early Childhood Folio

5. Jon Duckett, Beginning HTML, XHTML, CSS, and JavaScript.

6. Ivan Bayross, HTML, JavaScript, DHTML and PHP, BPB Publications, 4th Edition, 2009.

Part-B (Practical)

Time : 3 hours **Max. Marks : 40**

There will be a separate practical course based on the above theory course.

Indira Gandhi University, Meerpur (Rewari)

Scheme of Examination and Syllabi

for

M.Sc.(Mathematics with Computer Science)

3rd Semester

w.e.f. session 2020-21

as per

Choice Based Credit System (CBCS)

Indira Gandhi University, Meerpur (Rewari)
Scheme of Examination
M.Sc.(Mathematics with Computer Science)
Under Choice Based Credit System
w.e.f. Session 2020-21

Semester-III

Core Courses

Course Code	Title of the Course	Theory Marks	Internal Marks	Practical Marks	Credits L:T:P	Contact hrs per week	Total Credits
MCS-301	Functional Analysis	80	20	-	4:0:0	4	4
MCS-302	Partial Differential Equations	80	20	-	4:0:0	4	4
MCS-303	Fluid Dynamics	80	20	-	4:0:0	4	4
MCS-304	Mathematical Statistics	80	20	-	4:0:0	4	4
MCS-305	Seminar	-	-	25	-	-	1
MCS-306	Self Study Paper	-	-	25	-	-	1

Discipline Centric Elective Courses (Any two)

Course Code	Title of the Course	Theory Marks	Internal Marks	Practical Marks	Credits L:T:P	Contact hrs per week	Total Credits
MCS-307	Computer Graphics and Multimedia	60	-	40	2:0:2	6	4
MCS-308	MATLAB	60	-	40	2:0:2	6	4
MCS-309	Software Engineering	80	20	-	4:0:0	4	4
MCS-310	Core Java	60	-	40	2:0:2	6	4
MCS-311	Information Security	60	-	40	2:0:2	6	4
MCS-312	Cyber Security	60	-	40	2:0:2	6	4

Open Elective Course

To be chosen from the pool of open elective courses provided by the University (excluding the open elective course offered by the Department of Mathematics)	3:0:0	3

Total Credits : 29
Total Contact Hours per Week : 26
Max Marks : 750

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

General Guidelines

1. Seminar

In each semester, there will be a paper on seminar presentation of 25 marks with 01 credit. In this paper, the student will be required to present a seminar of about 15-20 minutes on the theme/topic such as review of research papers/articles published in National/International Journals in his /her area of interest. The topic will be selected by the student in consultation with the teacher alloted to him/her by the department.

An internal committee of two teachers constituted by the Chairperson of the department for each student will evaluate the seminar presentation. The evaluation (Internal evaluation only) will be based on the presentation of student, depth of subject matter and answer to questions. There will be a Coordinator to be nominated by the Chairperson of the Department among the teachers of the Department.

For seminar, the topics should be chosen in the following manner:

1st Semester	Any topic (not related to the syllabi)
2nd Semester	Any Basic Research Paper/Article
3rd Semester	Any National Level Research Paper/Article
4th Semester	Any Foreign Research Paper/Article

2. Self Study Paper

In each semester, there will be a self study paper of 25 marks with 01 credit. The objective of this paper is to create habits of reading books and to develop writing skills in a manner of creativity and originality. The students will select a topic of their own interest in the given area in consulation with their teachers/incharge/mentors. After selecting a suitable title for the paper, the students will be required to prepare a hand written report of about 6-10 pages in his/her own handwritng. The students will be required to submit the report after getting it checked by the concerned teacher and will be asked to re-submit the report after making the required corrections(if any) before the commencment of the examinations of that semester. The structure of the paper will include the following:

- Introduction
- Main Body
- Conclusion

The thoughts presented in the paper must be original work of the students.

The paper will be evaluated by the panel (one external and one internal examiner) to be appointed by the Chairperson of Department from the prescribed panel of the University.

The evaluation of Self Study paper will be done as given below:

- Evaluation of the paper : 15 marks
- Viva-Voce on the paper : 10 marks
- Total : 25 marks

MCS-301: Functional Analysis

Time : 3 hours **Max. Marks : 80**
Credits : 4:0:0

Note: The question paper will consist of five Sections. Each of the sections I to IV will contain two questions of 16 marks each 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 of 2 marks each without any internal choice covering the entire syllabus.

