Master of Science in Computer Engineering

Syllabus

FACULTY OF SCIENCE AND TECHNOLOGY

POKHARA UNIVERSITY

2005

Contents

1. General descriptions

1.1 Course title
Master of Science in Computer Engineering (M.Sc. CE)

1.2 Objective
The objective of this M. Sc. CE program is to provide opportunity to the aspirants of the higher education in the field of computer engineering in the country and to produce high quality computer graduates who can assume teaching positions at various undergraduate and graduate levels, involve in research works and are capable of designing, developing and handling various systems and applications for related field.

1.3 Duration of the course
The program is divided into four semesters (two academic years). The semester begins in September and in February.

1.4 Medium of instruction
The English language shall be used for instructions and examination in the M. Sc. CE program.

1.5 Entry requirements
Candidates having Bachelor level in engineering (BE) with 2.0/4 CGPA (in second division) or above from the universities recognized by the Pokhara University are considered as eligible for admission in M. Sc. CE program.

1.6 Admission procedure
The entrance examination shall be conducted by the concerned college for admission and therefore, the date and procedure for entrance examination will be communicated to the applicants by the college.

1.7 Evaluation and grading of the students
All other requirements related with the students' regularity, behavior, evaluation, grading and etc the Pokhara University and the concerned college rules and regulations should govern.

2. Course structure

The course structure of the M. Sc. Computer Engineering (2 years) program is as given below:

Course Code	**Course Description**
1st Semester (15 Credits)	
MTH 611.3	Discrete Structure
COM 609.3	Advanced Problem Solving Technique
COM 615.3	Object Oriented Software Engineering
MTH 612.3	Algorithmic Mathematics
COM 602.3	Digital System Design
2nd Semester (15 Credits)	
COM 603.3	Theory of Computation
COM 608.3	Advanced Computer Architecture
COM 605.3	Distributed Operating System
COM 714.3	Computer Graphics
COM 613.3	Mobile and Wireless Communication
3rd Semester (15 Credits)	
COM 730.3	Distributed Database
COM 706.3	Image Processing and Pattern Recognition
COM 713.3	Artificial Intelligence
COM732.3	Network Security
….3	**Elective-I**
4th Semester (15 Credits)	
COM 733.3	Multimedia Computing
.3	**Elective-II**
COM 722.9	Thesis
Total credit	**60**

Note: Electives will be offered based on the demand of the time, choice of the students and availability of the resource persons. In general ten students are expected in each group to offer elective subjects.

3. Detail course structure

a) Discrete Structure
b) Advanced Problem Solving Technique
c) Object Oriented Software Engineering
d) Algorithmic Mathematics
e) Digital System Design
f) Theory of Computation
g) Advanced Computer Architecture
h) Distributed Operating System
i) Computer Graphics
j) Mobile and Wireless Communication
k) Distributed Database
l) Image Processing and Pattern Recognition
m) Artificial Intelligence
n) Network Security
o) Multimedia Computing

Course Title: **Discrete Structure**
Course Code: MTH-611.3
Administration: First Semester
Duration: One Semester
Class Load: 3 Hrs. per Week (Theory: 3 Hrs.)
Pre-requisite: Nil
Evaluation:

	Theory	Practical	Total
Sessional	50	-	50
Final	50	-	50
Total	100	-	100

Course Objective:

- Main objective of this course is to provide the necessary mathematical foundation for the study of various computer science and technology related subjects of M.Sc.(CS) program.
- After completing this course, the target student will gain knowledge in discrete mathematics and finite state automata in an algorithmic approach. It helps the target student in gaining fundamental and conceptual clarity in the area of Logic, Reasoning, Algorithms, Recurrence Relation, Graph Theory, and Theory of Automata.

Course Contents:

1. **Logic, Induction and Reasoning** **(12 hrs)**
Proposition and Truth function, Propositional Logic, Expressing statements in Logic Propositional Logic, The predicate Logic, Validity, Informal Deduction in Predicate Logic, Rules of Inference and Proofs, Informal Proofs and Formal Proofs, Elementary Induction, Complete Induction, Methods of Tableaux, Consistency and Completeness of the System.

2. **Finite State Automata** **(10 hrs)**
Sequential Circuits and Finite state Machine, Finite State Automata, Language and Grammars, Non-deterministic Finite State Automata, Language and Automata, Regular Expression.

3. **Recurrence Relations** **(8 hrs)**
Recursive Definition of Sequences, Solution of Linear recurrence relations, Solution to Nonlinear Recurrence Relations, Application to Algorithm Analysis.

4. **Graph Theory** **(15 hrs)**
Undirected and Directed Graphs, Walk Paths, Circuits, Components, Connectedness Algorithm, Shortest Path Algorithm, Bipartite Graphs, Planar Graphs, Regular Graphs, Planarity Testing Algorithms, Eulerian Graph, Hamiltonian Graph, Tree as a Directed Graph, Binary Tree, Spanning Tree, Cutsets and Cutvertices, Network Flows, Maxflow and Mincut Theorem, Data Structures Representing Trees and

Graphs in Computer, Network Application of Trees and Graphs, Concept of Graph Coloring.

