

SYLLABUS
FOR
COMPUTER SCIENCE
AS ONE SUBJECT IN
B.SC. WITH GROUP OF SUBJECTS



**H. N. B. GARHWAL UNIVERSITY
SRINAGAR (GARHWAL)**

H. N. B. Garhwal University Srinagar Garhwal

	CORE COURSE (12)	Ability Enhancement Compulsory Course (AECC) (2)	Skill Enhancement Course (SEC) (2)	Discipline Specific Elective DSE (6)
I	DSC1A	(English/MIL Communication)/ Environmental Science		
	DSC2A			
	Object Oriented Programming in C++			
II	DSC1B	Environmental Science /(English/MIL Communication)		
	DSC2B			
	Data Structures and File Processing			
III	DSC1C		SEC-1	
	DSC2C			
	Numerical Computing			
IV	DSC1D		SEC -2	
	DSC2D			
	Design and Analysis of Algorithms			
V			SEC-3	DSE-1A
				DSE-2A
				DSE-3A
VI			SEC -4	DSE-1A
				DSE-2A
				DSE-3A

FIRST SEMESTER

S.N	Course No.	Subject	Evaluation – Scheme								Credit
			Period			Sessional			Examination		
			L	T	P	TA	CT	TOT	ESE	Sub. Total	
Theory											
1.	SOS/CSE/C103	Object Oriented Programming in C++	4	-	-	10	20	30	70	100	4
Practical											
1.	SOS/CSE/CP13	Object Oriented Programming in C++	-	-	3	30	-	30	70	100	2
		Total	4	-	3	40	20	60	140	200	6

AECC English of 2 Credit & Core -1 Papers of each of the combination subject of 6 Credits each Total 20 Credits

SECOND SEMESTER

S.N	Course No.	Subject	Evaluation – Scheme								Credit
			Period			Sessional			Examination		
			L	T	P	TA	CT	TOT	ESE	Sub. Total	
Theory											
1.	SOS/CSE/C203	Data Structures and File Processing	4	-	-	10	20	30	70	100	4
Practical											
1.	SOS/CSE/CP23	Data Structures and File Processing	-	-	3	30	-	30	70	100	2
		Total	4	-	3	40	20	60	140	200	6

AECC Env, Sci. of 2 Credit & Core-2 Papers of each of the combination subject of 6 Credits each Total 20 Credits

THIRD SEMESTER

S.N	Course No.	Subject	Evaluation – Scheme								Credit
			Period			Sessional			Examination		
			L	T	P	TA	CT	TOT	ESE	Sub. Total	
Theory											
1.	SOS/CSE/C303	Numerical Computing	4	-	-	10	20	30	70	100	4
Practical											
1.	SOS/CSE/CP33	Numerical Computing Lab	-	-	3	30	-	30	70	100	2
		Total	4	-	3	40	20	60	140	200	6

Skill Enhancement course -1 of 2 credit & Core-3 Papers of each of the combination subject of 6 Credits each Total 20 Credits

FOURTH SEMESTER

S.N	Course No.	Subject	Evaluation – Scheme								Credit
			Period			Sessional			Examination		
			L	T	P	TA	CT	TOT	ESE	Sub. Total	
Theory											
1.	SOS/CSE/C403	Design and Analysis of Algorithms	4	-	-	10	20	30	70	100	4
Practical											
1.	SOS/CSE/CP43	Design and Analysis of Algorithms Lab	-	-	3	30	-	30	70	100	2
		Total	4	-	3	40	20	60	140	200	6

Skill Enhancement course -2 of 2 credit & Core-4 Papers of each of the combination subject of 6 Credits each Total 20 Credits

FIFTH SEMESTER

S.N	Course No.	Subject	Evaluation – Scheme								Credit
			Period			Sessional			Examination		
			L	T	P	TA	CT	TOT	ESE	Sub. Total	
Theory											
1.	SOS/CSE/DSE3A	Discipline Specific Elective 3A	4	-	-	10	20	30	70	100	4
Practical											
1.	SET/CSE/CP3A	Discipline Specific Elective 3A Lab	-	-	3	30	-	30	70	100	2
		Total	4	-	3	40	20	60	140	200	6

Skill Enhancement course -3 of 2 credit & Discipline Specific Elective 1 of each of the combination subject of 6 Credits each Total 20 Credits

