INSTITUTE OF INFORMATION TECHNOLOGY
UNIVERSITY OF DHAKA

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BACHELOR OF SCIENCE IN SOFTWARE ENGINEERING (BSSE)

[Session 2009-2010]

Institute of Information Technology
University of Dhaka

Syllabus for
Bachelor of Science in Software Engineering (BSSE)

Semester 1

Course Code	Course Title	Credit	Theory	Lab
CSE101	Structured Programming	3	1	2
CSE 102	Discrete Mathematics	3	3	0
STAT 103	Probability and Statistics for Engineers-I	3	3	0
MATH 104	Calculus and Analytical Geometry	3	3	0
GE 105	Sociology	3	2	1
SE 106	Introduction to Software Engineering	3	3	0
6 Courses		18	15	3

Semester 2

Course Code	Course Title	Credit	Theory	Lab
CSE 201	Data Structure & Algorithm	3	1	2
EEE 202	Digital Systems Design	3	2	1
STAT 203	Probability and Statistics for Engineers-II	3	3	0
MATH 204	Ordinary Differential Equations	3	3	0
SE 205	Theory of Computing	3	2	1
SE 206	Object Oriented Concepts I	3	2	1
6 Courses		18	13	5

Semester 3

Course Code	Course Title	Credit	Theory	Lab
CSE 301	Combinatorial Optimization	3	2	1
CSE 302	Computer Architecture	3	2	1
CSE 303	Data Communication and Networking	3	2	1

MATH 304	Numerical Analysis for Engineers	3	2	1
SE 305	Software Project Lab I	3	0	3
SE 306	Object Oriented Concepts II	3	2	1
6 Courses		18	10	8

Semester 4

Course Code	Course Title	Credit	Theory	Lab
CSE 401	Operating Systems and System Programming	3	2	1
GE 402	Business Psychology	3	2	1
CSE 403	Computer Networking	3	2	1
CSE 404	Database Management System-I	3	2	1
BUS 405	Business Studies for Engineers	3	3	0
SE 406	Software Requirements Spec. and Analysis	3	2	1
6 Courses		18	13	5

Semester 5

Course Code	Course Title	Credit	Theory	Lab
CSE 501	Parallel Computing	3	2	1
CSE 502	Web Technology	3	1	2
BUS 503	Business Communications	3	2	1
CSE 504	Database Management System-II	3	1	2
SE 505	Software Project Lab II	3	0	3
SE 506	Design Patterns	3	2	1
6 Courses		18	8	10

Semester 6

Course Code	Course Title	Credit	Theory	Lab
CSE 601	Distributed Systems	3	1	2
BUS 602	Management Information Systems	3	2	1
GE 603	Information Systems Ethics	3	1	2
CSE 604	Artificial Intelligence	3	2	1

SE 605	Software Testing and Quality Assurance	3	2	1
SE 606	Software Design and Analysis	3	2	1
6 Courses		18	10	8

Semester 7

Course Code	Course Title	Credit	Theory	Lab
SE 701	Internship	18	0	18
1 Course		18	0	18

Semester 8

Course Code	Course Title	Credit	Theory	Lab
SE 801	Project	6	0	6
CSE 802	Computer, Data and Network Security	3	2	1
SE 803	Software Project Management	3	2	1
CSE / SE / BUS 8XX	Elective	3	2	1
CSE / SE / BUS 8XX	Elective	3	2	1
5 Courses		18	8	10

Semester 1 (1st year 1st Semester)

Course Title: Structured Programming
Code: CSE 101
Credit: 1 Credit Theory and 2 Credit Lab

Course Outline: Fundamentals of C programming; Introducing C's Program Control Statements; Data types, Variables and Expressions; Exploring Arrays and Strings; Understanding Pointers and Functions; Console and File I/O; Structures and Unions.

References:

1. Teach Yourself C, Herbert Schildt, McGraw Hill
2. C: The Complete Reference, Herbert Schildt, McGraw Hill
3. Schaum's Outline of programming with C, McGraw Hill

Course Title: Discrete Mathematics
Code: CSE 102
Credit: 3 Credit Theory

Course Outline: The Foundations: Logic and Proofs: propositional logic, applications of propositional logic, propositional equivalences, predicates and quantifiers, nested quantifiers, rules of inference, introduction to proofs; **Basic Structures:** Sets, Functions, Sequences, Sums, and Matrices; **Number Theory:** The division algorithm, divisibility and the euclidean algorithm, prime numbers, congruence, applications of congruence; **Induction and Recursion:** Mathematical Induction, Recursive Definitions and Structural Induction, Program Correctness; **Counting:** The addition and multiplication rules, The principle of Inclusion-Exclusion, The pigeon-hole principle, permutations, combinations, Generalized Permutations and Combinations, Generating Permutations and Combinations; **Relations and Functions:** Symmetry, transitivity, reflexivity, equivalence classes, congruence, closure of relations, partial orderings; **Graphs:** Graphs and Graph Models, Graph Terminology and Special Types of Graphs, Representing Graphs and Graph Isomorphism, Connectivity, Euler and Hamilton Paths; **Trees:** Introduction to Trees, Tree Traversal, Spanning Trees.

References:

1. Discrete Mathematics and its Applications, Seventh Edition by Kenneth H. Rosen.

Course Name: Probability and Statistics for Engineers – I
Code: STAT 103
Credit: 3 Credit Theory

Course Outline: Introduction to Statistics: Concept of Data and Variables, Data Collection and Descriptive Statistics, Inferential Statistics, Populations and Samples; **Descriptive Statistics:** Frequency Tables and Graphs, Relative Frequency Tables and Graphs, Grouped Data, Histograms,

Ogives, Stem and Leaf Plots, Sample Mean, Sample Median, Sample Mode, Sample Variance and Standard Deviation, Sample Percentiles and Box Plots, Chebyshev's Inequality, Normal Data Sets, Paired Data Set and Sample Correlation Coefficient; **Elements of Probability:** Basic Terminology in Probability, Sample Space and Events, Venn Diagrams and Algebra of Events, Axioms of Probability, Conditional Probability, Bayes' Theorem and Independent Events; **Random Variables and Expectation:** Random Variables, Types of Random Variables, Jointly Distributed Random Variables, Expectation, Property of Expected Values, Use of Expected Values in Decision Making, Variance, Covariance and Variance of Sums of Random Variables and Moment Generating Functions; **Special Random Variables:** Binomial Random Variables, Poisson Random Variables, Uniform Random Variables, Normal Random Variables, Exponential Variables, Gamma Distribution, Chi-Square Distribution, t-Distribution and F-Distribution; **Distributions of Sampling Statistics:** Central Limit Theorem, Sampling Distribution for Normal Population, and Sampling from a Finite Population; **Parameter Estimation:** Maximum Likelihood Estimators, Interval Estimates, Estimating the difference in Means of Two Normal Population, Approximate Confidence Interval for the Mean, Confidence Interval of the Mean of the Exponential Distribution and Bayes' Estimator.

References:

1. Sheldon M. Ross, Introduction to Probability and Statistics for Engineers and Scientists, Elsevier/Academic Press, 3rd Ed.
2. M. Nurul Islam, An Introduction to Statistics and Probability, Book World, 3rd Edition.
3. Lipschutz, Lipschutz Seymour, 2000 Solved Problems in Discrete Mathematics, McGraw-Hill, 1st Ed

Course Title: Calculus and Analytical Geometry
Code: Math 104
Credit: 3 Credit Theory

Course Outline: **Basic Concepts:** Real Numbers and Real Lines, Polar Coordinates, Parametric Equations, Functions, Algebra of Functions, Inverse Functions, Quadratic Functions, Shifting Graphs, Trigonometric Functions, Complex Numbers, Inequalities, Infinite Series and Sequences, Taylor Series, Rate of Change and Limit, Rules of Finding Limits, Formal Definition of Limit, Extension of the Limit Concepts, L'Hospitals Rule, Continuity, Tangent Lines; **Differential Calculus:** The Derivatives of a Function, Differentiation Rules, Rates of Change, Derivatives of Trigonometric Functions, Chain Rule Differentiation, Implicit Differentiation and Rational Exponents, Related Rates of Change, Extreme Values of Functions, Mean Value Theorem, First Derivative and Second Derivative Tests for Extreme Values, Optimization, Linearization and Differentials and Newton's Method; **Integral Calculus:** Indefinite Integrals, Integration by Substitution, Riemann Sums, Definite Integral, Fundamental Theorem of Calculus, Mean Value Theorem, Substitution in Definite Integrals, Areas between Curves, Finding Volumes by Slicing, Volumes of Solids of Revolution, Cylindrical Shells, Lengths of Plane Curves, Areas of Surfaces of Revolution, Moments and Center of Mass, Fluid Pressures and Forces, Integration by Parts, Improper Integrals, Multiple Integrals and Line Integrals; **Linear Algebra and Vector Calculus:** Matrices, Operation on Matrices, Inverse of a Matrix, Rank of Matrix, Determinant, Vectors, and Solutions of System of Linear Equations, and Eigen value Problems.

