

# *Course Curriculum and Syllabus*

*for*

## *Master of Computer Application (MCA) Programme*

*In*

**Department of Computer Science & Engineering**



**Motilal Nehru National Institute of Technology Allahabad  
Prayagraj - 211004, Uttar Pradesh**

**Department of Computer Science & Engineering**  
**Motilal Nehru National Institute of Technology Allahabad**

**Curriculum for**  
**Master of Computer Application (MCA)**

**1<sup>st</sup> Semester**

Sub. Code	Subject	Lectures	Tutorials	Practical	Credits
CS31101	Programming & Problem Solving	4	-	-	4
CS31102	Principles of IT Industries Management	2	-	-	2
CS31103	Digital & Computer Organization	4	-	-	4
CS31104	Foundation of Logic	4	--	--	4
CS31201	Programming & Problem Solving (Lab)	-	-	3	2
CS31202	Digital Computer Organization (Lab)			3	2
CS31203	Shell Programming (Lab)	-	-	3	2
	<b>Total</b>	<b>14</b>		<b>9</b>	<b>20</b>

**Total Hours = 23 Total Credits = 20**

**2<sup>nd</sup> Semester**

Sub. Code	Subject	Lectures	Tutorials	Practical	Credits
CS32101	Data Structures	4	-	-	4
CS32102	Object Oriented Programming	3	-	-	3
CS32103	XML Applications	3	-	-	3
CS32104	Automata Theory	3	-	-	3
CS32105	Technical Writing	2	-	-	2
CS32201	Data Structure (Lab)	-	-	3	2
CS32202	XML Applications (Lab)	-	-	3	2
CS32203	Object Oriented Programming (Lab)	-	-	3	2
	<b>Total</b>	<b>15</b>		<b>09</b>	<b>21</b>

**Total Hours = 24 Total Credits = 21**

### **3<sup>rd</sup> Semester**

<b>Sub. Code</b>	<b>Subject</b>	<b>Lectures</b>	<b>Tutorials</b>	<b>Practical</b>	<b>Credits</b>
CS33101	Operating System	4	-	-	4
CS33102	Dabatase Management System	4	-	-	4
CS33103	Soft Computing	3	-	-	3
CS33104	Analysis of Algorithms	3	-	-	3
CS33105	Object based Modeling	3	-		3
CS33201	Operating System (Lab)	-	-	3	2
CS33202	Dabatase Management System (Lab)	-	-	3	2
CS33203	Analysis of Algorithms (Lab)	-	-	3	2
CS33204	Web Programming (Lab)			3	2
	<b>Total</b>	<b>17</b>	<b>--</b>	<b>12</b>	<b>25</b>

**Total Hours = 29 Total Credits= 25**

### **4<sup>th</sup> Semester**

<b>Sub. Code</b>	<b>Subject</b>	<b>Lectures</b>	<b>Tutorials</b>	<b>Practical</b>	<b>Credits</b>
CS34101	Computer Graphics	4	-	-	4
CS34102	Software Engineering	3	-	-	3
CS34103	Computer Network	4	-	-	4
CS34104	Data Mining	3	-	-	3
CS34201	Computer Graphics (Lab)	-	-	3	2
CS34202	Computer Network (Lab)	-	-	3	2
CS34301 – 34499	Professional Elective – I	3	-	-	3
CS34601	Mini Project I (SRS and Design)		-	3	2
	<b>Total</b>	<b>17</b>		<b>09</b>	<b>23</b>

**Total Hours = 26 Total Credits= 23**

## 5<sup>th</sup> Semester

Sub. Code	Subject	Lectures	Tutorials	Practical	Credits
CS35101	Multimedia Technology	3	-	-	3
CS35102	E-Commerce	4	-	-	4
CS35103	Professional Ethics	2			2
CS35104	Software Project Management	2		-	2
CS35201	Multimedia Technology (Lab)	-	-	3	2
CS35202	E-Commerce (Lab)	-	-	3	2
CS35301-35499	Professional Elective – II	3	-	-	3
CS35301-35499	Professional Elective – III	3	-	-	3
	<b>Total</b>	<b>17</b>	<b>-</b>	<b>06</b>	<b>21</b>

**Total Hours = 23 Total Credits= 21**

## 6<sup>th</sup> Semester

Sub. Code	Subject	Lectures	Tutorials	Practical	Credits
CS36601	Industrial Training	--	-	-	20
	<b>Total</b>	<b>--</b>	<b>--</b>	<b>-</b>	<b>20</b>

**Total Hours = 00 Total Credits= 20**

## List of Electives (for MCA)

### Professional Elective - I

Sl. No.	Subject
1.	Artificial Intelligence
2.	Design Pattern
3.	Functional Programming
4.	Genetic Algorithm
5.	Network Administration
6.	Advanced Computer Network
7.	SOSE (Service Oriented Software Engineering)
8.	Simulation & Modeling
9.	Mobile Computing
10.	Cryptography & Network Security
11.	Image Processing

### Professional Elective – II & III

Sl. No.	Subject
1.	Business Intelligence
2.	Data Compression
3.	Information Retrieval
4.	Pattern Recognition
5.	Semantic Web
6.	Software Metric & Quality
7.	Web Mining
8.	Wireless Network Security
9.	Distributed Database
10.	Real Time Systems
11.	Software Testing

Note: The list of Professional Electives would be enriched further.

**Curriculum for  
Master in Computer Application (MCA)**

**Summery Sheet (Semester Wise)**

**MCA 1<sup>st</sup> Semester**

**Total Hours = 23 Total Credits= 20**

**MCA 2<sup>nd</sup> Semester**

**Total Hours = 24 Total Credits= 21**

**MCA 3<sup>rd</sup> Semester**

**Total Hours = 29 Total Credits= 25**

**MCA 4<sup>th</sup> Semester**

**Total Hours = 26 Total Credits= 23**

**MCA 5<sup>th</sup> Semester**

**Total Hours = 23 Total Credits= 21**

**MCA 6<sup>th</sup> Semester**

**Total Hours = 00 Total Credits= 20**

**Total Credits (from 1<sup>st</sup> to 6<sup>th</sup> Semester) = 130**

# Programming and Problem Solving (I Semester 4L)

## Syllabus

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### Course Description

This is a first course in programming which intends to introduce students to the foundations of computing, programming and problem-solving. Aim is to develop basic programming skills necessary for engineering education. Students would learn C/C++ programming in Unix/Linux environment. This course has a associated lab with it.

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### Course Outline (To be covered in 40 lectures)

1. Introduction, LINUX Commands, editors, Files & Directories, Design of algorithms (4)
  2. Writing a Simple Program: Learning the form of a C program, Declaring variables, designing program flow and control, using standard terminal I/O functions. (6)
  3. Fundamental Data Types and Storage Classes, Operators and Expressions Conditional Program Execution Loops and Iteration, Introduction to Abstraction, functions, (8)
  4. Arrays, Pointers, Structures (7)
  5. Introduction to Object Oriented Programming concepts, Classes and Objects, Important C++ constructs, Brief introduction to few other object oriented languages (10)
  6. The Standard C/C++ Preprocessor, The Standard C/C++ Library (5)
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### Text Books

1. How to solve it by Computer by R. J. Dromey
2. The C Programming Language by Brian W. Kernighan, Dennis M. Ritchie
3. On to C++ by P H Winston ( also available online)
4. Structure and Interpretation of Computer Programs by Harold Abelson and Gerald Sussman with Julie Sussman, (Also available online)
5. Thinking in Java by Bruce Eckel

# **Principles of IT Industries Management (I Semester 2L)**

## **Syllabus**

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### **Course Description**

This course introduces students the working and management of IT industries. The emphasis of the course will be on the skills and knowledge needed to understand and successfully manage an IT based organization. A central concept of the course is that there is a general framework for understanding management that applies to managers in all organizations-large or small, public or private, product-oriented or service-oriented.

