Indira Gandhi University, Meerpur (Rewari)

Scheme of Examination and Syllabi

for

M.Sc.(Mathematics with Computer Science)

Ist and 2nd 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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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
MAT-210	Value Education	40	10	-	2:0:0	2	2
MAT-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

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.