References:

1. G.B. Thomas and R.L. Finney, *Calculus and Analytical Geometry*, Addison Wesley, 9th Ed.
2. Erwin Kreyszig, *Advanced Engineering Mathematics*, John Wiley & Sons, 9th Ed.

Course Title: Sociology
Code: GE 105
Credit: 2 Credit Theory and 1 Credit Lab

Course Outline: Introducing Sociology: Definition, Nature, Subject Matter, Sociology and Common Sense, Importance of Sociological Study; The Development of Sociology: The Origins, Early Sociologists (Auguste Comte, Herbert Spencer, Karl Marx, Emile Durkheim, and Max Weber), Modern Developments and Industrial Revolution; Capitalism and Socialism, The Theoretical Perspectives: The Functionalist Perspective, The Conflict Perspective, and The Interactionist Perspective.

Sociological Research Methods: Scientific Methods and their Application in Sociological Research: Fact, Concept, Variables, Correlations, Control, Hypothesis, Assumption, and Theory; The Methods of Social Research: Historical, Comparative, Statistical, Case-study, Experiments etc; The Research Process: Select the problem, Review the Literature, Formulate a Hypothesis, Choose a Research Design, Collect the Data, Analyze the Results, Draw a Conclusion, Report Writing and Use of SPSS in Sociological Research;

Basic Social Institutions, Marriage: Concept, Forms, and Functions; Family: Concept, Forms, and Functions, Changing Pattern of Marriage and Family in Modern Industrial Society; Culture, Society, and Socialization: Definition, Characteristics, Aspects and Elements of Culture, Cultural Lag, Culture and Civilization, Stages in the Evolution of Human Civilization; Agencies of Socialization: Family, Schools, Peer Groups, Mass Media etc;

Social Change and Social Stratification: Concept of Social Change, Social Evolution, Social Progress, and Social Development. Factors of Social Change and Its Impacts on Society; Social Stratification: of Concept, Forms, Social Stratification and Social Mobility; Social Problems and Applied Sociology: Concept of Social Problems; Major Social Problems: Crime, Juvenile Delinquency, Drug Addiction etc. Concept, Scope, Role of Sociologist in Applied Sociology; Social Policy and Planning: Objectives and prerequisites of Social Planning;

Globalization: Information and Communication Technology: Concept and Areas of Globalization, Impact of Globalization on Society, The Rise of Information and Communication Technology. Dimensions of Globalization: Technological and Information globalization; Technology and Society: Concept, Technological Innovation, and Technological Fix (Alvin Weinberg-1966), Technology and Society: Effects of technological factors on social life and Influence of Technology on Social Institution.

References:

1. Fairchild, Henry Pratt. Dictionary of Sociology.
2. Kalam ,Abul .Globalization and Bangladesh-In the New Century.
3. Koenig, Samuel. Sociology-An Introduction to the Science of Society.
4. Ogburn, William F. and Nimkoff, Meyer F. Sociology.
5. Robertson, Ian. Society-A Brief Introduction.
6. Rao, Shankor. Sociology.
7. Young,P.V. Scientific Social Survey and Research.

Course Title: Introduction to Software Engineering
Code: SE 106
Credit: 3 Credit Theory

Course Outline: Introduction to Computers, Basic Computer Organization, Processor and Memory,

Secondary Storage Devices, Input-Output Devices, Computer Software, Software and Software Engineering and Software Process Models.

References:

1. Computer Fundamentals, Pradip K Sinha, BPB Publications.
2. Software Engineering: A Practitioner's Approach, 7th Edition, McGraw Hill Higher Education.

Semester 2 (1st year 2nd Semester)

Course Title: Data Structures and Algorithm
Code: CSE 201
Credit: 1 Credit Theory 2 Credit Lab

Outline: Introduction - Data Structures and Complexity of Algorithms, Time Space Tradeoff, Searching Techniques: Linear and Binary Searching; Sorting and Recursion - Discussion of Common Sorting Techniques: Insertion Sort, Selection Sort, Bubble Sort, Quick Sort, Merge Sort, Radix Sort; Factorial and Tower of Hanoi Problem; Linked Lists - Abstract Data Types, List ADTs, and Linked Lists: Singly, Two Way and Circular Linked Lists; Stacks and Queues - Stacks and Queues and their Implementation Strategies; Prefix, Infix and Postfix Expressions, their Transformation and Evaluation Algorithms; Hashing - Hash Indices and Hash Functions, Static and Dynamic Hashing, Collisions in Hash Indices and Collision Resolving Techniques; Trees - Tree Concepts, Binary Tree, BST, Heaps, Heap Sort, Huffman Encoding Technique, AVL Tree, B Tree and B+ Tree; Graphs - Graph Terminologies, Representing Graphs, Graph Searching: BFS and DFS, Shortest Path Problems, Minimum Spanning Tree, Minimum Spanning Tree Algorithms, and Topological Sorting; Problem Solving Strategy - Greedy Algorithms, Divide and Conquer Strategy, Dynamic Programming and Backtracking.

References:

1. *Data Structures*. Schaum's Outline Series.
2. E. Horowitz and S. Sahni, *Fundamentals of Data Structures*, London Pitman.
3. Robert L. Kruse, *Data Structures and Program Design*, Prentice Hall, 2nd Ed.

Course Title: Digital System Design
Code: EEE 202
Credit: 2 Credit Theory 1 Credit Lab

Course Outline:

- **Introduction:** Number System, Number Base Conversation, Complements, Signed Number. Arithmetic Operation- Binary, Octal, Hexadecimal Binary Codes e.g. BCD, ASCII, Grey etc.
- **Boolean Algebra:** Theorems & Properties of Boolean Algebra, Boolean Functions, Canonical and Standard Forms and Simplification.
- **Logic Gates:** Switching Circuits, Electronic Logic Gates, Gate Symbols, Design and operation of NOT, OR, AND, NOR, NAND, XOR, XNOR Gates. Analysis of Combinational Circuits- Algebraic Method, Truth Table Method.

- **Synthesis of Combinational Logic Circuits:** AND-OR NAND Networks, OR-AND and NOR Network, AND-OR-Invert Circuits.
- **Combinational Logic Design:** Circuits (gate level), Design Hierarchy and procedures. Two-level and multi-level implementations, Arithmetic operation using gates (add, subtract, multiply), Logic Minimization, K-Map, Unate Covering, Quine McCluskey Method, CAD tools for two level minimization, ESPRESSO Algorithm and other popular (multiplexers, encoders, decoders) modules design.
- **Programmable Logic Devices:** Technologies, Performance, Classical and Mid-Complexity Architectures (PLDs, CPLDs, FPGAs) and Modern Architectures (SoPC).
- **Sequential Logic Design:** Latches, Flip-Plops, State Machine Design & Minimization (Mealy and Moore models) and Design Problems.
- Sequential Circuits: Design of Synchronous Counters, Ripple counters, parallel Load counters, Introduction of Registers and shift Register:
- **Memory Design:** Random Access Memory (RAMS), Static RAMS, Dynamic RAMS, Memory organizations and Read only Memories (ROM)

References:

1. Digital Logic Circuit Analysis and Design by Vicor P. Nelson and H. Troy Nagle, Bill D. Carroll, J. David Irwin.
2. Logic and Computer Design Fundamentals by M.M. Mano and C.R. Kime, Prentice-Hall, 4th Ed.
3. Introduction to Digital Logic Design by J.P. Hayes, Addison-Wesley, 1993.
4. Digital Systems: Principles and Applications, by Ronal J Tocci, Neal Widmer, Gregory L Moss, Prentice-Hall 1997.
5. Fundamentals of Digital Logic with VHDL Design by S. Brown and Z Vranesic, McGraw-Hill, 2nd Ed.
6. Analysis and Design of Digital Systems with VHDL by Allen Dewey, PWS Publication, 1st Ed.