Reference Books:

1. Kenth Rosen, *Discrete Mathematical Structures with Applications to Computer Science*, WCB/ McGraw Hill
2. G. Birkhoff, T.C. Bartee, *Modern Applied Algebra*, CBS Publishers.
3. R. Johnsonbaugh, *Discrete Mathematics*, Prentice Hall Inc.
4. G.Chartand, B.R.Oller Mann, *Applied and Algorithmic Graph Theory*, McGraw Hill
5. Joe L. Mott, Abrahan Kandel, and Theodore P. Baker, *Discrete Mathematics for Computer Scientists and Mathematicians*, Prentice-Hall of India

Course Title : **Advanced Problem Solving Techniques**
Course Code : COM 609.3
Semester : First
Credit : 3
Class Load : 3 hours
Evaluation :

	Theory	Practical	Total
Sessional	50	-	50
Final	50	-	50
Total	100	-	100

Course Objective:
The problem-solving task requires analytical and logical thinking. As the complexity rises, the analysis should be thorough and specialized one as contrary to general for general problem. The course objective is to improve and impart conceptual clarity in thinking analytically and logically so that verbal discussion of any problem and possible solutions could be translated into analytical data with formal representation for the purpose of computer solving.

Course Contents:

1. Basic Concept of Problem Solving (6 hrs)
Problem & Problem solving approaches, Counting, Induction Principle, Logic Problem, Contradiction Principle, Parity Problem

2. Miscellaneous Problem Solving Techniques (15 hrs)
Probabilistic approach to solving Counting Problems, Logic Problems (Simple Logic, Theory of Games, Tracing Routes, Learning from Parity, Mysterious Arithmetic Problems and Surprise), Problems from Recreational Math. (Magic square and Weighing Problems), Problems of Algebra and Analysis (Inequality, Trigonometry and related ideas).

3. Solving Miscellaneous Real Life Problem (6 hrs)
Miscellaneous Problems, Impossible Problems, Problems from everyday life, and Statistics.

4. Problem Solving Using Computer (3 hrs)
Problem Analysis, Algorithmic approach to Problem Solving, Algorithm Development, Characteristics of Algorithms.

5. Mathematical Foundation of Programs (9 hrs)
Programs and Refinement; Predicate calculus; Functions, Expressions, Operations Types; Iteration and Recursions; Inductive proofs; Programs in Logic.

6. Algorithmic Analysis (6 hrs)

Efficiency of Algorithms, Computational Complexity, The order notation, Worst-case, average case analysis

References :

1. Krantz, Steven G., *Techniques of Problem Solving*, University Press, 1998, ISBN: 81-737-116-X
2. Dromey, R. G., *How to Solve it by Computer*, Prentice Hall of India, New Delhi-110 001, 1998, ISBN: 81-203-0388-1
3. Morgan Carrol, *Programming from Specifications*, Second Edition, Prentice Hall, 1994.
4. Polya, G., *How to Solve It,* Princeton University Press, Princeton, 1988.
5. Etter, D. M., *Engineering Problem Solving with ANSI C*, Prentice Hall, NJ, 1995

Course Title : **Object Oriented Software Engineering**
Course Code : COM615.3
Credit : 3
Class Load : 3 hours
Evaluation :

	Theory	Practical	Total
Sessional	50	-	50
Final	50	-	50
Total	100	-	100

Objectives:
The course objective is to provide required knowledge on the various issues of software project management and related tasks including planning, design, development, implementation, maintenance and cross life cycle activities using object oriented concepts and models.

Course Contents:

1. **Introduction** **(3 hrs)**
History of software engineering, SDLC, Various Software Process Models (Linear, prototyping, RAD, Evolutionary, Waterfall, Incremental, Spiral, etc), Complex System Structure and Design

2. **Project Management Planning & Risk Analysis** **(5 hrs)**
Four P's (People, Product, Process, & Project), Software scope, Feasibility: Importance, Feasibility assessment, Economic, Technical, Operational, and Schedule Feasibility, Resources: human, reusable software, environment, Project Estimation, The make/buy decision, outsourcing, Project scheduling tracking, Risk Management Strategies, Software Risks, Risk Identification, Projection and Assessment

3. **Requirement Analysis and Modeling** **(3 hrs)**
Requirements Analysis, Analysis Principles, Software Prototyping, Specification and Specification Review, Analysis Modeling: Elements of Analysis Model, Data Modeling, Functional Modeling and Information Flow, Behavioral Modeling, Structured Analysis, Data Dictionary

4. **Object Orientiation Fundamentals** **(3 hrs)**
OO Paradigm: Classes, objects, attributes, operations, methods, services, messages, encapsulation, inheritance, polymorphism, etc.

5. **Object Oriented Analysis** **(6 hrs)**
OO based Analysis, Unified approach, Domain and reuse analysis, Identification of class and objects, Identification of class, object, relationship, Object-relationship modeling, Events and States identification, State representation, Systems behavior representation.

6. **Object Oriented Design** **(6 hrs)**
Micro and Macro development processes, Partitioning of analysis model, Concurrency and subsystem allocation, task management component, User interface component, Data management component, Resource management component, Inter-subsystem Communication, Component and interfaces, Design Patterns and reuse, Elaboration and implementation of Use cases, Class, Object, Collaboration, Interaction, State Transition, Module, Process diagrams, etc.

7. **UML** **(8 hrs)**
Unified Modeling Language Fundamentals, UML notations, Structural Models: (concepts: class, object, relationship, interfaces, packages, instances) Class Diagram, and Object Diagram, Behavioral Models (concepts: interactions, scenarios, use cases, event, signal, process), Use Case Diagram, Interaction Diagram, Collaboration Diagram, State Transition Diagram, Activity Diagram, Architectural Models (concepts: components, deployment, collaboration, patterns, etc), Component Diagram, Deployment Diagram, UML based any CASE tool and its use, UML for Real-Time Systems (UML-RT), Real-Time Systems Artifacts.

8. **Software Quality Issues** **(3 hrs)**
Classification of software qualities, representative qualities, quality requirements based on application areas, Quality Concepts, Software Quality Assurance, Software Reviews, Formal Technical Reviews, Software Reliability, Software Configuration Management, SCM Standards.

