M.C.A CURRICULUM

NATIONAL INSTITUTE OF TECHNOLOGY KARNATAKA SURATHKAL
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2017

MOTTO

* Work is Worship

VISION

* To Facilitate Transformation of Students into- Good Human Beings, Responsible Citizens and Competent Professionals, focusing on Assimilation, Generation and Dissemination of Knowledge.

MISSION

* Impart Quality Education to Meet the Needs of Profession and Society and Achieve Excellence in Teaching-Learning and Research.

* Attract and Develop Talented and Committed Human Resource and Provide an Environment Conducive to Innovation, Creativity, Team-spirit and Entrepreneurial Leadership

* Facilitate Effective Interactions Among Faculty and Students and Foster Networking with Alumni, Industries, Institutions and Other Stake-holders.

* Practise and Promote High Standards of Professional Ethics, Transparency and Accountability.

REGULATIONS

SPECIFIC TO

POST GRADUATE PROGRAMME

Master of Computer Applications (MCA) Degree

NATIONAL INSTITUTE OF TECHNOLOGY KARNATAKA, SURATHKAL
Post : Srinivasnagar, Mangalore - 575025, India.
- 2017 -

CONTENTS

REGULATIONS
specific to
M.C.A. Degree Programme

{also refer: REGULATIONS (General) – Common to all Degree Programmes}

1. ADMISSION

1.1 **Student Status** There is only one type of student status in the MCA degree Programme, namely, full-time.

1.2 **Duration** The duration of study shall be a minimum of SIX semesters and a maximum of SIX years.

1.3 Admissions will be made in accordance with the instructions received from MHRD from time to time. Seats are reserved for candidates belonging to Other Backward Classes Scheduled Caste and Scheduled Tribes, Physically challenged candidates, children of defence personnel and other categories as per the guidelines issued by MHRD.

1.4 The admissions will be on the basis of the performance in the prescribed Entrance Examination, and performance in the qualifying examination and interview. The prescribed qualifying examinations are given separately in the Institute prospectus for M.C.A. Programme.

1.5 Admission to M.C.A. Programme shall be open to candidates who have -

(a) passed the prescribed qualifying examination with a Cumulative Grade Point Average (CGPA) of at least 6.5 in the 0-10 scale grading system, OR not less than 60% marks in the aggregate (taking into account the marks scored in all the subjects of all the public/university examinations conducted during the entire prescribed period for the degree programme). However, this prescribed minimum shall be CGPA of 6.0 OR 55% marks in the aggregate for SC/ST candidates.

(b) a valid score in NITMCA Common Entrance Test (NIMCET)

1.6 A limited number of admissions is offered to Foreign Nationals and Indians Living Abroad in accordance with the rules applicable for such admission, issued from time to time, by MHRD.

1.7 If, at any time after admission, it is found that a candidate had not in fact fulfilled all the requirements stipulated in the offer of admission, in any form whatsoever, including possible misinformation etc., this matter shall be reported to the Senate, recommending revoking the admission of the candidate.

1.8 Candidates have to fulfil the medical standards required for admission as prescribed in the *Information Brochure* or the *Prospectus*.

1.9 The Institute reserves the right to cancel the admissions of any student and ask him to discontinue his studies at any stage of his career on the grounds of unsatisfactory academic performance or indiscipline or any misconduct.

1.10 The decision of the Senate regarding the admissions is final and binding.

1.11 Student Exchange Programmes and the Transfer of Credits in such cases shall be as per the corresponding MOU approved by Competent Authority.

2. COURSE STRUCTURE:

2.1 The total course package for a M.C.A. Programme will typically consist of the following components.

(a)	Programme Core Courses	Pc	≥ 60 Credits
(b)	Elective Courses	Ele	≥ 24 Credits
(c)	Major Project	MP	= 20 Credits
(d)	Mandatory Learning Courses	MLC	= 04 Credits

2.2 The Department Post Graduate Committee (DPGC) will discuss and recommend the exact credits offered for the programme for the above components, the semester-wise distribution among them, as well as the syllabi of all postgraduate courses offered by the department from time to time before sending the same to the Board of Studies (BOS). The BOS will consider the proposals from the departments and make recommendations to the senate for consideration and approval.

2.3 **The Minimum Credit Requirement for the M.C.A Degree is 120**.

2.4 ***Major Project:***

(a) The Major Project carries 20 credits and spreads over ONE semester, during 6th semester (or as recommended by DPGC). The progress of the Project Work shall be monitored by the Project Guide. No candidate will be permitted to submit the project report before the last day of the classes in the project work semester as per the Academic Calendar.

(b) The method of evaluation, including intermediate assessment shall be evolved by the pertinent DPGC.

(c) A candidate shall submit 5 copies of the Project Work to Chairman, DPGC, on or before the specified date. The dissertation shall be in the format prescribed by the Institute.

(d) The date for the submission of Report shall be announced by the DPGC after getting the approval of the Dean (A).

(e) The final evaluation is done by a Project Work Evaluation Committee (PWEC) constituted by the pertinent DPGC. There shall be an open seminar followed by a viva-voce examination as part of the final evaluation. After the final evaluation, appropriate double-letter grade is awarded, which will not however be considered for SGPA and CGPA calculations.

(f) Extension of time beyond the announced last date for submission of the Project Report may be granted by the Dean (A) on recommendation from the Chairman, DPGC.

(g) If in the opinion of the PWEC, the Project Report is acceptable with minor modifications for the passing grade 'DD', the PWEC shall value and instruct the candidate suitably to incorporate the necessary modifications and to resubmit it to the Chairman, PWEC. After such resubmission, the Chairman, PWEC will certify that the necessary modifications have been incorporated.

(h) The title of the Project Report shall be indicated in the Student Grade Card.

2.5 ***Mandatory Learning Courses:***

These are courses that must be completed by the student at appropriate time as suggested by the Faculty Adviser or the DPGC. The 'S' grade is awarded for satisfactory completion of the course and 'N' grade is awarded for non-completion of the course. In case 'N' grade is awarded the student has to re-register for the same course wherein he has no alternative options. However, he can opt for other courses if he has been provided with multiple options. The 'S' and 'N' grades do not carry grade points and hence not included in the SGPA, CGPA computations.

Course that comes under this category is the following:

Seminar:

This course is a 4-credit course to be completed at appropriate time stipulated by DPGC. The student will make presentations on topics of academic interest.

3. DEGREE REQUIREMENTS:

3.1 The degree requirements of a student for the M.C.A. programme are as follows:

(a) ***Institute Requirements:***

(i) Minimum Earned Credit Requirement for Degree is 120.
(ii) Securing a CGPA of at least 5.50 in the Course Work.
(iii) Satisfactory completion of all Mandatory Learning Courses.

(b) ***Programme Requirements:***

Minimum Earned Credit Requirements on all Core Courses, Elective Courses and Major Project as specified by the DPGC and conforming to Clause No: 2(Course Structure).

(c) The Maximum duration for a student for complying to the Degree Requirement from the date of registration for his first semester, is SIX years.

4. TERMINATION FROM THE PROGRAMME:

A student shall be required to leave the Institute without the award of the Degree, under the following circumstances:

(a) If a student fails to earn the minimum credit specified below:

Check Point	Credit Threshold
End of FIRST year	20
End of SECOND year	40
End of THIRD year	60

Note: The period of temporary withdrawal is not to be counted for the above Credit Threshold.

(b) If a student is absent for more than 6 (Six) weeks in a semester without sanctioned leave.
(c) Fails to get the minimum cutoff CGPA of at least 5.50 in the Course Work.
(d) Based on disciplinary action suggested by the Senate, on the recommendation of the appropriate committee.

NOTE: Under any circumstances of termination, the conditions specified in Permanent Withdrawal (refer: Clause No: G10.2) shall also apply.

5. COMMITTEES / FUNCTIONARIES:

The following committees shall be constituted for the Post Graduate Degree programme:

5.1 Board of Studies (BOS-PG):

(Same as BOS-PG Mentioned in M.Tech regulations)

5.2 Departmental Post Graduate Committee (DPGC):

(Same as DPGC mentioned in M.Tech regulations)

5.3 Project Work Evaluation Committee (PWEC)

Constitution:

(a)	Chairman of DPGC or his nominee	…	Chairman
(b)	Project Guide(s)	…	Member(s)
(c)	One referee from outside the Department, selected by the DPGC	…	Member

Note:

- There shall be one PWEC for each MCA project work.
- One external guide/referee, if any, invited as a member of PWEC, is entitled for TA/DA as per the Institute Rules.

Functions (Highlights):

i. To evaluate the MCA project work and to award an appropriate letter grade. The chairman of PWEC shall submit the report, signed by all the members of the PWEC, to DPGC. The DPGC Chairman shall forward this report to the Academic Section of the Dean (A) without moderation.

5.4 Project Guide:

Functions (Highlights):

i. He will help the student under him in selecting the Project topic.

ii. He shall monitor the progress of the student working under him.

iii. He shall report to the DPGC the performance of the student from time to time.

iv. He will coordinate with the HOD/DPGC to arrange for facilities to carry out the project work.

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Master of Computer Applications (MCA)

Suggested Plan of Study

Sl. No.	Semester					
	I	II	III	IV	V	VI
1	MCA601	MCA602	MCA611	MCA712	*Elective 5*	MCA899
2	MCA603	MCA704	MCA614	MCA721	*Elective 6*	
3	MCA604	MCA605	MCA711	*Elective 3*	*Elective 7*	
4	HU703	MCA606	*Elective 1*	*Elective 4*	*Elective 8*	
5	MCA607	HU612	*Elective 2*	MCA714	MCA725	
6	MCA608	MCA701	MCA617	MCA723		
7		MCA690	MCA713	MCA790		

Credit Requirements:

Category	Minimum Credits to be Earned
Programme Core (Pc)	72
Elective Courses (Ele)	24
Mandatory Learning Courses (MLC)	04
Major Project (MP)	20
Total	**120**

Programme Core (Pc)

MCA601 Computer Organization Architecture (4-0-0) 4
MCA602 Computational Mathematics (4-0-0) 4
MCA603 Discrete Mathematical Structures (4-0-0) 4
MCA604 Programming Concepts (4-0-0) 4
MCA605 Data Structures & Algorithms (4-0-0) 4
MCA606 Data Structures and algorithms Lab (0-0-3) 2
MCA607 Computer Architecture Lab (0-0-3) 2
MCA608 Programming Lab (0-0-3) 2
MCA611 Computer Oriented Statistical Methods (4-0-0) 4
MCA614 Operating Systems (4-0-0) 4
MCA617 Operating Systems Lab (0-0-3) 2
MCA701 Database Management Systems (4-0-0) 4
MCA711 Software Engineering (4-0-0) 4
MCA712 Computer Graphics (4-0-0) 4
MCA713 Software Engineering Lab (0-0-3) 2
MCA714 Computer Graphics Lab (0-0-3) 2
MCA721 Computer Networks (4-0-0) 4
MCA723 Computer Networks Lab (0-0-3) 2
MCA725 Computer Applications Lab (0-0-6) 4
HU612 Managerial Economics (4-0-0) 4
HU703 Accounting & Financial Management (4-0-0) 4
MCA704 Database Management systems Lab (0-0-3)2

Elective (Ele) Courses

MCA613 Microprocessors (3-0-0) 3
MCA615 Theory of Computation (3-0-0) 3
MCA616 Microprocessor Lab (0-0-3) 2
MCA702 Object Oriented Programming (3-0-0) 3
MCA705 Object Oriented Programming Lab (0-0-3) 2
MCA722 Internet Technology & Applications (3-0-0) 3
MCA724 Internet Technology & Applications Lab (0-0-3) 2
MCA801 Computer Algorithms (3-0-0) 3
MCA802 Fuzzy System Models (3-0-0) 3
MCA803 Management Information Systems (3-0-0) 3
MCA804 Operations Research (3-0-0) 3
MCA805 Optimization Techniques & Statistical Methods (3-0-0) 3
MCA806 Artificial Intelligence (3-0-0) 3
MCA807 Artificial Neural Networks (3-0-0) 3
MCA808 Computer Simulation & Modeling (3-0-0) 3
MCA809 Genetic Algorithms (3-0-0) 3
MCA810 Knowledge Management (3-0-0) 3
MCA811 Natural Language Processing (3-0-0) 3
MCA812 Network Optimisation (3-0-0) 3
MCA813 Object Oriented Analysis & Design (3-0-0) 3
MCA814 Performance Modeling (3-0-0) 3
MCA815 Stochastic & Queuing Systems (3-0-0) 3
MCA816 Unix & Network Programming (3-0-0) 3
MCA817 Advanced Client Server Computing (3-0-0) 3
MCA818 Adv Database Management Systems (3-0-0) 3
MCA819 Advanced Operating Systems (3-0-0) 3
MCA820 Cryptography & Network Security (3-0-0) 3
MCA821 Data Mining & Warehousing (3-0-0) 3
MCA822 Digital Image Processing (3-0-0) 3
MCA823 Distributed Computing System (3-0-0) 3
MCA824 Information & Coding Theory (3-0-0) 3
MCA825 Parallel Processing (3-0-0) 3
MCA826 Pattern Recognition & Scene Analysis (3-0-0) 3
MCA827 Web Design (3-0-0) 3
MCA828 Compiler Design (3-0-0) 3
MCA830 Object oriented programming with JAVA(3-0-0)3
SY828 Information Storage and Management (3-0-0) 3
SY829 Collective Decision Making Processes (3-0-0) 3

Mandatory Learning Courses (MLC)

MCA690 Seminar 1 2
MCA790 Seminar 2 2

Major Project (MP)

MCA899 Major Project 20

DEPARTMENT OF MATHEMATICAL & COMPUTATIONAL SCIENCES

CMA701 Data Structures and Algorithms (3-0-2)4

Abstract data structures and their implementations: arrays, list, stack, queue.Tree data structures: Binary trees, Height balanced trees, priority queues, Tree traversal algorithms.Dynamic Data structures: 2-3 trees, Red-black trees, binary heaps, binomial and Fibonacci heaps, Skip lists, universal hashing.Graphs and algorithms: Breadth first search and Depth First Search, Shortest paths, minimum spanning trees.Introduction to analysis of algorithms: Big Oh, Omega and Theta notations. Basic algorithm design techniques: Dynamic programming and divide-and-conquer, Sorting algorithms with analysis.