Course Title: Probability and Statistics for Engineers – II
Code: STAT 203
Credit: 3 Credits

Course Outline: Hypothesis Testing: Tests Concerning the Mean of a Normal Population, Testing the Equality of Means of Two Normal Populations, Hypothesis Tests Concerning the Variance of a Normal Population, Hypothesis Tests in Bernoulli Populations and Tests Concerning the Mean of a Poisson Distribution. Regression and Correlation Analysis: Least Squares Estimators of the Regression Parameters, Distribution of the Estimators, Statistical Inference about the Regression Parameters, Coefficient of Determination and Sample Correlation Coefficient, Analysis of Residuals, Transforming to Linearity, Weighted Least Squares, Polynomial Regression, Multiple Linear Regression, Logistic Regression Models for Binary Output Data and Correlation Analysis. Analysis of Variance: One-way Analysis of Variance, Two-Factor Analysis of Variance: Introduction and Parameter Estimation, Testing Hypotheses and Two-way Analysis of Variance with Interaction Problems. Goodness of Fit Tests and Categorical Data Analysis: Goodness of Fit Tests when All Parameters are Specified, Goodness of Fit Tests when All Parameters are Unspecified, Tests of Independence in Contingency Tables, Tests of Independence in Contingency Tables Having Fixed Marginal Totals and Kolmogorov-Smirnov Goodness of Fit Test for Continuous Data. Nonparametric Hypothesis Tests: Sign Test,

Signed Ranked Test, Two-Sample Problem and Runs Tests for Randomness. Quality Control: Control Charts for Average Values, The X-Control Chart, S-Control Charts, and Control Charts for the Fraction Defective, Control Charts for Number of Defects and Other Control Charts for Detecting Changes in the Population Mean.

References:

1. Sheldon M. Ross, Introduction to Probability and Statistics for Engineers and Scientists, Elsevier/Academic Press, 3rd Ed.
2. Douglas C. Montgomery and George C. Runger, Applied Statistics and Probability for Engineers, John Wiley and Son, 4th Ed.
3. Murray R Spiegel, John J Schiller, R Alu Srinivasan, Schaum's Outline: Probability and Statistics, McGraw Hill, 3rd Ed.

Course Title: Ordinary Differential Equations
Code: Math 204
Credit: 3 Credit Theory

Course Outline: Differential Equations and Mathematical Modeling, Initial Value Problem, Separable Differential Equations, Exact Differential Equations, Linear Differential Equations, Bernoulli Equation, Homogeneous Linear Equations of Second Order, Second Order Homogeneous Equations with Constant Coefficients, Euler-Cauchy Equation, Existence and Uniqueness Theory, Non-homogeneous Equations, Solution by Undetermined Coefficients, Solution by Variation of Parameters, Higher-Order Linear Differential Equations, Higher-Order Homogeneous Equations with Constant Coefficients, and Higher-Order Non-homogeneous Equations, Vectors, Matrices, and Eigenvalues, Homogeneous Systems with Constant Coefficients, Critical Points, Criteria for Critical Points, Stability, Qualitative Methods for Nonlinear Systems, Non-homogenous Linear Systems, Laplace Transform, Inverse Transform, Transforms of Derivatives and Integrals, Differentiation and Integration of Transforms, Convolution, and Partial Fractions, System of Differential Equations.

References:

1. Erwin Kreyszig, *Advanced Engineering Mathematics*, John Wiley & Sons, 8th Ed.
2. S.L. Ross, *Differential Equations.*
3. Earl A. Coddington, *An Introduction to Ordinary Differential Equations*, Dover Publications, Unabridged Ed.
4. Morris Tenenbaum and Harry Pollard, *Ordinary Differential Equations*, Courier Dover Publications, 1985 Ed.

Course Title: Theory of Computing
Code: SE 205
Credit: 2 Credit Theory and 1 Credit Lab

Course Outline: Brief Review of mathematical background: Binary relations, digraph, string, languages, proofs, inductive definitions; Finite automata and regular expressions: Deterministic and non-deterministic finite automata, regular expressions and regular sets, Kleene's Theorem; Properties of regular sets: pumping lemma, closure properties, decision algorithms; Context Free grammar and languages: Context-free grammars, regular grammars; Simplified forms and normal forms: useful

symbols, productions, unit productions, chomsky normal form; Pushdown automata: pushdown automaton, equivalence between pushdown automata and context-free languages; Turing machine: introduction to Turing machines.

References:

1. Introduction to Automata Theory, Languages, and Computation by John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, Third Edition, Pearson Education.

Course Title: Object Oriented Concepts I
Code: SE 206
Credit: 2 Credit Theory and 1 Credit Lab

Course Outline: Object Oriented Concepts - Introduction to Object Oriented Concepts – Procedural vs Object Oriented (OO) Programming, What is an Object – Object Data and Behavior, What is a Class – Attributes, Methods and Messages, Using UML to model a Class Diagram, Encapsulation and Data Hiding: Interfaces and Implementations, Inheritance: Superclasses and Subclasses, Abstraction and Is-a Relationships; Polymorphism, Composition: Abstraction and Has-a Relationships; How to think in terms of Objects – Interface vs Implementation, Abstract thinking when designing Interfaces and Giving the user minimal Interface possible; Object Oriented concepts in details – Constructors: Default constructor, When is a constructor called, Using multiple constructors and The design of constructors, Error handling and The concept of scope; The Anatomy of a Class – The Name, Comments, Attributes, Constructors, Accessors, Public Interface methods and Private implementation methods; Class Design Guidelines – Modeling Real World Systems, Identifying Public Interfaces, Designing Robust Constructors, Designing Error Handling to a Class, Documenting a Class and Using Comments, Designing with Reuse, Extensibility, Maintainability in Mind and Using Object Persistence; Designing with Objects – Proper Analysis, Statement of Work, Requirements Collection, Prototype of User Interface, Identifying the Classes, Determining the responsibilities of Each Class, Class Collaboration, Class Model to Describe the System; Mastering Inheritance – Reusing Objects, Generalization and Specialization, How Inheritance weakens Encapsulation; Frameworks and Reuse – When should we Reuse, Frameworks, Contract: Abstract Classes and Interfaces. **Programming lessons -** Introduction to Java – Java Virtual Machine (JVM) and Java Runtime (JRE), Java Development Kit (JDK), Integrated Development Environment (IDE) for Java, Java installation, Hello World! Program, compiling and running Java program, using Java classpath and JVM Architecture; Java syntax – Package, Import, Class, Fields, Methods, Constructors, Primitive data types, Strings and literal, Wrapper class, Nonexistence type: null. Object Oriented Programming (OOP) - The students will implement each of the object oriented concepts which are discussed in the class. Java features to support practical OOP – String Operations: String creations and operations, immutability property of String, String comparison and searching, String buffers and builders; Java I/O: Streams, Input and Output Stream, File, Path, Directory and tree; Exception handling: try and catch, checked exception vs unchecked exceptions, throw and throws, Common exception and User defined exceptions; Logger and Debugging: Logger, Log levels, Formatters and Filters, Logger Handlers and Manager, Configuration, Introduction to Debugging and Debugging Workflow.

References:

1. The Object Oriented Thought Process, Matt Weisfeld, Addison-Wesley
2. Java How to Program, Paul Deitel and Harvey Deitel, McGraw Hill
3. Java: The Complete Reference, Herbert Schildt, McGraw Hill

Semester 3 (2nd year 1st Semester)

Course Name: Combinatorial Optimization
Code: CSE 301
Credit: 2 Credit Theory and 1 Credit Lab

Course Outline: Introduction - Algorithms, Analyzing & Designing Algorithms, Correctness of Algorithms; Greedy Algorithms - Introduction to Greedy Algorithms, Greedy Choice Property, Greedy vs. Dynamic Programming, Fractional Knapsack Problem, Activity Selection Problem, Huffman Encoding, Task Scheduling Problem, Coin Changing Problem, Kruskal's and Prim's Minimum Spanning Tree Algorithms; Divide and Conquer Algorithms - Introduction to Divide and Conquer Design Technique, Quick Sort, Merge Sort, Proof of Correctness, and Run Time Analysis; Dynamic Programming - Introduction to Dynamic Programming Technique, Principle of Optimality, Optimal Substructure Property, Assembly Line Scheduling, Matrix Chain Multiplication, LCS, Viterbi Algorithm, Bitonic Euclidean Traveling Salesperson Problem and Runtime Analysis; Graph Searching and Shortest Path Problems - Breadth First Search, Depth First Search, Flow Networks, Single Source and All Pair Shortest Path Algorithms; Linear Programming -Overview of Linear Programming, Formulating Problem as Linear Programs, Simplex Algorithm and Integer Linear Programming; Selected Topics - Computational Geometry, Number Theoretic and String Matching Algorithms; NP Completeness and Approximation Algorithms - NP Completeness, Polynomial Time Verification, NP Completeness and Reducibility, NP Complete Problems and Approximation Algorithms.

References:

1. Thomas Corman, *Introduction to Algorithms*, Stein Pub MIT Press, 3rd Ed.
2. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, *The Design and Analysis of Computer Algorithms*, Addison Wesley Series, 1974 Ed.