9. **Software Testing Techniques** **(3 hrs)**
Testing Fundamentals, Test Case Design, White Box Testing, Basis Path Testing, Control Structure Testing, Black-Box Testing, Unit Testing, Integration Testing, Validation Testing, System Testing

10. **Software Quality Assurance and Configuration Management** **(5 hrs)**
Concepts, Software Quality Assurance, Software Reviews, Formal Technical Reviews, Formal Approaches to SQA, Statistical Quality Assurance, Software Reliability, ISO 9000 Quality Standards, SQA Plan, Software Configuration Management, SCM Process, Identification of Objects in the Software Configuration, Version Control, Change Control, Configuration Audit, Status Reporting, SCM Standards

Case Study:
An individual case study should be given to each student on software project and should be analyzed with any UML CASE tool (like *Rational Rose Enterprise Suit 2000*) and implemented in OO. 25 % to 50% of sessional marks should be allocated for evaluation.

References:
1 R. S. Pressman, Software Engineering: A Practitioner's Approach, 5/e.
McGraw Hill International Edition

2 G. Booch, J. Rumbaugh, I. Jacobson, The Unified Modeling Language- User Guide, Addison-Wesley
3 C. Ghazi, M. Jazayeri, and D. Mandrioli, Fundaments of software Engineering, Prentice Hall of India, Ltd.
4 Grady Booch, Object Oriented Analysis and Design with Applications, Second Edition, Pearson
5 C. Larman, Applying UML and Patterns, Pearson
6 R. Fairly, Software Engineering, McGraw Hill Publishing Co.

Course Title : **Algorithmic Mathematics**
Course Code : MTH 612.3
Credit : 3
Class Load : 3 Hrs
Evaluation :

	Theory	Practical	Total
Sessional	25	25	50
Final	50	-	50
Total	75	25	100

Course Objectives:
To solve the technical and scientific problems by using the theory of numerical, statistical, and optimal computational procedures along with practical applications.

1. **Solution of Algebraic and Transcendental Equations (3 Hrs)**
   Newton Raphson Method, Secant Method, Solution of systems of Nonlinear Equations (Newton Raphson Method)

2. **Interpolation (5 Hrs)**
   Errors in polynomial interpolation, Finite Differences, Differences of a polynomial, Newton's formulae for Interpolation, Bessel's Formula, Everett's Formula, Relation between Bessel's and Everett's Formulae, Lagrange 's Interpolation Formula

3. **Curve Fitting, B-Splines and Approximation (4 Hrs)**
   Least- squares Curve Fitting Procedures (Linear, Quadratic and Exponential), B-splines, Approximation of Functions

4. **Numerical Differentiation and integration (4 Hrs)**
   Numerical Differentiation, Trapezoidal Rule, Simpson's 1/3 –Rule, Simpson's 3/8 –Rule, Volume calculation, Newton-Cotes Integration Formulae, General Quadrature Formula, Gaussian Integration

5. **Matrices and Linear Systems of Equations (3 Hrs)**
   Solution of Linear Systems- Direct Methods (Gauss Jordan), Solution of Linear Systems- Iterative Method (Gauss-Seidel), Eigen value Problem (Eigen Value, Eigen Vector)

6. **Numerical Solution of Ordinary Differential Equations (4 Hrs)**
   Solution of Taylor's Series, Euler's Method (Modified Method), Predictor-Corrector Methods, Simultaneous and Higher Order Equations (4^{th} order Runge Kutta Method), Boundary Value Problems (Finite Difference Method)

7. **Numerical Solution of the Partial Differential Equations (3 Hrs)**
   Finite- Difference Approximations to derivatives, Laplace's Equation, Parabolic Equations, Hyperbolic Equations, Iterative Methods for solution of Equations

8. **Introduction and Descriptive Statistics** **(4 Hrs)**
   An overview of probability and statistics, Pictorial and tabular methods in descriptive statistics, Measures of central tendency, dispersion, and direction, Joint and conditional probabilities, Central limit theorem
9. **Discrete Random Variables and Probability Distributions** **(4 Hrs)**
   Random variables, Probability distributions for random variables, Expected values of discrete random variables, The binomial probability distribution, Hypothesis testing using the binomial distribution, The Poisson probability distribution

10. **Hypothesis Testing Procedures** **(5 Hrs)**
    Tests about the mean of a normal population, The t-test, Test procedures for a population variance, Z-tests for differences between two populations means, The two-sample t-test, A confidence interval for the mean of a normal population

11. **Optimization Techniques** **(4 Hrs)**
    The simplex method, objective function and constraint conditions, changing inequalities to equalities, the conical form, of solution, optimal values of variables, Integer programming, Dynamic programming

12. **Transformation** **(5 Hrs)**
    Laplace transform, Fourier transform, Discrete Fourier transform, Fast Fourier transform, Z transform and their inverse transform

Reference:

1. E. Kreyszig, "*Advanced Engineering Mathematics*", Wiley-Eastern Publication
2. Jay L. Devore, "Probability and Statistics for Engineering and the Sciences", Brooks/Cole Publishing Company, Monterey, California, 1982.
3. Introductory methods of Numerical analysis, S.S. Sastry
4. An Introduction to numerical computations, S. Yakowitz and F. Szidarovszky
5. Numerical Methods, Dr. V.N. Vedamurthy, Dr. N. Ch. S.N . Iyengar
6. Numerical Methods , E. Balagurusamy

Course Title : **Digital System Design**
Course Code : COM602.3
Credit : 3
Class Load : 3 hours
Evaluation :

	Theory	Practical	Total
Sessional	50	-	50
Final	50	-	50
Total	100	-	100

Objectives:
The course objective is to provide ample knowledge on VLSI design procedure, and to enhance the knowledge of hardware design applying subsystem design with VHDL and FPGA.