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### **Course Outline (To be covered in 20 lectures)**

1. Introduction, Nature & Concept of Management; Managerial skills; Evolution of management thought; Concept of functional management; Management styles, Productivity measurement, productivity index, types of production system.
  2. Human Resource Management: Definition and theories of Managing People for IT Industry, Human Resource Planning, responsibility assignment matrix, resource management, developing and managing the project team, Case Studies
  3. IT Industry Supply Chain Management: Types, Business processes, Strategic, tactical, and operational decisions in supply chains, performance measures, inventory management, bullwhip effect, e-marketplaces, e-procurement, e-logistics, e-fulfillment, customer relationship management, web services, ERP and supply chains, Case Studies
  4. IT Project Quality Management: Tools and techniques for quality control (Pareto Analysis, Statistical sampling, testing), process control, SQC control charts, single, double and sequential sampling, TQM. Case Studies
  5. Environmental Issues, Pollution Control Acts, Green IT Practices, Establishing a Green IT Action Plan, techniques and technologies available to enable Green IT Case Studies
  6. Comprehensive Case studies: Any three from TCS, Cisco, Infosys, Wipro, Facebook, Accenture, Google, IBM, Microsoft etc.
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### **Text Books**

1. Management :Global Perspectives, by Koontz and Weihrich
2. Principles of Management by Prasad, L.M.,
3. Environmental and Pollution Awareness by Sharma B.R.



# **Digital Computer Organization (I Semester 4L)**

## **Syllabus**

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### **Course Description**

This is a first course dealing with layout and design principles of a computing system and its peripherals. It prepares foundations for the operating system, microprocessor and embedded systems courses. This course has associated lab with it.

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### **Course Outline (To be covered in 40 lectures)**

1. Introduction, Boolean Algebra and fundamental theorems, Basic Logic Gates, Realization of combinational circuits using universal gates, Gate level minimization, Important Digital Circuits Decoder, Multiplexer, PLA, ROM, RAM Design of Sequential Circuits, Flip Flops, Registers, Counters (10)
  2. Register Transfer Language, Bus and Memory Transfers, Bus Architecture, Arithmetic Logic Unit (6)
  3. Fundamental concepts of controller design, Processor design and related issues (10)
  4. Input/Output Organization and related concepts(4)
  5. Optical, magnetic and semiconductor memory devices, Memory organization (6)
  6. Case Studies of Microprocessors (4)
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### **Text Books**

1. Digital Design by Morris Mano, M D Ciletti
2. Computer Organization and Design: The Hardware-Software Interface, by David Patterson and John Hennessy.
3. Computer Organization, by Vravice, Zaky & Hamatcher
4. Structured Computer Organization, by Tannenbaum

# Foundation of Logic (I Semester 4L)

## Syllabus

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### Course Description

This course offers a presentation of fundamental tools required in advanced computer science. The main topics covered in this subject include propositional and first-order logic, recursion, proofs, other kinds of logic. This forms the basis for the subjects like Automata theory and formal methods.

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### Course Outline (to be covered in 40 lectures)

1. Introduction, Set theory, Notion of proofs , Linear congruence (6)
  2. Formal logic: Propositional Logic, Relational logic, First order logic, and related issues (10)
  3. Lattices and related issues (10)
  4. Group Theory and related issues, Finite Fields and related issues (8)
  5. Generating Functions and related issues (6)
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### Text Books

1. The Essence of Logic, by John Kelly, Ed.
2. Logic for Applications, Anil Nerode and Richard A. Shore, Ed.
3. Logic, Sets, and Recursion, by Robert L. Causey, Ed.
4. Concrete mathematics: a foundation for computer science, by R. Graham, D. Knuth, O. Patashnik,
5. *A Mathematical Introduction to Logic*, Enderton, H
6. Discrete Mathematical Structure with Application to Computer Science”, J.P Trembley,. & R. Manohar

# **Data Structures (II Semester 4L)**

## **Syllabus**

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### **Course Description**

This course introduces the students fundamentals of data structures and takes them forward to software design along with the course on Algorithms. It details how the choice of data structures impacts the performance of programs for given software application. This is a precursor to DBMS and Operating Systems. A lab course is associated with it to strengthen the concepts.

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### **Course Outline (To be covered in 40 lectures)**

1. Introduction, Elementary Data Organization, Data Structure Operations, Algorithms Complexity, Time-Space Trade off (6)
  2. Arrays, Linked List, stacks and Queues (10)
  3. Tree, Binary tree, Search tree, Heap, B+ tree (12)
  4. Sorting methods, External Sorting/Searching, Hashing (8)
  5. Graphs (6)
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### **Text Books**

1. The Art of Computer Programming (Volume 1 and Volume 3) - D E Knuth,
2. Data Structures Using C & C++, Langsam, Augenstein & Tenenbaum,
3. Data Structures – A Programming Approach with C, Kushwaha & Mishra,
4. R.L. Kruse, B.P. Leary, C.L. Tondo, “Data structure and program design in C”
5. Fundamentals of Data Structures in C, by Ellis Horowitz, Sartaj Sahni, and Susan Anderson-Freed

# Object Oriented Programming (II Semester 3L)

## Syllabus

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### Course Description

This is an introductory course, where students learn and practice essential programming skills using the Java programming language. This course provides an overview of Object Oriented Programming (OOP) concepts using Java/C++. It helps to understand basic OOP concepts and assist in applying these concepts. The principles behind OOP discussed. It covers object-oriented principles such as classes, objects, abstraction, composition, Inheritance, polymorphism, and interfaces. These concepts can be implemented in the Java language. Along the way, many of the Java library classes are seen that can be organized to solve a variety of problems. The Java collection classes are studied. Additional topics include exception handling, database connectivity with JDBC, and multi-threading. The course is programming intensive. By the end of this course student will able to understand the basics of OOP and be prepared to take on more complex challenges. A lab course is associated with it to strengthen the concepts.

### Course Outline (To be covered in 30 lectures)

1. *Core Java*: Introduction to Object Oriented Software development through Java. Classes and Objects. (6)
2. Inheritance, Polymorphism, Nested classes and interfaces, Exceptions, Strings, Packages, The I/O Package.(8)
3. *Advanced Java*: Event Handling, AWT, Swing, Applets, Multi-Threading, Generic, The collection frameworks.(8)
4. Networking, Java Server Pages (JSP), Java Servlet, Enterprise Java Beans (EJB), Java Messaging Service (JMS), Java Database connectivity (JDBC).(6)

### Text Books

1. Kathy Sierra and Bert Bates, “Head First Java”, 2<sup>nd</sup> edition, O’Reilly
2. Herbert Schildt , “Java : The Complete Reference”, 9<sup>th</sup> edition, Oracle Press
3. Cay S. Horstmann and Gary Cornell , “Core Java Volume I & II”, 10<sup>th</sup> edition, Prentice-Hall
4. Tony Gaddis, “Starting Out with Java: From Control Structures through Objects”, 6<sup>th</sup> edition, Pearson
5. David Flanagan, “Java in a Nutshell”, 5<sup>th</sup> edition, O’Reilly

# **XML and Applications (II Semester 3L)**

## **Syllabus**

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### **Course Description**

This course introduces students to the basic concepts of the eXtensible markup language (XML). XML has made a major impact in almost every aspect of software development. Designed as an open, extensible, self-describing language, it has become the world-wide standard for data and document delivery on the Web. Students will be instructed as to the purpose of an XML document and what it consists of, in how a Document Type Definition (DTD) or schema is used to validate an XML document and the extensible style language (XSL) to transform XML documents into HTML/XHTML. XML-related technologies continue to develop, to enable validation, navigation, transformation, linking, querying, description, and messaging of data. Students would be exposed to such wide range of application domains. A lab course is associated with it.

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### **Course Outline (To be covered in 30 lectures)**

1. Emerging Technologies; XML Documents: Syntax, Well formed and Valid; CCS and XHTML; Document Type Definition(DTD); XML Schema : XSD, XDR, Examples; JavaScript (12)
  2. SAX and DOM Parser and APIs, Example of API usage; XPATH, XLink, Xpointer; XSL: XSLT (10)
  3. Applications: RDF and RDFS, JENA API, Case Study (8)
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### **Text Books**

1. XML The Microsoft Way By Peter G. Aitken
2. Learning XML By Erik T. Ray and Christopher R. Maden
3. XML How to Program By Harvey M. Deitel, Paul J. Deitel, Tem R. Nieto, Ted Lin and Praveen Sadhu

# **Automata Theory (II Semester 3L)**

## **Syllabus**

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### **Course Description**

Automata theory is the study of abstract computational devices. They have applications in modelling hardware, lexical analysis, machine design, syntax analysis, parser generation, program verification, text editing and so on. The class of formal languages, context free grammar, DFA, NFA and PDA are being covered up in the course. The knowledge of these concepts form the foundations of computer science and continues towards the development of the student's skills in understanding mathematical models. The prerequisite is basic knowledge of mathematics. A lab course is associated with it to strengthen the concepts.