Course Title: Computer Architecture
Code: CSE 302
Credit: 2 Credit Theory and 1 Credit Lab

Outline: Introduction: Function and structure of a computer, Functional components of a computer, Interconnection of components, Performance of a computer; **Number representation and arithmetic**: Binary, octal, and hexadecimal numbers, One's and two's complements and other representations, Addition and subtraction; **Digital logic and integrated circuits**: Boolean algebra and truth tables, Boolean functions (Gates, Functions, Simplification), Integrated circuits (Combinational circuits - adders, shifters, decoders, multiplexers and ROM's; Flip-flops; Sequential circuits - registers, counters and RAM); **Representation of Instructions:** Machine instructions, Operands, Addressing modes, Instruction formats, Instruction sets, Instruction set architectures - CISC and RISC architectures; **Introduction to Assembly Language:** Programming with Assembly language, The assembly process, Linking and loading, Register-level debugging, **Processing Unit:** Organization of a processor - Registers, ALU and Control unit, Data path in a CPU, Instruction cycle, Organization of a control unit - Operations of a control unit, Hardwired control unit, Micro-programmed control unit; **Memory Subsystem:** Semiconductor memories, Memory cells - SRAM and DRAM cells, Internal Organization of a memory chip, Organization of a memory unit, Error correction memories, Interleaved memories,

Cache memory unit - Concept of cache memory, Mapping methods, Organization of a cache memory unit, Fetch and write mechanisms, Memory management unit - Concept of virtual memory, Address translation, Hardware support for memory management; **Input/Output Subsystem:** Access of I/O devices, I/O ports, I/O control mechanisms - Program controlled I/O, Interrupt controlled I/O, and DMA controlled I/O, I/O interfaces - Serial port, Parallel port, PCI bus, SCSI bus, USB bus, Firewall and InfiniBand, I/O peripherals - Input devices, Output devices, Secondary storage devices; **Multiprocessing Systems:** Shared memory multiprocessor, Message-passing multiprocessor, Hardware multithreading

References

1. D. A. Patterson and J. L. Hennessy, "Computer Organization and Design - The Hardware/Software Interface", Morgan Kaufmann, 1998.
2. C. Hamacher, Z. Vranesic and S. Zaky, "Computer Organization", McGraw-Hill, 2002.
3. W. Stallings, "Computer Organization and Architecture - Designing for Performance", Prentice Hall of India, 2002.
4. J .P. Hayes, "Computer Architecture and Organization", McGraw-Hill, 1998.

Course Title: Data Communication and Networking
Code: CSE 303
Credit: 2 Credit Theory and 1 Credit Lab

Outline: Introduction: Overview of Data communication, networking and network models; Physical Layer and Media: Data and Signal, Digital Transmission, Analog Transmission, Transmission Media; Data Link Layer: Error detection and Correction, Flow and error control, Medium access control protocols (ALOHA, CSMA/CD, CSMA/CA), Channelization (FDMA, TDMA, CDMA) Ethernet, Wireless LANs; Network Layer: Logical Addressing.

References:

1. Data Communications and Networking, B. A. Forouzan, 5/e

Course Title: Numerical Analysis for Engineers
Code: MATH 304
Credit: 2 Credit Theory and 1 Credit Lab

Outline: Introductory concepts and calculus review, 'C' programming, the sources and propagation of errors, root finding for nonlinear equations, solution of system of linear equations, interpolation and approximation theory, numerical integration and differentiation.

References:

1. Numerical Methods, E Balagurusamy, Tata McGraw-Hill Publishing Company, 2002

Course Title: Software Project Lab I
Code: SE 305
Credit: 3 Credit Lab

Course Outline: Each of the students should complete the software project separately. They will be marked based on their individual software. Student will be encouraged to develop software which requires significant "problem solving" effort. The project should be sufficiently large and the size of the project will mostly depend on "problem solving" effort. Besides, students must showcase the skills they have acquired from their so far completed courses.

Course Title: Object Oriented Concepts II
Code: SE 306
Credit: 2 Credit Theory and 1 Credit Lab

Course Outline: Object Oriented Concepts - Review of Object Oriented Concept - Object Data, Object Behaviors, Class, Attributes, Methods, Encapsulation and Data Hiding: Is-A relationship, Polymorphism, Compositions: Abstractions and Has-A Relationship; Mastering Composition and Building Objects – Representing Composition with UML, Composition Relationships, Building in Phases, Types of Composition: Aggregation and Associations, Avoiding Dependencies and Cardinality; Details of Creating Object Models with UML – Class Diagram, Attributes and Methods, Access Designations, Inheritance, Interfaces, Composition: Aggregations and Associations, and Cardinality; Objects and Portable Data - Portable Data, The Extensible Markup Language (XML); Objects and Client/Server Applications – Client/Server Approaches, Proprietary Approaches and Nonproprietary Approaches; Principal, Interface Segregation Principle and Dependency Inversion Principle; Introduction to Component Based Design, Design Patterns and Code Smells. **Programming lessons** - Generics: Wildcard, Generic class definitions, Generic method definitions, Using generics; Collection Framework: Collection interfaces, List and SortedList, Map and SortedMap, Navigable Map, Set and Sorted Set, Navigable Set, Queue and DeQueue, Stack, hashCode() and equals(), Comparator and Comparable; Reflection: Exception Handling and Reflections and Dynamic Programming; Multi-Threaded Programming: Overview of Thread, Java Thread Model, Creating and Running Thread, Thread Pools, Thread Synchronization, wait and notify, join and sleep and The concurrency API; User Interface: Swing, Components, Container, Events, Layouts and SwingWorker; Serialization: Serializable interface, Writing and Reading an Object, Handling Exceptions, Customized Serialization and Controlling Serialization; Socket Programming: Clients and Servers, Ports, Addresses and Protocols, Communication using I/O, Servers, The ServerSocket Class, The URL lass and URLConnction Class; Java Servlet Programming: Introduction To Servlet, Servlet Life cycle, HttpServlet, HttpRequest, HttpResponse, RequestDispatcher, HttpSession and ServletContext, Servlet Configuration, Cookies, Servlet Filters and Http Headers and MIME types; The Java Beans AOI: Introspector, PropertyDescriptor, EventSetDescriptor and MethodDescriptor.

References:

1. The Object Oriented Thought Process, Matt Weisfeld, Addison-Wesley
2. Java How to Program, Paul Deitel and Harvey Deitel, McGraw Hill
3. Java: The Complete Reference, Herbert Schildt, McGraw Hill
4. Head First Java by Kathy Sierra and Bert Bates, O Reilly

Semester 4 (2nd year 2nd Semester)

Course Title: Operating System and System Programming
Course Code: CSE401
Course Credit: 2 Credit Theory and 1 Credit Lab

Course Outline: Introduction: What is operating system? History of operating system Operating system concepts Operating system structure Processes and Threads Processes Threads Interprocess communication Scheduling Classical IPC problems Memory Management No memory abstraction Virtual memory Page replacement algorithms Design issues for paging systems Implementation issues File Systems Files Directories File system management Input / Ouptut Principles of I/O hardware Principles of I/O software I/O software layers Disks Clocks Thin clients Deadlocks Resources Detection Recovery Avoidance Prevention Virtualization and Cloud

Course Reference Books:

1. Operating System Concepts, 7th edition, by Silberschatz, Galvin, Gagne
2. Modern Operating Systems, 4th edition, Tanenbum, Bos

Course Title: Business Psychology
Code: GE 402
Credit: 3 Credit Theory

Course Outline:

Fundamentals: Definition of Psychology, Subfields of Psychology, Major Perspectives of Psychology, Psychology in Business; Job Analysis: Job-oriented Approach, Person-oriented Approach, Purposes of Job Analysis, Methods of Job Analysis, Job Evaluation; Assessment Methods for Selection and Placement: Psychological Tests: Ability Test, Personality Test, Intelligence Test, Vocational Interest Test; Training and Development: Training Need Analysis, Training Designs, Training Methods, Evaluation of Training; Theories of Employee Motivation: Need Theories, Reinforcement Theory, Expectancy Theory, Goal Setting Theory; Job Attitude and Emotion: Nature of Job Satisfaction, Assessment of Job Satisfaction, Antecedents of Job Satisfaction, Potential Effects of Job Satisfaction, Organizational Commitment, Emotion at work; Productive and Counterproductive Employee Behavior: Productive Behavior, Job Performance; Counterproductive Behavior, Withdrawal, Aggression, Mistreatment, Sabotage, and Theft; Occupational Health Psychology: Occupational Health and Safety, Work Schedules, Occupational Stress, Work-Family Conflict, Burnout, Hawthorne Studies; Leadership: Approaches to the Understanding of Leadership Trait Approach, Leader Behavior Approach, Contingency Theory, Path-Goal Theory, Leader-Member Exchange (LMX) Theory, Transformational Leadership Theory; Organizational Development and Theory: Organizational Development Employee Acceptance of Change, Management by Objectives, Survey Feedback, Team Building, T-Group; Effectiveness of Organizational Development: Organizational Theories, Bureaucracy, Theory X and Theory Y, Open System Theory, Socio-technical System Theory.