Course Contents:

1. **Introduction** **(5 hrs)**
Digital Systems and Integration, Electronic Design Automation, IC Manufacturing, Logic Families, IC Design Techniques, IC characteristics: fan-out, power dissipation, propagation delay, and noise margin of TTL and CMOS integrated circuit logic devices

2. **Logic Manipulation** **(5 hrs)**
DeMorgan's Theorem, Canonical Forms, Minterm and Maxterm, implicant, prime implicant, K-Maps, Quine-McCluskey Method, VEM.

3. **State Machine and Design** **(7 hrs)**
Mealy and Moore machines, state transition tables and diagrams, algorithmic state machine charts, Synchronous State Machine Design, Design of Input Forming Logic and Output Forming Logic of state machine.

4. **VLSI Design** **(16 hrs)**
Transistor and Layouts, Fabrication Process, Design Rules, Layout design and tools, Logic Gates, Combinational logic Networks and Design, Sequential Systems and Design, Subsystem Design, Various Floorplanning Methods, Off-Chip Connections.

5. **Testing** **(6 hrs)**
Testing logic circuits, Combinational gate testing, Combinational network testing, Sequential Testing, Test vector generation, fault, fault model and fault detection, SA0, SA1, Design for Testability, Scan Techniques.

6. **Hardware Description Languages** **(6 hrs)**
VHDL and its use in programmable logic devices (PLDs) like FPGA

References:

1. Wolf, Wayne, *Modern VLSI Design-Systems on Silicon* , Third Edition, Pearson
2. Comer, David J. *Digital Logic State Machine Design*, Third Edition, Oxford University Press
3. Ashenden, Peter J., *The Student's Guide to VHDL*, Morgan Kaufman

Course Title: **Theory of Computation**
Course Code: COM-603.3
Administration: Second Semester
Duration: One Semester
Class Load: 5 Hrs. per Week (Theory: 3 Hrs., Tutorial: 2 Hrs.)
Pre-requisite: MFCS

Evaluation:

	Theory	Practical	Total
Sessional	50	-	50
Final	50	-	50
Total	100	-	100

Course Objective:
To understand the concepts that is used to model and predict the behavior of all those computing activities that involve the manipulation of symbols. Areas like Compiler, Communication Protocols, Operating Systems, Optimization, Databases etc.

Course Contents:

1. **Introduction** **(3 hrs)**
   Some computing puzzles, understanding computability.

2. **Languages** **(10 hrs)**
   Symbols, Alphabets and Strings, Languages, Operation on Languages, Alphabet encoding, Problem representation, Types of problem (Representing Graphs, Spanning Tree, Decision Problem, Function Problem and Search Problem), Casting Problems into Languages, Regular Language, Regular Expression, Application of Regular Expression.

3. **Finite State Machines and Languages** **(8 hrs)**
   Church –Turing Thesis, Basic Machine Notions, DFA, NFA, Equivalence, Properties of Finite State Languages, Pumping Lemma for Regular Language, Application of Pumping Lemma.

4. **Stack and Tape machines** **(8 hrs)**
   Push Down Automata, Turing Machines, Undecidable Languages, and Grammars: Regular and Context Free, Parsing, Parse Tree and Attribution.

5. **Computational Complexity Theory** **(8 hrs)**
   Introduction, Asymptotic Notation, Time and Space Complexity, Reducibility, Introduction to Circuit Complexity. Complexity Class NC.

6. **Feasible and Intractable Problems** **(8 hrs)**
   Polynomial Time, p-Completeness Theory and Problems, Reduction, *np*-Completeness Theory and Problems, Reduction.

Reference Books :

1. Lewis H.R. and C.H. Papadimitrious, Elements of the theory of computation, 1998, Pearson Education.
2. Cohesn Daniel, I.A., Introduction to computer theory, 2E, 2000, John Woley and sons (Asia) Pvt. Ltd. Singapore.
3. Mishra, K.L.P. and Chandrasekhar, N., *Theory of Computer Science,* PHI, New Delhi, 1998.
4. Hopcroft, J.E. and Ulman, J.D., *Introduiction to Automata Theory, Languages and Computation*, Narosa Publishing House, New Delhi.

Course Title : **Advanced Computer Architecture**
Course Code : COM 608.3
Semester : Second Semester
Credit : 3
Class Load : 3 hours
Evaluation :

	Theory	Practical	Total
Sessional	50	-	50
Final	50	-	50
Total	100	-	100

Course Objective:
To make the student familiar with the fundamentals of the technology behind the design and architectural aspects of computer system, processor organization, storage system organization, parallel processing and multiprocessing concepts, and performance measures.

Course Contents:

1. **Fundamentals of Computer Design** **(5 hrs)**
Introduction, Technology trends; Cost, Price and their trends; Measuring Performances; Quantitative issues.

2. **Instruction Set Architecture** **(6 hrs)**
Classification, Memory Addressing and modes, Type and size of operands, Operations in the instruction set, Control flow instruction, Instruction set encoding.

3. **Memory and Storage System** **(12 hrs)**
Basic Concepts of Memory, Internal Organization of Memory Devices, Cache Memory, Cache Miss Penalty and Reducing Cache Misses, Reducing Cache Hit Time, Main Memory, Virtual Memory, Issues in the Design of Memory Hierarchies, Fallacies and Pitfalls in the Design of Memory Hierarchies. Storage Systems, Types of Storage Devices, Busses, I/O Performance Measures, Reliability, Availability and RAID, Interfacing to Processor, Memory and OS, Designing an I/O System, Unix File System Performance.