SIXTH SEMESTER

S.N	Course No.	Subject	Evaluation – Scheme								Credit
			Period			Sessional			Examination		
			L	T	P	TA	CT	TOT	ESE	Sub. Total	
Theory											
1.	SOS/CSE/DSE3B	Discipline Specific Elective 3B	4	-	-	10	20	30	70	100	4
Practical											
1.	SET/CSE/CP3B	Discipline Specific Elective 3B Lab	-	-	3	30	-	30	70	100	2
		Total	4	-	3	40	20	60	140	200	6

Skill Enhancement course -4 of 2 credit & Discipline Specific Elective 2 of each of the combination subject of 6 Credits each Total 20 Credits

Discipline Specific Elective Papers

DSE 3A: (Credit: 06 each) (Choose One)

1. Operating Systems
2. Data Mining
3. Cryptography

DSE 3B: (Credit: 06 each) (Choose One)

1. Information Security
2. Database Applications
3. Computer Networks

Skill Enhancement Courses

SEC 1 (choose one) (Credit: 02 each)

1. Logic and Sets
2. Analytical Geometry
3. Number Theory

SEC 2 (choose one) (Credit: 02 each)

1. Vector Calculus
2. Transportation and Game Theory
3. Probability and Statistics

SEC 3 (choose one) (Credit: 02 each)

1. Computer Graphics
2. Electronic Commerce
3. Combinatorial Optimization

SEC 4 (choose one) (Credit: 02 each)

1. Modeling and Simulation
2. Graph Theory
3. Boolean Algebra

FIRST SEMESTER

S.N	Course No.	Subject	Evaluation – Scheme								Credit
			Period			Sessional			Examination		
			L	T	P	TA	CT	TOT	ESE	Sub. Total	
Theory											
1.	SOS/CSE/C103	Object Oriented Programming in C++	4	-	-	10	20	30	70	100	4

Object Oriented Programming in C++

Programming Concepts: Algorithm and its characteristics, pseudo code / flow chart, program, identifiers, variables, constants, primitive data types, expressions, structured data types, arrays, compilers and interpreters.

Statements: Assignment statement, if then else statements, switch statement, looping statements- while, do while, for, break, continue, input/output statements, functions/procedures. Object Oriented Concepts: Abstraction, encapsulation, objects, classes, methods, constructors, inheritance, polymorphism, static and dynamic binding, overloading. Program Development: Object oriented analysis, design, unit testing & debugging, system testing & integration, maintenance.

Introduction to structured programming: data types- simple data types, floating data types, character data types, string data types, arithmetic operators and operator precedence, variables and constant declarations, expressions, input using the extraction operator >> and cin, output using the insertion operator << and cout, preprocessor directives, increment (++) and decrement operations (--), creating a C++ program, input/output, relational operators, logical operators and logical expressions, if and if ... else statement, switch and break statements. “for”, “while” and “do – while” loops, break and continue statement, nested control statement, value returning functions, void functions, value versus reference parameters, local and global variables, static and automatic variables, enumeration type, one dimensional array, two dimensional array, character array, pointer data and pointer variables.

Books Recommended

1. Richard Johnson, *An Introduction to Object-Oriented Application Development*, Thomson Learning, 2006
2. B. Stroustrup, *The C++ Programming Language*, Addison Wesley, 2004.

SECOND SEMESTER

S.N	Course No.	Subject	Evaluation – Scheme								Credit
			Period			Sessional			Examination		
			L	T	P	TA	CT	TOT	ESE	Sub. Total	
Theory											
1.	SOS/CSE/C203	Data Structures and File Processing	4	-	-	10	20	30	70	100	4

Data Structures and File Processing

Basic Data Structures: Abstract data structures- stacks, queues, linked lists and binary trees.

Sets: Dictionary implementation, use of priority queues, hashing, binary trees, balanced trees, sets with merge-find operations.

Searching: Internal and external searching, use of hashing and balancing techniques. Memory

Management: Garbage collection algorithms for equal sized blocks, storage allocation for objects with mixed size, buddy systems.

Physical Devices: Characteristics of storage devices such as disks and tapes, I/O buffering. Basic

File System Operations: Create, open, close, extend, delete, readblock, write-block, protection mechanisms.

