SWE 227 THEORY OF COMPUTATION

2 Hours/Week , 2.0 Credits

Finite Automata: Deterministic and nondeterministic finite automata and their equivalence. Equivalence with regularexpressions. Closure properties. The pumping lemma and applications. **Context-free Grammars:** Definitions. Parse trees. The pumping lemma for CFLs and applications. Normal forms. General parsing. Sketch of equivalence with pushdown automata. **Turing Machines:** Designing simple TMs. Variations in the basic model(multi-tape, multi-head, nondeterminism). Church-Turing thesis and evidence to support it through the study of other models.

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Reference:

1. Art of Programming Contest – Ahmed Shamsul Arefin.
2. 102 Combinatorial Problems – Titu Andreescu & Zuming Feng
3. Problem-Solving Methods in Combinatorics – Pablo Soberón
4. Competitive Programming 3 – Steven Halim

SWE 223 OBJECT ORIENTED PROGRAMMING LANGUAGE

3 Hour/week, 3 Credits

Introduction to Java: History of Java, Java Class Libraries, Introduction to Java Programming, A simple Program. **Developing Java Application:** Introduction, Algorithms, Pseudo code, Control Structure, The If /Else Selection Structure,The While Repetition Structure, Assignment Operators, Increment and Decrement Operators, Primitive Data Types, Common Escape Sequence, Logical Operator.
Control Structure: Introduction, The For Structure, The Switch Structure, The Do/While Structure, The Break and Continue Structure. **Methods:** Introduction, Program Module in Java, Math Class Methods, Method Definitions, Java API Packages, Automatic Variables,Recursion, Method Overloading, Method of the Applet Class. **Arrays :** Introduction, Arrays, Declaring and Allocating Arrays, Passing Arrays to Methods, Sorting Arrays, Searching Arrays, Multiple-Subscripted Arrays.
Object-Based Programming: Introduction, Implementing a Time Abstract DataType with a Class, Class Scope,Controlling Access to Members, Utility Methods, Constructors, Using Overload Constructor, Using Set and Get Method, Software Reusability, Friendly Members, Finalizers, Static Class Members, Data Abstraction and Information Hiding.
Object-Oriented Programming: Introduction, Superclasses and Subclasses, Protected Members, Using Constructor andFinalizers in Subclasses, Composition vs. Inheritance, Introduction to polymorphism, Dynamic method building, Final Methods and Classes, Abstract Superclasses and Concrete Classes. **String and Characters, Graphics, Exception**
Handling, Files and Stream, Java API, Utility Classes, 2D Graphics, GUI, Swing, Events.

Textbook

1. Introduction to Programming in Java, Robert Sedgewick & Kevin Wayne.
2. An Introduction to Object-Oriented Programming, Timothy Budd.

SWE 224 OBJECT ORIENTED PROGRAMMING LANGUAGE LAB

4 Hours/Week, 2.0 Credits

Object-Oriented Programming: Classes and objects, Constructors and destructor, Encapsulation of class members andmethods, Manipulating objects. **Dynamic Memory Allocation:** Pointers to objects, Pointers and arrays, Call-by-reference and call-by-value. **Concept of Inheritance, Interface and Polymorphism:** Direct and indirect inheritance, Private and protected members of inherited class, Constructors and destructors under inheritance, Polymorphism, Abstract base classes. **Exceptions:** Error handing in program, Creating own exception. **Handing Files:**

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Input/Output streams, Processing files,Random access files. **Thread Programming:** Introduction to threads, Using threads to solve multi-tasking problems, Thread synchronization. **Client-Server programming:** Applet and Servlets, Introduction to JSP, Socket programming. GUI: Basic user interface design using Java swing. **Understanding Java Enterprise Level Works.**

SWE 225 SOFTWARE REQUIREMENT ENGINEERING

2 Hours/Week, 2 Credits

Introduction : The Business Case for Requirements Analysis, Requirements Analysisthrough Software Life Cycles, Requirements Analysisbased on the Nature of Software Development, Requirement Specification, Quality Assurance Methods, The Nature of Meetings, Understanding Requirements, System Planning Approaches, Requirements Validation and Testing, **Requirements Analysis in Detail :** System Scope Models, Universal Modeling Language (UML) ,The Requirements Document, The Specifications Document, Software Tools Assisting Development of Requirements and Specifications. **Advanced Topics in Requirements Analysis :**User Interface Design, Data Flow Modeling, Viewpoint Oriented Requirements Methods, Non Functional Requirements (Performance, Safety Critical Systems) **Formal Methods :** Introduction to Formal Methods, Formal Methods in Industrial Applications, Underpinnings of Formal Methods, Z and B for producing specifications.