Section-I

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

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.

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.

Books recommended

1. E. Kreyszig, Introductory Functional Analysis with Applications, John Wiley.
2. H.L. Royden, Real Analysis, MacMillan Publishing Co., Inc., New York, 4th Edition, 1993.
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.

MCS-302: Partial Differential Equations

Time : 3 hours **Max. Marks : 80**
Credits : 4:0:0

Note: The question paper will consist of five Sections. Each of the sections I to IV will contain two questions of 16 marks each 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 of 2 marks each without any internal choice covering the entire syllabus.

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.

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: (Graduate Studies in Mathematics) 2nd Edition, American Mathematical Society, 2010.
4. H.F. Weinberger, A First Course in Partial Differential Equations, John Wiley and Sons, 1965.
5. M.D. Raisinghania, Advanced Differential equations, S. Chand and Co.

MCS-303: Fluid Dynamics

Time : 3 hours **Max. Marks : 80**
Credits : 4:0:0

Note: The question paper will consist of five Sections. Each of the sections I to IV will contain two questions of 16 marks each 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 of 2 marks each without any internal choice covering the entire syllabus.

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-ordinates.

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.

Books recommended

1. W.H. Besant and A.S. Ramsey, A Treatise on Hydromechanics, Vol.2, CBS Publishers and Distributors, Delhi, 2006.
2. F. Chorlton, Text Book of Fluid Dynamics, C.B.S. Publishers, Delhi, 2004.
3. O'Neill, M.E. and Chorlton, F., Ideal and Incompressible Fluid Dynamics, Ellis Horwood , 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.

MCS-304: Mathematical Statistics

Time : 3 hours **Max. Marks : 80**
Credits : 4:0:0

Note: The question paper will consist of five Sections. Each of the sections I to IV will contain two questions of 16 marks each 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 of 2 marks each without any internal choice covering the entire syllabus.

Section-I

Probability: Definition and various approaches of probability, Addition theorem, Boole's 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.

Books recommended

1. A. M. Mood, F. A. Graybill, and D. C. Boes, Introduction to the Theory of Statistics, McGraw-Hill,1974.
2. S. C. Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand and Sons, New Delhi.
3. J. E. Freund, Mathematical Statistics, Prentice Hall College Div, 1992.
4. M. Spiegel, Probability and Statistics, Schaum Outline Series.

MCS-307: Computer Graphics and Multimedia

Part-A (Theory)

Time : 3 hours **Max. Marks : 60**
Credits : 2:0:2

Note: The question paper 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.

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, Reflection, 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.
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.

Section-IV

Introduction to Multimedia : Classification of Multimedia, Multimedia Software.
Components of Multimedia- Audio : Analog to digital conversion, Audio playbacking and recording video.
Text : Hypertext, Hypermedia and Hypergraphics.
Graphics and Animation : Classification of Animation, process of Animation, Authoring process and tools.

Books recommended

1. Computer Graphics Principles and Practices third edition by James D. Foley, Andries Van Dam, Stevan K. Feiner and John F. Hughes, 2013, Addison 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, Addison Wesley.

5. Computer Graphics: Secrets and Solutions by Corrign John, BPB

6. Graphics, GUI, Games and Multimedia Projects in C by Pilania and Mahendra, Standard Publ.

7. Introduction to Computer Graphics by N. Krishanmurthy T.M.H 2002

8. S. Gokul : Multimedia Magic, BPB Publication.

9. Bufford : Multimedia Systems, Addison Wesley.

10. Jeffcoate : Multimedia in Practice, Prentice-Hall.

Part-B (Practical)

Time : 3 hours **Max. Marks : 40**

There will be a separate practical course based on the above theory course.

MCS-308 : MATLAB

Part-A (Theory)

Time : 3 hours **Max. Marks : 60**
Credits : 2:0:2

Note: The question paper 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.

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.

Books recommended

1. Amos Gilat, MATLAB: An Introduction with Applications, 5th Edition, 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 and B. B. Chaudhari, MATLAB Programming, PHI Learning Private Ltd., New Delhi 2010.

4. Krister Ahlersten, An Introduction to MATLAB, Bookboon.com.

5. Rudra Pratap, Getting Started with MATLAB, Oxford University Press.

Part-B (Practical)

Time : 3 hours **Max. Marks : 40**

There will be a separate practical course based on the above theory course.