File Organizations: Sequential, indexed sequential, direct, inverted, multi-list, directory systems,

Indexing using B-tree, B+ tree and their variants, hashing – hash function, collision handling methods, extendible hashing.

Books Recommended

1. M.T. Goodrich, R. Tamassia and D. Mount, *Data Structures and Algorithms in C++*, John Wiley and Sons, Inc., 2004.
2. T.H. Cormen, C.E. Leiserson, R.L. Rivest and C. Stein, *Introduction to Algorithms*, 2nd Ed., Prentice-Hall of India, 2006.
3. Robert L. Kruse and A.J. Ryba, *Data Structures and Program Design in C++*, Prentice Hall, Inc., NJ, 1998.
4. B. Stroustrup, *The C++ Programming Language*, Addison Wesley, 2004
5. D.E. Knuth, *Fundamental Algorithms* (Vol. I), Addison Wesley, 1997

THIRD SEMESTER

S.N	Course No.	Subject	Evaluation – Scheme								Credit
			Period			Sessional			Examination		
			L	T	P	TA	CT	TOT	ESE	Sub. Total	
Theory											
1.	SOS/CSE/C303	Numerical Computing	4	-	-	10	20	30	70	100	4

Numerical Computing

Solution to Transcendental and Polynomial Equations: Iterative methods, bisection method, secant method, Newton-Raphson method, fixed point iteration, methods for finding complex roots. Matrices and Linear System of Equations: LU decomposition method for solving systems of equations, Symmetric positive definite matrices and least square approximation, iterative algorithms for linear equations.

Interpolation: Polynomial interpolation, Newton-Gregory, Stirling's, Bessel's and Lagrange's interpolation formula, Newton's divided differences interpolation formulae. Curve fitting: B-spline and Approximation: Fitting linear and non-linear curves, weighted least square approximation, method of least square for continuous functions.

Numerical Differentiation and Integration: Numerical differentiation and errors in numerical differentiation, Newton-Cotes formulae, trapezoidal rule, Simpson's rule, Gaussian integration. Numerical Solutions of Ordinary Differential Equations: Picard's and Taylor's series, Euler's and Runge-Kutta (RK) methods. Finite Element Method: Boundary value problems, Rayleigh and Galerkin methods of approximation, applications.

Books Recommended

1. K.E. Atkinson, W. Han, *Elementary Numerical Analysis*, 3rd Ed., Wiley, 2003.
2. C. Xavier, S.S. Iyengar, *Introduction to Parallel Algorithms*, Wiley-Interscience, 1998.
3. A. Kharab, R.B. Guenther, *An Introduction to Numerical Methods: A MATLAB Approach*, 1st Ed., Chapman and Hall/CRC, 2001.
4. B. Bradie, *A Friendly Introduction to Numerical Analysis*, Pearson Education, 2007.
5. S.R. Otto and J.P. Denier, *An Introduction to Programming and Numerical Methods in MATLAB*, Springer, 2005.
6. M.K. Jain, S.R.K. Iyengar and R.K. Jain, *Numerical Methods for Scientific and Engineering Computation*, 7th Ed., New Age International Publishers, 2007.

FOURTH SEMESTER

S.N	Course No.	Subject	Evaluation – Scheme								Credit
			Period			Sessional			Examination		
			L	T	P	TA	CT	TOT	ESE	Sub. Total	
Theory											
1.	SOS/CSE/C403	Design and Analysis of Algorithms	4	-	-	10	20	30	70	100	4

Design and Analysis of Algorithms

Introduction: RAM model, $O(\log n)$ bit model. Review of data structures: Balanced trees, Mergeable sets. Algorithm Design Techniques: Iterative techniques, Divide and conquer, dynamic programming, greedy algorithms.

Searching and Sorting Techniques: Review of elementary sorting techniques-selection sort, bubble sort, insertion sort, more sorting techniques-quick sort, heap sort, merge sort, shell sort, external sorting.

Lower bounding techniques: Decision Trees, Adversaries. String Processing: KMP, Boyre-Moore, Robin Karp algorithms.

Introduction to randomized algorithms: Random numbers, randomized Qsort, randomly Built BST Number Theoretic Algorithms: GCD, Addition and Multiplication of two large numbers, polynomial arithmetic, Fast-Fourier Transforms.

Graphs: Analysis of Graph algorithms Depth-First Search and its applications, minimum Spanning Trees and Shortest Paths.