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### **Course Outline (To be covered in 30 lectures)**

1. Introduction, inductive Proofs Relations and Functions, Regular Languages DFA, NFA Machines and their equivalence, Regular Expressions, Equivalence of Regular Expressions and Finite State Machines, Closure Properties of Regular Languages Proving Non-Regularity (6)
  2. Context-free Languages Context-free Grammars, Derivations, Leftmost, Rightmost, Inherent Ambiguity, Parse Trees, Normal Forms, Proof of Containment of the Regular Languages Pushdown Automata, Equivalence of PDAs and Context-free Grammars Closure Properties of Context-free Languages (9)
  3. Pumping Lemma for both Regular & Context-free Languages, Proving Some Languages are not Context-free. (6)
  4. Recursive and Recursively Enumerable Languages, Turing Machines Definition of Recursive and Recursively Enumerable, Church's Hypothesis, Computable Functions, Methods for Turing Machine Construction (9)
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### **Text Books**

1. Introduction to the Theory of Computation, by Michael Sipser
2. Introduction to Automata Theory, Languages, and Computation, by Hopcroft, Motwani, and Ullman (ISBN 0-321-45536-3)
3. Theory of Computer Sciences Korral,
4. Automata, Computability and Complexity: Theory and Applications. by E Rich

# Technical Writing (II Semester 2L)

## Syllabus

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### Course Description

This course is an introduction to Technical Writing. To help students analyze the communication situation fully and accurately: which includes needs, audiences, and users. To gather, interpret, and document information logically, efficiently, and ethically. To develop professional work and teamwork habits. To be able to design usable, clear, persuasive, accessible documents. To educate the students to select the appropriate format for presenting information and organize information using reader-based principles. To motivate them to use graphics effectively. And finally develop an effective, clear writing style.

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### Course Outline (To be covered in 20 lectures)

1. Introduction, Introduction To Latex, Introduction to Xfig and other drawing software. (8)
  2. English usage, when English is a foreign language. (6)
  3. Reading a draft, Writing a draft, revising a draft, Introduction to IEEE, ACM style files (6)
  4. Writing a technical talk, presenting the technical talk (4)
  5. Writing a project/thesis. Introduction to various styles. (4)
  6. Copyright issues and plagiarism (2)
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### Text Books

1. Handbook of Writing for the Mathematical Sciences By Nicholas J. Higham
2. *The Elements of Style*, William Strunk, [ISBN 0-205-30902-X](#)
3. LaTeX: A document preparation system, User's guide and reference manual  
*Leslie Lamport*, ISBN 0-201-52983-1
4. Cambridge English for Engineering, Mark Ibbotson

# **Operating System (III Semester 4L)**

## **Syllabus**

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### **Course Description**

In this course students will study the basic facilities provided in modern operating systems. The emphasis will be on understanding general concepts that are applicable to a wide range of operating systems, rather than a discussion of the features of any one specific system. Topics that will be covered in the course include: protected kernels, processes and threads, concurrency and synchronization, memory management, virtual memory, file systems, secondary storage, protection, and security. This course requires as prerequisite the course on computer programming, data structures and computer organization. This course has an associated lab with it.

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### **Course Outline (To be covered in 40 lectures)**

1. Introduction and Overview (2)
  2. Process fundamentals, scheduling, synchronization (12)
  3. Inter-process communication, Deadlock (8)
  4. Memory management and virtual memory (7)
  5. File system and secondary storage (5)
  6. Protection and security issues, Case studies e.g. Linux, Solaris and Android (6)
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### **Text Books**

1. Operating Systems, by William Stallings
2. Operating Systems Concepts by Silberschatz, Galvin, and Gagne
3. The Design of the UNIX Operating System, by Maurice J. Bach
4. Advanced Programming in the UNIX Environment, by W. R. Stevens & S. A. Rago
5. The Design and implementation of the 4.4 BSD UNIX operating system by Marshall Kirk McKusick, Keith Bostic, Michael J. Karels, John S. Quarterman



# **Database Management System (III Semester 4L)**

## **Syllabus**

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### **Course Description**

In this course students will study the basic functions and capabilities of database management systems (DBMS). Emphasis is placed on the use of DBMS in solving information processing problems which will include database design case studies as well as SQL programming assignments along with transactions. A lab course is associated with it to strengthen the concepts.

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### **Course Outline (To be covered in 40 lectures)**

1. Database system concept and architecture, Entity Relationship and Enhanced E-R (5)
  2. Relational Data Model and Relational Algebra, SQL, Indexing, Query Optimization (10)
  3. Relational Database Design, Normalization principles and normal forms (8)
  4. Transaction concept and concurrency control (8)
  5. Web Interface to DBMS, Semi-structured databases, Object oriented databases (6)
  6. DBMS Case studies (3)
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### **Text Books**

1. Database system concepts, by Korth, Silberschatz, and Sudarshan
2. Fundamentals of Database Systems by Elmasari and Nawathe
3. Databases by O Neil,
4. Database Systems The Complete Book by Garcia-Molina, Ullman, & Widom
5. Database Management System by Ramakrishnan and Gehrke

# Soft Computing ( III Semester 3L)

## Syllabus

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### Course Description

This course has a associated lab with it. This course introduces soft computing methods. The principal constituents of soft computing are fuzzy logic, neural network theory, and probabilistic reasoning. The course studies the methods and explores how they are employed in associated techniques such as Case-Based Reasoning and expert systems for pattern recognition, clustering, diagnosis, and control both individually and in hybrid arrangement. The basics of each technique will be discussed and industrial applications will illustrate the strengths of each approach.

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### Course Outline (to be covered in 30 lectures)

1. Introduction, Learning Processes, Neural Network (NN) (9)
  2. Single and Multi-Layer Perceptron, Fuzzy Logic and Fuzzy Set Theory (9)
  3. Fuzzy Systems, Neuro-Fuzzy Modeling (8)
  4. Applications of Soft Computing (4)
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### Text Books

1. Neuro-Fuzzy and Soft Computing by J.-S.R. Jang, C.-T. Sun, E. Mizutani;
2. Applying Case-Based Reasoning by I. Watson
3. Fuzzy Logic with Engineering Applications by T J ross

# **Analysis of Algorithms (III Semester 3L)**

## **Syllabus**

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### **Course Description**

This course teaches techniques for the analysis of efficient algorithms, emphasizing methods useful in practice. Algorithms are recipes for solving computational problems. In this course we will study fundamental algorithms for solving a variety of problems, including sorting, searching, divide-and-conquer, dynamic programming, greediness, and probabilistic approaches. Algorithms are judged not only by how well they solve a problem, but also by how effectively they use resources like time and space. Techniques for analyzing time and space complexity of algorithms and to evaluate tradeoffs between different algorithms. Analysis of algorithms is studied - worst case, average case, and amortized - with an emphasis on the close connection between the time complexity of an algorithm and the underlying data structures. NP-Completeness theory is examined along with methods of coping with intractability, such as approximation and probabilistic algorithms. A basic understanding of mathematical functions and data structures is a prerequisite for the subject. A lab course is associated with it to strengthen the concepts.

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### **Course Outline (To be covered in 30 lectures)**

1. Introduction, Review of basic concepts, advanced data structures like Binomial Heaps, Fibonacci Heaps (5)
  2. Divide and Conquer with examples such as Sorting, Matrix Multiplication, Convex hull etc(6)
  3. Dynamic programming with examples such as Kanpsack, All pair shortest paths etc (4)
  4. Backtracking, Branch and Bound with examples such as Travelling Salesman Problem etc (6)
  5. Algorithms involving Computational Geometry (4)
  6. Selected topics such as NP-completeness, Approximation algorithms, Randomized algorithms, String Matching (5)
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### **Text Books (Not Applicable)**

1. Thomas H. Cormen, Charles E. Leiserson and Ronald L. Rivest, "Introduction to Algorithms", Printice Hall of India
2. E. Horowitz & S Sahni, "Fundamentals of Computer Algorithms"
3. Aho, Hopcraft, Ullman, "The Design and Analysis of Computer Algorithms" Pearson Education

# Object Based Modeling (III Semester 3L)

## Syllabus

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### Course Description

In this course students will study the fundamental principles of object-oriented approaches to modeling software requirements and design. Topics include strategies for identifying objects and classes of objects, specification of software requirements and design, the design of class hierarchies, software reuse considerations, graphical notations, system implementation using object-oriented and object-based programming languages, and comparison of object-oriented approaches to more traditional approaches based on functional decomposition.