MCS-309: Software Engineering

Time : 3 hours **Max. Marks : 80**
Credits : 4:0:0

Note: The question paper will consist of five Sections. Each of the sections I to IV will contain two questions of 16 marks each 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 of 2 marks each without any internal choice covering the entire syllabus.

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.

Books recommended

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

MCS-310: Core Java

Part-A (Theory)

Time : 3 hours **Max. Marks : 60**

Credits : 2:0:2

Note: The question paper 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.

Section-I

Introduction to Java Programming: Overview of Java, Features of Java as programming language/ Platform JDK Environment and Tools.
Java Programming Fundamentals: 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 and 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, Input Stream, Output Stream, Working with Reader classes, Input Stream Reader, Buffered Reader, File Input Stream, File Output Stream.
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.

Books recommended

1. Herbert Schildt, Java: A Beginners 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 : 3 hours **Max. Marks : 40**

There will be a separate practical course based on the above theory course.

MCS-311: Information Security

Part-A (Theory)

Time : 3 hours **Max. Marks : 60**
Credits : 2:0:2

Note: The question paper 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.

Section-I

Introduction: History of Information Security- Critical characteristics of information.
NSTISSC security model: Components of Information System- Securing components.
Balancing information security and access: Approaches to information security implementation SDLC Security System Development Life Cycle SDLC and SecSDLC 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.

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 : 3 hours **Max. Marks : 40**

There will be a separate practical course based on the above theory course.

MCS-312: Cyber Security

Part-A (Theory)

Time : 3 hours **Max. Marks : 60**
Credits : 2:0:2

Note: The question paper 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.

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.

Books recommended

1. Charles P. Fleeger, "Security in Computin", 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 : 3 hours **Max. Marks : 40**

There will be a separate practical course based on the above theory course.

Indira Gandhi University, Meerpur (Rewari)

Scheme of Examination and Syllabi

for

M.Sc.(Mathematics with Computer Science)

4th Semester

w.e.f. session 2020-21

as per

Choice Based Credit System (CBCS)

Indira Gandhi University, Meerpur (Rewari)
Scheme of Examination
M.Sc.(Mathematics with Computer Science)
Under Choice Based Credit System
w.e.f. Session 2020-21

Semester-IV

Core Courses

Course Code	Title of the Course	Theory Marks	Internal Marks	Practical Marks	Credits L:T:P	Contact hrs per week	Total Credits
MCS-401	Inner Product Spaces and Measure Theory	80	20	-	4:0:0	4	4
MCS-402	Classical Mechanics	80	20	-	4:0:0	4	4
MCS-403	Discrete Mathematics	80	20	-	4:0:0	4	4
MCS-404	Operations Research Techniques	80	20	-	4:0:0	4	4
MCS-405	Seminar	-	-	25	-	-	1
MCS-406	Self Study Paper	-	-	25	-	-	1

Discipline Centric Elective Courses (Any two)

Course Code	Title of the Course	Theory Marks	Internal Marks	Practical Marks	Credits L:T:P	Contact hrs per week	Total Credits
MCS-407	Database Management System	60	-	40	2:0:2	6	4
MCS-408	Data and File Structure	60	-	40	2:0:2	6	4
MCS-409	Network Security	60	-	40	2:0:2	6	4
MCS-410	Digital Image Processing	60	-	40	2:0:2	6	4
MCS-411	Artificial Intelligence and Expert Systems	60	-	40	2:0:2	6	4
MCS-412	Data Warehousing and Mining	60	-	40	2:0:2	6	4

Total Credits : 26
Total Contact Hours per Week : 28
Max Marks : 650

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

General Guidelines

1. Seminar

In each semester, there will be a paper on seminar presentation of 25 marks with 01 credit. In this paper, the student will be required to present a seminar of about 15-20 minutes on the theme/topic such as review of research papers/articles published in National/International Journals in his /her area of interest. The topic will be selected by the student in consultation with the teacher alloted to him/her by the department.

An internal committee of two teachers constituted by the Chairperson of the department for each student will evaluate the seminar presentation. The evaluation (Internal evaluation only) will be based on the presentation of student, depth of subject matter and answer to questions. There will be a Coordinator to be nominated by the Chairperson of the Department among the teachers of the Department.