Introduction to Complexity Theory: Class P, NP, NP-Hard, NP Completeness. Introduction to Approximation Algorithms

Books Recommended

1. T.H. Cormen, C.E. Leiserson, R.L. Rivest and C. Stein, *Introduction to Algorithms*, Prentice-Hall of India, 2006.
2. J. Kleinberg and E. Tardos, *Algorithms Design*, Pearson Education, 2006.
3. S. Baase, *Computer Algorithms: Introduction to Design and Analysis*, Addison Wesley, 1999.
4. A.V. Levitin, *Introduction to the Design and Analysis of Algorithms*, Pearson Education, 2006.

FIFTH SEMESTER

S.N	Course No.	Subject	Evaluation – Scheme								Credit
			Period			Sessional			Examination		
			L	T	P	TA	CT	TOT	ESE	Sub. Total	
Theory											
1.	SOS/CSE/DSE3A	Discipline Specific Elective 1	4	-	-	10	20	30	70	100	4

DSE 3A: (Credit: 06 each) (Choose One)

1. Operating Systems
2. Data Mining
3. Cryptography

DSE 3A.1: Operating Systems

Introduction: Operating System as a resource manager, operating system classification, system calls, traps, architectures for operating systems.

Device Management: Goals of I/O software, Design of device drivers. Processor Management: Process overview, process states and state transition, multiprogramming, multi-tasking, levels of schedulers and scheduling algorithms.

Process Synchronization - Critical section and mutual exclusion problem, classical synchronization problems, deadlock prevention.

Multithreading Memory Management: Classical memory management techniques, paging, segmentation, virtual memory.

File Management: Overview of file management system, disk space management, directory structures. Protection domains, access control lists, protection models.

Books Recommended

1. A.S. Tanenbaum, *Modern Operating Systems*, 3rd Ed., Prentice-Hall of India, 2008.
2. William Stallings, *Operating Systems: Internals and Design Principles*, 5th Ed. Prentice-Hall of India, 2006.
3. Gary Nutt, *Operating Systems: A Modern Approach*, 3rd Ed., Addison Wesley, 2004.
4. D.M. Dhamdhere, *Operating Systems: A Concept Based Approach*, 2nd Ed., Tata McGraw-Hill, 2007.

DSE 3A.2: Data Mining

Overview: The process of knowledge discovery in databases, predictive and descriptive data mining techniques, supervised and unsupervised learning techniques.

Techniques of Data Mining: Link analysis, predictive modeling, database segmentation, score functions for data mining algorithms, Bayesian techniques in data mining.

Issues in Data Mining: Scalability and data management issues in data mining algorithms, parallel and distributed data mining, privacy, social, ethical issues in KDD and data mining, pitfalls of KDD and data mining.

Books Recommended

1. Margaret H. Dunham, *Data Mining: Introductory and Advanced Topics*, Pearson, 2002.
2. Jiawei Han and Micheline Kamber, *Data Mining: Concepts and Techniques*, 2nd Ed., Morgan Kaufmann, 2006.
3. Arun Pujari, *Data Mining Techniques*, University Press, 2001.
4. D. Hand, H. Mannila and P. Smyth, *Principles of Data Mining*, Prentice-Hall of India, 2006.
5. G.K. Gupta, *Introduction to Data Mining with Case Studies*, Prentice-Hall of India, 2006.

DSE 3A.3: Cryptography

Elementary number theory: Prime numbers, Fermat's and Euler's theorems, Testing for primality, Chinese remainder theorem, discrete logarithms. Finite fields: Review of groups, rings and fields; Modular Arithmetic, Euclidean Algorithms, Finite fields of the form $GF(p)$, Polynomial Arithmetic, Finite fields of the form $GF(2)$. Data Encryption Techniques: Algorithms for block and stream ciphers, private key encryption – DES, AES, RC4; Algorithms for public key encryption – RSA, DH Key exchange, KERBEROS, elliptic curve cryptosystems. Message authentication and hash functions, Digital Signatures and authentication protocols, Public key infrastructure, Cryptanalysis of block and stream ciphers.

Book Recommended

1. W. Stallings, *Cryptography and Network Security Principles and Practices*, 4th Ed., Prentice-Hall of India, 2006.
2. C. Pfleeger and S.L. Pfleeger, *Security in Computing*, 3rd Ed., Prentice-Hall of India, 2007.
3. M.Y. Rhee, *Network Security*, John Wiley and Sons, NY, 2002.