References:

1. Industrial and Organizational Psychology: Research and Practice, Paul E. Spector, 5th Edition

Course Title: Computer Networking

Code: CSE 403
Credit: 2 Credit Theory and 1 Credit Lab

Course Outline: Introduction: Overview of the Internet, Overview of Networking Protocols, Network Edge, Network Core, Protocol Layers / Service Model, General Networking Example; Application Layer: Principles of Networking Applications, Web and HTTP, FTP, E-mail, DNS; Transport Layer: Transport Layer Services, Multiplexing and De multiplexing, Connectionless Transport: UDP, Principles of Reliable Data Transport, Connection-Oriented Transport: TCP, Principles of Congestion Control, TCP Congestion Control; Network Layer: Datagram Networks, Inside a Router, Details of the Internet Protocol (IP), IP Sub netting, Routing Algorithms (Link State, Distance Vector), Routing in the Internet (Routing Information Protocol (RIP), Open Shortest Path First (OSPF), Border Gateway Protocol (BGP)).

References:

1. Data Communications and Networking, B. A. Forouzan, 5/e

Course Title: Database Management Systems I
Code: CSE 404
Credit: 2 Credit Theory 1 Credit Lab

Course Outline: Introduction to Database Systems: Evolution of file processing systems, role of databases in organizations, core components of a database environment; Data Modeling: the Entity-Relationship Diagram and its symbols and constructs; The Relational Model and Normalization: relational model, normalization, transformation of an entity-relationship data diagram into a relational model; SQL - A Standard Navigation Language for Relational Databases; Overview of Object-Oriented Databases: object-oriented data model, implementation of object persistence using relational databases.

References:

1. Database System Concepts by Avi Silberschatz, Henry F. Korth and S. Sudarshan, Sixth Edition

Course Title: Business Studies for Engineers
Code: CSE 405
Credit: 3 Credit Theory

Course Outline: Managers and Entrepreneurs: Management Defined, Role of a Manager, Small-Business Management, The Evolution of Management Thought, Organization, Organization Charts, Contrasting Theories of Organization, Organizational Effectiveness, Organizational Cultures, Change, Conflict, and Negotiation in Organization; The Strategic Management Process, Strategic Implementation and Control, Forecasting. **Accounting Basic:** Forms of Business Organization, Types of Activities performed by Business Organization, Financial statements of Business Organization, The Accounting Equation, The Account and Rules of Debit and Credit, The Journal: Recording of Transaction, Adjusting the Accounts, Closing Entries, and Preparing Financial statements from the Work Sheet. **Analysis and Interpretation of Financial Statement:** Objectives of Financial Statement Analysis, Analysis of a Balance Sheet, Analysis of Statement of Income and Retained Earnings, Ratio Analysis: Liquidity Ratios, Equity or Long Term Solvency Ratio, Profitability Test, Market Test.

References:

1. Stephen P. Robbins and Mary Coulter, *Management*, Prentice Hall, Latest Edition
2. Jerry J. Weygandt, Donald E. Kieso, and Paul D. Kimmel, *Accounting Principles*, Wiley, 8th Ed.

Course Title: Software Requirements Specification and Analysis
Code: SE 406
Credit: 2 Credit Theory and 1 Credit Lab

Course Outline: Review of – The Nature of Software, Software Engineering, The Software Process, Software Engineering Practices, Generic Software Process Model, Process Assessment and Improvement, Prescriptive Process Models, Specialized Process Model and Agile Development. Requirements Engineering, Establishing the ground work, Eliciting Requirements, Negotiating Requirements, Validating Requirements, Requirements Analysis, Scenario-Based Modeling, UML Models, Data Modeling Concept, Class Based Modeling, Requirements Modeling Strategies, Flow-Oriented Model, Behavioral Model, Requirements Modeling for WebApps.

Lab: One small real life system will be given to all the students for analyzing in the class room. Three real life mid-scale systems will be distributed among groups (created randomly) of 5/6 students to analyze (one project per group). The output of both of the analysis will be specification reports.

References:

1. R. S. Pressman, Software Engineering. A Practitioner's Approach, 7/e or higher, McGraw Hill
2. Ian Sommerville. Software Engineering, 9th or higher Edition, Addison-Wesley.

Semester 5 (3rd year 1st Semester)

Course Title: Parallel Computing
Code: CSE 501
Credit: 2 Credit Theory and 1 Credit Lab

Course Outline: Introduction, Parallel Computer Model, the State of Computing, Flynn's Classification, Parallel/Vectors Computers, and Challenges for Parallel Computing, System Attributes to Performance, Clock Rate and CPI, Performance Factors, System Attributes, MIPS rates, Throughput rate, Implicit and Explicit Parallelism, Multiprocessors and Multicomputers, Shared Memory Multiprocessors, different types of model (UMA, NUMA, COMA), Distributed Memory Multicomputer, Multicomputer Generation, Multivector and SIMD Computers, Vector supercomputer, SIMD supercomputers, PRAM and VLSI Models, Parallel Random Access Machines, Time and Space Complexities, NP Completeness, PRAM models, VLSI complexity model and discussion about related papers, Introduction to Program and Network Properties, Condition of Parallelism, Data and Resource Dependencies, Control Dependence, Resource Dependence, Bernstein's Conditions, Hardware and Software Parallelism, The role of compiler, Program Partitioning and Scheduling, Grain Sizes and Latencies, Grain Packing and Scheduling, Static Multiprocessor Scheduling, Node duplication, Program Flow Mechanisms, Control Flow versus Data Flaw, Demand Driven Mechanisms, System

Interconnect Architectures, Network Properties and Routing, Node Degree and Network Diameter, Bisection Width, Data Routing Function (Permutations, Perfect Shuffle and Exchange, Hypercube Routing Functions, Broadcast and Multi cast), Network Performance, Related Paper Studies, Static connection Networks (Linear array, Ring and Chordal Ring, Barrel Shifter, Tree and Star, Mesh and Torus, Systolic Array, Hypercube, Cube Connected Cycles), Network Throughput, Dynamic Connection Networks, Principles of Scalable Performance, Performance Metrics and Measures, Parallelism Profile in Programs, Degree of Parallelism, Average Parallelism, Available Parallelism, Asymptotic Speedup, Harmonic Mean Performance, Arithmetic Mean Performance, Geometric mean Performance, harmonic Mean Performance, Harmonic Mean Speedup, Amdahl's Law, System Efficiency, Quality of Parallelism, Scalability of Parallel Algorithms, and Speedup Performance Laws, Processors and Memory Hierarchy: Advanced processor Technology, Design Space of Processors, Instruction Pipelines, Processors and Coprocessors, Superscalar and Vector Processors, Virtual Memory Technology, Pipelining and Superscalar Techniques: Linear Pipeline Processors, Asynchronous and Synchronous Models, Speedup Efficiency and Throughput, Nonlinear Pipeline Processors, Reservation and Latency Analysis, Collision Free Scheduling, state diagram, greedy cycles, Pipeline Schedule Optimization, Pipeline Throughput, and Instruction Pipeline Design, Branch Handling Techniques, Effects of Branch, Related Paper discussion, Multiprocessors and Multicomputer: Hierarchical Bus Systems, Crossbar Switch and Multi port Memory, Hot spot problem, Cache Coherence and Synchronization Mechanisms, cache coherence problem, process migration, snoopy bus protocols, Directory based protocols, Hardware Synchronizations Mechanisms, Software for Parallel Programming: Object Oriented Model, Functional and Logic Model, Parallel Language and Compilers.

References:

1. Kai Hwang, "Advanced Computer Architecture", McGraw-Hill.
2. Principles of Parallel Programming, by Calvin Lin and Larry Snyder, Addison-Wesley, 2009.
3. Patterns for Parallel Programming, by Mattson, Sanders, and Massingill, Addison-Wesley, 2005.
4. The Art of Multiprocessor Programming, by Herlihy and Shavit, Morgan Kaufmann, 2008.

Course Title: Web Technology
Code: CSE 502
Credit: 1 Credit Theory and 2 Credit Lab

Course Outline: Introduction To Html, Java Script & CSS, Server Side Programming: HTTP Server, Application Server, MVC Web Framework, Web Services, Database Access: Object Relational Mapping, Lambda Expression, Language Integrated Query, Data Reader, Writer, Web Security: Denial of Service, Buffer Overflow, Cross Site Scripting, Authentication and Access Control

References:

1. Deitel & Deitel, Goldberg, "Internet and world wide web – How to Program", Pearson Education Asia, 2001.
2. Rajkamal, "Web Technology", Tata McGraw-Hill, 2001.