T.H Cormen, C.E Leiserson, R.L. Rivest, C. Stein, Introduction to algorithms, Third edition, PHI, 2009.
Algorithm Design, Michael T. Goodrich, Robert Tamassia, John Wiley& Sons, 2006
Ellis Horowitz, Sartaz Sahni, S. Rajasekaran, Fundamentals of computer Algorithms, Second edition, University Press (India) Limited, 2008.

CMA702 Computational Combinatorics (3-0-0)3

Combinatorics: Generating Permutations and Combinations, Relations, Recurrence Relations and Generating Functions. Lattice Theory: Lattices and their properties, Duality Principle, New Lattices – Lattice Homomorphisms, Product Lattices, Modular and Distributive Lattices, Boolean Algebras/ Boolean Lattices, Boolean Polynomial. Graph Theory: Different classes of graphs, Digraphs and their fundamental properties, Representations of graphs, Trees, Connectivity, Traversability, Planarity and Colorability.

Ralph P. Grimaldi, Discrete and Combinatorial Mathematics – An applied introduction, Pearson Addison Wesley, 5th Edition, 2004.
Richard A. Brualdi, Introductory Combinatorics, China Machine Press, 5th Edition, 2009.
J. P. Tremblay and R. Manohar, Discrete Mathematical Structures with applications to Computer Science, McGraw Hill
Jonathan L. Gross and Jay Yellen, Handbook of Graph Theory, CRC Press.
Geir Agnarsson and Raymond Greenlaw, Graph Theory – Modeling, Applications and Algorithms, Pearson Education, 2007.

CMA703 Computational Linear Algebra (3-0-0)3

Matrix multiplication problems: Basic algorithms and notations, exploiting structure, block matrices and algorithms, vectorization and re-use issues.Matrix analysis: basic ideas from linear algebra, vector norms, matrix norms, finite precision matrix computations, orthogonality and SVD, projections and the CS decomposition, the sensitivity of square linear systems. General linear systems: Triangular systems, the LU factorization, roundoff analysis of Gaussian elimination, pivoting, improving and estimating accuracy.Special linear systems: The LDM^T and LDL^T factorizations, positive definite systems, banded systems, symmetric indefinite systems, block systems, vandermonde systems and the FFT, Toeplitz and related systems.

Gene H. Golub nad Charles F. Van Loan, Matrix Computations, Third Ed, Hindustan book agency, 2007.
A.R. Gourlay and G.A. Watson, Computational methods for matrix eigenproblems, John Wiley & Sons, New York, 1973.
W.W. Hager, Applied numerical algebra, Prentice-Hall, Englewood Cliffs, N.J, 1988.
D.S. Watkins, Fundamentals of matrix computations, John Wiley and sons, N.Y, 1991.
C.F. Van Loan, Introduction to scientific computing: A Matrix vector approach using Mathlab, Prentice-Hall, Upper Saddle River, N.J, 1997.

CMA704 Computer Organization and Operating Systems (3-0-2)4

Introduction to basic digital electronic circuits: Combinational and sequential circuits, flip-flops, registers, memory, counters.Computer organization: Design of basic computers, hardwired and micro programmed control, programming a basic computer, instruction formats and addressing modes, stack organization.Computer architectures: RISC and CISC architectures, Parallel processing.Operating system: Introduction to operating system, functionalities of an operating system. Process management: creation, scheduling and termination of a process, light-weight process, Inter process communication, Deadlocks handling, process synchronisation.Memory management: static and dynamic memory, memory allocation methods. Input output management: Handling interrupts, Disk scheduling algorithms.File Management: File and Directory structures, allocation methods, free space management, UNIX file structure.System Security and protection methods.

Morris Mano, Computer system architecture, third edition, PHI, 2007.

V. Carl Hamacher, Zvonko G. Vranesic, Safwat G. Zaky, Computer organization, McGraw-Hill, 2002
A. Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Concepts, John Wiley & Sons, 2012.

CMA705 Theory of Computation (3-0-0)3

Introduction, Abstract Models for Computation and their relationship with formal languages and Theory of Recursive Functions; Computational and Representational System Models: Finite Automata; Push-down Automata; Linear Bounded Automata; Turing Machines; Formal Language Models; Regular Expressions, Context free Languages, Context Sensitive Languages, Recursively, Enumerable Languages, Generative Grammars, Recognition Procedures; Finite Representation for formal languages, Chomsky Hierarchy; Normal Forms; Derivation Graphs; Pumping Lemma; Undecidability; Recursive Functions and Computability; Computational Effectiveness, Complexity Measures, Reducibility; Complexity Classes.

Hopcroft and Ullman, Introduction to Automata Theory; Languages and Computation, Narosa.
Gyorgy E. Revesz, Introdution to Formal Languages, Dover.
Aho, Hopcraft & Ullman, Automata, Languages and Computation, Narosa, 1986.
Mishra and Chandrashekar, Theory of Computer Science, Prentice Hall of India, 1999.

CMA706 StochasticAnalysisand Applications (3-0-0)3

Overviewof probability, randomvariables, probability functions, functions of r.v.s, some important probability distributions,stochasticprocesses,basicconcepts, classification,Markovchains,C-Kequations,ergodicchains, steady statebehaviour, Poisson processes, birthand deathprocesses,queuingsystems,basicconcepts,M| M| 1 and M| M| s queues, Reliability, definitions,conceptof hazard,bath-tub curve, systemreliability forvarious configurations.

J. Medhi,StochasticProcesses,NewAgeInternationalPublishers.
K.S.Trivedi,ProbabilityandStatisticswithReliability,QueuingandComputerScienceApplications,PHI.

CMA707 Numerical Algorithms and Analysis (3-0-2)4

Errors and Approximations: Order/Rate of convergence of an Iterative method-Solution of Algebraic, Transcendental and Polynomial equation-Newton-Raphson method, Extension of Newton-Raphson method for finding multiple roots and to solve system of non-linear equations. Mullers method, Chebyshev's methods. Interpolation: Newton's Divided difference method. Hermite's interpolation. Cubic spline interpolation. Errors in interpolation. Numerical Differentiation: Finite difference operator techniques. Richardson's extrapolation technique and differentiation of interpolating polynomials. Numerical Integration: Method of undetermined coefficients. Errors in integration formulae. Iterative solution of linear equations. Numerical solution of ordinary different equations: Initial value problems. Single step and multistep methods for solving first and second order Initial value problems. Solution of Boundary value problems by finite difference method and shooting method. Numerical solution of partial differential equations: Solution of elliptic partial differential equations by 5-point and 9-point schemes. Solution of hyperbolic partial differential equations by explicit and implicit schemes. Error Analysis.

Jain M K, Iyengar S R K and Jain R K, Numerical Methods for Scientific and Engineering Computation, 4th Edn, New Age International Pvt Ltd (2005)
Jain M K, Numerical Solutions of Differential Equations, 2nd Edn, John Wiley and Sons Ltd (1984)
S S Sastry, Introductory Methods of Numerical Analysis, 5th Edn. Prentice Hall of India.

CMA801 Computer Networks (3-0-0)3

Introduction: Uses of Computer Network, Network hardware, Network software, Hierarchical Reference Models; Physical Layer: The theoretical Basis for Data Communication, Transmission media. Wireless transmission, The Telephone system, Data Link Layer: Data Link Layer Design Issues, Error correction and detection, Elementary data link layer protocols; Sliding Window Protocols, Protocol Specification and verification, Medium Access Sublayer: The channel allocation problem, Multiple Access Protocols, IEEE 802 standards for LANs and MANs, Bridges. Network Layer: Network Layer Design issues, Routing algorithms, congestion control algorithms, internet working. Transport Layer: Transport services, transport protocols. Application layer Application layer protocols, Cryptography.

Jim Kurose and Keith Ross Computer Networking- Top Down approach, 5th edition, Pearson Education, 2010
Larry L. Peterson, Bruce S. Davie, Computer Networks: A Systems Approach, 5th edition, Morgan Kaufmann, 2011
Behrouz A. Forouzan , Data Communications & Networking, 4th edition, Tata McGraw-Hill Education, 2006
Douglas E.Comer, The Internet Book, 4th edition, Prentice Hall, 2007

CMA802 Machine Learning (3-0-0)3

Introduction to machine learning, Concept Learning and the General-to-Specific Ordering, Decision Tree Learning, Artificial Neural Networks, Dimensionality reduction, linear discrimination, Evaluating Hypotheses, Bayesian Learning , Computational Learning Theory, Instance-Based Learning, Genetic Algorithms, Learning Sets of Rules, Analytical Learning, Combining Inductive and Analytical Learning, Reinforcement Learning.

Ethem Alpaydin, "Introduction to machine learning", second edition, PHI publication, 2010.
Tom Mitchell , "Machine Learning", McGraw Hill, 1997
Christopher M. Bishop, "Pattern Recognition and Machine Learning", Springer, 2006.

CMA803 Software Engineering (3-0-0)3

Introduction to software engineering. Generic view of Process, Process models. System Engineering: Business Process Engineering, Product Engineering, Requirements Engineering, Building Analysis model, Design Engineering, Creating an Architectural Design, Modeling component – level Design, Software Testing: Testing strategies, Testing tactics Product metrics, Managing Software Projects: Project management. Metrics for process and projects. Estimation, projects scheduling, Risk management, Quality management, change management.

Roger S. Pressman, Software Engineering – A practitioner's Approach, 7th Edn, MacGraw-Hill
Ian Sommer ville, Software Engineering, 9th Edn, Addison-Wesley
Rajib Mall, Fundamentals of Software Engineering, 3rd Edn, Prentice-Hall India(PHI) Learning Pvt Ltd.

CMA804 Computer Graphics (3-0-0)3

Graphics hardware: Display devices, Input devices; Basic raster graphics algorithms: line and circle drawing algorithms; Windowing and 2D/ 3D clipping: Cohen and Sutherland line clipping, Cyrus Beck clipping method; 2D and 3D Geometrical Transformations: scaling, translation, rotation, reflection; Viewing Transformations: parallel and perspective projection; Curves and Surfaces: cubic splines, Bezier curves, B-splines, Parametric surfaces, Surface of revolution, Sweep surfaces, Fractal curves and surfaces; Hidden line/surface removal methods; illuminations model; Shading: Gouraud, Phong; Introduction to Ray-tracing; Animation; Programming practices with standard graphics libraries like openGL.

Foley, Van dam, Fundamentals of Interactive Computer graphics, Addison Wesley.
Hearn D. Baker, Computer graphics, PHI.
Rogers D.F. and Adams J., Mathematical Elements for Computer Graphics, McGraw Hill.

CMA805 Image Processing (3-0-0)3

Introduction to image processing, Image acquisition, sampling and quantization, Image transforms: Discrete Fourier transform, Discrete cosine transform, Discrete sine transform and wavelet transform, Image restoration: Image degradation models, blurs and noise models, restoration methods, Weiner filter and regularization filters, Image enhancement: Enhancement in Spatial and frequency domain, unsharp masking and high-boost filtering, Image segmentation: Image thresholding, region based segmentation methods, region growing, region merging & splitting and active contour models, Image Compression : lossy/lossless compression methods, Image Analysis, Introduction to image processing tool box in Matlab, Applications of image processing to various imaging systems.

R.C. Gonzalez, R.E. Woods, "Digital image processing using MATLAB", Prentice Hall, Second edition, 2003.
Henri Maitre, "Image Processing",first edition, Wiley, 2008.
T.F. Chan, J.H. Shen, "Image processing and analysis", SIAM,First edition, 2005.
Rafael C. Gonzalez & Richard E. Woods, "Digital Image Processing" , Addison-Wesley, 2nd edition, 2002.
Anil K. Jain , Fundamentals of Digital Image Processing, Prentice Hall, 1992.

CMA806 Algorithmic Combinatorics (3-0-0)3

Fundamental Notions Related to Enumerative Combinatorics (Lists/Permutations, Sets/Combinations, Special Bijections, etc.), The Twelve-fold Way of Counting, Integer Partitions, Finite Group Actions, The Cauchy-Frobenius Lemma, Structures and Algorithms, Analysis of Algorithms, Complexity Classes, Integer Partitions, Set Partitions, Bell and Stirling Numbers, Labeled Trees, Catalan Families, Backtracking Algorithms, Permutation Groups

Donald L. Kreher, Douglas R. Stinson, Combinatorial Algorithms: Generation, Enumeration, and Search, Series: Discrete Mathematics and its applications, CRC Press, 1998
Tucker A. , Applied Combinatorics, 2nd edn, John Wiley, 1984
R. Graham, D. Knuth, and O. Patashnik, Concrete Mathematics,Addison-Wesley, 1994
R. Stanley, Enumerative Combinatorics, Volumes I and II, Cambridge UniversityPress, 2001

CMA807 Cryptology (3-0-0)3

Introduction to Cryptocomplexity, Foundations of Computer Science and Mathematics, Algorithmics, Formal Languages and Recursive Function Theory, Algebra, Number Theory and Graph Theory, Probability Theory.Foundations of Cryptology, Tasks and Aims of Cryptology, Some Classical Cryptosystems and Their Cryptanalysis, Perfect Secrecy.RSA Cryptosystem, Primality, and Factoring, Other Public-Key Cryptosystems and Protocols: Diffie-Hellman and the Discrete Logarithm Problem, ElGamal's Protocols, Rabin's Public-Key Cryptosystems, Arthur-Merlin Games and Zero-Knowledge, Merkle and Hellman's Public-Key Cryptosystem, Rabi, Rivest, and Sherman's Protocols.