SIXTH SEMESTER

S.N	Course No.	Subject	Evaluation – Scheme								Credit
			Period			Sessional			Examination		
			L	T	P	TA	CT	TOT	ESE	Sub. Total	
Theory											
1.	SOS/CSE/DSE3B	Discipline Specific Elective 2	4	-	-	10	20	30	70	100	4

DSE 3B: (Credit: 06 each) (Choose One)

1. Information Security
2. Database Applications
3. Computer Networks

DSE 3B.1: Information Security

Overview of Security: Protection versus security; aspects of security–data integrity, data availability, privacy; security problems, user authentication, Orange Book.

Security Threats: Program threats, worms, viruses, Trojan horse, trap door, stack and buffer overflow; system threats- intruders; communication threats- tapping and piracy. Cryptography: Substitution, transposition ciphers, symmetric-key algorithms- Data Encryption Standard, advanced encryption standards, public key encryption - RSA; Diffie-Hellman key exchange, ECC cryptography, Message Authentication- MAC, hash functions. Digital signatures: Symmetric key signatures, public key signatures, message digests, public key infrastructures. Security Mechanisms: Intrusion detection, auditing and logging, tripwire, system-call monitoring;

Books Recommended

1. W. Stallings, *Cryptography and Network Security Principles and Practices*, 4th Ed., Prentice-Hall of India, 2006.
2. C. Pfleeger and SL. Pfleeger, *Security in Computing*, 3rd Ed., Prentice-Hall of India, 2007.
3. D. Gollmann, *Computer Security*, John Wiley and Sons, NY, 2002.
4. J. Piwprzyk, T. Hardjono and J. Seberry, *Fundamentals of Computer Security*, Springer-Verlag Berlin, 2003.
5. J.M. Kizza, *Computer Network Security*, Springer, 2007.
6. M. Merkow and J. Breithaupt, *Information Security: Principles and Practices*, Pearson Education, 2006.

DSE 3B.2: Database Applications

Application Design and Development: User interfaces and tools, web interfaces to Databases
Web Fundamentals: HTML, static vs. dynamic web pages, client (Java script/VB) and server side scripting (JSP/ASP/PHP/VB), web servers and sessions, two level & three level architecture, Real Life Application Development using Popular DBMS: SQL, procedures & functions, exception handling, triggers, large objects, user defined data types, collection types, bulk loading of data. Query Optimization: Query Processing, query tree, query plans, measures of query cost, estimates of basic operations, equivalent relational algebra expressions, evaluation of expressions.

Authorizations in SQL: System and user privileges, granting and revoking privileges, roles, authorization on views, functions and procedures, limitations of SQL authorizations, audit trails Application Security: Encryption techniques, digital signatures and digital certificates.

Books Recommended

1. A. Silberschatz, H. Korth and S. Sudarshan, *Database System Concepts*, 5th Ed., Tata McGraw Hill, 2006.
2. J. Morrison, M. Morrison and R. Conrad, *Guide to Oracle 10g*, Thomson Learning, 2005.
3. Loney and Koch, *Oracle 10g: The Complete Reference*, Tata McGraw Hill, 2006.
4. David Flanagan, *JavaScript, The Definitive Guide*, O'Reilly Media, 2006.
5. Marty Hall, Larry Brown, and Yaakov Chaikin, *Core Servlets and Java Server Pages: Core Technologies (Vol. II)*, 2nd Ed., Sun Microsystems Press, 2006.
6. S.K. Singh, *Database Systems Concepts, Design and Applications*, Pearson Education 2006.

DSE 3B.3: Computer Networks

Basic Concepts: Components of data communication, distributed processing, Line configuration, topology, transmission mode, and categories of networks. OSI and TCP/IP Models: Layers and their functions, comparison of models. Digital Transmission: Interfaces and Modems: DTE-DCE Interface, modems, cable modems.

Transmission Media: Guided and unguided, Attenuation, distortion, noise, throughput, propagation speed and time, wavelength, Shannon Capacity. Telephony: Multiplexing, error detection and correction, Many to one, one to many, WDM, TDM, FDM, circuit switching, packet switching and message switching. Data Link control protocols: Line discipline, flow

control, error control, synchronous and asynchronous protocols overview. ISDN: Services, historical outline, subscriber's access, ISDN, Layers, and broadband ISDN.