Text:

1. Software Requirements Analysis and Specifications – Jag Sodhi

Reference:

1. Software Requirements Engineering–Richard H. Thayer, Merlin Dorfman, Sidney C. Bailin
2. Innovations for Requirement Analysis–Barbara Paech, Craig Martell

SWE 226 SOFTWARE REQUIREMENT ENGINEERING LAB

2 Hours/Week, 1 Credits

Case Study, Requirement Analysis and Specification on real life projects, Use of Design tools, Use of validation tools.

SWE 227 THEORY OF COMPUTATION

2 Hours/Week , 2.0 Credits

Finite Automata: Deterministic and nondeterministic finite automata and their equivalence. Equivalence with regularexpressions. Closure properties. The pumping lemma and applications. **Context-free Grammars:** Definitions. Parse trees. The pumping lemma for CFLs and applications. Normal forms. General parsing. Sketch of equivalence with pushdown automata. **Turing Machines:** Designing simple TMs. Variations in the basic model(multi-tape, multi-head, nondeterminism). Church-Turing thesis and evidence to support it through the study of other models.

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Undecidability: The undecidability of the halting problem. Reductions to other problems. Reduction in general.

Textbook

1. Introduction to Languages and the Theory of Computation, by J. C. Martin.

SWE 229 ALGORITHM DESIGN AND ANALYSIS

3 Hours/Week , 3 Credits

Analysis of Algorithm: Asymptotic analysis: Recurrences, Substitution method, Recurrence tree method, Master method, Divide and Conquer Algorithms.
Hash Table: Hash tables, hash function, open addressing, perfect hashing, single and multi probe hashing.
Greedy Algorithms: Elements and properties of Greedy algorithms, fractional knapsack, Huffman Coding.
Dynamic Programming: Elements of DP (Optimal substructure, Overlapping sub problem), Coin change related problem,
0-1 knapsack, Longest Common Subsequence finding problem, LCS and LIS/LDS variations, Matrix Chain Multiplication.
Red black Tree and Binomial Heaps, Stassen's algorithm.
Network Flow: Flow Networks, Max-Flow Min-Cut Theorem, Ford Fulkerson method and its limitation, Edmonds Karp algorithm, Maximum Bipartite Matching, minimum path cover, minimum edge cover.
Matrix Operation: Matrix Chain Multiplication.
Backtracking/Branch-and-Bound: Permutation, Combination, 8-queen problem, 15-puzzle problem, Graph Coloring, N-queen problem, Hamiltonian cycle, Branch and Bound in backtracking. Traveling salesman problem.
Geometric algorithm: Properties of Line-Segment intersection, Convex-hull, Closest pair problem.
Number Theory: Chinese Remainder Theorem, Euler phi, extended Euclid, application of prime factorization application of phi. **RSA public key generation,** NP Completeness, NP hard and NP complete problems.
String Matching Algorithms: Naïve string matching algorithm, Rabin Karp algorithm, String matching with finite automata, Knuth Morris Pratt (KMP) algorithm, Trie, Suffix tree and Suffix Array. Basic combinatorics, Probability and Game theory. Least Common Ancestor, Range Minimum Query, Polynomials, DFT and FFT.

Reference:

1. Introduction to Algorithms Thomas H. Cormen , Charles E. Leiserson.
2. 102 Combinatorial Problems – Titu Andreescu & Zuming Feng
3. Problem-Solving Methods in Combinatorics – Pablo Soberón
4. Algorithms – Robert Sedgewick and Kevin Wayne.

SWE 230 ALGORITHMS DESIGN AND ANALYSIS LAB

3 Hours/Week, 1.5 Credits

Hash Table: Hash tables, hash function, open addressing, perfect hashing, single and multi probe hashing.

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Greedy Algorithms: Elements and properties of Greedy algorithms, fractional knapsack, Huffman Coding.
Dynamic Programming: Elements of DP (Optimal substructure, Overlapping sub problem). Coin change related problem,
0-1 knapsack, Longest Common Subsequence finding problem, LCS and LIS/LDS variations, Matrix Chain Multiplication.
Red black Tree and Binomial Heaps, Stassen's algorithm.
Network Flow: Flow Networks, Max-Flow Min-Cut Theorem, Ford Fulkerson method and its limitation, Edmonds Karp algorithm, Maximum Bipartite Matching, minimum path cover, minimum edge cover.
Matrix Operation: Matrix Chain Multiplication.
Backtracking/Branch-and-Bound: Permutation, Combination, 8-queen problem, 15-puzzle problem, Graph Coloring, N-queen problem, Hamiltonian cycle, Branch and Bound in backtracking. Traveling salesman problem.
Geometric algorithm: Properties of Line-Segment intersection, Convex-hull, Closest pair problem.
Number Theory: Chinese Remainder Theorem, Euler phi, extended Euclid, application of prime factorization application of phi. **RSA public key generation,** NP Completeness, NP hard and NP complete problems.
String Matching Algorithms: Naïve string matching algorithm, Rabin Karp algorithm, String matching with finite automata, Knuth Morris Pratt (KMP) algorithm, Trie, Suffix tree and Suffix Array. Basic combinatorics, Probability and Game theory. Least Common Ancestor, Range Minimum Query, Polynomials, DFT and FFT.