3. Teach yourself web technologies part I & II- I. Bayross. BPB
4. Web Design in a Nutshell- J. Niederst, SPD

Course Title: Business Communication
Code: BUS 503
Credit: 2 Credit Theory and 1 Credit Lab

Outline: Communication Concept: The Role of Communication in Business, Importance of Communication Skills, Main Form of Business Communication, Process of Human Communication. **Fundamentals of Business Writing:** Adaptation and the Selection of Words, Construction of Clear Sentences and Paragraphs, Writing for Effect. **Basic Pattern of Business Messages:** Directness in Good News and Neutral Situations, Indirectness in Bad Message, Indirectness in Persuasion Message, Letter and Memorandum, Letter Writing Styles, Pattern Variations in Memorandums and the Email, Job Search Activities: Strategies in the Job Search Process, Job search activities, Writing CV, Facing Interviews, Feedback letters for goodwill, **Fundamentals of Report Writing:** Basics of Report Writing, Report Structure: The Short Forms, Long and Formal Report, Usages of Graphics. **Other Form of Business Communication:** Informal Oral Communication, Technology-Enabled Communication.

References:

1. Raymond V. Lesikar, John D. Pettit, Maire E. Flatley, Lesikar's Basic Business Communication, Mc Graw Hill

Course Title: Database Management System – II
Code: CSE 504
Credit: 2 Credit Theory and 1 Credit Lab

Outline: Indexing and Hashing: Basic Concepts, Ordered Indices, B+-Tree Index Files, B-Tree Index Files, Static Hashing, Dynamic Hashing, Comparison of Ordered Indexing and Hashing; Query Processing: Overview, Measures of Query Cost, Selection Operation, Sorting, Join Operation, Evaluation of Expressions; Query Optimization: Introduction, Transformation of Relational Expressions, Catalog Information for Cost Estimation, Statistical Information for Cost Estimation, Cost-based optimization; Transactions: Transaction Concept, Transaction State, Concurrent Executions, Serializability; Concurrency Control: Lock-Based Protocols, Timestamp-Based Protocols; Recovery System: Failure Classification, Storage Structure, Recovery and Atomicity, Log-Based Recovery, Recovery With Concurrent Transactions; Data Analysis and Mining: Data Mining, Decision tree, Bayes theory, Randomize tree; Database System Architectures: Centralized and Client-Server Systems, Server System Architectures, Parallel Systems, Distributed Systems, Network Types; Parallel Databases: Introduction, I/O Parallelism, Interquery Parallelism, Intraquery Parallelism, Intraoperation Parallelism, Interoperation Parallelism; Distributed Databases: Heterogeneous and Homogeneous

Databases: Distributed Data Storage, Distributed Transactions, Commit Protocols; Additional should be included: Database Design, Database Tuning Security and Authorization, Multidimensional query.

References:

1. Ramez Elmasri and Shamkant B. Navathe Fundamentals of Database Systems. Third Edition. Addison-Wesley Pub Co, 1999.
2. Database Systems: The Complete Book, Hector Garcia-Molina, Jeffrey D. Ullman and Jennifer D. Widom Prentice Hall. (best supporting book)
3. Fundamentals of Database Systems, by Ramez Elmasri and Shamkant Navathe, Addison Wesley.
4. Database System Concepts,Fifth Edition, Avi Silberschatz, Henry F. Korth, S. Sudarshan

Course Title: Software Project Lab II
Course Code: SE505
Credit: 3 Credit Lab

Course Outline: Students will create project teams of 3 members each. Number of team members can be varied for special cases, decided by the assigned course manager. All the project teams are required to prepare their Software Requirements Specification (SRS) first, and later develop the project accordingly.

Course Name: Design Patterns
Code: SE 506
Credit: 2 Credit Theory and 1 Credit Lab

Course Outline: Revision of Concepts of OOP, Importance of learning design patterns, Types of Design Patterns - Structural, Behavioral and Creational Patterns, Creational Patterns – Singleton, Factory, Factory Method, Abstract Factory, Builder, Prototype and Object Pool, Behavioral Patterns - Chain of Responsibility, Command, Interpreter, Iterator, Mediator, Memento, Observer, Strategy, Template Method, Visitor and Null Object, Structural Patterns – Adapter, Bridge, Composite, Decorator, Flyweight and Proxy, REFACTORING CODE SMELL, Different type of code smells - Inappropriate Naming, Comments, Dead Code, Duplicated code, Primitive Obsession, Large Class, Lazy Class, Alternative Class with Different Interface, Long Method, Long Parameter List, Switch Statements, Speculative Generality, Oddball Solution, Feature Envy, Refused Bequest, Black Sheep and Train Wreck, Design Principles (SOLID) - Single responsibility principle, Open Close Principle, Liskov substitution principle, Interface segregation principle, Dependency Inversion principle.

References:

1. Gamma, Erich. *Design patterns: elements of reusable object-oriented software*. Pearson Education, 1995.

Semester 6 (3rd year 2nd Semester)

Course Title: Distributed Systems
Code: CSE 601
Credit: 1 Credit Theory and 2 Credit Lab

Course Outline: Foundations - Characterization of DS, System Models, Networking and Internetworking, Interprocess Communication, Remote Invocation, Indirect Communication and Operating System Support **Middleware** - Dist. Objects and Components, Web Services and Peer-to-Peer Systems System services – Security, Distributed File Systems and Name Services Distributed algorithms - Time and Global States, Coordination and Agreement Shared data, Transactions and Concurrency Control, Distributed Transactions, and Replication, New challenges -Mobile and Ubiquitous Computing. **Lab:** Introduction to Message passing technology and its applications, Sockets Programming, Remote Procedure Calls code implementation, Synchronization assignments, Group Communication code implementation, Distributed mutual exclusion assignment, Implementation of Election Algorithms, Implementation of Distributed File system: MapReduce, Spanner, Distributed Systems Design assignments: Cloud Services and Content Delivery Networks configuration.

References:

1. Distributed Systems: Concepts and Design (5th Edition). George Coulouris (Author), Jean Dollimore (Author), Tim Kindberg (Author), Gordon Blair (Author)

Course Title: Management Information Systems
Course Code: BUS 602
Credit: 2 Credit Theory and 1 Credit Lab

Course Outline: Foundation Concepts a) Foundations of Information Systems in Business i. Foundation Concepts: Information Systems in Business ii. Foundation Concepts: The components of Information Systems b) Competing with Information Technology i. Fundamentals of Strategic Advantage ii. Using Information Technology for Strategic Advantage 2. Information Technologies a) Computer Hardware b) Computer Software c) Data Resource Management i. Technical Foundations of Database Management ii. Managing Data Resources d) Telecommunications and Networks i. The Networked Enterprise ii. Telecommunications Network Alternatives; Business Applications a) E-business Systems i. e-Business Systems ii. Functional Business Systems b) Enterprise Business Systems i. Management at Enterprise Level ii. Enterprise Resource Planning iii. Supply Chain Management c) E-commerce Systems i. e-Commerce Fundamentals ii. e-Commerce Applications and Issues d) Supporting Decision Making i. Decision Support in Business ii. Artificial Intelligence Technologies in Business 4. Development Process a) Developing Business / IT Strategies i. Planning Fundamentals ii. Implementation Challenges b) Developing Business / IT solutions i. Developing Business Systems ii. Implementing Business Systems 5. Management Challenges a) Security and Ethical Challenges i. Security, Ethical and Societal Challenges of IT ii. Security Management of Information Technology b) Enterprise and Global Management of Information Technology i. Managing Information Technology ii. Managing Global IT

Reference:

1. Management Information Systems, 10th edition, James O' Brien

Course Title: Information Systems Ethics
Code: GE 603
Credit: 1 Credit Theory and 2 Credit Lab

Course Outline: Introduction to Ethics, Morals, Integrity, Ethical use of Information Technology, Ethics for IT Workers and IT Users - Trade secret, Whistle blowing, fraud, misrepresentation, bribery, professional code of ethics, IT professional malpractice and Common Ethical issues for IT users, Computer and Internet Crime - Exploit, Viruses, Phishing and Types of perpetrators, Privacy - Information privacy, fair information practices, EU data protection directive, key privacy and anonymity issues, Freedom of Expression - Right to freedom of expression, obscene speech, hate speech, defamation, controlling access to information on the internet, anonymity on the internet, corporate blogging and pornography, Intellectual property - Copyright, fair use doctrine, patent, software patents, trade secret and key intellectual property issues, Impact of IT on society, Social networking ethical issues, Ethics for IT organization.