Rothe, Jorg: Complexity Theory and Cryptology- An Introduction to Cryptocomplexity, Springer, 2005.
Paar,Christof and Pelzl, Jan: Understanding Cryptography, Springer International Edition, 2010.

CMA808 Selected Topics in Graph Theory (3-0-0)3

Graphs – An Introduction, Classes of graphs, Distances in graphs, Domination, Labelling, Coloring – Introduction & Types of coloring – Complete Colorings, Colorings and Distance: T-Coloring, $L(2,1)$-Coloring, Radio Coloring, Hamiltonian Coloring, Critical Concepts, Independence, Matching and Covering, Chordal graphs, Perfect graphs, Interval graphs, Planar graphs, Graph Operations, Graph Partition, Probability on graphs – Random graphs, Hyper graphs, Algebraic concepts in graph theory, IP & LP formulation of selected graph problems, Graph Models.

Douglas B. West, Introduction to Graph Theory, 2nd Edition, PHI Learning Pvt. Ltd., 2012.
Haynes, T.W., Hedetniemi, S.T. and Slater, P.J., Fundamental of Domination in graphs, Marcel Dekker, Inc.,New York 1998.
Gary Chartrand and Ping Zhang, Chromatic Graph Theory, CRC Press.
Tommy R. Jensen and Bjarne Toft, Graph Coloring problems, John Wiley & sons.
Michael Stiebitz, Diego Scheide, Bjarne Toft and Lene M. Favrholdt, Graph Edge Coloring, Wiley.
Random Graphs – Béla Bollobás, 2nd Edition, Cambridge University Press.
Haynes, T.W., Hedetniemi, S.T. and Slater, P.J., Domination in graphs – Advanced Topics, Marcel Dekker, Inc.,New York 1998.

CMA809 Distributed Computing Systems (3-0-0)3

Introduction:Computer Networks and Multi-processor systems, Evolution of modern operating systems, Design Goals, transparencies and fundamental issues in Distributed systems, Temporal ordering of events, Global state detection, Physical clocks, Mutual Exclusion Algorithms, Interprocess Communication, Deadlocks in distributed systems, Load balancing techniques, Distributed databases. Security in distributed systems.

Shivarathi & Shingal, Advanced Operating Systems
Randy Chow, Distributed Operating Systems and Algorithms
George Couloris et al, Distributed Systems - concepts and design, Pearson Education, 2002
A.S. Tanenbaum and M.V. Steen, Distributed Systems - Principles and Paradigms, Pearson Education 2003.
Wolfgang Emmerich, Engineering Distributed Objects, Wiley, 2000.
Gerald Tel, Introduction to Distributed Algorithms, 2/e, Cambridge, 2004.

CMA810 Soft Computing (3-0-0)3

Learning and Soft Computing: basic tools of Soft Computing, Learning and Statistical Approaches to Regression and Classification.Neural Networks: Mathematical Models of Neurons, ANN Architecture, Learning Rules, Learning Paradigms – Supervised, Unsupervised, and Reinforced Learning. ANN Training Algorithms. Multi Layer Perception Model, Hopfield Networks, Associative Memories, Application of Artificial Neural Networks. Fuzzy Logic : Classical and Fuzzy Sets, Membership Function, Fuzzy Rule generation. Operations on Fuzzy sets, Fuzzy Arithmetic, Fuzzy Logic, Uncertainty Based Information: Combination of Operations, Aggregation Operations.Fuzzy numbers, Linguistic variables, Arithmetic Operations on Intervals and Numbers, Lattice of Fuzzy Numbers, Fuzzy Equations.Classical Logic, Multi Valued Logic, Fuzzy Propositions, Non Specificity of Fuzzy & Crisp Sets, Fuzziness of Fuzzy sets. Neuro-Fuzzy Systems, Applications of Fuzzy Logic in Medicine, Economics, Genetic Algorithms in Problem Solving.

Vojislav Kecman, Learning and Soft Computing , Pearson Education (Asia) PTE, 2004
Anderson J A, An Introduction to Neural Networks, PHI, 1999
S Haykin, Neural Networks: A Comprehensive Foundation ", Pearson Education, 2003
Hertz J, Krogh, R. G. Palmer, Introduction to the Theory of Neural Computation, Addition-Wesley, 1991
G.J. Klir and B Yuan, Fuzzy Sets and Fuzzy Logic", PHI 2001
Melanie Mitchell, An Introduction to Genetic Algorithms , PHI, 1998

CMA811 Combinatorial Optimization (3-0-0)3

Algorithms for optimization of combinatorial optimization problems. Integer Programming and Network Optimization algorithms, combinatorial problems on Graphs or Networks, Polyhedral Combinatorics, Complexity of Problems such as linear programming and the traveling salesman problem. NP-Completeness, approximation algorithms, worst case and probabilistic analysis of algorithms and local search.

C.H. Papadimitriou and K. Steiglitz, Combinatorial Optimization, Algorithms and Complexity, Prentice Hall, 1982.
E. L. Lawler, Combinatorial Optimization – Networks and Matroids, Holt, Rinehart and Winston, 1976
C. Berge, Principles of Combinatorics, Academic Press, 1971
Tucker, Applied Combinatorics, 2nd edn, John Wiley, 1984
L. R. Ford Jr. and D. R. Fulkerson, Flows in Networks, Princeton, Univ. Press, 1952.
Pardalos, Panos; Du, Ding-Zhu; Graham, Ronald L., Handbook of Combinatorial Optimization, Springer, 2013
Lex Schrijver, Combinatorial Optimization: Polyhedra and Efficiency, 3-Volume book, Springer-Verlag 2003

CMA812 System ModellingandSimulation (3-0-0)3

Basicsimulation Modeling:The nature of simulation,definition ofsystems,models andsimulation.Structure of simulation models; advantages and disadvantages of simulation, steps in a simulation study. Classification of simulation models;Discrete-Event simulation: Selecting Input Probability Distributions, Random-number Generators, GeneratingRandom variables forstandard distributions,Output Analysisfora singlesystem.System Software: GPSS;general description, facilities,storages, Queues,transfer blocks,controlstatements, variablelogic switches,Booleanvariables,functions,concept of userchains,facilitypreemption,matching Introductiontoother simulationlanguagessuchas MATLAB, TUTSIM ModelingandSimulation of ContinuousSystems.

G.Gordon,SystemSimulation,PHI.
A. M.LawandW.D.Kelton,simulation,modelingandanalysis,McGrawHill.
J.A.Payne,Introductionto simulation,ProgrammingTechniquesandmethodsofanalysis.
ThomasJ. Schriber,SimulationUsingGPSS,JohnWileyandSons.
Mariyansky,DigitalComputerandSimulation,CBSPublishers,NewDelhi.

CMA813 Database Systems (3-0-0)3

The Database system, structure of a database, three level Architecture of databases and its importance. The Relational model, the Entity Relationship model, conversion of ER diagram to Relational Database. The concepts of integrity, referential integrity, functional dependency, the normal forms. Sequential file organization, indexes, index and B tree, multi key file organization. The structured Query Language: data definition and manipulation commands, views, nested queries, examples. Transactions, concurrency related problems and control, locks, two phase locking, deadlock. Database recovery techniques, security and integrity, authorization, data access control. The need and advantages of the distributed and client server database systems, data replication and fragmentation, distributed queries.

Avi Silberschatz, Henry F Korth, S. Sudarshan, Database System Concepts, 6th Edn, McGraw-Hill
Hector Garcia- Molina, Jeffrey D. Ullman, Jennifer Widom, Database Systems: The Complete Book, 2nd Edn,
Coronel/Morris/Rob, Database Systems Design, implementation and Management,10th Edn
C.J. Date, An Introduction to Database Systems, 8th Edn
Raghu Ramakrishnan, Johannes Gchrhe, Database Management Systems, 3rd Edn

CMA814 Linux and Network Programming (3-0-0)3

Overview of LINUX OS, File I/O, Files and directories, Standard I/O library, System data files and information. Processes: Process relationships, Terminal I/O, Advanced I/O, Threads. Interprocess communication, Message passing,Synchronization, Shared memory, Sockets: Name and address conversions. Applications: TCP echo client server, UDP echo client server.

W Richard Stevens, Advanced programming in the UNIX environment, Addison Wesley,1999.
W Richard Stevens, UNIX Network Programming Volume 1 and 2, Prentice Hall, 1998.
N.Matthew, R.Stones, Beginning Linux Programming, 4th Edition, ,Wrox, Wiley India Edition,rp-2008

CMA815 Internet Technology and Applications (3-0-0)3

History of Internet, Internet addressing,TCP/IP. DNS and directory services, Internet resources and applications.,SMTP, FTP, TELNET and HTTP, WWW Overview, HTML, Javascript, ASP and JSP, Advanced java programming, Applet Programming, N/w programming, JDBC. Servlet programming.

Douglas Comer, The Internet Book, 4th edition, Prentice Hall, 2007

Deitel & Deitel, Internet & World Wide Web, How to program, Prentice Hall, 2000
D Norton and H Schild, Java2: The complete reference, Tata McGraw-Hill Education, 2000

CMA816 General Systems Theory (3-0-0)3

Boundary, interface, structure, behaviour and description of a system; state transitions. General systems approach to problem solving; Primary dimensions in systems studies. Problem Classification: Analysis; Design; Optimization; Control; Simulation; etc. System Models; Modeling of system uncertainties; parametric uncertainties.

G.M. Weinberg, General Systems Thinking-An Introduction, Dorset House
H.A. Simon, The Sciences of the Artificial, MIT Press
http://pespmc1.vub.ac.be/CYBSYSTH.html
http://systemtheory.net/
http://www.well.com/abs/
http://www.er.ele.tue.nl/sweiland/ssyst.htm

CMA817 Web Technology (3-0-0)3

The Web Design Environment; Designing for a variety of Browsers, Designing for a variety of displays, Web design principles for print designer, beginning guide for the server; HTML: HTML Overview, Structural HTML Tags, formatting text, creating links, adding image and other page elements,Tables, Frames, forms, Image mapping, cascading style sheets; Using Web design Tools like MS Front page, Flash Dreamweaver, coreldraw, Photoshop; Multimedia and Client side scripting: Audio on the web, Video on the web, DHTML, Introduction to java script, Java Applets. Server-side scripting: Active Server Pages, XML.

Hiroshi Maruyama, Kent Tamura, XML and Java Developing Web Applications., Naohiko Uramoto.
Thomas Powell, Fritz Schneider, Javascript, the complete reference, Tata McGraw Hill, 2002.
David Crowder, Rhonda crowder, Web design, IDG books of India Pvt. Ltd., 2001.
Jennifer Neiderst, Web design in a nutshell, Orielly Publications.

CMA818 Selected Topics in Computer Algorithms (3-0-0)3

Computational geometry: Convex Hull, Polygon triangulation, Voronoi diagram. String processing algorithms: KMP algorithm, Boyer-Moore algorithm. Algebraic and number theoretic algorithms: Modular arithmetic, Chinese remainder theorem.Linear programming and combinatorial optimization: LPP formulation, simplex method
NP-completeness and Approximation: Polynomial time reduction, NP-complete proofs

De Berg, Mark and Cheong, Otfried and van Kreveld, Marc and Overmars, Mark}, Computational geometry, Springer, 2008.
Charras, Christian, and Thierry Lecroq. Handbook of exact string matching algorithms. King's College Publications, 2004.
T.H Cormen, C.E Leiserson, R.L. Rivest, C. Stein, Introduction to algorithms, Third edition, PHI, 2009.
Jon Kleinberg Eva Tardos, Algorithm Design, Pearson, 2006

CMA819 Number Theory and Cryptography (3-0-0)3

Elementary Number Theory Congruences, applications to Factoring. Finite fields, Quadratic residiues and reciprocity. Simple cryptosystems, public key cryptography, RSA, Discrete logs. Primality and Factoring, the rho method, Fermat factorization, continued fraction and Quadratic Sieve methods.

N. Koblitz., A Course in Number Theory and Cryptography, Springer, 1994.

CMA820 Mobile Computing (3-0-0)3

Mobility:Issues, challenges, and benefits; Review of mobile andcellular communication technology; Review of distributed/networkoperating systems, ubiquitous computing.Network Programming:Process communication techniques, remotelogin, ftp, socket programming, RPC, RMI, client-server programming.Process Migration:Steps, advantages, application taxonomy,alternatives, case study of DEMOS/MP.Mobile Computing:Physical mobility, challenges, limits andconnectivity, mobile IP and cellular IP in mobile computing, case studyof CODA. Wireless LANs:Introduction to IEEE 802.11, Bluetooth and IrDAtechnologies and standards.Mobile Adhoc Networks:Hidden and exposed terminal problems;Routing protocols: DSDV, DSR, AODV.Wireless Sensor Networks:Motes, smart dust, TinyOS, routingprotocols.Handheld Devices and OS:Palm, HP; PalmOS, WindowsCE,Windows Mobile.Mobile Internet and WAP:WWW programming model, WAPprogramming model, gateways.Mobile agents:Aglets, Tcl, PMADE.

Hansman, U. and Merck, L., Principles of Mobile Computing, 2nd Edition., Springer.

Jochen Schiller, Mobile Communications, second edition, Addison-Wesley, 2004
Milojicic, D., Douglis, F. and Wheeler R., Mobility Processes, Computers and Agent, Addison Wesley. 2000
Lange, D. B. and Oshima, M., Programming and Deploying JavaMobile Agents with Aglets, Addison Wesley. 1998

CMA821 Mathematical Modeling (3-0-0)3

Introduction: Mathematical modeling through ordinary differential equations and systems of ordinary differential equations of first order, Mathematical modeling through difference equations, Modeling using partial differential equations, Mathematical modeling through graphs.