For seminar, the topics should be chosen in the following manner:

1st Semester	Any topic (not related to the syllabi)
2nd Semester	Any Basic Research Paper/Article
3rd Semester	Any National Level Research Paper/Article
4th Semester	Any Foreign Research Paper/Article

2. Self Study Paper

In each semester, there will be a self study paper of 25 marks with 01 credit. The objective of this paper is to create habits of reading books and to develop writing skills in a manner of creativity and originality. The students will select a topic of their own interest in the given area in consulation with their teachers/incharge/mentors. After selecting a suitable title for the paper, the students will be required to prepare a hand written report of about 6-10 pages in his/her own handwritng. The students will be required to submit the report after getting it checked by the concerned teacher and will be asked to re-submit the report after making the required corrections(if any) before the commencment of the examinations of that semester. The structure of the paper will include the following:

- Introduction
- Main Body
- Conclusion

The thoughts presented in the paper must be original work of the students.

The paper will be evaluated by the panel (one external and one internal examiner) to be appointed by the Chairperson of Department from the prescribed panel of the University.

The evaluation of Self Study paper will be done as given below:

- Evaluation of the paper : 15 marks
- Viva-Voce on the paper : 10 marks
- Total : 25 marks

MCS-401: Inner Product Spaces and Measure Theory

Time : 3 hours **Max. Marks : 80**
Credits : 4:0:0

Note: The question paper will consist of five Sections. Each of the sections I to IV will contain two questions of 16 marks each 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 of 2 marks each without any internal choice covering the entire syllabus.

Section-I

Hilbert Spaces: Inner product spaces, Hilbert spaces, Schwarz's inequality, Hilbert space as normed linear space, Convex sets in Hilbert spaces, Projection theorem.

Section-II

Orthonormal sets, Separability, Total Orthonormal sets, Bessel's inequality, Parseval's identity.

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.

Measure space, Generalized Fatou's 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-Nikodym theorem, Lebesgue decomposition, Lebesgue-Stieltjes integral, Product measures, Fubini's theorem, Baire sets, Baire measure, Continuous functions with compact support.

Books recommended

1. George F. Simmons, Introduction to Topology and Modern Analysis, McGraw-Hill Book Company, 1963
2. H.L. Royden, Real Analysis, MacMillan Publishing Co., Inc., New York, 4th Edition, 1993.
3. E. Kreyszig, Introductory Functional Analysis with Applications, John Wiley (1978).
4. S.K. Berberian, Measure and Integration, Chelsea Publishing Company, New York, 1965.
5. K.C. Rao, Functional Analysis, Narosa Publishing House, Second edition, 2006.

MCS-402: Classical Mechanics

Time : 3 hours **Max. Marks : 80**
Credits : 4:0:0

Note: The question paper will consist of five Sections. Each of the sections I to IV will contain two questions of 16 marks each 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 of 2 marks each without any internal choice covering the entire syllabus.

Section-I

Moments and products of inertia, The theorems of parallel and perpendicular axes, Angular momentum of a rigid body about a fixed point and about fixed axes, Principal axes and principal moments 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 and constrained systems, Constraints and their classification, Holonomic and non-holonomic systems, Scleronomic and Rheonomic systems, Possible and Virtual Displacements, Possible velocities and possible accelerations, Ideal constraints, The General equation of dynamics, Lagrange's equations of the first kind. The Principle of Virtual Displacements, D' Alembert's Principle.

Independent coordinates and Generalized forces, Lagrange's equations of the second kind in independent coordinates, Generalized velocities and accelerations, Kinetic energy as a function of generalized velocities, Uniqueness of solution, Theorem on Variation of total energy, Potential, Gyroscopic and Dissipative Forces.

Section-III

Lagrange's equations for Potential Forces, The Generalized Potential, Lagrangian and Hamiltonian variables, Donkin's theorem, Hamilton canonical equations, Routh variables and Routh function, Routh's equations, Cyclic or Ignorable coordinates, Poisson Bracket and their simple properties, Poisson identity, Jacobi-Poisson theorem.

Hamilton's principle, Poincare-Carton Integral Invariant, Generalized Conservative Systems, Whittaker's equations, Jacobi's equations, Lagrangian action and the principle of least action. The Universal Integral Invariant of Poincare, Lee Hwa-Chung's Theorem (Statement only).