References:

1. Ethics In Information Technology, George W. Reynolds

Course Title: Artificial Intelligence
Code: CSE 604
Credit: 2 Credit Theory and 1 Credit Lab

Course Outline: Intelligent Agents and their Environments - The concept of a Rational Agent, Specifying the Task environment (PEAS description), Different characteristics of environments (Fully vs Partially observable, Static vs Dynamic, Episodic vs Sequential etc.) and Different types of agents (Reflex, Goal-based, Utility-based etc.),Search - Formulating a search problem , Uninformed Search strategies: BFS, DFS, DLS, ID-DFS, their working principles, complexities, relative advantages and disadvantages, Informed (heuristic) Search strategies: Greedy Best-first search, A* search: Working principle, Characteristics of heuristics (admissibility and consistency), Proof of A*'s optimality, Local search: Hill Climbing, Searching with non-deterministic actions: AND-OR search trees and Searching with partial observability: Belief state-space search, Adversarial Search - Formulation of a Game tree, The minimax algorithm, Alpha-Beta pruning: Its rationale, working principle and Additional techniques such as Move ordering and Search cut-off, Probabilistic Reasoning - Bayes' rule and its uses, Bayesian Network: Building a Bayes-net and making inference from it, Markov Chains and Hidden Markov Models: Transition and Sensor models, Building and HMM, applications of HMM, Inference in temporal models: Filtering, Prediction, Most Likely explanations (Viterbi algorithm) etc. and Particle Filters: basic working principle, Making Decisions - Decision theory and Utility theory: Lottery, Utility functions, Maximum Expected Utility principle, Constraints of Utility (Orderability, Transitivity etc) and Markov Decision Processes: Policies, Rewards, Optimal policies and the Utility of States, Value Iteration, Supervised Learning - Basic concepts of classification and supervised learning: Training set, Test set, Overfitting, Underfitting etc., Decision trees: Basic understanding, Learning a Decision tree through entropy calculation, Nearest Neighbor classifier: Basic working principle, Relative advantages and disadvantages, Naive Bayes classifier: Basic working principle, Calculating classification procedures, Relative advantages and disadvantages, Artificial Neural Network: Basic working principle, Basic structure and calculation of a perceptron, Basics of backpropagation algorithm and Support Vector Machines: Basic working principle, Unsupervised Learning (Clustering) - Basic

concepts and applications of Clustering, Different types of Clustering: Partitional vs. Hierarchical, Exclusive vs Overlapping vs Fuzzy, Complete vs Partial, K-means Clustering: Basic working principle, characteristics, advantages, disadvantages, Agglomerative Hierarchical Clustering: Basic concepts, Representations (Dendrograms and Nested cluster diagrams), Different techniques to define cluster proximity: Single link, Complete link, Group average, Centroid method, their relative advantages and disadvantages and DBSCAN: Basic principle and applications, Classification of points (Core, Border and Noise), Reinforcement Learning - Understanding basics of Reinforcement Learning: MDPs, Policies, Rewards, Utilities etc., Passive and Active Reinforcement Learning, Exploration and Exploitation, Adaptive Dynamic Programming, Temporal Difference Learning and Q-Learning.

References:

1. Russell, Stuart, and Peter Norvig. "Artificial intelligence: a modern approach." (1995).

Course Title: Software Testing and Quality Assurance
Course Code: SE 605
Course Credit: 2 Credit Theory and 1 Credit Lab

Course Outline: The Psychology and Economics of Software Testing, Software Testing Life Cycle (STLC), Software Testing Terminology and Methodology, V&V Model, Dynamic Black Box Testing – Boundary Value Analysis, Equivalence Partitioning, State Transition based Testing, Decision Table based Testing, Cause-Effect Graphing based Testing and Error Guessing, Dynamic White Box Testing – Basis Path Testing, Data Flow Testing and Mutation Testing, Inspections, Walkthroughs, Technical Reviews, Unit Testing, Integration Testing, Function Testing, System Testing, Acceptance Testing, Regression Testing, Test Management – Test Organization, Test Plan, Test Design and Specifications, Software Metrics, Software Quality, Quality Control and Quality Assurance, Quality Management and Project Management, Software Quality Metrics, Testing Internet Applications - Security and Performance Testing, Debugging, Test Driven Development (TDD), Behavior Driven Development (BDD). **Tools and Project** - The students will be divided into small groups having at most 3 members and a class project will be given to them for preparing a system test case. They must validate the requirements and create Mock UIs during the preparation of test cases. Besides, each of the students will relate their learnings on unit, regression, performance and security testing, debugging, behavior driven development via different tools like JUnit, Selenium, Apache JMeter, Sprajax, Sqlninja, Bugzilla, Cucumber

References:

1. Naresh Chauhan, Software Testing: Principles and Practices, 1st or higher Edition, Oxford University Press.
2. Glenford J. Myers, Corey Sandler, and Tom Badgett. The Art of Software Testing, 3rd or higher Edition, John Wiley & Sons.
3. Lisa Crispin and Janet Gregory. Agile Testing: A Practical Guide for Testers and Agile Teams, 1st or higher Edition, Pearson Education.

Course Title: Software Design and Analysis
Code: SE 606
Credit: 2 Credit Theory and 1 Credit Lab

Course Outline: Design Concept - The Design Process, Design Concepts, The Design Model; Architectural Design: Software Architecture, Architectural Genres, Architectural Styles, Architectural Design, Assessing, Alternative Architectural Designs, Architectural Mapping Using Data Flow; Component-Level Design: What Is a Component, Designing Class-Based Components, Conducting Component-Level Design, Component-Level Design for WebApps, Designing Traditional Components, Component-Based Development; User Interface Design: The Golden Rules, User Interface Analysis and Design, Interface Analysis, Interface Design Steps, Web App Interface Design, Design Evaluation.

References:

1. Software Engineering – A Practitioner's Approach. 7th Edition, Roger S. Pressman
2. Software Engineering. 9th Edition, Ian Sommerville

Semester 7 (4th year 1st Semester)

Course Title: Internship
Code: SE 701
Credit: 18 Credit Lab

Outline: The student will work full-time as an intern to particular company for a period of six months. S/he will be evaluated based on the marks provided by the company along with the marks of at least two presentations given at IIT.

Semester 8 (4th year 2nd Semester)

Course Title: Project
Code: SE 801
Credit: 6 Credit Lab

Outline: Each student can perform a software development or research project. For a research project a student has to submit a thesis. For software development project, a student should submit documents having the following: Project proposal, Software Requirements Specification, Software Design Specification, Software Test Plan and User Manual. Besides, each of the students has to give multiple intermediate presentations to report their project progress.

Course Title: Computer, Data and Network Security
Code: CSE 802
Credit: 2 Credit Theory and 1 Credit Lab

Course Outline: Overview: Network Security Concepts, Security Attacks, Services and Mechanisms; Classical Encryption techniques: Symmetric Cipher Model, Substitution and Permutation Ciphers, Steganography; Block Ciphers and Data Encryption Standard: Design principles and modes of operation; Public-key cryptography: Introduction to number theory, RSA and Diffie-Hellman; Message Digest: Requirements for cryptographic hash functions,MD5 ,SHA, Message authentication codes, digital signatures; Key Management and Distribution: Symmetric Key Distribution using Symmetric Encryption, Symmetric Key Distribution using asymmetric Encryption, public key distribution, public key certificates, x.509 certificates; Network and Internet Security: Transport Layer Security, Wireless LAN security, e-mail security.

References:
Data and Computer Communications By Stallings, 8th Edition, Pearson Education, 2007

Course Title: Software Project Management
Code: SE 803
Credit: 2 Credit Theory and 1 Credit Lab

Course Outline: Introduction to Project management: Historical background and evolution, Terminologies, Software project management objectives, Scope, focus and basic rules Principles of software project management: Basic PM Skills, SPM framework, elements, stakeholders, boundaries, challenges of SPM Software Project planning: Planning objective, project plan, variations, structure of SPM plan, project estimation, estimation methods, models and decision process. PM organization and scheduling: WBS, types of WBS, functions, activities, tasks, life cycles, phasing and purpose of phasing, building project schedule, network diagrams: PERT, CPM, Bar charts, Gantt charts Software project management techniques: Use of methodologies, Managing risks and issues, Managing Quality, Configuration, Change, Crisis, Documentation, Release. Project monitoring and control: Dimensions of monitoring and control, earned value indicators (BCWS, CV, SV, CPI, SPI), backlog management, dispute and error tracking, RMMM charts Industry scenarios: Domain analysis, Business case analysis, Dynamicity, Success and failure factors, case studies

References:

1. Stellman, Andrew, and Jennifer Greene. *Applied software project management*. " O'Reilly Media, Inc.", 2005.
2. Phillips, Joseph. *IT project management: on track from start to finish*. McGraw-Hill, Inc., 2002.
3. Rubin, Kenneth S. *Essential Scrum: A practical guide to the most popular Agile process*. Addison-Wesley, 2012.