J.N. Kapoor, Mathematical Modeling, Wiley Eastern, 1988.
R. Aris, Mathematical Modeling Techinques, Pitman, 1978.

CMA822 Finite Element Methods (3-0-0)3

Introduction to finite element Method, Physical Interpretation, Variational Interpretation, Generalised Interpretation, Elements & Interpolation functions, Applications: General field problems, Fluid mechanics and Heat transfer problems, Boundary Conditions, Mesh Generation and other Practical Considerations.

K.H.Huebner, D.L. Dewhirst, D.E.Smith, T.G. Byron, The finite element method for engineers, John Wiley & Sons.
J.N.Reddy, An Introduction to the finite Element Method, Mc Graw Hill.
K.J.Bathe, Finite element Procedures, Cambridge, MA.

CMA823 Nonlinear Programming (3-0-0)3

Convex sets and functions, Unconstrained and Constrained optimization problems, Optimality conditions, Lagrange multipliers, The Fritz John conditions, The Karush-Kuhn-Tucker conditions, Constraint qualifications, Lagrangian Duality, Quadratic Programming, Wolfe's method, Newton's method, Conjugate gradient methods.

M. S. Bazaraa, H. D. Sherali and C. M. Shetty, Nonlinear Programming: Theory and Algorithms, Wiley, 2006.
N. Andreasson, A. Evgrafov and M. Patriksson, An introduction to continuous optimization, Overseas press, 2006.
E. K. P. Chong and S. H. Zak, An introduction to optimization, Wiley 2004.
S. G. Nash and A. Sofer, Linear and Nonlinear Programming. McGraw-Hill, 1996.
S. Chandra, Jayadeva and A. Mehra, Numerical optimization with applications, Narosa, 2009.

CMA824 Selected Topics in Network Flow Modeling and Analysis (3-0-0)3

Representation and analysis network structures. Painted Network Algorithms and applications. Representation and analysis of flows in networks. Max Flow Min Cut Theorem. Feasible Distributor Problem. Flow Rectification Problem. Tucker Representation of Circulation Space and Differential Space. Extremal Representation Problem. Matching and Assignment Problems. Bottleneck Optimization Problems. Potentials and Spans. Max Tension Min Path Theorem. Feasible Differential Problem. Tension Rectification Problem. Routing Problem. Optimal Differential Problem. Optimal Distribution Problem. Network Flow Duality Theorem. Network Simplex Method for Flows. Thrifty Adjustment algorithm. Out-of-Kilter Algorithm. Optimal Flows and Potentials. Characteristic Curves. Network Flow Equilibrium Conditions. Boundedness of Optimizing Sequences. Linear Systems of Variables. Generalized Circuits & Cuts. Painted Index Theorem and Algorithm. Extremal Representation Theorem. Extremal Solutions.

R. T. Rockafellar, Network Flows and Monotropic Optimization, Wiley Interscience.
Ford and Fulkerson, Flows in Networks, Princeton Univ. Press

CMA825 Collective Decision Making Process (3-0-0)3

Decision Making Processes, Individual Preferences, Collective Outcomes, Process Influence, Arrow's Theorem, Sen's Theorem, Voting Profiles, Voting Paradoxes and their resolution through refinements in axioms, Binary Independence, Transitivity, Monotonicity, General Aggregation Processes.

Donald G. Saari, "Chaotic Elections – A Mathematician Looks At Voting", AMS.
Donald G. Saari, "Decisions and Elections – Explaining the Unexpected", Cambridge Univ. Press.
Donald G. Saari, "Geometry of Voting", Springer – Verlag.
Kenneth J.Arrow "social Choice and Individual Values", Yale Univ. Press.

CMA826 Computational Fluid Dynamics (3-0-0)3

Philosophy of CFD, Governing Equations of Fluid Dynamics - Derivation, Physical Interpretation, Forms of Governing Equations suitable to CFD, Mathematical behavior of Partial differential Equations. Finite differences,

Error & Stability Analysis of numerical schemes, Grid generation with appropriate transformations, CFD techniques - Lax – Wendroff technique, MacCormack's technique. Numerical Solutions to some one and two -dimensional flows.
J. Anderson, Computational fluid dynamics: The basics with applications, McGraw Hill.
C.A.J. Fletcher, Computational techniques for fluid dynamics vol 1& 2,Springer – Verlag.
H.K. Versteeg, W Malalasekera, An Introduction to Computational Fluid Dynamics, Longman Scientific & Technical.

CMA827 Design and Analysis of Experiments (3-0-0)3

Introduction to probability, one-dimensional random variables, two and higher dimensional random variables, probability distributions, Samplingtheory,moments, mgf andtheir properties, parameter estimation, point estimation,intervalestimationofmeansandvariances,Hypothesistesting,Goodnessoffittests,analysisof varianceofone-wayandtwo-wayclassifieddata,experimentaldesign.
DouglasMontogomery, Design andAnalysis of Experiments, John Wiley
Sheldon M. Ross,IntroductiontoProbabilityandStatistics forEngineersandScientists,John Wiley
Hogg R.V., & Craig A.T.,Introduction to MathematicalStatistics,McMillan

CMA828 Reliability Theory and Applications (3-0-0)3

Reliability,conceptsanddefinitions,causesoffailure,conceptofhazard,failuremodels,bathtubcurve,MTTF, MTBF,systemreliabilityforvariousconfigurations,reliabilityimprovement,redundancy,reliability-costtrade-off, maintainabilityandavailabilityconcepts,systemsafetyanalysis,FTA,FMEA.
E.E.Lewis,IntroductiontoReliabilityEngineering,JohnWiley.
KS.Trivedi,ProbabilityandStatisticswithReliability,QueuingandComputerScienceApplications,PHI.

CMA829 Computational Number Theory (3-0-0)3

Elementary Number Theory: Theory of Divisibility, Diophantine Equations, Arithmetic Functions, Congruences, Arithmetic of Elliptic Curves. Computational Number Theory: Introduction, Algorithms for Primality Testing, Integer Factorization, Discrete Logarithms. Quantum Number Theoretic Algorithm. Miscellaneous Algorithms in Number Theory. Cryptography and Information Security
Song Y. Yan, Number Theory for Computing, 2nd Ed. Springer, 2002.
Richard Crandall and Carl Pomerance , Prime numbers: a Computational perspective, Springer, 2001.
Henri Cohen, A course in Computational Algebraic Number Theory, Springer, 2000.

CMA830 Pattern Recognition (3-0-0)3

Introduction to pattern recognition, Classification, Non-Metric methods, Maximum-Likelihood and Bayesian Parameter Estimation, Supervised learning, Nonparametric Techniques, Linear Discriminant Functions, Feature extraction and selection, Multilayer Neural Networks, Algorithm-Independent Machine Learning, Unsupervised Learning and Clustering, Comparison of classifiers.
Richard O. Duda, Peter E. Hart, David G. Stork , "Pattern Classification", 2nd Edition, Wiley, 2001.
Christopher M. Bishop, "Pattern Recognition and Machine Learning", Springer, 2006.
Geoff Dougherty, Pattern recognition and classification an Introduction, Springer, 2013.

CMA831 Statistical Techniques in Data Mining (3-0-0)3

Overviewofdataminingtechniques,Taxonomyofdataminingtasks,Stepsindataminingprocess,Predictive modeling,Associationrules, Statistical perspective,Clustering, Regression analysis, Time series analysis, Bayesianlearning,Datawarehousing,Dimensionalmodeling,Performanceissuesandindexing,Developmentlife cycle,Casestudies.
JiaweiHan,MichelineKamber,DataMining ConceptsandTechniques,MotganKaufmannPublishers.
UsamaMFayyad,GregoryPiatetsky-Shapiro,PadhraiSmythandRamasamyUthurusamy,Advancesinknowledge discoveranddatamining,TheM.I.T.press.

CMA832 Mathematical Finance (3-0-0)3

Introductionto Stochastic Processes, Poisson process,BrownianMotion,Martingales. PresentValue Analysis, InterestRateAnalysis,MarketModelSpecificationProblems.ArbitageTheorem, Multi-PeriodBinomialModel, Block-Scholesformula,ValuingInvestmentsbyExpectedUtility,PortfolioSelectionProblem,CapitalAssets PricingModel,RatesofReturn,SinglePeriodandGeometricBrownianMotion,Mean-VarianceAnalysisofRisk- Neutral-Priced CallOptions,AutoregressiveModelsandMeanRegression,OtherPricingOptionsandApplications
S. M. Ross, An Elementary Introduction to Mathematical Finance, CUP.
Thomas Mikosch, Elementary Stochastic Calculus with Finance in view, World Scientific.

Mark S. Joshi, The Concepts and Practice of Mathematical Finance, CUP.

CMA833 Game Theory (3-0-0)3

Introduction: Definition of Games. Actions, Strategies, Preferences, Payoffs. Examples**.** Strategic Form Games: Strategic form games and examples: Prisoner's Dilemma, Bach or Stravinsky. Dominant Strategy Equilibrium:Strongly dominant strategies, weakly dominant strategies, dominant strategy equilibrium; Examples of Prisoner's Dilemma and Vickrey Auction. Two Player Zerosum Games (Matrix Games): Maxminimization and Minmaximization. Saddle points. Nash equilibrium in matrix games. Minimax theorem. Solution via linear programming. Examples. Bayesian Games: Motivational Examples. Definition of a Bayesian Game and Bayesian Nash Equilibrium and examples.

Martin Osborne. An Introduction to Game Theory. Oxford University Press, 2003.
Y. Narahari. Game Theory and Mechanism Design. IISc Press and World Scientific, 2014.
Philip D. Straffin, Jr. Game Theory and Strategy. The Mathematical Association of America, January 1993.
Ken Binmore, Fun and Games : A Text On Game Theory, D. C. Heath & Company, 1992.

CMA834 Fuzzy Sets and Fuzzy Logic (3-0-0)3

Characteristics of Fuzzy System Models, Classification, Problems; Examples, Modeling of system uncertainties; parametric uncertainties; scope and validity of results. From Classical (Crisp) Sets to Fuzzy Sets: A grand Paradigm shift, Fuzzy Numbers, Fuzzy Arithmetic, Fuzzy Measures, Operations on Fuzzy Sets, Fuzzy Relations, Multi-valued Logic, Fuzzy Logic; Uncertainty and information, Uniqueness of Uncertainity Measure; Possibility Theory; Approximate Reasoning; Fuzzy Decision Making.

Klir and Yuan, Fuzzy Sets and Fuzzy Logic, Prentice Hall of India.
Klir and Folger, Fuzzy Sets, Uncertainty and Information, Prentice Hall of India.
T. J. Ross, Fuzzy Logic with Engineering Applications, McGraw Hill.
Zimmermann, Fuzzy Set Theory and its applications, Kluwer Academic Publishers.
C. V. Negoita, Fuzzy Systems, Abacus Press.

CMA835 Computational Graph Theory (3-0-0)3

Graph Enumerations, Distances in Graphs, Matchings, Coverings, Independence and Factorizations. Fundamental algorithmic techniques for solving graph problems – Traversal and Search Techniques, Greedy Approach, Dynamic Programming, Backtracking, Branch and Bound Techniques and their applications to various graph problems, Network Flow Algorithms, Classification of graph problems: P, NP-Hard and NP-Complete. Spanning Trees and Optimization: Basics of Minimum Cost Spanning Trees, Optimal Routing Trees, Optimal Communication Trees.

Fred Buckley and Frank Harary, Distances in Graphs, Addison Wesley, 1990.
Gary Chartrand and Ping Zhang, Introduction to Graph Theory, Tata McGraw Hill, 2006.
Geir Agnarsson and Raymond Greenlaw, Graph Theory – Modeling, Applications and Algorithms, Pearson Education, 2007.
Anany Levitin, Introduction to the Design and Analysis of Algorithms, Pearson Education, 2nd Edition, 2009.
T. H. Cormen, C.E. Leiserson, R.L. Rivest and C. Stein, Introduction to Algorithms, Prentice Hall of India, 2nd Edition, 2005.
Wu Bang Ye and Kun-Mao Chao, Spanning Trees and Optimization Problems, CRC Press, 2004.

MCA 601 Computer Organization and Architecture (4-0-0) 4

Data Representation, Number systems, Logic design, Addressing modes, Assembly Language programming, Memory organization, Arithmetic: Adders, Carry Look ahead Adder, CSA, Fast multipliers, Booth multiplier, Floating point representation and operations, CPU architecture and organization, Microprogramming, Hardwired control unit, Instruction Formats I/O architecture. Multiprocessing, RISC vs., CISC Architectures, Pipelining and superscalar machine, Parallel processing.

VC Hamachar, ZG Vranesic and SG Zaky, Computer Organization, McGraw Hill
1996 Moris Mano, Computer System Architecture, Prentice Hall, 1992

MCA 602 Computational Mathematics (4-0-0) 4

Numerical solution of algebraic and Transcendental equations, Solution of system of linear algebraic equations by direct and iterative methods, Interpolation - Finite differences, Curve fitting by least Square Principle, Numerical Differentiation and Integration, Numerical solution of ordinary differential equations, Solution of boundary value problems in ordinary differential equations, Solution of partial differential equations.

S S Sastry: Introductory methods for Numerical analysis, 3rd edition, 2000, Prentice Hall.