4. **Pipelining and Parallelism** **(12 hrs)**
Basic concepts of Pipelining, DLX Pipeline, Pipeline Hazards, Data and Control Hazards, Difficulties in Implementation, Instruction Set Design and Pipelining, Concepts and Challenges of Instruction Level Parallelism, Overview of Data Hazards with Dynamic Scheduling, Reducing Branch Penalties with Dynamic Hardware Prediction, ILP with Multiple Issue, Hardware Support for Extracting More Parallelism, Exploiting ILP with software approaches

5. **Multiprocessors and Thread level Parallelism** **(6 hrs)**
   Multiprocessing and characteristics of application domain, Symmetric Shared-Memory Architectures, Distributed Shared-Memory Architectures, Performance Metrics, Synchronization, Multithreading and related issues

6. **Interconnection and Cluster Computing** **(4 hrs)**
   Interconnection requirements, Issues for interconnection networks, Clusters; Cluster design and other trends.

References

1. J. L. Henessy and D.A. Patterson, *Computer Architecture – A Quantitative Approach*, Third Edition, Morgan Kaufmann Publishers.
2. V. C. Hammacher, Z. G. Vranesic, and S. G. Zaky, *Computer Organization*, McGraw Hills
3. K. Hawang, Advanced Computer Architecture, McGraw Hills
4. J. L. Hennessy and D.A. Patterson, *Computer Organization and Design*, Second Edition, Morgan Kaufmann Publishers.
5. D. Sima, T. Fountain, and P. Kacsak, Advanced Computer Architecture – A Design Space Approach, Addison Wesley

Course Title : **Distributed Operating Systems**
Course Code : COM 605.3
Credit : 3
Class Load : 3 hours
Evaluation :

	Theory	Practical	Total
Sessional	50	-	50
Final	50	-	50
Total	100	-	100

Course Objective:
To provide the students a comprehensive exposure to the concepts and techniques necessary for understanding how the operating systems are designed and implemented for efficient operation of pervasive distributed computer system.

Course Contents:

1. **Introduction** **(3 hrs)**
Distributed System, System Models (Architecture and Fundamental Models), Multiprocessors and Multicomputers, Network OS, True Distributed system, Design Issues, Transparency, Flexibility, Reliability, Performance, Scalability.

2. **Communication in Distributed Systems** **(7 hrs)**
Layered Protocols and Seven Layer, ATM Networks, Client Server Model; Addressing, Blocking vs nonblocking primitives, Buffered vs Unbuffered primitives, Reliable vs unreliable primitives, Implementation, RPC; Operation, parameter passing, dynamic binding, implementation issues; Events & Notification, Group Communication,

3. **Synchronization in Distributed Systems** **(6 hrs)**
Clock Synchronization Logical and Physical Clocks, Clock Sychronization Algorithms, Mutual exclusion, Centralized, Distributed, and Token Ring Algorithms and their comparision, Election Algorithm, Transaction Model, Concurrency Control and Implementation, Deadlock in Distributed Systems.

4. **Processes and Processors in Distributed Systems** **(8 hrs)**
Thread concept, Thread usage, Design for Thread Packages, Threads and RPC, System model, Workstation model, Processor Pool model, Hybrid Model, Processor Allocation Algorithms and Issues, Scheduling, Faults and Various Fault Tolerance methods, Real-time systems and issues

5. **Distributed File Systems & Name Services** **(6 hrs)**
Distributed File System Design, File Service Architecture, File sharing, File System Implementation, File usage, System Structure, Caching, Replication, Trends in Distributed File System, New Hardware, Scalability, Networking, Mobile Users,

Fault Tolerance, Multimedia, Name Services and DNS, Directory and Discovery Services.

6. Distributed Shared Memory (9 hrs)

Shared Memory, On-chip memory, Bus-based, Ring based and Switched Multiprocessors, NUMA Multiprocessors, Consistency Models, Strict, Sequential, Causal, PRAM, Weak, Release, Entry Consistency, Page Based Distributed Shared Memory, Basic design, Replication, Granularity, Achieving Sequential Consistency, Finding the Owner, Finding the Copies, Page Replacement and Synchronization, Shared Variable Distributed Shared Memory, Object Based Distributed Shared Memory

Case Studies (6 hrs)

AMOEBA, MACH, CHORUS, DCE

References:

1. Andrew S. Tanenbaum, *Distributed Operating Systems*, 2001, Pearson
2. Abraham Silberschatz and Peter Baer Galvin, *Operating System Concepts*, Fifth Edition, 2001, John Wiley & Sons
3. George Coulouris, Jean Dollimore, Tim Kindberg,*Distributed Systems – Concepts and Design*, Third Edition, 2002, Pearson
4. Garry Nutt, *Operating Systems – A Modern Perspective*, Second Edition, 2001, Pearson

Course Title: **Computer Graphics**
Course Code: COM-714.3
Administration: Second Semester
Duration: One Semester
Class Load: 6 Hrs. per Week (Theory: 3 Hrs., Practical: 3 Hrs.)
Pre-requisite: Nil

Evaluation:

	Theory	Practical	Total
Sessional	30	20	50
Final	50	-	50
Total	80	20	100

Course Objective:
The objective of this course is to understand the theoretical foundation of 2D and 3D graphics.

Course Contents:

Unit-I **(6 hrs)**
Introduction, Advantage of Computer Graphics, Areas of Applications, Hardware and Software for Computer Graphics. (Hard Copy, Display Technologies), Random Scan Display System, Video Controller, Random Scan Display Processor. Raster Graphics, Scan Conversion Algorithms (Line, Circle, Ellipse), Area Filling (Rectangle, Ellipse), Clipping (Lines, Circle, Ellipse), Clipping Polygons.