SWE 231 NUMERICAL ANALYSIS

2 Hours/Week, 2 credits

Numerical analysis: Errors in numerical calculations. Error : Definitions, sources, examples. Propagation of Error. A general error formula. **Root finding :**The bisection method and the iteration method, the method of false position. Newton-raphson method. **Methods of approximation theory :** Polynomial interpolation: Lagrange form, divided formula for interpolation. **Solution of systems of Linear equations:** Gaussian elimination. The pivoting strategy, Iteration method solution of tridiagonal systems. **Numerical solution of ordinary differential equations:** Euler's method (including modified form), Rnge-Kutta method. **Numerical Integration :**Trapezoidal method. Simpson's method. Weddle's method; Eigen value problems for matrices, Use of computer to implement projects in numerical methods.

Text:

1. Numerical Methods for Engineers–Steven C. Chapra, Raymond P. Canale

Reference:

1. Numerical Analysis Using MATLAB and Excel –Steven T. Karris
2. Numerical Analysis – Walter Gautschi

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SWE 232 NUMERICAL ANALYSIS LAB

3 Hours/Week, 1.5 credits

The material presented in this course is intended to acquaint students with some of the elementary numerical methods found useful in the fields of computing and applied mathematics.

Tasks: 1. Utilize numerical techniques to find the roots of an equation. 2. Set up a difference table and use it to interpolate and extrapolate data, determine the algebraic equation which will approximate the data, and perform numerical differentiations. 3. Perform linear and non-linear regression analysis of a set of data points using the method of least squares. 4. Calculate definite integrals using numerical integration methods and comparing those methods. 5. Solve systems of equations using matrix computations on the computer. 6. Use number theory to develop a solution better than sieve of Eratosthenes prime algorithm. 7. Solve Josephus problem and Tower of Hanoi problem. 8. Using summation factors to solve different recurrence problems. 9. Compute the probabilities of events using summation for some calculations of probabilities and averages.

SWE 233 OPERATING SYSTEM AND SYSTEM PROGRAMMING

3 Hours/Week, 3 Credits

Introduction: Operating Systems Concept, Computer System Structures, Operating System Structures, Operating Systemoperations, Protection and Security, Special-Purpose Systems. **Fundamentals of OS :** OS services and components, multitasking, multiprogramming, time sharing, buffering, spooling **Process Management:** Process Concept, Process Scheduling, Process State, Process Management, Interprocess Communication, interaction between processes and OS, Communication in Client-Server Systems, Threading, Multithreading, Process Synchronization.**Concurrency control:** Concurrency and race conditions, mutual exclusion requirements, semaphores, monitors, classical IPC problem and solutions, Dead locks - characterization, detection, recovery, avoidance and prevention. **Memory Management**: Memory partitioning, Swapping, Paging, Segmentation, Virtual memory - Concepts, Overlays, Demand Paging, Performance of demand paging, Page replacement algorithm, Allocation algorithms. **Storage Management**: Principles of I/O hardware, Principles of I/O software, Secondary storage structure, Disk structure, Disk scheduling, Disk Management, Swap-space Management, Disk reliability, Stable storage implementation. **File Concept:** File support, Access methods, Allocation methods, Directory systems, File Protection, Free Space management **Protection & Security**: Goals of protection, Domain of protection, Access matrix, Implementation of access matrix, Revocation of access rights, The security problem, Authentication, One-time passwords, Program threats, System threats, Threat monitoring, Encryption, Computer-security classification. **Distributed Systems :** Types of Distributed Operating System, Communication Protocols, Distributed File Systems,Naming and Transparency, Remote File Access, Stateful Versus Stateless Service, File Replication.

Case Studies: Study of a representative Operating Systems,

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System Programming: Introduction to System Programming and Linux / Unix, Shell Programming, C Language forSystem Programming, Make and Make files, Process and Signals, Threads, Inter process Communications, X- Window Programming, Principle of single and multi user operating systems.