M K Jain, S R K Iyengar and R K Jain, Numerical methods for Scientific and Engineering computation, Wiley Eastern, 1985
M K Jain, Numerical solution of Differential equations, Wiley Eastern, 1984

MCA 603 Discrete Mathematical Structures (4-0-0) 4

Fundamentals of logic: Propositional and predicate calculus, Graph Theory: trees, Representation of graphs, Spanning Tree and shortest path algorithms, Planarity, Connectivity, Traversability, Colorability, Network flow algorithms, Search procedure, Recurrence relations and generating functions, Group Theory: Groups, Subgroups, Lagrange's Theorem, Cyclic groups, Permutation groups, Normal subgroups, Lattice Theory: Order relations, Partial order, Linear order, Lattices, Boolean lattices, Boolean algebra.

J.P. Tremblay and R. Manohar, Discrete Mathematical Structures with applications to Computer Science, McGraw Hill. Judith L. Gerstring, Mathematical Structures for Computer Science, Freeman, 5th edn.
Ralph P. Grimoldi, Discrete and Combinatorial Mathematics, An applied introduction, Pearson Education, 4th edn.

MCA 604 Programming Concepts (4-0-0) 4

Introduction to Algorithms, Flow charts, Procedure oriented Programming concepts, Data types, Operators and Expression, I/O functions, composite Data types (Arrays, Structs, Union) Queues (FIFO), Stacks (LIFO), Pointers, Dynamic Memory Allocation, Linked lists: - Single and doubly linked list, Introduction to Object oriented Paradigms:- Encapsulation, Data hiding, Polymorphism (Operator and Function overloading), Inheritance, Data abstraction, Introduction to Object Oriented Design.

B. Kernighan and D. Ritchie, The C Programming Language, Prentice Hall, 1990
E. Balagurusamy, Programming in ANSI C, Tata Mc.Graw Hill 2004
Hilbert Schilds, C++ complete Reference 1999.

MCA 605 Data Structures & Algorithms (4-0-0) 4

Introduction to analysis of algorithms: asymptotic notations, big-oh, big-omega, theta, small-oh, small-omega notations, worst-case and average-case analysis, solving recurrences. Abstract data types, Linear Data Structures and their sequential storage representation: stacks, queues, priority queues, and their applications. Pointers and linked storage representation: singly linked list, circular linked list, doubly linked lists and their application, skip lists. Nonlinear data structures: trees, storage representation of binary trees, operations on binary trees: tree traversals, insertion, deletion, searching, trees, applications of trees, AVL trees. Graphs: representation of graphs, breadth first search and depth first search, shortest path problem, minimum cost spanning trees, applications of graphs. Sorting: selection sort, bubble sort, insertion sort, merge sort, heap sort, quick sort, radix sort. Searching: sequential search, binary search, search trees, hash tables.

T.H. Cormen, C.E. Leiserson, R.L. Riverst, C.Stein, Introduction to Algorithms, Prentice -Hall of India, 2003
A.V. Aho, J.E. Hopcraft and J.D. Ullman, Data Structures and Algoriths, Pearson Education, 2003
J.P. Tremblay and P.G. Sorenson, An Introduction to Data Structures with Application. Tata McGraw-Hill 1991.

MCA 606 Data Structures and Algorithms Lab (0-0-3) 2

MS-DOS editor commands. Unix commands. Simple programs using I/O. Implementation of programs using control statements, Functions, Arrays, Pointers, Structures, Unions, File handling, Graphics function and animation.

Brian W.Kernigham and Pike R., The Practice of Programming, Addison Wesley, 1999.

MCA 607 Computer Architecture Lab (0-0-3) 2

MCA 608 Programming Lab (0-0-3) 2

C programming: - Data types, Operators, Functions, Arrays, Structures, Unions, Dynamic Allocation, Linked list
C++:- Class, Inheritance, Overriding Function and Operator Overloading.

MCA 611 Computer Oriented Statistical Methods (4-0-0)4

Introduction of probability, total probability theorem, conditional probability, Baye's theorem, one and two dimensional random variables, functions of random variable, probability distributions, discrete and continuous cases, marginal and conditional distributions, independence of random variables, expectation and variance of a random variable, correlations, sampling theory, sampling distributions, weak law of large numbers, central limit theorem and applications, methods of estimation, parameter estimation, tests of statistical hypothesis.

Meyer P.L., Introduction to Probability and Statistical Applications, Oxford & IBH, 1979.
RV Hogg and AT Craig, Introduction to Mathematical Statistics McMilan, 1975.

HU 612 Managerial Economics (4-0-0) 4

Business Objectives and Business Decisions - Nature and scope of managerial economics, Economic theories, Firms Objectives, Profit maximization, Entrepreneurship, Manager role, Managerial decisions. Demand Analysis, Forecasting and Market Structure - Demand determinants, types of demand, Demand function, Demand Elastictiy's, Demand forecasting -methods, market structure, type of competitions, price and output decisions under perfect and imperfect competition. Monopoly, Monopolistic, Oligopoly competitions, safeguarding competition and anti-trust lanes. Production, Pricing and Profit Management - Production theory, Determinants of price, Pricing structure, Price discrimination, Pricing of joint products, Pricing methods, statutory price fixation in India, Price discounts and differentials, Nature of profit, profit policy, measurement, planning and forecasting. Decision Techniques and Capital Budgeting - Optimization, Resource allocation, Evaluation alternatives, formulation of linear programming problem, marketing decision concepts, Introduction to capital budgeting, Types and evaluation of investment decisions. Data of Macroeconomics - National income, Aggregate demand and expenditure, saving and Investment, Trade cycle and control, International trade, Balance of payments and Foreign exchange. Money System - Market for money, Interest rates, the capital market - banks, stock exchange, multiplier and accelerator. Case Studies.

Mote V.L Paul Samuel and Gupta G.S. "Managerial Economics", McGraw -Hill, 1985
Craig Petersen H. and Cris Lewis W., "Managerial Economics", Prentice Hall of India, 2000 Dwivedy D.N., "Managerial economics", Vikas Publishing House, 1995.
Mcguigam, "Managerial Economics Applications Strategy and tools", South Western, 2002. N. Gregory Mankiw. "Principles of Economics", (3rd Ed) Thomson, 2002.

MCA 613 Microprocessors PREREQ MCA601 (3-0-0) 3

Introduction to microprocessors. Architecture of 8086/8088. Assembly language programming. Addressing modes of 8086. Instruction set. Subroutines. Modular programming. Macros and conditional assembly. Interrupt processing. Hardware architecture of 8086/8088. Memory System Design and peripherals. Introduction to 80386, 80486. Hardware details of PENTIUM.

BB Barry, The Intel Microprocessors, Prentice Hall of India,1996.
Liu and Gibson, Microcomputer System, the 8086/8088 family, Prentice Hall 1989.

MCA 614 Operating System (4-0-0) 4

Operating System Functionalities, Types of Operating System- Multi programming, Multi tasking, Multi processing and Realtime Operating system, Processes and threads, Process Management (learning fork system call), Inter process communication (using shared memory, Message Queues,. Pipes etc.), CPU scheduling, Process synchronization Mechanism (Semaphores in Unix), Dead locks - Prevention, avoidance and recovery techniques, Memory Management (Paging, Segmentation and Swapping), Virtual Memory (Dynamic Paging Techniques and Page replacement Algorithms), File Systems Management, IO Management, Protection and Security

Silberschatz, Galvin, Gagne Operating System Concepts (Sixth Edition), John Wiley 2008
Mourice J. Bach, The Design of the Unix Operating System PHI 2002

MCA 615 Theory of Computation PREREQ MCA603 (3-0-0) 3

Finite automata. Moore and Melay machines. Regular Expressions. Pumping lemma. Minimizing the automata. Formal Languages. Regular languages. Context free languages (CFL). Chomsky and Greibach Normal forms. Pushdown automata (PDA). Equivalence of PDA and CFL. Turing machines. Theory of recursive functions. Complexity theory. NP-completeness.

Aho, Hopcraft & Ullman, Automata, Languages and Computation, Narosa,1986
Mishra and Chandrashekar, Theory of Computer Science, Prentice Hall 1998.

MCA 616 Microprocessor Lab (0-0-3) 2

MCA 617 Operating Systems Lab (0-0-3) 2

Unix Operating System familiarization, UNIX shell scripting, Implementation of IPC Using Shared Memory, Pipes, Files, Message queues etc., Process synchronization using Semaphores (Reader writer and Dining Philosopher Problem), Disc scheduling Algorithms.

MCA 701 Database Management Systems (4-0-0)4

Files versus database systems, Three-level architecture of databases, Data Models, ER-diagram, EER-model, Relational model, ER-Relational mapping, Relational algebra and calculus. Query languages, SQL, Embedded SQL, Relational database design algorithms, Normalization, Physical database organization, Indexing and hashing,

Transaction processing, Concurrency control techniques, Database recovery techniques, Database security and authorization.

Ramez Elmasri, Shamkant B Navathe, Fundamentals of database system, Addison Wesley, McGraw-Hill, 2000.
Silberschatz Korth and Sudarshan, Database System Concepts, McGraw Hill.
Ramakrishnan, R., Gehrke, Database Management Systems, Third edition McGraw Hill.

MCA 702 Object Oriented Programming PREREQ MCA604 (3-0-0) 3

Key concepts of Object Oriented Programming. Overview Of C++, Classes,Inheritance. Polymorphism, Overloading. Virtual functions, Templates, Exception handling, I/O stream. File I/O, Java Programming

Herbert Schild, C++ The complete References, 1999.
HM.Deitel and PE Deitel, Java How to Program, Prentice Hall, 1998.

HU 703 Accounting and Financial Management (4-0-0) 4

Principles of Accounting - Concepts - Conventions - Principles. Accounting Systems as source of Financial Information for Decision Making. Financial Accounting - Financial Statements - Ratio Analysis. Inventory Management - Depreciation Policy. Cost Accounting - Classifications. Management Accounting - Cost for Profit Planning and Decision Making. Financial Decisions. Accounting Systems for Planning Control and Decision Making. Budgeting and Budgetary Control.

I.M. Pandey, Elements of Management Accounting. Vikas Publishing House. Khan and Jain, Financial Management, Tata McGraw Hill Publication.
Prasanna Chandra, Financial Management, Tata McGraw Hill Publication. Van Horne James C., Financial Management Policy, Prentice Hall of India.
Anthony & A. Alkinson, Robert S. Kaplan & S. Mark Young, Management Accounting 4th Ed.
Ther Robert S. Kalpan Series in Management Accounting.

MCA 704 Database Management Systems Lab (0-0-3) 2

Creation of tables, Views, Insertion, Modification and deletion of elements. Implementation of queries. Implementation of joins. Implementation of PL/SQL, triggers, cursors and sub programs. Implementation of database connectivity through front end tools. Database design and implementation. Mini project.

MCA 705 Object Oriented Programming Lab PREREQ MCA606 (0-0-3) 2

Simple C++ Program. Dynamic memory allocation. Constructor/Destructor, Friend function, Function overloading, Operator overloading. Inheritance. Virtual functions and Dynamic binding. Templates. File Handling. Exception handling. Simple Java programs. Inheritance. Event handling programs.

MCA 711 Software Engineering (4-0-0) 4

Software engineering paradigms, Planning, Cost estimation, Organization structure, Software project scheduling, Risk analysis and management, Requirements and specification, Rapid prototyping, Software design, Software metrics, Software testing and maintenance, Software configuration management and case tools, OO modeling, OO software development process, OOT concepts, Unified software development process, Development Phases, UML, structural and behavioral modeling, architectural modeling.

Roger S. Pressman, Software Engineer: A Practitioner Approach, McGraw Hill, 1999
L Sommerville, Software Engineering, Addision Wesley, 1996
Grady Booch "OO Analysis and Design with Applications" Pearson Education Asia
Jacobson, Booch and Rambaugh, "The unified software Development process" Pearson Education Asia

MCA 712 Computer Graphics (4-0-0) 4

Graphic Hardware, Display Devices: line and point plotting algorithms, I/O Devices, Display processors, Color display Techniques (Shaddow masking & Penetration CRT), Coordinates (Screen and User), 2D and 3D transformation, Curves, Surfaces and solids, Hidden line and surface elimination, illumination and shading, Color Models (RGB, HIS etc), Animation techniques.

Hearn D and Baker MP, Computer Graphics, PHI, 2002
Roger DF, Procedural Elements of Computer Graphics, McGraw Hill, 2002, Gonzalez C and Woods RE, Digital Image Processing, Addison Wesley, 2000.

MCA713 Software Engineering Lab (0-0-3) 2

MCA 714 Computer Graphics Lab (0-0-3) 2

Line and Point Drawing Algorithms, 2D 3D Transformations, Clipping and Windowing, Animation

MCA 721 Computer Networks (4-0-0) 4

Introduction :Uses of Computer Network, Network hardware, Network software, Types of networks, topology, Hierarchical Reference Models OSI and TCP/IP Models. The theoretical basis for Data Communication, Transmission media. Physical Layer. Bit signal transformation, Bit rate control, Multiplexing, Circuit switching, Line coding, Data Link Layer, Data Link Layer Design issues, Addressing, Error correction and detection, Flow control, Medium Access control, Framing, Network Layer Network Layer Design issues, IP addressing, Subnetting, NAT IP v6, DHCP, ICMP, ARP, Routing algorithms, IP datagram and fragmentation, Internetworking devices Transport Layer Transport layer services, Addressing, Connection control, transport protocols such as UDP and TCP, congestion control algorithms, Quality of service. Application layer: Application layer protocols SMTP, DNS, FTP, HTTP, Introduction to Network Security, Introduction to wireless network and Mobile Ad-hoc Networks

AS Tannenbaum, Computer Networks, Prentice - Hall 2003.
William Stallings, Data and Computer Communication, PHI, 1997
James F. Kurose and Keith W Rose, Computer Networking Pearson Education, 2003

MCA 722 Internet Technology & Applications (3-0-0) 3

History of Internet. Internet addressing. TCP/IP. DNS and directory services. Internet resources and applications. WWW Overview. Advanced java programming. Applet Programming. N/w programming, JDBC. Servlet programming.