Devices: Repeaters, bridges, gateways, routers, The Network Layer, Design Issues, Network Layer Addressing and Routing concepts (Forwarding Function, Filtering Function); Routing Methods (Static and dynamic routing, Distributed routing, Hierarchical Routing); Distance Vector Protocol, Link State protocol. Transport and upper layers in OSI Model: Transport layer functions, connection management, Functions of session layers, Presentation layer, and Application layer.

Books Recommended

1. A.S. Tanenbaum, *Computer Networks*, 4th Ed., Pearson Education Asia, 2003.
2. Behrouz A. Forouzan, *Data Communication and Networking*, 2nd Ed., Tata McGraw Hill.
3. D. E. Comer, *Internetworking with TCP/IP*, Pearson Education Asia, 2001.
4. William Stallings, *Data and Computer Communications*, 7th Ed., Pearson education Asia, 2002.

Skill Enhancement Courses

SEC 1 (choose one) (Credit: 02 each)

1. Logic and Sets
2. Analytical Geometry
3. Number Theory

SEC 1.1: Logic and Sets

Introduction, propositions, truth table, negation, conjunction and disjunction. Implications, biconditional propositions, converse, contra positive and inverse propositions and precedence of logical operators. Propositional equivalence: Logical equivalences. Predicates and quantifiers: Introduction, Quantifiers, Binding variables and Negations.

Sets, subsets, Set operations, the laws of set theory and Venn diagrams. Examples of finite and infinite sets. Finite sets and counting principle. Empty set, properties of empty set. Standard set operations. Classes of sets. Power set of a set. Difference and Symmetric difference of two sets. Set identities, Generalized union and intersections. Relation: Product set, Composition of relations, Types of relations, Partitions, Equivalence Relations with example of congruence modulo relation.

Book Recommended

1. R.P. Grimaldi, *Discrete Mathematics and Combinatorial Mathematics*, Pearson Education, 1998.
2. P.R. Halmos, *Naive Set Theory*, Springer, 1974.
3. E. Kamke, *Theory of Sets*, Dover Publishers, 1950.

SEC 1.2: Analytical Geometry

Techniques for sketching parabola, ellipse and hyperbola. Reflection properties of parabola, ellipse and hyperbola. Classification of quadratic equations representing lines, parabola, ellipse and hyperbola. Spheres, Cylindrical surfaces. Illustrations of graphing standard quadric surfaces like cone, ellipsoid.

Books Recommended

1. G.B. Thomas and R.L. Finney, *Calculus*, 9th Ed., Pearson Education, Delhi, 2005.
2. H. Anton, I. Bivens and S. Davis, *Calculus*, John Wiley and Sons (Asia) Pvt. Ltd. 2002.
3. S.L. Loney, *The Elements of Coordinate Geometry*, McMillan and Company, London.
4. R.J.T. Bill, *Elementary Treatise on Coordinate Geometry of Three Dimensions*, McMillan India Ltd., 1994.

SEC 1.3: Number Theory

Division algorithm, Lamé's theorem, linear Diophantine equation, fundamental theorem of arithmetic, prime counting function, statement of prime number theorem, Goldbach conjecture, binary and decimal representation of integers, linear congruences, complete set of residues.

Number theoretic functions, sum and number of divisors, totally multiplicative functions, definition and properties of the Dirichlet product, the Mobius inversion formula, the greatest integer function, Euler's phi-function.

Books Recommended:

1. David M. Burton, *Elementary Number Theory*, 6th Ed., Tata McGraw-Hill Edition, Indian reprint, 2007.
2. Richard E. Klima, Neil Sigmon, Ernest Stitzinger, *Applications of Abstract Algebra with Maple*, CRC Press, Boca Raton, 2000.
3. Neville Robinns, *Beginning Number Theory*, 2nd Ed., Narosa Publishing House Pvt. Limited, Delhi, 2007.

Skill Enhancement Courses

SEC 2 (choose one) (Credit: 02 each)

1. Vector Calculus
2. Transportation and Game Theory
3. Probability and Statistics

SEC 2.1: Vector Calculus

Differentiation and partial differentiation of a vector function. Derivative of sum, dot product and cross product of two vectors. Gradient, divergence and curl.