Textbook

1. Operating System Concepts – Silberschatz & Galvin Wiley 2000 (7th Edition)
2. Operating Systems - Achyut S. Godbole Tata Mc Graw Hill (2nd Edition)

SWE 234 OPERATING SYSTEMS AND SYSTEM PROGRAMMING LAB

3 Hours/Week, 1.5 Credits

Thread programming: Creating thread and thread synchronization. **Process Programming:** The Process ID, Running aNew Process, Terminating a Process, Waiting for Terminated Child Processes, Users and Groups, Sessions and Process Groups **Concurrent Programming:** Using fork, exec for multi-task programs. **File Operations:** File sharing across processes, System lock table, Permission and file locking, Mapping Files into Memory, Synchronized, Synchronous, and Asynchronous Operations, I/O Schedulers and I/O Performance. **Communicating across processes:** Using different signals, Pipes, Message queue, Semaphore, Semaphore arithmetic and Shared memory.

Textbook

1. The 'C' Odyssey UNIX-The Open, Boundless C – Meeta Gandhi, Tilak Shetty, Rajiv Shah.
2. Beginning Linux Programming – Neil Matthew and Richard Stones
3. Linux System Programming – Robert Love

SWE 235 ETHICS AND CYBER LAW

2 Hours/Week, 2 credits

Ethics:

Introduction. **Meta Ethics:** Objectivism and Relativism, Non-naturalism, Cognitivism and Non-Cognitivism, The epistemic problem for congnitivism, Moral relativism., Cross-cultural differences and similarities, Different Psychological Issues in Metaethics: Egoism and Altruism, Emotion and Reason, Male and Female morality. **Normative Ethics:** Goodness, Rightness, Consequentialism, Utilitarianism. **Applied Ethics:** Business Ethics, Environmental Ethics and Social Ethics, Computer and Information Ethics. Developing the ethical analysis skills and professional values.

Cyber Law:

Module I: Introduction

Computers, Internet and their Impacts in Society
Need for Cyber Law in Social and International Perspectives
Overview of Cyber Law, Cyberspace
Building blocks of Cyber Space
Cyber Jurisprudence at International and National Level
Jurisdictional Aspects in Cyber Law

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Module II: Cyber Crimes & Legal Framework
Cyber Crimes against Individuals, Institution and State
Hacking
Digital Forgery
Cyber Stalking/Harassment
Cyber Pornography
Identity Theft & Fraud
Cyber terrorism
Cyber Defamation
Different offences under ICT Act, 2006

Module III: Intellectual Property Issues in Cyber Space
Interface with Copyright Law
Interface with Patent Law
Trademarks & Domain Names Related issues

Module IV: E Commerce
Concept
E-commerce-Salient Features
Online approaches like B2B, B2C & C2C
Online contracts
Click Wrap Contracts
Applicability of Contract Act, 1872

Module V:
Cyber Tribunal: Establishment of Cyber Tribunal, Trial Procedure of Cyber Tribunal, Bail Rules, Time Limit, Power of Investigation etc.
Cyber Appellate Tribunal: Establishment of Cyber Appellate Tribunal, Procedure and Power Cyber Appellate Tribunal, Appeal Procedure in case of not establishing Cyber Appellate Tribunal

SWE 237 MANAGEMENT INFORMATION SYSTEM
2 Hours/Week, 2 Credits

Introduction to MIS: Management Information System Concept. Definitions, Role of MIS, Approaches of MIS development. MISand Computer: Computer Hardware for Information System, Computer Software for Information System, Data Communication System, Database Management Technology, Client-Server Technology. Decision-Support System: Introduction, Evolution of DSS, Future development of DSS. Application of MIS: Applications in manufacturing Sector, Applications in service sector, Case Studies.

Text:
Management Information Systems by Kenneth C. Laudon, Carol Guercio Traver

SWE 250 PROJECT WORK II
4 Hours/Week, 2.0 Credits

Project focusing on Object oriented programming approach and using standard algorithm is preferable. Every project should maintain a goal so that it can be used

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as a useful tool in the IT fields. Also innovative project ideas that require different types scripting/programming languages or programming tools can be accepted with respect to the consent of the corresponding project supervisor.

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Second Year : *Semester II*

Course No	Course Title	Hours/Week	Credits	Prerequisite
		Theory + Lab		
SWE 227	Theory of Computation	2 + 0	2	
SWE 229	Algorithm Design & Analysis	3 + 0	3	SWE 127
SWE 230	Algorithm Design & Analysis Lab	0 + 3	1.5	
SWE 231	Numerical Analysis	2 + 0	2	
SWE 232	Numerical Analysis Lab	0 + 3	1.5	
SWE 233	Operating Systems and System Programming	3 + 0	3	
SWE 234	Operating Systems and System Programming lab	0 + 3	1.5	
SWE 235	Ethics and Cyber Law	2 + 0	2	
SWE 237	Management Information System	2 + 0	2	
SWE 250	Project Work -II	0 + 4	2	
	Total	**14 + 13 = 27**	**20.5**	

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