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### Course Outline (To be covered in 30 lectures)

1. Introduction to Object Orientation: Abstractions, Encapsulation, Interfaces & their Implementations, Abstract Data Types, Design by Contract, Classes, Implementation sharing & 'this' reference, Single inheritance, Dynamic Binding, Methods and Messages, Polymorphism, Sub-typing in Inheritance, Engineering Properties: building abstractions and hierarchies. (06)
2. Unified Modeling Languages (UML): Overview of Unified Modeling Language (UML), Static and Dynamic Models, Use-Case Diagrams, UML Class Diagrams, Object Diagram, Sequence Diagram, Activity Diagram, Collaboration Diagram, Deployment Diagrams. (06)
3. Object Oriented Analysis & Design: Identifying Relationships, Attributes, and Methods, Associations, Inheritance Relationships, A Part of Relationship-Aggregation, Class Responsibilities, Object Responsibilities. Object Oriented Design Processes, Design Properties. (06)
4. Logical Architecture: Packages, Subsystems, View Layer /UI Layer/Boundary Objects, Application Logic Layer/ Business Logic Layer /Domain Objects/ Control Objects, Access Layer/Technical Services Layer/Entity Objects (04)
5. Design Pattern and frameworks : Design Reuse, Creational Patterns with Example Applications, Structural Patterns with Example Applications, Behavioral Patterns with Example Applications, Application Frameworks (08)

### Text Books

1. *Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design and Iterative Development*, By Craig Larman.
2. "[Design Patterns: Elements of Reusable Object-Oriented Software](#)" by Erich Gamma et. al.
3. *Object-Oriented Modeling and Design with UML* - Michael Blaha, James Rumbaugh
4. *Pattern-Oriented Software Architecture A System of Patterns, Volume 1* - Frank Buschmann, Regine Meunier, Hans Rohnert, Peter Sommerlad, Michael Stal
5. *Object-Oriented Analysis and Design with Applications* - Grady Booch et al
6. *Object-Oriented Design with UML and JAVA* - K. Barclay, J. Savage
7. *Practical Object-Oriented Design with UML* - Mark Priestley.

# **Computer Graphics (IV Semester 4L)**

## **Syllabus**

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### **Course Description**

In this course students will study the fundamental concepts in creating graphical images on the computer. Computer graphics uses ideas from Art, Mathematics, and Information Technology to create images. The students are expected to be comfortable writing programs in an upper level language, and have sound background in mathematics, as a great deal of computer graphics is best described mathematically. This course leads to courses on multimedia and image processing. This course has an associated lab course with it.

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### **Course Outline (To be covered in 40 lectures)**

1. Introduction, Input-Output devices, Line Scan algorithms, Mid –point Circle and Ellipse Generating algorithms, Polygon Filling, Clipping (7)
  2. Geometrical Transformations (2D & 3D), Projections, Visible-Surface Determination (9)
  3. Representation of Curves and Surfaces, Solid Modeling (6)
  4. Color models and applications(4)
  5. CAD/CAM and Applications of computer Graphics (4)
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### **Text Books**

1. Computer Graphics, by Hearn and Bakerand
2. Procedural Elements of Computer Graphics by Rogers
3. Principle of Interactive Computer Graphics by Newman and Sproul
4. Computer Graphics, A programming Approach by Steven Harrington

# Software Engineering (IV Semester 3L)

## Syllabus

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### Course Description

In this course students will study the fundamentals of software engineering, including understanding system requirements, finding appropriate engineering compromises, effective methods of design, coding, and testing, team software development, and the application of engineering tools. The course will combine a strong technical focus with a mini project (offered alongside), providing the opportunity to practice engineering knowledge, skills, and practices in a realistic development setting. This course has a associated Mini Project with it.

### Course Outline (To be covered in 30 lectures)

1. Introduction, Software life-cycle models (4)
2. Software requirements, Requirements Specification (6)
3. Software design and Software user interface design(7)
4. Coding Issues, Software integration and testing. (6)
5. Software support processes and Quality Assurance, IEEE Software Engineering Standards (4)
6. Software maintenance, Software reuse, (3)

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### Text Books

1. Software Engineering – A Practitioner’s Approach, by Pressman R. S. and Ince D
2. Software Engineering by Sommerville
3. Software Engineering, Volume 1 and Volume 2, by Thayer, and Christiansen,
4. Fundamentals of Software Engineering by Rajib Mall

# **Computer Networks (IV Semester 4L)**

## **Syllabus**

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### **Course Description**

In this course students will study computer networks within the context of the Internet. It will build on prior knowledge in Communication foundations, computer organization, basic algorithms, data structures and C programming. Students will study the fundamental principles, elements, and protocols of computer networks. Course will investigate how the different protocols work, why they work that way, and their performance trade-offs. This course prepares foundations for wireless networks and distributed systems. This has a lab course associated with it.

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### **Course Outline (To be covered in 40 lectures)**

1. Introduction, Fundamental requirements of network, OSI & TCP/IP model (3) Physical and Link layer issues (4)
  2. Medium Access protocols (IEEE 802.3 ...) and related issues (8)
  3. Network layer: IP and other protocols, Routing protocols, and LAN design. (11)
  4. Transport layer Protocols and related Issues (8)
  5. Basic client server architecture, introduction to different application layer protocols like ftp, telnet, mail(SMTP), HTTP, DNS, DHCP and peer to peer (6)
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### **Text Books**

1. Computer Network – Top down approach by James. F. Kurose & Keith W. Rose,
2. Computer Network – A system approach by Larry.L.Peterson & Bruce.S.Davie
3. Data Communication & Networking by Behrouz Forouzan
4. Unix Network Programming –volume-I by W.Richard Stevens

# **Data Mining (IV Semester 3L)**

## **Syllabus**

### **Course Description**

This course will offer a comprehensive coverage of well known Data Mining topics including classification, clustering and association rules. A number of specific algorithms and techniques under each category will be discussed. Methods for feature selection, dimensionality reduction and performance evaluation will also be covered. Students will learn and work with appropriate software tools and packages in the laboratory. They will be exposed to relevant Data Mining research. A separate lab course is associated with this course.

### **Course Outline (to be covered in 30 lectures)**

#### **UNIT-I (8)**

##### **DATA MINING, DATA PROCESSING AND DATA WAREHOUSES**

Data Mining – History – Strategies – Techniques – Applications – Challenges – Future- Types of Data – Data Warehouses – Data Processing - Quality Measure – OLAP – Sampling.

##### **DATA TYPES, INPUT AND OUTPUT OF DATA MINING ALGORITHMS**

Different Types of features – Concept Learning – Output of Data Mining Algorithms.

##### **PREPROCESSING IN DATA MINING**

– Steps – Discretization – Feature Extraction, Selection and construction – Missing Data and Techniques for dealing it.

#### **UNIT-II CLASSIFICATION TASK: (8)**

Introduction – Decision trees – Naïve Bayes' classification- Artificial Neural Networks and Support Vector Machines.

#### **UNIT-III MODEL EVALUATION TECHNIQUES (6)**

Accuracy Estimation- ROC-Lift Charts- Cost –Bagging and Boosting- Model Ranking Approach.

##### **ASSOCIATION RULE MINING:**

Concepts, Relevance, Functions of Association rule Mining – Apriori Algorithm- Strengths and Weaknesses of ARM- Applications.

#### **UNIT IV - CLUSTERING AND ESTIMATION(8)**

##### **CLUSTERING TASK:**

Introduction- Distance Measure – Types – KNN for clustering – validation -Strengths and Weaknesses of Algorithms – Applications.

##### **ESTIMATION TASK:**

Scatter Plots and Correlation – Linear regression Models – Logistic regression – Regression Analysis - Strengths and Weaknesses of Estimation- Applications.

##### **Text Books**

1. Shawkat Ali A B M, Saleh A. Wasimi “Data Mining: Methods and Techniques” Third Indian Reprint, Cengage Learning, 2015
2. Soman K. P., Shyam Diwakar, Ajay V. “Insight into Data Mining Theory and Practice” ,Fifth Printing, PHI Learning, 2011.