Deitel & Deitel, Internet & World wide Web, How to program, Prentice Hall 2000.
D Norton and H Schild, Java2: The complete reference, TMH 2000.

MCA 723 Computer Networks Lab. (0-0-3) 2

Implementation of Datalink, Network, Transport, Application layer protocols techniques based on computer networks. Client/server programming. Internetworking of LANs. File transfer using TCP/IP Remote command execution UNIX socket programming.

MCA724 Internet Technology & Applications LabPREREQ MCA705 (0-0-3) 2

Client and Server Side Scripting Programs. Use of Components. Creating dynamic web pages. Experiments with ASP/ACTIVEX / JAVA Server Pages. Socket programming and applications. Java servlets. On-line transactions. Database connectivity. Mini project.

MCA725 Computer Applications Lab (0-0-6)4

MCA801 Computer Algorithms PREREQ MCA605 (3-0-0) 3

Mathematical Background. Design and Analysis of algorithms. Complexity measures. Worst-case and average-case complexity. Sorting and selection. Searching and set manipulation. Hashing. Union-Find problem. Design techniques: Divide and conquer, Dynamic programming, Greedy method, Backtracking, Branch & bound. Graph and parallel algorithms. Algebraic problems. String processing. NP-completeness.

A Aho, J Hopcroft, and J Ullman, The design and analysis of computer algorithms, Pearson Education 2001.
Thomas H. Cormen, Charles E Leiserson, and Ronald L. Rivest, Introduction to Algorithms, Prentice Hall 1998.

MCA802 Fuzzy System Models (3-0-0) 3

Classical (Crisp) sets versus fuzzy Sets. Fuzzy Numbers. Fuzzy arithmetic. Fuzzy measures. Operations on fuzzy sets. Fuzzy relations. Multi-valued logic. Fuzzy logic. Uncertainty and information. Uniqueness of uncertainty measure. Possibility theory. Approximate reasoning. Fuzzy decision making.

Klir and Folger, Fuzzy Sets, Uncertainty and Information, Prentice Hall 2001.
Klir and Yuan, Fuzzy Sets and Fuzzy Logic, Prentice Hall of India 2001.

MCA803 Management Information Systems (3-0-0) 3

Definition of management information systems. Information systems for decision making process. Information-based support systems. Information system requirements. Planning, designing and implementing MIS. Case study.

GB Davis and MH Olson, Management Information Systems, Mc-Graw Hill, 1984.
Murdick RG and Ross JE, Information systems for modern management, Prentice Hall.

MCA804 Operations Research (3-0-0) 3

Linear Programming. Formulation and graphical solutions. Simplex Algorithm. Quality and sensitivity analysis. Dual simplex method. Transportation and assignment problems. Games and their solution by linear programming. Network

Analysis. Queuing Theory. Basic structure of a queuing Model. M/M/1 and M/M/S models and their variants.
Hamdy A Taha, Operations Research, Prentice Hall of India, 1997.
Hiller and Liberman: Introduction to Operations Research, Prentice Hall 1995.

MCA805 Optimization Techniques & Statistical Methods (3-0-0) 3

Linear programming problem. Simplex method. Two-Phase method. Duality theory. Transportation problem. Assignment problem. Reliability. Concepts of hazard, Bath-tub curve, MTTF , MTBF. System reliability for series, parallel and mixed configurations. Data Analysis. Time series analysis, Time series models, Method of moving averages. Seasonal movements, Cyclical movements.
Kanthi Swarup, PK Gupta and Man Mohan, Operations Research, Sultan chand & Sons, 1978.
J Medhi, Statistical Methods, Wiley Eastern, 1987.

MCA806 Artificial Intelligence PREREQ MCA603 (3-0-0) 3

Foundation and history of AI. AI Problems and techniques. Heuristic search techniques. Knowledge representation. Reasoning under uncertainty. Planning and learning. Genetic algorithms. Applications of AI. Principles of natural language processing. Expert systems. Current trends in intelligent systems. AI programming languages. Introduction to LISP and PROLOG.
Elain Rich and Kevin Knight, Artificial Intelligence, Tata McGraw Hill Publishing Company Limited, 1995.
Stuart Russel and Peter Norvig, Artificial Intelligence: A Modern Approach, Prentice Hall, 1995.

MCA807 Artificial Neural Networks PREREQ MCA721 (3-0-0) 3

Introduction to artificial neural network. Learning process. Single layer and multilayer perceptrons. Back propagation algorithm. Convolution network. Radial basis function network. Kernel regression and its relation to RBF network. Learning strategies. Support vector machines. Linearly separable patterns. Non-separable patterns. SVM for nonlinear regression. Principal component analysis. Pattern classification. Hierarchical vector quantization.
Simon Haykin, Neural Networks: A comprehensive Foundation, Prentice-Hall International, New Jersey, 1999. B Yegnanarayana, Artificial Neural Networks, Prentice-Hall of India, New Delhi.

MCA808 Computer Simulation & Modeling PREREQ MCA611 (3-0-0) 3

Components of a system. Models of system. Random number generation. Probabilistic distribution. Simulation languages. Applications
Jerry Banks and John Carson. S, Discrete Event System Simulation, PHInc, 1984.
Gotifried B, Elements of Stochastic process simulation, PHInc, 1984.

MCA809 Genetic Algorithms PREREQ:MCA605 (3-0-0) 3

Robustness of traditional optimization and search techniques, Goals of optimization, A simple genetic algorithm, Similarity templates, Mathematical Foundations, Computer Implementation of Genetic Algorithms, Advanced operators and techniques in genetic algorithm search. Industrial application of genetic algorithms.
David Goldberg, Genetic Algorithms in search, optimization and machine learning, Addision Wesley International,1999.
Charles L Karr and L Michael Freeman, Industrial applications of Genetic Algorithms, CRC Press, 1998.

MCA810 Knowledge Management (3-0-0) 3

Introduction to knowledge Management. Types of knowledge within an organization. Intellectual capital. KM Architecture and Tools. ERP for KM. Knowledge sharing tools. Data ware housing. Knowledge strategy creation. KM practices. KM Process. Integrating knowledge sharing and learning. The chief knowledge Officer (CKO) and his/her job. Training programmes for organization. Wide learning. Making KM work across various segments of industry and business firms. Case studies of KM practices in successful companies, Future challenges in KM.
Ratnja Gogula (Ed), Knowledge Management: A New Down., The Institute of Hartered Financial Analysts of India, Hyderabad 2002.

MCA811 Natural Language Processing PREREQ MCA603 (3-0-0) 3

Issues and difficulties in NLP. Language understanding systems. Types of NLP Systems. Grammars and parsing. Semantic Interpretation. Language communication. Typical Systems. Current trends in NLP.
James Allen, Natural Language Understanding, Benjamin / Cummings Publishing Co, 1995.
Ronald Hausser, Foundations of Computational Linguistics, Springer-Verleg, 1999.

MCA812 Network Optimization PREREQ MCA603 (3-0-0) 3

Net work models. Minimal spanning trees. Shortest route problem. Matching and coloring problems. Max flow min- cut theorem. Capaciated network model. Network simplex method. PERT and CPM. Resource analysis in network scheduling. Precedence planning. Resource allocation and scheduling.

CH Papadimitriou and K Steiglitz, Combinatorial optimization: Algorithms and Complexity, Prentice Hall,1982.
Hamdy A Taha, operations research, PHI, 1997.

MCA813 Object Oriented Analysis & Design PREREQ MCA702 (3-0-0) 3

Object oriented design fundamentals. OOSD life cycle. Object oriented analysis. UML. Object oriented design methods. Design patterns and frameworks. Object oriented development. Coding, Testing, Maintenance. Case studies in object oriented development.

Grady Booch, James Rumbaugh and Ivar Jacobson, The Unified Modeling Language User Guide, Addison Wesley Long man, 1999.
Erich Gamna, Design Patterns, Addison Wesley, 1994.

MCA814 Performance Modeling PREREQ MCA611 (3-0-0) 3

Performance evaluation methods. Analytical versus simulation modelling. Performance measurement and benchmarking. Workload modelling. Random variables. Commonly used distributions. Stochastic processes. Markov chain models of computer systems. Queuing models. Discrete event simulation. Simulation Languages. Confidence intervals. Variance reduction techniques. Case studies of analytical and simulation studies of computer systems.

Raj Jain, The Art of Computer Systems Performance Analysis, John Wiley and Sons, New York, USA, 1991.
KS Trivedi, Probability and Statistics with Reliability, Queuing and computer science, PHI, 1982.

MCA815 Stochastic and Queuing Systems PREREQ MCA611 (3-0-0) 3

Probability concepts. Random variables. Functions of random variable. Distributions. Moment generating function. Stationary process. Markov process. Binomial process. Poisson process. Birth and death process. Renewal process. Markov chains. Chapman-Kolmogorov equations. Transition probabilities. Series and parallel systems. Reliability and Availability of Markovian systems. Maintainability. Preventive maintenance. Markovian queuing models.
Little's formula. Multi-server queues. M/G/1 Queues. Pollaczek-Khintchine formula. Decision theory and games.

Trivedi KS, Probability and Statistics with reliability, Queuing and Computer Science Applications, Prentice-Hall 1984.
J Medhi, Stochastic process, Wiley eastern 1987.

MCA816 UNIX and Network Programming PREREQ MCA615 (3-0-0) 3

Overview of UNIX OS. File I/O. Files and directories. Standard I/O library. System data files and information. Processes. Process relationships. Terminal I/O. Advanced I/O. Threads. Interprocess communication. Message passing. Synchronization. Shared memory. Sockets. Name and address conversions. Applications: TCP echo client server, UDP echo client server.

W Richard Stevens, Advanced programming in the UNIX environment, Addison Wesley,1999.
W Richard Stevens, UNIX Network Programming Volume 1 and 2, Prentice Hall, 1998.

MCA817 Advanced Client Server Computing PREREQ MCA614, MCA721 (3-0-0) 3

Development of Client/Server computing. Architecture of client/server. Three tired architecture. Client characteristics and tools. Use of GUI and local processing with examples. Services like file, database, communication and security. Platforms: LAN, WAN and enterprise wide services. Network operating system. Connectivity: SWMP, NFS, SMPT, IPC. Services: pipes, semaphores, shared memory, DDE, RPC, OLE. Application development. Management and risk issues.

Robert Orfalietall, Essential Client/Server Survival guide.
Larry T. Vaughn, Client /Server System Design & Implementation.

MCA818 Advanced Database Management Systems PREREQ MCA701 (3-0-0) 3

Basic concepts. Architecture for data sharing, Federated DBMS. Distributed databases. Client/server architecture. Multimedia databases. Object oriented data bases. Data mining and knowledge discovery. Pattern clustering abstraction and similarity. Clustering for data mining. Data mining using neural networks and genetic algorithms. Discovery of association rules. Frequent episodes in event sequences. Applications of data mining.

Ramez Elmasri, Shamkant B Navathe, Fundamentals of Database Systems, Addison Wesley, 2000.
Stefano Ceri & Giuesppe Pelagatti, Distributed Databases - Principles and Systems, McGraw Hill 1987.

MCA819 Advanced Operating Systems PREREQ MCA614 (3-0-0) 3

An overview of operating system functions. Distributed operating systems. Design issues. Distributed shared memory. Scheduling algorithms. Recovery. Protection and Security. Cryptography. Architecture of multiprocessor operating systems. Database operating systems.Transaction processing. Serializibility. Concurrency control algorithms. Object oriented operating systems. Case studies: UNIX, LINUX, Windows.

Mukesh Singhal Niranjan, G.Shivorothri, Advanced concepts in Operating Systems, Tata Mc-Graw Hill, 1994.
Andrew S Tenanbaum, Modern Operating Systems, PHI, 1995.

MCA820 Cryptography and Network Security PREREQ MCA721 (3-0-0) 3

Conventional encryption. Introduction to Finite Fields. Contemporary symmetric ciphers. Confidentiality using conventional encryption. Public-Key Encryption. Hash Functions. Introduction to Number Theory. Public-Key Cryptography. Message authentication. Hash and Mac algorithms. Digital signatures and authentication protocols. Network security. System security.

William Stallings, Cryptography and Network Security, Pearson Education India 2002.
RE Smith, Internet Cryptography, Pearson Education India.

MCA821 Data Mining and Warehousing PREREQ MCA701 (3-0-0) 3

Overview of data mining techniques. Taxonomy of data mining tasks. Steps in data mining process. Predictive modeling. Association rules. Statistical perspective. Clustering. Regression analysis. Time series analysis. Bayesian learning. Data warehousing. Dimensional modeling. Performance issues and indexing. Development life cycle. Case studies.

Jiawei Han, Micheline Kamber, Data Mining : Concepts and Techniques, Motgan Kaufmann Publishers, 2000.
Usama M Fayyad, Gregory Piatetsky-Shapiro, Padhrai Smyth and Ramasamy Uthurusamy, Advances in knowledge discover and data mining, The M.I.T. press, 1996.

MCA822 Digital Image Processing PREREQ MCA712 (3-0-0) 3

Digital image fundamentals. Elements of visual perception. Colour models. Mathematical preliminaries of 2D systems. Image transforms. Image enhancement and restoration. Image compression. Image segmentation.

Gonzalez C and Woods RE, Digital image processing Addition Wesley, 2000.
Anil K Jain, Fundamentals of digital image processing, PHI, 1997.
William. K Pratt, Digital image processing, Wiley International, 2000.

MCA823 Distributed Computing System PREREQ MCA701 , MCA721 (3-0-0) 3

Introduction to distributed Systems. Design Goals. Fundamental issues in distributed systems. Basics of networking, Temporal ordering of events. Lamport's logical Clocks. Vector clocks. Global state detection. Physical clocks. Process Synchronization. Distributed mutual exclusion. Performance matrix. Interprocess communication. RPCs. Deadlocks in distributed systems. Load balancing techniques. Distributed databases.