Books Recommended

1. G.B. Thomas and R.L. Finney, *Calculus*, 9th Ed., Pearson Education, Delhi, 2005.
2. H. Anton, I. Bivens and S. Davis, *Calculus*, John Wiley and Sons (Asia) P. Ltd. 2002.
3. P.C. Matthew's, *Vector Calculus*, Springer Verlag London Limited, 1998.

SEC 2.2: Transportation and Game Theory

Transportation problem and its mathematical formulation, northwest-corner method, least cost method and Vogel approximation method for determination of starting basic solution, algorithm for solving transportation problem, assignment problem and its mathematical formulation, Hungarian method for solving assignment problem.

Game theory: formulation of two person zero sum games, solving two person zero sum games, games with mixed strategies, graphical solution procedure.

Books Recommended

1. Mokhtar S. Bazaraa, John J. Jarvis and Hanif D. Sherali, *Linear Programming and Network Flows*, 2nd Ed., John Wiley and Sons, India, 2004.
2. F.S. Hillier and G.J. Lieberman, *Introduction to Operations Research*, 9th Ed., Tata McGraw Hill, Singapore, 2009.
3. Hamdy A. Taha, *Operations Research, An Introduction*, 8th Ed., Prentice---Hall India, 2006.

SEC 2.3: Probability and Statistics

Sample space, probability axioms, real random variables (discrete and continuous), cumulative distribution function, probability mass/density functions, mathematical expectation, moments, moment generating function, characteristic function, discrete distributions: uniform, binomial, Poisson, continuous distributions: uniform, normal, exponential.

Joint cumulative distribution function and its properties, joint probability density functions, marginal and conditional distributions, expectation of function of two random variables, conditional expectations, independent random variables.

Books Recommended

1. Robert V. Hogg, Joseph W. McKean and Allen T. Craig, *Introduction to Mathematical Statistics*, Pearson Education, Asia, 2007.
2. Irwin Miller and Marylees Miller and John E. Freund, *Mathematical Statistics with Applications*, 7th Ed., Pearson Education, Asia, 2006.
3. Sheldon Ross, *Introduction to Probability Models*, 9th Ed., Academic Press, Indian Reprint, 2007.

Skill Enhancement Courses

SEC 3 (choose one) (Credit: 02 each)

1. Computer Graphics
2. Electronic Commerce
3. Combinatorial Optimization

SEC 3.1: Computer Graphics

Development of computer Graphics: Raster Scan and Random Scan graphics storages, displays processors and character generators, colour display techniques, interactive input/output devices.

Points, lines and curves: Scan conversion, line-drawing algorithms, circle and ellipse generation, conic-section generation, polygon filling anti aliasing. Two-dimensional viewing: Coordinate systems, linear transformations, line and polygon clipping algorithms.

Books Recommended

1. D. Hearn and M.P. Baker, *Computer Graphics*, 2nd Ed., Prentice–Hall of India, 2004.
2. J.D. Foley, A van Dam, S.K. Feiner and J.F. Hughes, *Computer Graphics: Principals and Practices*, 2nd Ed., Addison-Wesley, MA, 1990.
3. D.F. Rogers, *Procedural Elements in Computer Graphics*, 2nd Ed., McGraw Hill Book Company, 2001.
4. D.F. Rogers and A.J. Admas, *Mathematical Elements in Computer Graphics*, 2nd Ed., McGraw Hill Book Company, 1990.

SEC 3.2: Electronic Commerce

Building Blocks of Electronic Commerce: Introduction, internet and networking technologies, Internet and network protocols, web server scalability, software technologies for building E-commerce applications, distributed objects, object request brokers, component technology, web services, web application architectures.

Design of auction, optimization algorithms, for market places, multi-agent systems. Global E-commerce and Law: Cyber law in India. Comparative evaluation of Cyber laws of certain countries.

Books Recommended

1. E.M. Awad, *Electronic Commerce from Vision to Fulfillment*, 3rd Ed., Prentice- Hall of India, 2006
2. P.T. Joseph, *E-Commerce: An Indian Perspective*, Prentice-Hall of India, 2007.
3. Scott Bonneau, Tammy Kohl, Jeni Tennison, Jon Duckett and Kevin Williams, *XML Design Handbook*, Wrox Press Ltd., 2003.