# Multimedia Technology (VI Semester 3L)

## Syllabus

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### Course Description

In this course students will study multimedia technologies, both standard and newly developed. Course coverage will include both theoretical understanding of multimedia technologies, and hands-on experience with applications and hardware. Topics may include perception, cognition, and communication issues, multimedia interface standards, multimedia evaluation, digitizing and manipulating images, voice, and video materials. Courses namely Computer graphics, Operating System and Computer Networks are prerequisites. A lab course is associated with it to strengthen the concepts.

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### Course Outline (To be covered in 30 lectures)

1. Introduction, Multimedia Information, Multimedia Objects, Convergence of Computer, Communication and Entertainment products, Digital representation (6)
  2. Multimedia hardware, Memory & storage devices, Communication devices, Multimedia software's, presentation tools, tools for object generations, video, sound, image capturing, authoring tools, card and page based authoring tools (6)
  3. Introduction to Text, hypertext & hypermedia, Sound, MIDI, Digital Audio concepts, audio file formats Sampling Variables, Loss less compression of sound, Audio Capture. (6)
  4. Introduction to video& images :Multiple monitors, bitmaps, Vector drawing, Image format conversion, image compression, JPEG Compression, image & video file formats, animation, animation file formats. Video representation, Video Compression, color models, MPEG standards, Video Streaming on net, Video on demand. (6)
  5. Introduction to multimedia communications. multimedia over I.P, multimedia Over ATM Networks, multimedia Data Base, content based retrieval in Digital libraries, multimedia over wireless networks. Serial port programming and interrupts (6)
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### Text Books

1. Fundamental of Multimedia by Li and Drew
2. Principle of Multimedia by Rajan Parekh
3. Multimedia, Making it Work by Tay Vaughan

# **E-Commerce (V Semester 4L)**

## **Syllabus**

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### **Course Description**

The growth of the Internet continues to have a tremendous influence on business. Companies and organizations of all types and sizes are rethinking their strategies and how they run their operations. This new course in the Temple E-Marketing program challenges students to explore the realities and implications of e-commerce from a marketer's perspective. Business-to-consumer (B2C) and business-to-business (B2B) e-commerce markets are examined. The course introduces students to a wide range of electronic commerce issues for marketers, as a foundation for continual learning in the dynamic e-commerce environment. This course has a associated lab with it.

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### **Course Outline (To be covered in 30 lectures)**

1. Introduction to e-Commerce and Network Infrastructure for e-commerce. (6)
  2. E-commerce Models, e-Advertising & Marketing (8)
  3. Electronic Payment Systems and Electronic Data Exchange (8)
  4. E-commerce Security (6)
  5. e-CRM (7)
  6. Mobile Commerce (5)
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### **Text Books**

1. Introduction to E-commerce by Jeffrey F.Rayport & Bernard J.Jaworski
2. Frontiers of E-commerce by Kalakota & Winston
3. E-Commerce- Strategy technologies and Applications by David Whiteley
4. E-Commerce-Concepts, Models & Strategies by C.S.V. Murthy
5. E-Commerce by Perry

# **Professional Ethics (V Semester 2L)**

## **Syllabus**

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### **Course Description**

In this course students will study application of moral reasoning to established profession of computer engineering. Moral reasoning entails the search for values and principles that promote a good life and human flourishing. As a professional, one has to employ ones expertise in the ways that greatly affect the lives of others. After crediting the course the students are expected to identify ethical conflicts, identify their responsibilities and options, and think through the implications of possible solutions to ethical conflicts.

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### **Course Outline (To be covered in 20 lectures)**

1. Introduction, Ethical theories (4)
  2. Ethics in IT societies, Intellectual rights and privacy (6)
  3. Professional Relationships, Professional Responsibilities, Professional Ethics in Computing (6)
  4. Online crime, hacking, Legal aspects of Professional Ethics (4)
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### **Text Books**

1. **IEEE/ACM** Software Engineering Code of Ethics and Professional Practice (online)
2. Computer Ethics by Deborah Johnson
3. Ethics in Engineering by Martin M.W., Schinzinger R.
4. Ethics in Information Technology by George Reynolds
5. Readings in Cyber Ethics, Edited by Richard Spinello and Herman Tavani.

# Software Project Management (V Semester 2L)

## UNIT -I: (04 Lecture)

Overview of Software Project Planning

Software Project, Categorization of software Project, Introduction to Stepwise Project Planning,

## UNIT- II: (04 Lecture)

Project Evaluation

Strategy assessment, Technical Assessment, Cost Benefit Analysis, Cash flow forecasting, Risk

## Unit III: (08 Lecture)

Software Effort Estimation & Activity Plan Over & under estimation problem. basis for software estimation. Estimation by analogy. COCOMO. Parameter Model function. point analysis, Project schedule, Planning Model, Project Time management, Activity duration estimation.

## Unit IV : (04 Lecture)

Risk management. Identification. Analysis and abatement of risk. Nature of resources. critical, county cost, schedule, Monetary & control, Cost Monitoring, Priority by monetary, Managing

## Reference Books :

- Software Project Management, A Unified Framework "WALKER ROYCE" "First Edition" "Pearson Education".
- Software Project Management, 6<sup>th</sup> Edition (TMH)
- Quality Software Project Management by Robert T. Futrel, Pearson Education.

# **Professional Elective – I**

# Artificial Intelligence (Professional Elective 3L)

## Syllabus

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### Course Description

This course introduces students to the basic knowledge representation, problem solving, and learning methods of artificial intelligence (AI). It covers basic elements of AI, such as knowledge representation, inference, machine learning.

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### Course Outline (To be covered in 30 lectures)

1. Introduction, Intelligent agents, reactive, deliberative, goal-driven, utility-driven, and learning agents, Artificial Intelligence programming (5)
  2. Defining problems at state space search, Production system, Problem and production system characteristics, Forward and backward, state-space, blind, heuristic, problem-reduction, A, A\*, AO\*, minimax, constraint propagation, neural, stochastic, and evolutionary search algorithms, sample applications. Issues in design of search programs (7)
  3. foundations of knowledge representation and reasoning, issues in knowledge representation, representing and reasoning about objects, relations, events, actions, time, and space; predicate logic, situation calculus, description logics, reasoning with defaults, sample applications. (6)
  4. Planning as search, partial order planning, construction and use of planning graphs, planning and acting in the real world (3)
  5. Basics of utility theory, decision theory, sequential decision problems, elementary game theory, sample applications. (4)
  6. Learning from memorization, examples, explanation, and exploration. Supervised and unsupervised learning, learning nearest neighbor, naive Bayes, and decision tree classifiers, Q-learning for learning action policies, applications. Sample Applications of AI (5)
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### Text Books

1. Artificial Intelligence: A Modern Approach, by Stuart Russell and Peter Norvig,
2. Artificial Intelligence by Eliane Rich, Kevin Knight and Shivashankar B Nair,
3. Introduction to Artificial Intelligence by Charniak, McDermott

# Design Patterns (Professional Elective 3L)

## Syllabus

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### Course Description

This course is an introduction to software design patterns. Each pattern represents a best practice solution to a software problem in context of some application. The course will cover both the rationale and benefits of object-oriented software design patterns. Several example problems need to be studied to investigate the development of good design patterns. Specific patterns, such as Observer, State, Adapter, Strategy, Decorator and Abstract Factory would be covered.

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### Course Outline

1. Introduction To Design Patterns, Introduction To Java, Some OO Design Principles , The Observer Pattern, The Template Method Pattern (6)
  2. Factory Patterns: Factory Method and Abstract Factory, The Singleton Pattern, The Iterator Pattern, The Composite Pattern, The Facade Pattern (6)
  3. The State and Strategy Patterns, Functors and the Command Pattern, The Proxy Pattern (5)
  4. RMI, The Adapter Pattern, The Decorator Pattern (4)
  5. Dynamic Proxies In Java, The Chain of Responsibility Pattern, Concurrency Patterns, The Visitor Pattern, Anti Patterns (5)
  6. Layer, Pipe and Filters, Black Board Broker, Case Studies (4)
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### Text Books

1. Design Patterns - Elements Of Reusable Object-Oriented Software, Erich Gamma, Richard Helm, Ralph Johnson, and John Vlissides,
2. Head First Design Patterns, Eric Freeman and Elisabeth Freeman
3. Applied Java Patterns, Stephen Stelting and Olav Maassen,
4. Java Design Patterns - A Tutorial, James W. Cooper,
5. Refactoring To Patterns, Joshua Kerievsky,

# Functional Programming (Professional Elective 3L)

## Syllabus

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### Course Description

This course aims to make functional techniques and thought patterns part of programming skills of the students. This course presents the functional programming paradigm, based on the idea of functions as "first-class" values that can be computed and operated. Functional languages provide great power of expression while maintaining simplicity, making it easier to write correct and maintainable software. Upon successful completion of the course, students would be able to analyze problems and apply functional programming concepts and techniques to solve the problems.