Unit-II **(12 hrs)**
Geometrical Transformations, Homogenous Coordinates, 2D and 3D Transformations, Matrix Representations, Window to View Port Transformation. 3D Viewing, Projections, Mathematics of Projections.

Unit-III **(12 hrs)**
3D Object Representation, Representing Curves and Surfaces, (Polygon Meshes, Parametric Cubic Curves, Quadratic Surface), Solid Modeling (Sweep Representation, Boundary Representation, Spatial Partitioning Representation)

Unit-IV **(9 hrs)**
Visible Surface Determination, Various Techniques, Algorithms for Visible Surface Detection, (Z- Buffer, List priority, Scan Line Algorithms), Shading and Illumination models.

Unit-V **(6 hrs)**
Introduction to virtual Reality and Animation.

Laboratory:
All algorithms covered in the text to be implemented in PHIGS/OpenGL in C/C++.

References Books:

1. Foley, J. D., A. V. Dam, S. K. Feiner, J. F. Hughes, *Computer Graphics Principle and Practices*, Addison Wesley Longman, Singapore Pte. Ltd., 1999.
2. Hearn Donald, M. P. Baker, *Computer Graphics*, 2E, Prentice Hall of India Private Limited, New Delhi, 2000.

Course Title : **Mobile and Wireless Communication**
Course Code : COM 613.3
Credit : 3
Class Load : 3 hours
Evaluation :

	Theory	Practical	Total
Sessional	25	25	50
Final	50	-	50
Total	75	25	100

Course Objective:
The main objective of this course covering basic principle, coding, equalization in mobile and wireless communication

1. **Introduction** **(2 Hrs)**
History and evolution of wireless communication, The cellular concept, evolution of mobile communication, global mobile communication systems

2. **Speech Coding for Wireless System Applications** **(4 Hrs)**
Speech coding techniques for audio and voice, Speech codes

3. **Radio Propagation and Cellular Engineering Concepts** **(6 Hrs)**
Introduction to radio wave propagation and antenna, Free space propagation model, Models of multi-path faded radio signals, fading in the mobile environment, Practical link budget design using path loss models

4. **Modulation Techniques for Wireless Communication:** **(6 Hrs)**
Overview of analog and digital modulation, Pulse shaping techniques, Digital carrier modulation techniques: BPSK, MSK, GMSK, MPSK, MFSK

5. **Coding and Error Control:** **(6 Hrs)**
Error control requirements, Block codes, Convolutional codes, Automatic Repeat Request, Word-error rate, False-alarm rate, probability of bit error

6. **Equalization and Diversity:** **(4 Hrs)**
Introduction and fundamentals of equalization, Diversity techniques, RAKE receivers

7. **Multiple Access Techniques:** **(6 Hrs)**
Overview of FDM and TDM, FDMA, TDMA, The concept of spread spectrum, Frequency hopping spread spectrum, Direct sequence spread spectrum, Code-division multiple access (CDMA), Spread-spectrum application in cellular, mobile and wireless communication

8. **Wireless communication systems and standards: (6 Hrs)**
   Global system for mobile (GSM): services and features, system architecture, radio subsystem, channel types, frame structure, signal processing, IS-95: frequency and channel specifications, forward CDMA channel, reverse CDMA channel, DECT: features and characteristics, architecture, functional concept, radio link, Recent developments in GSM and CDMA technology
9. **Wireless Networking: (5 Hrs)**
   Introduction to wireless networks, wireless and fixed telephone networks, Development of wireless networks: first, second and third generation, Cordless systems and wireless local loop, Fixed broadband wireless access standards, Mobile IP and wireless application protocol, Wireless LAN technology: infrared LAN, spread spectrum LAN, narrow band microwave LAN, standards

Laboratory:

Five experiments (including computer simulation and modeling) related to basic principles of wireless communication systems as decided by the course instructor

Reference:

1. K. Feher, " Wireless Digital Communications " PHI, 2001
2. W. Stallings, "Wireless Communications and Networks", PEA, 2002
3. J. Schiller, " Mobile Communications", PEA, 2000
4. B.P. Lathi, "Modern Digital and Analog Communication Systems", Third Edition, Oxford University Press, 1999.
5. J. Proakis, M. Salehi, " Communication Systems Engineering", Prentice Hall, New Jersey, 1994.

Course Title : **Distributed Database Management Systems**
Course Code : COM 730.3
Credit : 3
Class Load : 3 hours
Evaluation :

	Theory	Practical	Total
Sessional	50	-	50
Final	50	-	50
Total	100	-	100

Course Objective:
To make the student familiar with the fundamentals of the technical issues behind the design and architectural aspects of distributed database management systems

Course Contents:

1. **Introduction** **(3 hrs)**
Distributed database (DDB) management system, Review of Relational DB concepts and Network concepts.

2. **DDB Architecture and Design** **(6 hrs)**
Architectural models: autonomy, distribution, heterogeneity, Client server, Peer-to-peer Multi-DB , Global directory issues; Distribution design issues, Horizontal and Vertical fragmentation, Allocation.

3. **Semantic Data Control** **(3 hrs)**
View Management, Views in Centralized DBMS, Update through Views, Views in Distributed Database, Data Security, Centralized and Distributed Authorization Control, Centralized and Distributed Integrity Control.

4. **Query Processing and Optimization** **(14 hrs)**
Query Processing Problem, Complexity of Relational Algebra Operation, Characterization of Query Processors, Query Processing Layers, Query Decomposition, Localization of Distributed data, Query Optimization, Distributed cost model, Join ordering in Fragment queries, Distributed query optimization algorithms.