SEC 3.3: Combinatorial Optimization

Introduction: Optimization problems, neighbourhoods, local and global optima, convex sets and functions, simplex method, degeneracy; duality and dual simplex algorithm, computational considerations for the simplex and dual simplex algorithms- Dantzig-Wolfe algorithms.

Integer Linear Programming: Cutting plane algorithms, branch and bound technique and approximation algorithms for travelling salesman problem.

Books Recommended

1. C.H. Papadimitriou and K. Steiglitz, *Combinatorial Optimization: Algorithms and Complexity*, Prentice-Hall of India, 2006
2. K. Lange, *Optimization*, Springer, 2004.
3. Mokhtar S. Bazaraa, John J. Jarvis and Hanif D. Sherali, *Linear Programming and Network Flows*, John Wiley and Sons, 2004.
4. H.A. Taha, *Operations Research: An Introduction*, 8th Ed., Prentice Hall, 2006.

Skill Enhancement Courses

SEC 4 (choose one) (Credit: 02 each)

1. Modeling and Simulation
2. Graph Theory
3. Boolean Algebra

SEC 4.1: Modeling and Simulation

Systems and environment: Concept of model and model building, model classification and representation, Use of simulation as a tool, steps in simulation study.

Continuous-time and Discrete-time systems: Laplace transform, transfer functions, state space models, order of systems, z-transform, feedback systems, stability, observability, controllability.

Statistical Models in Simulation: Common discrete and continuous distributions, Poisson process, empirical distributions.

Random Numbers: Properties of random numbers, generation of pseudo random numbers, techniques of random number generation, tests for randomness, random variate generation using inverse transformation, direct transformation, convolution method, acceptance-rejection.

Books Recommended

1. Narsingh Deo, *System Simulation with Digital Computer*, Prentice Hall of India, 1999.
2. Averill Law, *Simulation Modeling and Analysis*, 3rd Ed., Tata McGraw-Hill, 2007.
3. G. Gordan, *System Simulation*, 2nd Ed., Pearson Education, 2007.
4. A.F. Seila, V. Ceric and P. Tadikamalla, *Applied Simulation Modeling* (International Student Edition), Thomson Learning, 2004.
5. Jerry Banks, *Handbook of Simulation: Principles, Methodology, Advances, Applications and Practice*, Wiley Inter Science, 1998.
6. J. Banks, J.S. Carson, B.L. Nelson, *Discrete Event System Simulation*, 4th Ed., Prentice Hall of India, 2004.
7. N.A. Kheir, *Systems Modeling and Computer Simulation*, Marcel Dekker, 1988.
8. B.P. Zeigler, T.G. Kim, and H. Praehofer, *Theory of Modeling and Simulation*, 2nd Ed., Academic Press, 2000.

SEC 4.2: Graph Theory

Definition, examples and basic properties of graphs, pseudo graphs, complete graphs, bi-partite graphs, isomorphism of graphs, paths and circuits, Eulerian circuits, Hamiltonian cycles, the adjacency matrix, weighted graph, travelling salesman's problem, shortest path, Dijkstra's algorithm, Floyd-Warshall algorithm..

Books Recommended

1. Edgar G. Goodaire and Michael M. Parmenter, *Discrete Mathematics with Graph Theory*, 2nd Ed., Pearson Education (Singapore) P. Ltd., Indian Reprint 2003.
2. Rudolf Lidl and Günter Pilz, *Applied Abstract Algebra*, 2nd Ed., Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint, 2004.

SEC 4.3: Boolean Algebra

Definition, examples and basic properties of ordered sets, maps between ordered sets, duality principle, maximal and minimal elements, lattices as ordered sets, complete lattices, lattices as algebraic structures, sublattices, products and homomorphisms. Definition, examples and properties of modular and distributive lattices, Boolean algebras, Boolean polynomials, minimal forms of Boolean polynomials, Quinn- McCluskey method, Karnaugh diagrams, switching circuits and applications of switching circuits.

Books Recommended

1. B A. Davey and H.A. Priestley, *Introduction to Lattices and Order*, Cambridge University Press, Cambridge, 1990.
2. Rudolf Lidl and Günter Pilz, *Applied Abstract Algebra*, 2nd Ed., Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint, 2004.