Section-IV

Canonical transformations, Necessary and sufficient condition for a transformation to be canonical, Univalent canonical transformations, Free canonical transformations, Hamilton-Jacobi equation, Jacobi's theorem, Method of separation of variables in HJ equation.

The Lagrange Brackets, Necessary and sufficient conditions for the canonical character of a transformation in terms of Lagrange Brackets, The Simplicial Nature of the Jacobian Matrix of a canonical transformation, Conditions of canonicity of a transformation in terms of Poisson Brackets, Invariance of the Poisson Brackets in a canonical transformation.

Books recommended

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

2. F. Gantmacher, Lectures in Analytical Mechanics, MIR Publishers, Moscow, 1975.

3. N.C. Rana and P.S. Joag, Classical Mechanics, Tata McGraw- Hill, New Delhi, 1991.

4. P.V. Panat, Classical Mechanics, Narosa Publishing House, New Delhi, 2005.

5. Louis N. Hand and Janet D. Finch, Analytical Mechanics, CUP, 1998.

6. K. Sankra Rao, Classical Mechanics, Prentice Hall of India, 2005.

7. M.R. Speigal, Theoretical Mechanics, Schaum Outline Series.

MCS-403: Discrete Mathematics

Time : 3 hours **Max. Marks : 80**
Credits : 4:0:0

Note: The question paper will consist of five Sections. Each of the sections I to IV will contain two questions of 16 marks each 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 of 2 marks each without any internal choice covering the entire syllabus.

Section-I

Statements: Symbolic Representation and Tautologies, Quantifiers, Predicates and validity, Prepositional Logic.
Semigroups and Monoids- Definitions and examples of semigroups and monoids. Homomorphism of semigroups and monoids. Congruence relation and Quotient semigroups. Subsemigroups and submonoids. Direct products. Basic homomorphism theorem. Pigeonhole principle, principle of inclusion and exclusion, derangements.

Section-II

Lattices - 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. Join-irreducible elements, Atoms and Minterms.

Section-III

Boolean Algebras- Boolean Algebras as Lattices. Various Boolean Identities. The Switching Algebra example. Subalgebras, Direct Products and Homomorphism, Boolean forms and their equivalence, Minterm Boolean forms, Sum of Products, Canonical forms, Minimization of Boolean functions, Applications of Boolean Algebra to Switching Theory (using AND, OR 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, Rewriting rules, Derivations, Sentential forms, Language generated by a Grammar, Regular, Context-free and Context sensitive grammars and Languages, Regular sets, Regular expressions and the Pumping Lemma, Kleene's theorem.

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, Albert D. Otto, Lawrence E. Spence and Charles Vanden Eynden, Discrete Mathematics, Pearson, Fifth Edition.

4. J.P. Tremblay and R. Manohar, Discrete mathematical structures with applications to computer science, Tata-McGraw Hill Education Pvt.Ltd.

5. J. Ullman and J. Hopcroft, Introduction to Automata Theory, Languages and Computation, Addison-Wesley.

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.

MCS-404: Operations Research Techniques

Time : 3 hours **Max. Marks : 80**
Credits : 4:0:0

Note: The question paper will consist of five Sections. Each of the sections I to IV will contain two questions of 16 marks each 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 of 2 marks each without any internal choice covering the entire syllabus.

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, Transshipment problem.
Assignment problems: Solution by Hungarian method, Unbalanced problem, Case of maximization, Travelling salesman and crew assignment problems.

Section-III

Queuing models: Basic components of a queuing system,Concepts of stochastic processes, Poisson process, Birth-death process. 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).
Sequencing problems: Solution of sequecing problems, processing n jobs through 2 machines, n jobs through 3 machines, n jobs through m machines, 2 jobs through m machines.

Section-IV

Inventory control models: Economic order quantity(EOQ) model with uniform demand and with different rates of demands in different cycles, 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, Algebraic, Graphical and linear programming methods for solving mixed strategy games.

Books recommended

1. H. A. Taha, Operations Research-An Introduction, Prentice Hall, 1997.
2. P. K. Gupta and D.S. Hira, Operations Research, S. Chand and Co. Ltd., 2014.
3. S. D. Sharma, Operations Research, Kedar Nath Ram Nath Publications.
4. J. K. Sharma, Mathematical Models in Operations Research, Tata McGraw-Hill Publishing Company Ltd., 1989.
5. Kanti Swarup, P. K. Gupta and ManMohan, Operations Research, Sultan Chand and Sons, New Delhi, 2005.