5. **Transaction Management and Distributed Concurrency Control** **(12 hrs)**
Transaction and Transaction Properties –ACID, Types of Transaction, Serializability Theory, Lock-based concurrency control, Timestamp–based concurrency control, Optimistic concurrency control, Deadlock Management, Relaxed concurrency control.

6. **Distributed Database Management System Reliability** **(4 hrs)**
Reliability Concepts and Measures, Failures and Fault Tolerance, Failures in DDBM, Local Reliability Protocols, Distributed Reliability Protocols, Site Failures, Network Partitioning.

7. **Parallel Database Systems** **(3 hrs)**
DB Servers, Parallel Architecture, Parallel DBMS Techniques, Parallel Execution Problem, Parallel Execution for Hierarchical Architecture.

References:

1. M. Tamer Ozsu and Patrick Valduriez, *Principles of Distributed Database Systems*, Second Edition, Pearson.
2. Abraham Silberschatz, Henry F. Korth, S. Sudarshan, *Database System Concepts*, Fourth Edition, McGraw Hills
3. C. J. Date, An Introduction to Database Systems, Addison Wesley Publishing

Course Title : **Image Processing and Pattern Recognition**
Course Code : COM 706.3
Credit : 3
Class Load : 3 hours
Evaluation :

	Theory	Practical	Total
Sessional	25	25	50
Final	50	-	50
Total	75	25	100

Course Objectives:
To be familiar with processing of the images, recognition of the pattern and their applications.

1. **Introduction to digital image processing: (4 hours)**
Digital image representation, Digital image processing: Problems and applications, Elements of visual perception, Sampling and quantization, relationships between pixels

2. **Two-dimensional systems: (5 hours)**
Fourier transform and Fast Fourier Transform, Other image transforms and their properties: Cosine transform, Sine transform, Hadamard transform, Haar transform

3. **Image enhancement and restoration: (8 hours)**
Point operations, contrast stretching, clipping and thresholding, digital negative, intensity level slicing, bit extraction, Histogram modeling: Equalization modification, specification, Spatial operations: Averaging, directional smoothing, median, filtering spatial low pass, high pass and band pass filtering, magnification by replication and interpolation

4. **Image coding and compression: (4 hours)**
Pixel coding: run length, bit plan, Predictive and inter-frame coding

5. **Introduction to pattern recognition and images: (3 hours)**

6. **Recognition and classification: (5 hours)**
Recognition classification, Feature extraction, Models, Division of sample space

7. **Grey level features edges and lines: (6 hours)**
Similarity and correlation, Template matching, Edge detection using templates, Edge detection using gradient models, model fitting, Line detection, problems with feature detectors

8. **Segmentation: (3 hours)**
Segmentation by thresholding, Regions for edges, line and curve detection

9. Frequency approach and transform domain: (3 hours)

10. Advanced Topics: (4 hours)

Neural networks and their application to pattern recognition, Hopfield nets, Hamming nets, perceptron

Laboratory:

Developing programs of above features.

Reference:

1. K. Castlemann, "*Digital Image Processing*", Printice Hall of India Ltd., 1996.
2. A. K. Jain, "*Fundamental of Digital Image Processing*", Printice Hall of India Pvt. Ltd., 1995.
3. R. C. Gonzalez and P. Wintz, "*Digital Image Processing*", Addison-Wesley Publishing, 1987.
4. Sing_Tze Bow, M. Dekker, "*Pattern Recognition and Image Processing*", 1992
5. M. James, "*Pattern Recognition*", BSP professional books, 1987.
6. P. Monique and M. Dekker, "*Fundamentals of Pattern Recognition*", 1989.

Course Title : **Artificial Intelligence**
Course Code : COM 713.3
Credit : 3
Class Load : 3 hours
Evaluation :

	Theory	Practical	Total
Sessional	50	-	50
Final	50	-	50
Total	100	-	100

Course Objective:
The objective of the course is to understand modeling of real world problem solving techniques to fit into AI domain. Also techniques of knowledge representation are also covered.

Course Contents:

1. **Introduction** **(3 hrs)**
Introduction, Foundation of AI, History of AI, Intelligent Agents, Structure of Intelligent Agents, Environments.

2. **Problem Solving & Searching** **(9 hrs)**
Problem Solving, State Space Approach, Search Techniques (Breadth first, Uniform Cost, Depth First, Depth Limited, Iterative Deepening, Bi-Directional Search, Constraint Satisfaction Search), Informed Search Methods (Best First, Greedy Search, A* Search, Heuristics)

3. **Knowledge, Logic & Inferencing** **(8 hrs)**
Knowledge Representation, Propositional Logic, Rules of Inference, First Order Predicate, Logic, Inference Rules, Forward and Backward Chaining, Resolution.

4. **Uncertain Knowledge** **(9 hrs)**
Uncertainty, Handling Uncertain Knowledge, Basic Probability (Prior, Conditional, Axioms, Baye's Rule), Knowledge Representation, Semantics of Belief Networks, Inference in Belief Networks, Knowledge Engineering for Uncertain Reasoning, Other Approaches to Uncertain Reasoning.

5. **Learning** **(12 hrs)**
Learning, Learning Models, Inductive Learning, Learning from Observations, Decision Trees, Computational Learning Theory, Neural Networks, Learning in Neural Networks. Reinforcement Learning, Knowledge in Learning.

6. **Other Applications** **(4 hrs)**
Introduction to Expert system and Natural Language Processing.

Laboratory:

Programming exercises as assigned by the instructor are to be done using Prolog/ Visual Prolog, LISP.

References :

1. S. Russell and P. Norvig, *Artificial Intelligence A Modern Approach*, Pearson Education, 2001
2. Nilson A. J., *Artificial Intelligence – A New Synthesis*, Harcourt India Private Limited, 2000.