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### Course Outline (To be covered in 30 lectures)

1. Introduction, Problem Solving with Functional Language, Programming with functions, List constructors and selectors, Recursive functions, Accumulating parameters, Local definitions, Higher Order functions, Dot notation, and example simple functional programs (12)
  2. Un-typed and Typed Lambda Calculus and Combinators, Term structure and substitution, alpha and Beta reductions and Beta Equality, Normal Form, Combinators, Church Numerals, Reduction Rules, Y-Combinator, Bracket Abstraction, Standard Combinator Expressions, Typed Lambda Calculus and Reduction Rules (10)
  3. Lambda Calculus Semantics: Reduction Machines SECD Machine , Graph Reduction Machine, Lazy/delayed Evaluation, (8)
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### Text Books

1. Functional Programming : Application and Implementation by Peter Henderson
2. Lambda Calculus, Combinators and Functional Programming by G. Revesz
3. Lambda Calculus and Combinators : An Introduction by J. Roger Hindley and Jonathan P. Seldin



# Genetic Algorithm (Professional Elective 3L)

## Syllabus

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### Course Description

In this course students will study Genetic Algorithm and its application to optimization problems. The course covers Basics of Optimization, Optimization Problems, Point to Point Algorithms, Simulated Annealing, Population Based Algorithms, Brief Overview of Evolutionary Computation, Genetic Algorithms (Theory and Advanced Operators), Genetic Representation, search operators, selection schemes and selection pressure, Operators on Real-valued Representations, Niche and fitness sharing, Particle Swarm Optimization, Memetic Algorithms and Real Life application of Evolutionary Algorithms.

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### Course Outline (To be covered in 30 lectures)

1. Basics of Optimization, Optimization Problems, Point to Point Algorithms, Simulated Annealing (3)
  2. Population Based Algorithms, Brief Overview of Evolutionary Computation, Genetic Algorithms (Theory and Advanced Operators), Genetic Representation, search operators, selection schemes and selection pressure. (7)
  3. Operators on Real-valued Representations, Niche and fitness sharing, Particle Swarm Optimization, Memetic Algorithms (7)
  4. Evolution Strategies, Genetic Programming, Evolutionary Programming, Differential Evolution (6)
  5. Constraint Handling in optimization problems , Real Life application of optimization Algorithms, Introduction of Multi-objective Evolutionary Algorithms (7)
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### Text Books

1. Genetic Algorithms in Search, Optimization & Machine Learning by D E Goldberg
2. Multi-Objective Optimization Using Evolutionary Algorithms by K. Deb
3. Handbook on Evolutionary Computation by T. Baeck, D. B. Fogel, and Z. Michalewicz (eds.)

# **Network Administration (Professional Elective 3L)**

## **Syllabus**

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### **Course Description**

The course is designed to provide students with essential knowledge and skills that an effective network administrator must possess. It provides an overview of the essential TCP/IP protocols, and discusses how to properly configure and manage the network services based on these protocols (including DNS, DHCP, AD/LDAP directory services, print and file servers, NFS/NIS, and routing services). The course also takes up various issues like Configuration management, accounting management, Fault and disaster management, security management and performance management.

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### **Course Outline (To be covered in 30 lectures)**

1. Introduction, Basic System Administration (3)
  2. Windows Installation, Linux Installation and Package Management, Backup and Security, Monitoring and Managing Processes/Daemons, Scripting basics and start-up scripts (8)
  3. Unix Networking, Network Protocols - TCP, IP, UDP, NetBIOS, TCP/IP Concepts and Configuration - the basics, Sub netting Implementation, Basic Network Trouble-Shooting and Monitoring Tools (8)
  4. Server configuration and management, DHCP, NIS, NFS, LDAP and Samba (6)
  5. Apache Web Server with PHP, DNS, BIND and Sendmail, Tools like Webmin, Webalizer, and Phpmyadmin; Security and firewall (5)
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### **Text Books**

1. TCP/IP Network Administration?, by Craig Hunt,
2. Neural Networks and Learning Machines by S. Haykin
3. Artificial Neural Networks by Robert J. Schalkoff
4. Multi-Objective Optimization Using Evolutionary Algorithms by Deb Kalyanmoy
5. Genetic Algorithms + Data Structures = Evolution Programs by Z Michalewicz

# Advanced Computer Networks (Professional Elective 3L)

## Syllabus

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### Course Description

The area of computer networking is undergoing rapid development; it's important to focus not only on what computer networks are today, but also on *why* and *how* they are designed the way they are. The aim of this course is to provide a sound conceptual foundation to computer networks and its design principles. The focus of the course is on the protocols, algorithms and tools needed to support the development and delivery of advanced network services over networks.

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### Course Outline (to be covered in 40 lectures)

#### UNIT-1: Review of Networking Concepts. (10)

MAC layer issues, Ethernet 802.3, ARP, IP addressing and Subnetting, NAT and PAT, Variable Length Subnet Masking, CIDR

#### UNIT-2: End to End protocols (10)

TCP connection establishment and termination, Sliding window concepts, other issues: wraparound, silly window syndrome, Nagle's algorithm, adaptive retransmission, TCP extensions. Congestion and flow control, Queuing theory, TCP flavors: Tahoe, Reno, New-Reno, TCP-SACK, TCP-RED and TCP-Vegas. Transport protocol for real time (RTP), Quality of service: Integrated Services, Differentiated services

#### UNIT-3: Routing and Multicast. (10)

Structure of internet: Autonomous systems, Intra-domain routing: OSPF and RIP, Inter-domain routing: BGP. Multicasting: Group Management (IGMP), Internet scale multicasting: Reverse path broadcast, MOSPF, DVMRP, PIM.

#### UNIT-4 : Peer to peer and overlay networks. (10)

Concept of overlays, Unstructured Overlays: Gnutella, Concepts of Distributed Hash Table, Structured Overlays: Chord, CAN, Pastry.

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### Text Books

1. Computer Networks: A Systems Approach, by Peterson and Davie, 5<sup>th</sup> Ed. Morgan Kauffman, 2011
2. Computer Networking: Top Down Approach, by Kurose and Ross, 6<sup>th</sup> Ed. Pearson, 2011

### Reading List

1. V. Paxson. "End-to-end Internet packet dynamics," in IEEE/ACM Transactions on Networking, Vol 7, No 3, June, 1999.
2. W. Stevens, "TCP Slow Start, Congestion Avoidance, Fast Retransmit, and Fast Recovery Algorithms," RFC2001 .
3. K. Fall and S. Floyd, "Simulation-based comparison of Tahoe, Reno, and SACK TCP," Computer Communication Review, vol. 26, pp. 5--21, July 1996.
4. L. Brakmo and L. Peterson, "TCP Vegas: End-to-End Congestion Avoidance on a Global Internet," IEEE Journal on Selected Areas in Communications, 13(8), October 1995, 1465--1480.
5. Stoica, I., Morris, R., Karger, D., Kaashoek, F., Balakrishnan, H.: Chord: A scalable peer-to-peer lookup service for Internet applications.
6. Rowstron, A., Druschel, P.: Pastry: Scalable, decentralized object location and routing for large-scale peer-to-peer systems.

# **Service Oriented Software Engineering (Professional Elective 3L)**

## **Syllabus**

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### **Course Description**

Service oriented software development paradigm is becoming the delivery model by all major IT companies. This course is intended to introduce the students with this paradigm. In this course students shall study the fundamentals of Service Oriented Software Engineering. Prerequisite for this course is course on Software Engineering.

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### **Course Outline (To be covered in 30 lectures)**

1. Concepts of Service orientation (8)
  2. Service oriented Software architecture concepts (5)
  3. Requirements Analysis & Design Process (7)
  4. Service Testing and Estimation models (6)
  5. Cloud based services models (4)
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### **Text Books**

1. Service Oriented Architecture – Concept Technology & Design by Thomas Earl
2. Enterprise SOA – Designing IT for Business Innovation by Woods & Mattem
3. Web Service Essentials, Eiban Cerami, O’Reilly

# **Cryptography & Network Security (Professional Elective 3L)**

## **Syllabus**

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### **Course Description**

In this course students will study the essential mathematical foundations for Information Security. This course features a rigorous introduction to modern cryptography, with an emphasis on the fundamental cryptographic primitives of public-key encryption, digital signatures, pseudo-random number generation, and basic protocols and their computational complexity requirements. After crediting this course students can look forward to wireless network security and E-commerce courses.