Elective Courses

Course Title: Information Retrieval
Code: CSE 804
Credit: 2 Credit Theory 1 Credit Lab

Course Outline: Boolean Retrieval: Inverted Index, Processing boolean queries, extended Boolean retrieval; Term Vocabulary and Postings lists: Document delineation and character sequence decoding, Tokenization, Dropping common terms: stop words, Normalization (equivalence classing of terms), Stemming and lemmatization, skip pointers, Biword indexes, Positional indexes; Dictionaries and tolerant retrieval: Search structures for dictionaries, General wildcard queries, k-gram indexes for wildcard queries, Spelling correction; Index Construction: Blocked sort-based indexing, Single-pass in-memory indexing, Distributed indexing, Dynamic indexing; Scoring and Ranking: Parametric and zone indexes, Term frequency and weighting, The vector space model for scoring, variant tf-idf functions; Computing scores in a complete search system: Efficient scoring and ranking, Components of an information retrieval system; Evaluation in information retrieval: Evaluation of unranked retrieval sets, Evaluation of ranked retrieval results, Assessing relevance, Results snippets; Relevance feedback and query expansion: The Rocchio algorithm for relevance feedback, Relevance feedback on the web, Evaluation of relevance feedback strategies, Global methods for query reformulation; Language models for information retrieval; Enterprise Information Retrieval: Explore the capacity of Apache Lucene as a text search framework.

References:

1. An Introduction to Information Retrieval by Christopher D. Manning, Prabhakar Raghavan, Hinrich Schütze, Online Edition, 2009, Cambridge University Press, Cambridge, England.

Course Title: Data Mining and Warehousing
Code: CSE 825
Credit: 2 Credit Theory and 1 Credit Lab

Course Outline: Introduction to Data Mining, Knowing Data (Data objects, similarities and dissimilarities, statistical descriptions and visualizations), Data Pre-processing, Data Warehousing and Online Analytical Processing, Data Cube technology, Mining frequent patterns, Classification and Cluster Analysis, Research trends in Data mining and warehousing.

References:

1. Data Mining: Concepts and Techniques. Jiawei Han, Micheline Kambar, Jian Pei [Text Book]

Course Title: Pattern Recognition and Image Processing
Course Code: CSE 829
Course Credit: 2 Credit Theory 1 Credit Lab

Course Outline: Introduction to Image Processing; Digital Image Fundamentals - Elements of Visual Perception. Light and the Electromagnetic Spectrum. Image Sensing and Acquisition. Image Sampling and Quantization. Some Basic Relationships between Pixels. Linear and Nonlinear Operations; Image

Enhancement in the Spatial Domain - Background. Some Basic Gray Level Transformations. Histogram Processing. Enhancement Using Arithmetic/Logic Operations. Basics of Spatial Filtering. Smoothing Spatial Filters. Sharpening Spatial Filters. Combining Spatial Enhancement Methods; Image Enhancement in the Frequency Domain - Background. Introduction to the Fourier Transform and the Frequency Domain. Smoothing Frequency-Domain Filters. Sharpening Frequency Domain Filters. Homomorphic Filtering. Implementation; Restoration in the Presence of Noise Only-Spatial Filtering. Periodic Noise Reduction by Frequency Domain Filtering. Linear, Position-Invariant Degradations. Estimating the Degradation Function. Inverse Filtering. Minimum Mean Square Error (Wiener) Filtering. Constrained Least Squares Filtering. Geometric Mean Filter. Geometric Transformations; Color Image Processing - Color Fundamentals. Color Models. Pseudo color Image Processing. Basics of Full-Color Image Processing. Color Transformations. Smoothing and Sharpening. Color Segmentation. Noise in Color Images. Color Image Compression; Wavelets and Multiresolution Processing - Background. Multiresolution Expansions. Wavelet Transforms; Image Compression - Fundamentals. Image Compression Models. Elements of Information Theory. Error-Free Compression. Lossy Compression. Image Compression Standards; Morphological Image Processing - Preliminaries. Dilation and Erosion. Opening and Closing; Image Segmentation - Detection of Discontinuities. Edge Linking and Boundary Detection. Thresholding. Region-Based Segmentation. Segmentation by Morphological Watersheds. The Use of Motion in Segmentation; Representation and Description - Representation. Object Recognition - Patterns and Pattern Classes. Recognition Based on Decision-Theoretic Methods. Structural Methods.

References:

1. Digital Image Processing - Rafael C Gonzalez and Richard E. Woods.

Course Title: Computer Graphics and Multimedia
Course Code: CSE 831
Course Credit: 2 Credit Theory 1 Credit Lab

Course Outline: Introduction: History of computer graphics, graphics architectures and software, imaging: pinhole camera, human vision, synthetic camera, modeling vs. rendering OpenGL: architecture, displaying simple two-dimensional geometric objects, positioning systems, working in a windowed environment Color: Color perception, color models (RGB, CMY, and HLS), color transformations. Color in OpenGL. RGB and Indexed color. Input: working in a network environment, client-server computing; input measure, event, sample and request input, using callbacks, picking. Geometric transformations: affine transformations (translation, rotation, scaling, and shear), homogeneous coordinates, concatenation, current transformation and matrix stacks. Three dimensional graphics: classical three dimensional viewing, specifying views, affine transformation in3D, projective transformations. Ray Tracing. Shading: illumination and surface modeling, Phong shading model, polygon shading. Rasterization: line drawing via Bresenham's algorithm, clipping, polygonal fill, BitBlt. Introduction to hidden surface removal (z buffer). Discrete Techniques: buffers, bitblt, reading and writing bitmaps and pixel maps, texture mapping, compositing.

References:

1. Computer Graphics, Principle and Practices – James D. Foley, Andries van Dam, Steven K. Feiner and John F. Hughes.

Course Title: Machine Learning
Course Code: CSE 837
Course Credit: 2 Credit Theory 1 Credit Lab

Course Outline: Algorithmic models of learning. Learning classifiers, functions, relations, grammars, probabilistic models, value functions, behaviors and programs from experience. Bayesian, maximum a posteriori, and minimum description length frameworks. Parameter estimation, sufficient statistics, decision trees, neural networks, support vector machines, Bayesian networks, bag of words classifiers, N-gram models; Markov and Hidden Markov models, probabilistic relational models, association rules, nearest neighbor classifiers, locally weighted regression, ensemble classifiers., Clustering, Boosting, margin, and complexity, Spectral clustering, Clustering, mixture models, k-means clustering, hierarchical clustering, distributional clustering. Markov models, Hidden Markov models (HMMs).

References:

1. Machine Learning by Tom M. Mitchell (1st Edition)
2. Pattern Recognition and Machine Learning (Information Science and Statistics) by Christopher M. Bishop

Course Title: Strategic Management
Code: BUS 842
Credit: 3 Credit Theory

Course Outline: Strategic Management Concept: Strategic Leadership, Competitive Advantage, Superior Performance, Performance in Nonprofit Enterprises, Strategic Manager, Strategy Making Process. **Industry analysis, External Environment and Internal Resources Analysis:** Industry and Sector, market segments, Porter's Five Forces Model, , Strategic Groups, Industry Life Cycle Analysis, Macroeconomic Forces, Competitive Advantage, Value Creation and Profitability, Avoiding Failures and Sustaining Competitive Advantage. **Functional and Business Level Strategy:** Achieving Superior Efficiency, Learning Effects, Materials Management, Strategy for Attaining superior Reliability, Responsiveness to Customers, Competitive Positioning and Business Level Strategy, Strategies in Fragmented Industries, Embryonic, Growth and Mature Industries. **Technological Support for Adopting Strategies and Global Strategy:** Format War, Strategies for wining in Format War, Information System Strategy, Managing Intellectual Property Rights, Capturing First-Mover Advantages, Technological Paradigm Shifts, Disruptive Technology, Profitability and Profit Growth through Global Expansion, Global Standardization Strategy. **Strategic Software Engineering:** Architecture-Centric Software Development Strategy, Software Product Lines, Software Effort and Cost Estimation Strategies, Openness of a Software, Software Supply Chain, Software Economics.

References:

1. Theory of Strategic Management (Eighth Edition) By: Hill/Jones
2. Strategic Management (Concepts and Cases) Twelfth Edition By: Fred R. David