GF Coulouries, JD Dollimore and T Kindberg, Distributed Systems: Concepts and Design, Addison Wlesley, 1994.
Mukesh singhal and Niranjan G.Shivaratri, Advanced concepts in Operating system, Tata McGraw Hill 1994.

MCA824 Information and Coding Theory PREREQ MCA611 (3-0-0) 3

Entropy and its characterizations. Huffman codes. Shannon-Fano coding. Information measure-noiseless coding. Fundamental theorem of information theory. Error correcting codes. Minimum distance principles. Hamming bound. General binary code. Group code. Covolution encoding. Algebraic structure. Gilbert bound. Threshold decoding. Cyclic binary codes. BCH codes. Decoding. Optimum codes. Concepts of non-cyclic codes.

R Ash, Information theory, Interscience publication, Singapore, 1965.
N Abrahamson, Information theory and coding, Mc Graw Hill, 1963.

MCA825 Parallel Processing PREREQ MCA 601, MCA613 (3-0-0) 3

Theory of Parallelism. Multiprocessors and Multicomputer. Conditions for Parallelism. Data and resource dependencies. Hardware and software Parallelism. Program Flow Mechanisms. Control Flow versus data flow. Hardware technologies. Instruction set Architectures, CISC, RISC. Scalar Processors, Memory Hierarchy and Virtual Memory. Cache Memory organizations. Hardware synchronization mechanisms. Vector processing principles.

K Hwang & Briggs FA, Computer Architecture and Parallel Processing, McGraw Hill,
1985. Kai Hwang, Advanced Computer Architecture, McGraw Hill 1993.

MCA826 Pattern Recognition & Scene Analysis PREREQ MCA611 (3-0-0) 3

Pattern and features. Pattern recognition approaches. Discriminant functions. Statistical pattern recognition. Gaussian model. Parametric estimation. Bayesian parameter estimation. Pattern classification by distance functions Cluster

analysis. Syntactics pattern recognition. Features extraction and recent advances.
Earl Gose, Richard Johnsonbaugh, Steve Jost, Pattern Recognition and Image Analysis, Prentice Hall 1999.
Duda RO and Hart PE, Pattern Classification and Scene Analysis, Wiley, 1973.

MCA827 Web Design PREREQ MCA702 (3-0-0) 3
HTML overview. HTML tags. Formatting text. Cascading style sheets. DHTML. Web design tools. MS Front page. Dreamviewer Multimedia. Client side scripting. Introduction to java script. VB script. Server side scripting. Active server pages. Java server pages. Database connectivity. Web applications.
Thomas powell, Fritz Schneider, Java script:The complete reference, Tata Mc Graw Hill, 2002.
David crowder, Rhonda crowder, Web design, IDG books India Pvt. Ltd., 2001.

MCA828 Compiler Design PREREQ MCA605 (3-0-0) 3
Phases of a compiler. Lexical analysis. Syntax analysis. LEX and YACC utility. Syntax directed translation. Run time Environments. Intermediate code generation. Code optimization. Code generation.
AV Aho, Ravi Sethi, and JD Ullman, Compilers: Principles, techniques and tools, Pearson education Asia, 2001.

MCA830 Object oriented programming with JAVA (3-0-0)3
Introduction to Programming, and Java: Primitive Data Types and Operations: Selection Statements, Loops, Methods, Arrays, Strings and Text I/O; Exceptions and Assertions, Objects and Classes; Inheritance and Polymorphism; Getting Started with GUI Programming: Creating User Interfaces; Event Driven Programming; Java Database Programming; Remote Method Invocation; Java Server Pages; Multithreading; Networking; Advanced Swing Models; Menus, Toolbars, Dialogs; Containers, Layout Managers, and Borders.
References:
Y. Daniel Liang, Introduction to Java Programming Comprehensive version, Tenth Edition, Pearson publishers, 2015.
Herbert Schildt, Java: The Complete Reference, Ninth Edition, Oracle press (Mc. Graw Hill), 2014.
Bruce Eckel, Thinking in Java fourth edition, Prentice Hall, 2005.

MA701 Applied Statistics & Numerical Analysis (3-0-0) 3
Introduction to probability, probability distributions, Sampling theory, Hypothesis testing, Analysis of variances of one-way and two way classified data, Numerical solutions of ordinary differential equations, Numerical solution of partial differential equations, Introduction to finite element methods.
Sheldon Ross M., Introduction to Probability and Statistics for Engineers and Scientists, John Wiley. Hogg R. V., Craig A. T., Introduction to Mathematical Statistics McMillan.
Smith G. D., Numerical Solution of Partial Differential Equations, Oxford University Press.

MA702 Design & Analysis of Experiments (3-0-0) 3
Introduction to Probability, one - dimensional random variables, two and higher dimensional random variables, probability distributions, Sampling theory, moments, mgf and their properties, Parameter Estimation, point estimation, interval estimation of means and variances, Hypothesis testing, goodness of fit tests, Analysis of variances of one-way and two way classified data, experi*mental* design.
Douglas Montogomery, Design and Analysis of Experiments, 3 Edition, John Wiley.
Sheldon Ross M., Introduction to Probability & Statistics for Engineers & Scientists, John Wiley
Hogg R. V., Craig A. T., Introduction to Mathematical Statistics, 4th Edition, McMillan

MA703 Linear Algebra (3-0-0) 3
Finite dimensional vector spaces, Algebra of transformations, matrix algebra, solution sets of linear system of equations, eigenvectors, Real symmetric / Complex Hermitian matrices, Algebra of polynomial matrices, Inner product spaces, singular value decomposition, polar decomposition, Applications of linear algebra in signal processing, coding theory and control theory. *rd*
Gilbert Strang, Linear Algebra and Its Applications, 3 ed., Brooks/Cole, 1998.
David C. Lay, Linear algebra and its applications, 2nd ed., Pearson, 2000.

MA704 Numerical Analysis (3-0-0) 3
Solution of algebraic transcendental and polynomial equations, Interpolation, Numerical differentiation, Numerical Integration, Integration over infinite intervals, Error analysis, Numerical solution of ordinary differential equations, Numerical solution of partial differential equations, Introduction to finite elements

Jain M.K., Iyengar S.R.K., Jain R.K., Numerical Methods for Scientific and Engineering Computation
Jain M.K., Numerical Solutions of Differential Equations
Mitchell A.R., Wait R., Finite Element Method in Partial Differential Equations

MA705 Operation Research (3-0-0) 3

Introduction and formulation of models: simplex method, duality in LP, Dual Simplex method, sensitivity analysis, transportation and assignment problems, Integer programming, Classical optimization methods, Lagrangian Multipliers and Khun-Tucker Conditions, quadratic programming.
Hamy A. Taha, Operations Research: An Introduction, PHI.

MA706 Probability & Statistical Applications (3-0-0) 3

Probability & Statistics: Introduction, one - dimensional random variables, two and higher dimensional random variables, marginal and conditional distributions, independence of random variables, variances and correlations, Distributions: Sampling Theory. Parameter Estimation: Hypothesis testing, goodness of fit tests, Data Analysis, Linear regression.
Meyer P.L. Introduction to Probability & Statistical Applications -, Amerind Publishing Co
Sheldon Ross M., Introduction to Probability & Statistics for Engineers & Scientists, John Wiley

MA707 Random Processes (3-0-0) 3

Overview of Probability, Random variables, Probability functions, Functions of Random variables, some important probability distributions, sequence of random variables, limit theorem, Random Correlation function, power spectral densities, linear systems with random inputs, Gaussian and Poisson process.
Gray R.M. and Davisson L.D., An Introduction to Signal Processing
Papoulis A, Probability, "Random variables and Stochastic Processes". McGraw Hill, 1984.

MA708 Statistical Methods (3-0-0) 3

Probability and Statistics, Introduction , One dimensional random variables, Two and higher dimensional, random variables, marginal and conditional distributions, independence of random variables, variances and correlations. Distributions: Sampling theory. Parameter estimation: Hypothesis testing, Goodness of fit tests. Data Analysis, Linear regression.
Meyer P.L. Introduction to Probability & Statistical Applications -, Amerind Publishing Co
Sheldon Ross M., Introduction to Probability & Statistics for Engineers & Scientists, John Wiley

MA709 Database Management (3-0-0) 3

Introduction to database systems, relational data model, Relational databases- SQL, Database design- Entity relationship data model- normal Forms, Storage and file organization, access methods, Data warehouses and Data mining.
Elmasri, Ramex, Shamkant B Navathe : Fundamentals of database systems
Ullman J. D : Principles of database systems
Date C. J.: An Introduction to database system Vol I,II,III Addison Wesley
Prakash, Naveen : Introduction to Database management : Tata McGrawHill

MA710 Applied Mathematics for Surveyors (3-1-0) 4

Tracing of curves, Overview of methods of Integration. Applications of Integration to area, arc length, volume and surface of revolution. Multiple Integrals. Line Integrals, Surface Integrals, Volume Integrals. Numerical Integration : Trapezoidal and Simpson Rule's. Numerical double Integration. Projection: Projection of a point, line segment on a line, projection of planes and surfaces. Spherical Trignometry
K. A. Stroud, Advanced Engineering Mathematics, Palgrove Macmillan 4 edition
Thoma 7 Finney, Calculus and Analytical Geometry
B.S. Sastry, Higher Engineering Mathematics, Khanna Publishers. S.S.Sastry, Introductory methods of Numerical Analysis.

MA711 Statistics for Management (3-0-0)3

Applications of statistics in managerial decision making – Primary and secondary data collection methods, drafting of questionnaire – Classification and tabulation of data – sampling method – Probability and Non-Probability Methods – Simple Random Sampling Method – Stratified Random Sampling – Cluster random Sampling – Measurement and Scales of Measurement – Data Analysis – Compilation and Tabulation of Data – Graphical Representation of the Data – Summary Statistics – measures of Variation –measures of Co-Variation – Estimation – Interval Estimate –

Testing of Hypothesis –Null and Alternative – Types of Errors – Type I and Type II Errors – Concept of Size and Power of a test Hypothesis. Correlation analysis – Regressions analysis – Business forecasting and time series.

Gupta S.P., Statistical Methods, 33rd Edition, Sultan Chand and Sons, 2004.
Daniel W. W. and J.C. Terrell, Business Statistics for Management and Economics, Houghton Mistlin Co 1992.

MA712 Optimization Techniques and Random Processes (4-0-0) 4

Deterministic Models: Introduction and formulation of models, Linear Programming, Graphical Solution, Simplex method, Two-phase method, Big-M method, Duality in LP, Transportation problems and Assignment problems.

Probabilistic Models: Overview of Probability, Random Processes, Classification, Markov Chains, C-K equations, Ergodic chains, Poisson Processes, Birth and Death Processes, Queuing Theory, Basic concepts, M/M/1 and M/M/S queues, Reliability Theory, Concept of Hazard rate function, Bath-tub curve, MTTF and MTBF, System reliability for Series, Parallel and Mixed configurations.

H. A.Taha, Operations Research - An Introduction, 8thedition,2007,PHI.
F. S. Hillier and G.J. Lieberman, Introduction to Operations Research, Concepts and Cases, 8th edition, 2010, TMH.

MA713 Mathematical Methods For Engineers (3-1-0)4

Revision of Linear Algebra – Linear Transformations, Range and Kernel, Isomorphism, Matrix of transformations and Change of basis

Partial Differential Equations: Second order PDEs, Classifications, Formulation and method of solutions of Wave equation, Heat equation and Laplace equation.

Tensor Calculus: Line, area and volume integrals, Spaces of N-dimensions, coordinate transformations, covariant and mixed tensors , fundamental operation with tensors, the line element and metric tensor, conjugate tensor, Christoffel's symbols , covariant derivative.

G. Hadley, Linear Algebra, Narosa, 2002.
A. N. Kolmogorov & S. V. Fomin, Elements of the Theory of Functions and Functional Analysis, 2001.
Sokolnikoff and Redheffer – Mathematics of Physics and Engineering, 2nd edition, McGraw Hill, 2006.
S. Sokolnikoff, Tensor Analysis, Wiley, New York, 2006.
Marsden, Ratiu, Abraham, Manifolds, Tensor Analysis, and Applications, Springer, 2001.
J. L. Synge, Tensor Calculus, Dover Publications (July 1, 1978)
L.A.Pipes and L.R. Harwill: Applied Mathematics for Engineers and Physicists, McGraw Hill, 2004.

MA714 Mathematical Foundations of Computer Science (3-0-0) 3

Divisibility, GCD, Prime Numbers, Fundamental Theorem of Arithmetic, Congruences, Fermat's Theorem, Euler Function, Primality Testing, Solution of Congruences, Chinese Remainder Theorem, Wilson's Theorem

Groups and Subgroups, Homomorphism Theorems, Cosets and Normal Subgroups, Lagrange's Theorem, Rings, Finite Fields

Polynomial Arithmetic, Quadratic Residues, Reciprocity, Discrete Logarithms, Elliptic Curve Arithmetic

Fundamental Principles of Counting, Pigeonhole Principle, Countable and Uncountable Sets, Principle of Inclusion and Exclusion, Derangements, Equivalence Relations and Partitions, Partial Order, Lattices and Boolean Algebra, Generating Functions, Recurrence Relations, Solution of Recurrences

Graphs, Euler Tours, Planar Graphs, Hamiltonian Graphs, Euler's Formula, Applications of Kuratowski's Theorem, Graph Coloring, Chromatic Polynomials, Trees, Weighted Trees, Shortest Path Algorithms, Spanning Trees, The Max-Flow Min-Cut Theorem.