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### **Course Outline (To be covered in 30 lectures)**

1. Introduction, Prime Number Generation, Shannon's Theory of Perfect Secrecy (5)
  2. Asymmetric Key Cryptosystem and related issues (3)
  3. Public Key Cryptography and related concepts/methodologies (4)
  4. Cryptographic Hash Functions design and implementation issues. (4)
  5. Digital Signatures and related issues (5)
  6. E-Mail, IP and Web security (6)
  7. Malicious Programs & Firewall(3)
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### **Text Books**

1. Modern Cryptography : Theory and Practice by W Mao
2. Applied cryptography by Bruce Schneier
3. "Cryptography: Theory & Practice" D R Stinson,
4. Introduction to cryptography by Johannes A Buchmann
5. Network Security and Cryptography by Bernard Menezes

# Image Processing (Professional Elective 3L)

## Syllabus

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### Course Description

In this course students will study the theoretical foundations and modern applications in digital image processing. Insight into the basic operations like image acquisition, enhancement, restoration, transformations, compression, segmentation, object recognition and visual interpretation would be taken up along with the numerical interpretation. Wide variety of research applications ranging from pattern recognition, security measures such as digital signatures, watermarking; traffic video surveillance, medical imaging, remote sensing applications would be illustrated. Pre-requisite is the basic knowledge of mathematics and programming. A lab course is associated with it to strengthen the concepts.

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### Course Outline (To be covered in 30 lectures)

1. Introduction, digital image fundamentals Elements of digital image processing systems, Elements of visual perception, brightness, contrast, hue, saturation, Color image fundamentals - RGB, HSI models, Image sampling, Quantization, dither, Two-dimensional mathematical preliminaries, 2D transforms - DFT, DCT, KLT, SVD. (6)
  2. Image enhancement Histogram equalization and specification techniques, Noise distributions, Spatial averaging, Directional Smoothing, Median, Geometric mean, Harmonic mean, Conharmonic mean filters, Homomorphic filtering, Color image enhancement. (6)
  3. Image Restoration - degradation model, Unconstrained restoration - Lagrange multiplier and Constrained restoration, Inverse filtering-removal of blur caused by uniform linear motion, Wiener filtering, Geometric transformations-spatial transformations. (6)
  4. Image segmentation, Edge detection, Edge linking via Hough transform – Thresholding - Region based segmentation – Region growing – Region splitting and Merging – Segmentation by morphological watersheds – basic concepts – Dam construction – Watershed segmentation algorithm. (6)
  5. Need for image compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding, Vector Quantization, Transform coding, JPEG standard, MPEG. (6)
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### Text Books

1. Digital Image Processing by Rafael C. Gonzalez, Richard E. Woods,
2. Fundamentals of Digital Image Processing by Anil K. Jain,
3. Digital Image Processing by William K. Pratt
4. Professional Ethics(VII Semester CSE & IT 2L)

# **Professional Elective – II & III**

# **Business Intelligence (Professional Elective 3L)**

## **Syllabus**

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### **Course Description**

In this course students will study the features, uses, and design strategies for IT-enabled managerial decision support and business intelligence. The course includes an overview of business intelligence framework, business process management and application-based business analytics and reporting.

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### **Course Outline (To be covered in 30 lectures)**

1. Introduction, Overview of Business Intelligence, deduction, induction, machine learning and neural networks, (5)
  2. Introduction to analysis, quantitative methods for data analysis and knowledge extraction: classification and regression, Bayesian approaches, belief networks. (8)
  3. Introduction to DSS development, Traditional system development life cycle, Alternate development methodologies, Prototyping: DSS Methodology, Tools for DSS development, DSS Technology levels and tools (8)
  4. Enterprise system : Concept and definition, Enterprise Decision Support System, Evolution of executive and enterprise information system (EIS), Characteristics and capabilities of EDSS , Comparing and integrating EIS and DSS (6)
  5. BI applications: Knowledge management, Decision analysis, Investment Strategies, Marketing Campaigns (3)
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### **Text Books**

1. Decision Support Systems and Intelligent Systems by Efrain Turbon.
2. Adaptive Business Intelligence by Michalewicz Z., Schmidt M., Michalewicz M. and Chiriac C.
3. Business Intelligence: A Managerial Approach by Turban E., Sharda R., Aronson J.E. and King, D.
4. Advanced Management Information Systems by W.S. Jawadeka



# **Data Compression (Professional Elective 3L)**

## **Syllabus**

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### **Course Description**

The course discusses the theory and methods of data compression of signals, images, and video. Data Compression is the computational problem of how to encode a data file (text, image, audio, video) so that the new file has fewer bits than the original file. Techniques covered include: Quantization, Vector Quantization, Differential Schemes, Filterbanks and Subband Coding, Wavelet Transform, JPEG 2000, and MPEG. Coverage of selected topics of recent research issues in data compression is also taken up.

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### **Course Outline (To be covered in 30 lectures)**

1. Information theoretic foundations, Arithmetic coding (6)
  2. Dictionary techniques, Context modeling (6)
  3. Lossless image compression, Lossy coding preliminaries (6)
  4. Scalar and vector quantization (6)
  5. Differential encoding, Transform coding (6)
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### **Text Books**

1. Introduction to Data Compression by Sayood, Khalid,
2. Data Compression: The Complete Reference by M. Nelson,

# Information Retrieval (Professional Elective 3L)

## Syllabus

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### Course Description

This course will cover traditional material, as well as recent advances in Information Retrieval (IR). The course includes the study of indexing, processing, and querying textual data basic retrieval models, algorithms, and IR system implementations. The course will also address advanced topics in IR, including Natural Language Processing techniques, and Web agents.

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### Course Outline (To be covered in 30 lectures)

1. Introduction to IR models and methods, Text analysis / Web spidering Text properties (5)
  2. Vector-based model, Boolean model, Probabilistic model, other IR models; IR evaluation and IR test collections; Relevance feedback, query expansion (8)
  3. Web search: link based and content based; Query-based and content sensitive link analysis; Search engine technologies (8)
  4. Text classification and clustering; Question answering on offline and online collections (5)
  5. Personalized IR, Cross-language IR, Web 2.0, (4)
- 

### Text Books

1. Introduction to Information Retrieval by Christopher D. Manning, Prabhakar Raghavan, Hinrich Schütze (available online)
2. Information Retrieval: Algorithms and Heuristics. By D.A. Grossman, O. Frieder
3. Readings in Information Retrieval by K.Sparck Jones and P. Willett

# Pattern Recognition (Professional Elective 3L)

## Syllabus

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### Course Description

The emphasis of the course is on algorithms used for pattern recognition. Pattern Recognition is assigning a meaningful or classifying label to the elements of the input data. It uses the concepts of classification and clustering to separate the interclass elements. This information can then be used to classify or recognize new data using supervised or unsupervised learning methods and classifiers such as Support Vector Machine, Hidden Markov Model and Linear Discriminant Analysis. Pattern recognition has several important applications in the fields of data mining, artificial intelligence, networking and image processing. The prerequisites of the course are basic knowledge of statistics and linear algebra along with the concepts of probability theory.