MCS-407: Database Management System

Part-A(Theory)

Time : 3 hours **Max. Marks : 60**

Credits : 2:0:2

Note: The question paper 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.

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 in PL/SQL, Package functions, Package procedures.
Database Triggers: Use & type of database Triggers, Database Triggers Vs. Declarative Integrity Constraints, Creatinga Trigger, BEFORE vs AFTER Trigger Combinations, Dropping a Trigger.

Books recommended

1. C. J. Date, Sixth Edition, 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 Edition. Galgotia Publ. Pvt. Ltd.
7. Wiederhold, Database Design, McGraw Hill Book Comp.

Part-B (Practical)

Time : 3 hours **Max. Marks : 40**

There will be a separate practical course based on the above theory course.

MCS-408: Data and File Structure

Part-A (Theory)

Time : 3 hours **Max. Marks : 60**
Credits : 2:0:2

Note: The question paper 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.

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.

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. Schaum's Outline Series, Data Structures, Tata McGraw Hill.

7. Tannenbaum, Data Structure Using C, Tata McGraw-Hill.

Part-B (Practical)

Time : 3 hours **Max. Marks : 40**

There will be a separate practical course based on the above theory course.

MCS-409: Network Security

Part-A (Theory)

Time : 3 hours **Max. Marks : 60**
Credits : 2:0:2

Note: The question paper 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.

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.

Books recommended

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 Fundamental", 1st Ed. Ed., Cisco Press.
6. William Stallings, "Cryptography and Network Security", Pearson Education.

Part-B (Practical)

Time : 3 hours **Max. Marks : 40**

There will be a separate practical course based on the above theory course.

MCS-410: Digital Image Processing

Part-A (Theory)

Time : 3 hours **Max. Marks : 60**
Credits : 2:0:2

Note: The question paper 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.

Section-I

Introduction: What is Digital Image Processing, Origin of Digital Image Processing, Fundamentals to Digital Image Processing, Fundamental steps in Digital Image Processing, 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 level transformation, 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 and Sharpening 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 image processing, Color transformations.
Image Compression: Fundamentals, Image compression models, Error free compression, Lossy compression.

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 Science Press
4. Shashi Kumar Singh, Digital Image Processing, University Science Press
5. Alasdair McAndrew, Introduction to Digital Image Processing with Matlab, Thomson Course Technology

6. Rafeal C. Gonzalez, Richard E. Woods, Steven L. Eddins, Digital Image Processing using Matlab, Pearson Education.

Part-B (Practical)

Time : 3 hours **Max. Marks : 40**

There will be a separate practical course based on the above theory course.

MCS-411: Artificial Intelligence and Expert Systems

Part-A (Theory)

Time : 3 hours **Max. Marks : 60**

Credits : 2:0:2

Note: The question paper 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.

Section-I

Introduction and applications of artificial intelligence, Problem solving: Defining the problem as State Space search, Production system, Problem characteristics, Problem system characteristics, Problem spaces and searches. Blind Search techniques: 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 of artificial neural networks with biological neural networks, Learning in neural networks, Perceptrons, Back propagation networks, Application of neural networks.

Fuzzy logic: Definition, Difference between Boolean and Fuzzy logic, Fuzzy subset, Fuzzy membership function, Fuzzy expert system, Inference process for fuzzy expert system, Fuzzy controller.

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 : 3 hours **Max. Marks : 40**

There will be a separate practical course based on the above theory course.

MCS-412: Data Warehousing and Mining

Part-A (Theory)

Time : 3 hours **Max. Marks : 60**
Credits : 2:0:2

Note: The question paper 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.

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.

Books recommended

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 & Micheline Kamber : Data Mining - Concepts & Techniques, Harcourt India Pvt. Ltd. (Morgan Kaufmann Publishers).
4. Michall Corey, M. Abbey, I Azramson & 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 Adriaans Dolf Zantinge : Data Mining, Addition Wesley.

10. David J. Hand, Heikki Mannila and Padhraic Smyth : Principles of Data Mining, PHI Learning.

11. Anahory S., Murray D. : Data Warehousing in the Real World, Addision Wesley.

Part-B (Practical)

Time : 3 hours **Max. Marks : 40**

There will be a separate practical course based on the above theory course.