Course Title : **Network Security**
Course Code : COM 732.3
Credit : 3
Class Load : 3 hours
Evaluation :

	Theory	Practical	Total
Sessional	50	-	50
Final	50	-	50
Total	100	-	100

Course Objective:
The course objective is to impart fundamental understanding of every facet of information security, from the basics to advanced cryptography, authentication, secure web, email services and emerging best practices with security standards.

Course Contents:

1. **Introduction** **(4 hrs)**
Security, Attacks, Attack Types, Viruses, Worms, Trojan Horses, Hacker Techniques, Security Services, Network Security Model, Security Levels, Internet Standards and RFCs.

2. **Conventional Encryption / Secret Key Cryptography** **(9 hrs)**
Cryptography, Cryptanalysis, Cipher Structure, Encryption Algorithms, Data Enncryption Standard (DES), International Data Encryption Algorithm (IDEA), Advanced Encryption Standard (AES), Modes of Operation, Symmetric Block Ciphers, Cipher Block Chaining (CBC), Multiple Encryption DES

3. **Public Key Cryptography and Message Digests** **(10 hrs)**
Hashes, Secure Hash Algorithm (SHA), Encryption with Message Digest (MD), MD5, Public Key Cryptography Principles, Public Key Cryptography Algorithms, RSA, Digital Signature Standard (DSS).

5. **Authentication and Public Key Infrastructure (PKI)** **(6 hrs)**
Overview of Authentication Systems (Password, Address, Crptographic), Security Handshake Pitfalls, Authentication Standards, Kerberos, PKI Trust Models, Revocation, Realtime Communication Security.

6. **Network Security** **(8 hrs)**
Email Security, PGP, S/MIME, IPSecurity, Architecture, Authentication Header, Security Association, Key Management, Web Security, Secure Socket Layer(SSL), Transport Layer Security(TLS), Secure Electronic Transaction(SET), Network Management Security, Different versions of SNMPs

7. **System Wide Security** **(3 hrs)**
Intruders, Viruses, Firewalls, DMZ

8. **Other Issues** **(5 hrs)**
   Legal Issues, Various criminal laws related to Information Security, Privacy Issues, Policy, Importance of Policy, Various Policies, Risk Management, Measure Risks, Information Security Processes.

References :

1. Charlie Kaufman, Radia Perlman, Mike Speciner, *Nework Security Private Communication in a Public World*, Second Edition, 2004,Pearson.
2. William Stallings, *Network Security Essentials-Applications & Standards*, Pearson.
3. Eric Maiwald, *Fundamentals of Network Security*, 2004, Osborne/McGraw Hill, Dreamtech Press
4. Matt Bishop, *Computer Security, Art and Science*, Pearson

Course Title : **Multimedia Computing**
Course Code : COM 733.3
Credit : 3
Class Load : 3 hours
Evaluation :

	Theory	Practical	Total
Sessional	50	-	50
Final	50	-	50
Total	100	-	100

Course Objective:
The main objective of this course covering three main domains of Multimedia Systems : Devices, Systems and applications

1. **Introduction** **(4 Hrs)**
Multimedia and Personalized Computing, Multimedia on the MAP, Medium, Multimedia system and properties, Data Streams Characteristics, Data Stream Characteristics for Continuous Media, Information Units

2. **Sound / Audio System** **(3 Hrs)**
Concepts of sound system, Music and speech, Speech Generation, Speech Analysis, Speech Transmission

3. **Images and Graphics** **(4 Hrs)**
Digital Image Representation, Image and graphics Format, Image Synthesis, analysis and Transmission

4. **Video and Animation** **(4 Hrs)**
Video signal representation, Computer Video Format, Television, Computer- Based animation, Animation Language, Methods of controlling Animation, Display of Animation, Transmission of Animation

5. **Data Compression** **(4 Hrs)**
Storage Space, Coding Requirements, Source, Entropy and Hybrid Coding, JPEG, Lossy Sequential DCT- based Mode, Expanded Lossy DCT-based Mode, Hierarchical mode, MPEG, Video and Audio Encoding, DVI, Audio and still Image Encoding

6. **Communication Systems in Multimedia** **(4 Hrs)**
Application Subsystem, Transport subsystem, Quality of service and resource management, Trends in collaborative Computing, Trends in Transport Systems, Multimedia Database Management System

7. **Documents, Hypertext and MHEG (Multimedia and Hypermedia Information Coding Expert Group) (5 Hrs)**
Documents, Hypertext and Hypermedia, Document Architecture SGML (standard generalized markup language), Document Architecture ODA, MHEG

8. **User Interfaces (4 Hrs)**
Basic Design Issues, Video and Audio at the User Interface, User- friendliness as the Primary Goal

9. **Synchronization (4 Hrs)**
Notation of Synchronization, Presentation Requirements, Model for Multimedia Synchronization, Specification of Synchronization

10. **Abstractions for programming (4 Hrs)**
Abstractions Levels, Libraries, System Software, Toolkits, Higher Programming Languages, Object –oriented approaches

11. **Multimedia Application (5 Hrs)**
Program and Structure, Media Preparation, Media Composition, Media Integration, Media Communication, Media Consumption, Media Entertainment, Trends in multimedia applications

Practical:
There shall be application lab exercises covering all features of multimedia system

References:

1. Multimedia: Computing, Communications and Applications, Ralf Steinmetz and Klara Nahrstedt, Pearson Education Asia
2. Multimedia Communications, Applications, Networks, Protocols and Standards, Fred Halsall, Pearson Education Asia
3. Multimedia Systems, John F. Koegel Buford, Pearson Education Asia