Niven, H.S., Zuckerman and Montgomery, An Introduction to the Theory of Numbers, John Wiley New York, 1992
Grimaldi, R.P., Discrete and Combinatorial Mathematics: An Applied Introduction, Addison Wesley, 1994
Kolman, B. and Busby, R.C., Discrete Mathematical Structures for Computer Science, PHI, New Delhi, 1994

MA715 Statistics for Business Management (3-0-0) 3

Role of Statistics in Decision Making, Collecting & Tabulating Data-Measure of Central Tendency and Dispersion in Frequency Distribution, Probability Theory: Classical, Objective & Subjective Approach-Addition, Multiplication & Bayes Theorem –Applications-Binomial, Poisson and Normal - Decision Making Under Certainty, Uncertainty and Risk -Sampling and Sampling Distribution: Types of Sampling - Random Sampling-Concept of Standard Error Central Limit Theorem. Testing of Hypotheses, Significance Level-Type I & Type II Error- One-Two Tail Tests - Hypothesis Testing of Means, Variance & Proportions -Chi-Square Tests- Goodness of Fit, Independence of attributes, Correlation and Regression Analysis

Levine, Stephan, Krehbiel, Berenson, Statistics for Managers, Using Microsoft Excel, PHI New Delhi, 2011.
Daniel, Terrell, Business Statistics, For Management and Economics, 6th Edition, Houghton Mifflin Company, 1992.

Richard I. Levin and David S. Rubin, Statistics for Management, Prentice Hall of India, 1999.
Srivatasava, Shenoy and Sharma, Quantitative Techniques for Managerial Decision Making, Wiley Eastern, 1998

MA801 Dynamical Systems (4-0-0) 4

Discrete and Continuous dynamical systems, Damped and Undamped Dynamical systems, Autonomous and non-autonomous systems, Phase- Space analysis, Local and global Stability, Limit cycles, Critical Point Analysis, Lorentz Model, Deterministic Chaos, Bifurcation Theory, Saddle Node Bifurcation, Period Doubling and Hopf Bifurcation, Hamiltonian Systems

Ferdinand Verhulst (1996), Non-Linear Differential Equations and Dynamical Systems, Springer
Wiggins, S. Introduction to Non-Linear Dynamical Systems, Springer , 1990
Lawrence Perko, Differential Equations and Dynamical Systems, 3rd Edition, Springer.
M.W.Hirsch,S. Smale,R.L.Devaney, Differential Equations , Dynamical Systems and An Introduction to Chaos, Elsevier, 2nd Ed.

MA802 Modern Algebra (4-0-0) 4

Groups, Permutation groups, Sylows theorems, Simple groups, solvable groups, Direct Products of groups and structure of finite Abelian groups. Rings: Prime and Maximal Ideals, Euclidean and Principal ideal rings, Unique factorization domains and Polynomial rings. Fields: Extension fields, Prime fields, Algebraic and Transcendental extensions. Roots of polynomials, splitting fields, finite fields, Separable and Inseparable extensions, Perfect and Imperfect fields. Simple extensions, Galois theory, Solvability of polynomials by radicals, Abel's theorem.

I.N. Herstein, Topics in Algebra
J.B. Fraleigh, A First course in Abstract Algebra
J.A. Gallian, Contemporary Abstract Algebra

MA803 Approximation Theory & Numerical Methods (4-0-0) 4

Fundamentals : The approximation problem, general approach to the approximation problem, L_p norms, Tchebycheff norm and the Polya algorithm. Least squares and Orthogonal functions, Tchebycheff approximation. Approximation in the L_1 norm. The Weierstrass theorem and degree of convergence, Computational Methods.

J.R.Rice, The Approximation of Functions, Vol. 1, Addison - Wesley.

MA804 Computational Combinatorics (4-0-0) 4

Generating functions, Recurrence relations, Generalised Permutations and Combinations, Inclusion-Exclusion, Inversion formulae, The Van-der Waerden Conjecture, Partitions, Projective and Combinatorial Geometries, The Burnside -Frobenius Theorem, Group theory in Combinatorics, Permutations Groups and their Cyclic Indices, Polya's Enumeration Theorem;(0-1) Matrices, Latin Squares, Hadamard Matrices, Reed-Muller Codes

B.Bollobas, Combinatorics, Cambridge University Press
I.Anderson, Combinatorics of Finite Sets, Dover

MA805 Fluid Mechanics (4-0-0) 4

Navier-Stokes equations, boundary layer flows, similarity transformations, wave propagation and shocks, methods of characteristics; basic equations of hydromagnetic flows, Hartman flow, Reynolds equations for turbulent flows, statistical theory, empirical velocity profiles.

MA806 Formal Languages & Theory of Computation (4-0-0) 4

Finite automata: Moore and Melay machines, Regular Expressions, Pumping lemma, Minimizing the automata, Formal Languages: Regular languages. Context free languages (CFL), Chomsky and Greibach Normal forms. Pushdown automata (PDA), Equivalence of PDA and CFL, Turing machines, Theory of recursive functions,Complexity theory,NP-completeness.

Aho, Hopcraft & Ullman, Automata, Languages and Computation, Narosa, 1986
Mishra and Chandrashekar, Theory of Computer Science, Prentice Hall of India, 1998.

MA807 Mathematical Logic & Applications (4-0-0) 4

Propositional calculus. The notions of truth and proof, adequacy, truth functions and decidability. Predicate calculus, interpretation, proof substitution, soundness, the deduction theorem. Adequacy and compactness. First order theories, consistency, completeness, categoricity, models. The Lowenheim-Skolem theorem. Turing machines. Godel numbers. The undedidability of the predicate calculus.

MA808 Numerical Solution of Ordinary Differential Equations (4-0-0) 4

Initial value problem for systems of ODEs. Single-step methods, explicit and implicit, R-K methods. Linear multistep methods; convergence, order consistency and zero-stability, weak stability theory. Predictor-corrector methods. First

order systems and the problem of stiffness. LMM for special second-order ODEs.
Two point boundary value problems for ODEs, Finite difference methods; deferred correction and extrapolation. Numerical methods for Sturm-Liouville problems. Computer implementation of different, algorithms.

MA809 Optimization Techniques (4-0-0) 4

Linear programming, simplex method, duality, transportation and assignment problems, Reliability, definitions, concept of hazard, bath-tub curve, system reliability for various configurations, data analysis: correlation and regression of data, simple linear regression, time series analysis: definitions, characteristic movements, measurement of trend, secular trend, seasonal movements, cyclical movements.
H.A. Taha, Operations Research, Prentice Hall India
J. Medhi, Statistical Methods, Wiley Eastern.

MA810 Algorithmic Graph Theory (4-0-0) 4

Introduction to graphs Max-flow Min-cut theorem. Algorithms for computing maximum s-t flows in graphs. Algorithms for computing the minimum cut in a graph. Edge and vertex connectivity of graphs and menger's theorem. Maximum matching, Hall's theorem, algorithms for computing maximum matching in weighted and unweighted graphs. Arborescences and algorithm for computing minimum arborescence. Edmonds theorem for disjoint arborescences. Planar graphs and algorithms for checking for planarity. Edge and vertex coloring of graphs. Independent sets and perfect graphs. Extremal graph theory.
G Chartrand and O.Oellermann, Applied and Algorithmic Graph Theory, McGraw Hill, 1993
A Gibbons, Algorithmic Graph Theory, Cambridge University Press, 1985

MA811 Computational Fluid Dynamics (4-0-0) 4

Basic concepts and equations of fluid dynamics, non-dimensional forms, boundary layer equation, grid generation, grid refinement, adaptive grids, finite difference methods, explicit and implicit methods, fundamentals of fluid flow modeling, upwind scheme
Yuan S.W., Fluid Mechanics, PHI
Patankar S.V., Numerical Heat Transfer, McGraw Hill
White F.M., Viscous Fluid Flow, McGraw Hill

MA812 Design & Analysis of Experiments (4-0-0) 4

Introduction to probability, one-dimensional random variables, two and higher dimensional random variables, probability distributions, Sampling theory, moments, mgf and their properties, parameter estimation, point estimation, interval estimation of means and variances, Hypothesis testing, Goodness of fit tests, analysis of variance of one-way and two-way classified data, experimental design.
Douglas Montogomery, Design and Analysis of Experiments, 3rd Edition, John Wiley
Sheldon Ross M., Introduction to Probability and Statistics for Engineers and Scientists, JohnWiley
Hogg R.V.,Craig A.T.,Introduction to Mathematical Statistics, 4th Edition, McMillan

MA813 Special Topics in Mathematics (4-0-0) 4

The contents will depend on the topic chosen and will be announced before the course is offered.Sample Course titles are: i)Mathematical Theory of Chaos and Fractals; ii) Fuzzy Sets and Applications; iii) Nonlinear Dynamics

MA814 Number Theory & Cryptography (4-0-0) 4

Elementary Number Theory. Congruences, applications to Factoring. Finite fields, Quadratic residues and reciprocity. Simple cryptosystems, public key cryptography, RSA, Discrete logs. Primality and Factoring, the rho method, Fermat factorization, continued fraction and Quadratic Sieve methods.
N. Kobltiz, A course in Number Theory and Cryptography, Springer, 1994.

MA815 Finite Element Methods (4-0-0) 4

Introduction to calculus of variations, Approximate methods, Finite Elements, nodes classifications, approximate functions, Solution of Boundary value problems of second order differential equations, Finite element equations for the heat conduction equation, vibration equation elliptic problems using Galerkine and Ritz methods.
M.K. Jain, Numerical Solution of Differential Equations, PHI Ltd.
A.R. Mitchell and R. Wait, Finite Element methods in Partial Differential Equations, John Wiley, 1997.

MA816 Mathematical Modeling (4-0-0) 4

Introduction: Mathematical modeling through ordinary differential equations and systems of ordinary differential

equations of first order, Mathematical modeling through difference equations, Modeling using partial differential equations, Mathematical modeling through graphs

J.N. Kapoor, Mathematical Modeling, Wiley Eastern, 1988. R.
Aris, Mathematical Modeling Techniques,Pitman, 1978.

MA817 Reliability Theory & Applications (4-0-0) 4

Reliability, concepts and definitions, causes of failure, concept of hazard, failure models, bath tub curve, MTTF, MTBF, system reliability for various configurations, reliability improvement, redundancy, reliability-cost trade - off, maintainability and availability concepts, system safety analysis, FTA, FMEA.

E.E. Lewis, Introduction to Reliability Engineering, John Wiley.
K S. Trivedi, Probability and Statistics with Reliability, Queuing and Computer Science Applications, PHI

MA818 Statistical Quality Control (4-0-0) 4

Sampling theory: random samples, statistic sampling distributions, central limit theorem, concept of Quality, types of variations, process control and product control, control charts for variables and attributes, concept of acceptance sampling, by attributes, O.C., AQL, LTPD, AOQL, ATI etc, types of sampling plans, Reliability, definitions, concept of hazard, bath-tub curve, system reliability for various configurations.

E.L. Grant, Statistical Quality Control, Mc Graw Hill.
D C Montgomery, Introduction to Statistical Quality Control, John Wiley.

MA819 Combinatorial Optimization (4-0-0) 4

Polynomial Boundedness; network optimization problems; Greedy algorithms; Matroid theory; Matroid Intersections; Matroid Partitions; Primal weighted Intersection algorithm; Duality Theory; Matroid polyhedra; Primal-Dual weighted Intersection Algorithm; Matroid Parity; Generalizations.

MA820 Nonlinear Programming (4-0-0) 4

Linear Inequalities and Theorems of the Alternative; Convex sets; Convex and concave Functions; Saddle Point Optimality criteria of Nonlinear Programming without Differentially; Differential convex and concave Functions; Optimality criteria of Nonlinear Programming with differentiability; Duality in nonlinear Programming; generalizations of convex functions; Quasi convex, strictly quasi convex; Pseudoconvex; Optimality and Duality of generalized convex and concave Functions; Optimality and Duality in the presence of equality constraints.

MA821 Modeling & Simulation (4-0-0) 4

Components of a system. Models of system. Random number generation. Probabilistic distribution. Simulation languages. Applications.

Jerry Banks and John Carson S., Discrete Event System Simulation, PHInc., 1984
Gotifried B., Elements of Stochastic Process Simulation, PHInc, 1984

MA822 Statistical Techniques For Data Mining (4-0-0) 4

Overview of data mining techniques. Taxonomy of data mining tasks. Steps in data mining process. Predictive modeling. Association rules. Statistical perspective. Clustering. Regression analysis. Time series analysis. Bayesian learning. Data warehousing. Dimensional modeling. Performance issues and indexing. Development lifecycle. Case studies.

Jiawei Han, Macheline Kamber, Data Mining: Concepts and Techniques, Morgan Kaufmann Publishers, 2000
Usama M Fayyad, Gregory Piatesky-Shapiro, Padhari Smyth and Ramasamy Uthurusamy, Advances in Knowledge Discover and Data Mining, The MIT Press, 1996

MA823 Mathematical Finance (4-0-0) 4

Introduction to Stochastic Processes, Poisson process, Brownian Motion, Martingales. Present Value Analysis, Interest Rate Analysis, Market Model Specification Problems. Arbitage Theorem, Multi-Period Binomial Model, Block- Scholes formula Valuing Investments by Expected Utility, Portfolio Selection Problem, Capital Assets Pricing Model, Rates of Return, Single Period and Geometric Brownian Motion, Mean- Variance Analysis of Risk- Neutral-Priced Call Options, Autoregressive Models and Mean Regression, Other Pricing Options and Applications

S.M.Ross, An Introduction to Mathematical Finance, Cambridge University Press,1999.
A.J.Prakash, R.M. Bare, K. Dandapani, G.L.Ghai, T.E.Pactwa and A.M.Parchigari, The Return Generating Models in Global Finance, Pergamon Press, 1998.
S.M.Ross, Applied Probability Models with Optimization Applications, Holden- Day, 1980.