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### Course Outline (To be covered in 30 lectures)

1. Introduction to Pattern Recognition, Feature Detection, Classification, Decision Theory, ROC Curves, Likelihood Ratio Test, Linear and Quadratic Discriminants, Fisher Discriminant, Sufficient Statistics, Coping with Missing or Noisy Features, Template-based Recognition, Feature Extraction, Eigenvector and Multilinear Analysis (10)
  2. Training Methods, Maximum Likelihood and Bayesian Parameter Estimation, Linear Discriminant/Perceptron Learning, Optimization by Gradient Descent, Support Vector Machines, K-Nearest-Neighbor Classification (6)
  3. Non-parametric Classification, Density Estimation, Parzen Estimation, Unsupervised Learning, Clustering, Vector Quantization, K-means, Mixture Modeling, Expectation-Maximization (6)
  4. Hidden Markov Models, Viterbi Algorithm, Baum-Welch Algorithm, Linear Dynamical Systems, Kalman Filtering, Decision Trees, Multi-layer Perceptrons, Reinforcement Learning with Human Interaction (8)
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### Text Books

1. Pattern Classification by Richard O. Duda, Peter E. Hart and David G. Stork
2. Pattern Recognition and Machine Learning by C. M. Bishop
3. Pattern Recognition by S. Theodoridis and K. Koutroumbas

# **Semantic Web (Professional Elective 3L)**

## **Syllabus**

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### **Course Description**

This course introduces techniques that are useful stand-alone and can be integrated for building a semantic web. It will review XML with Document Type Definitions and Schemas; transformation/inference rules in XSLT, metadata with RDF (Resource Description Framework); metadata taxonomies with RDF Schema; description logic and the W3C ontology language OWL 2; as well as integrating these techniques for ontology/rule-based multi-agent systems. Students may note that besides enabling quick and accurate web search, semantic web may also allow the development of intelligent internet agents and facilitate communication between a multitude of heterogeneous web-accessible devices.

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### **Course Outline (To be covered in 30 lectures)**

1. Review of XML; Meta-model and Meta-data, RDF & RDFS; OWL; Ontology Engineering and tools (12)
  2. Description Logic(DL); Programming with DL; Example Application (12)
  3. Knowledge Acquisition and Management System, (6)
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### **Text Books**

1. A Semantic Web Primer by Antoniou, Grigoris and Frank van Harmelen
2. The Description Logic Handbook: Theory, Implementation and Applications by Franz Baader, Deborah L. Guinness, Daniele Nardi, and Peter F. Patel-Schneider (Eds.)
3. An Introduction to Description Logic by Daniele Nardi and Ronald J. Brachman

## **Syllabus**

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### **Course Description**

In this course students will study the foundational concepts of measurement of various aspects of software during the entire course of its development. The course takes up various existing metrics and tools that measure various activities of the software development. Topics such as Property-oriented measurement, Meaningfulness in measurement, Measurement quality, Measurement process, Scale, Measurement validation, Object-oriented measurement are covered. Students may note that the course is credited only after having undergone Software Engineering.

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### **Course Outline (To be covered in 30 lectures)**

1. The state of IT project management & basics of measurement (6)
  2. Measuring internal product attributes: size and structure (6)
  3. Measuring cost and effort (6)
  4. Measuring external product attributes: Quality & Reliability (6)
  5. Software test metrics (6)
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### **Text Books**

1. Software Metrics: A Rigorous and Practical Approach by N.E. Fenton and S.L. Pfleeger Metrics and Models in Software Quality Engineering by Stephen H. Kan
2. Software Project Management in practice by Pankaj Jalote
3. Software Project Management by Bob Hughes and Mike Cotterell

# **Web Mining (Professional Elective 3L)**

## **Syllabus**

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### **Course Description**

The course is an introduction to web mining technologies. Though the Web is rich with information, gathering and making sense of this data is difficult because the documents of the Web are largely unorganized. The course will cover machine learning techniques to mine the Web and other information networks, social networks, and social media. Applications to search, retrieval, classification, and recommendation would be studied. Various models to explain the dynamics of Web processes will also be emphasized.

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### **Course Outline (To be covered in 30 lectures)**

1. Introduction, Practical web mining applications overview (3)
  2. Natural Language Processing methods used for web information retrieval (6)
  3. Web Content Mining (5)
  4. Web Structure Mining (5)
  5. Web Usage Mining (6)
  6. Specific applications and case studies (5)
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### **Text Books**

1. Web data mining: exploring hyperlinks, contents, and usage data by LIU, B.
2. Mining the Web - Discovering knowledge from hypertext data, by Soumen Chakrabarti,
3. Ontology learning and population from text : algorithms, evaluation and applications by CIMIANO, P.

# Wireless Network Security (Professional Elective 3L)

## Syllabus

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### Course Description

In this course students will study wireless networks and their security. In this course, many recent, current and emerging developments will be discussed including advances in cellular, personal communications systems (PCS), wireless LANs, satellites, and fixed wireless networks. Significant details of wireless devices and middleware will be included. Many emerging challenges and solutions including ad hoc wireless networks, broadband wireless and quality of service, and location management besides security would be taken up. Communication Foundations, Computer Network and cryptography are prerequisite courses. A lab course is associated with it to strengthen the concepts.

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### Course Outline (To be covered in 30 lectures)

1. Introduction, Wireless Communications (2)
  2. Wireless devices and Middleware, Design of Wireless Networks (2)
  3. Ad-hoc wireless networks, wireless sensor networks(2)
  4. Security threats in wireless networks. Security requirements of wireless networks (4)
  5. Security case studies for Wireless LAN and Ad-hoc wireless networks (6)
  6. Speech Cryptology (5)
  7. Protocols and Applications of Cellular, Personal Communications Systems, and Bluetooth. Security issues and services. (9)
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### Text Books

1. Wireless Security Models, Threats, and Solutions By: Randall K. Nichols, Panos C. Lekkas
2. Wireless Communications: Principles & Practice, by Ted Rappaport,
3. Wireless Network Design: Optimization Models and Solution Procedures, by J. Kennington et. al.
4. Security and Cooperation in Wireless Networks, by Levente Buttyán and Jean-Pierre Hubaux [Available Online]
5. The IEEE 802.11 Handbook: A designers companion by Bob O Hara, Al Petrick

# Real time System (Professional Elective 3L)

## Syllabus

### Course Description

In this course students will be introduced to Concept of Real Time Systems and their applications. Real Time Task models will be taught along with their scheduling strategies. The resource allocation in presence of various types of tasks model will be covered.

### Course Outline (To be covered in 30 lectures)

#### **Unit-1**

Introduction: Applications, different type of real-time systems: Hard Real time system, Soft Real time Systems, reference models, Processor and Resources, Precedence constraints and Data dependency, Functional Parameters (3)

#### **Unit-2**

Release Time, Deadline, Periodic Task Model, Hyperperiod, Aperiodic Task Model, Sporadic Task Model, Real-time Scheduling: Scheduling hierarchies, commonly used scheduling approaches, Clock Driven Approach, Weighted Round Robin Approach, Priority Driven Approach. (5)

#### **Unit-3**

Priority driven scheduling of periodic tasks, Dynamic versus Static System, Off-Line Versus Online Scheduling, Fixed priority versus Dynamic Priority Algorithms, Maximum Schedulable Utilization, Rate Monotonic Scheduling(RM), deadline Monotonic Scheduling(DM), Earliest Deadline first Scheduling(EDF), Least Slack Time first Scheduling(LST), Tick Scheduling, (10)

#### **Unit-4**

Optimality of RM and DM scheduling, Practical Factors, Scheduling of aperiodic and sporadic tasks: Conventional Approaches, Deferrable server, sporadic servers, constant utilization, total utilization and weighted fair queue servers, slack stealing approaches. (6)

#### **Unit-5**

Resource access control: NPCS, Priority inheritance protocol, Uncontrolled Priority Inversion, Priority ceiling protocol, Slack based ceiling protocol, Use of Priority Ceiling protocol in Dynamic Priority system, Multiprocessor priority ceiling protocol. (6)

### **Text Books :**

1. Real Time System, Jane W.S.Liu
2. Real Time Systems Design and Analysis by Phillip A. Laplante,PHI

### **Reference Books:**

1. Hard Real Time Computing Systems Predictable Scheduling Algorithms and applications By Giorgio C. Buttazzo
2. Real Time Design Patterns: Robust Scalable Architecture for Real Time System by Bruce Powell Douglass
3. Real Time System: Scheduling, Analysis and Verification by Albert M. K. Cheng



# Software Testing (Professional Electives 3L)

## Syllabus

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### Course Description

In this course students shall study the fundamentals of testing, various approaches to testing, managing test cases and various testing strategies. Students may note that the course is credited only after having undergone Software Engineering and/or Software Project Management. A mini project has been associated with this course.

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### Course Outline (To be covered in 30 lectures)

1. Fundamentals of Testing and its current state of art (8)
  2. Various approaches to Testing (6)
  3. Test planning and Management (6)
  4. Test Strategies - Preventive, Reactive Approach, Analytical, Heuristic, Configuration Management (6)
  5. Mutation Testing & Testing Object Oriented Software (4)
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### Text Books

1. Software Testing Techniques by Borris Beizer
2. Software Testing – A Craftman’s Approach by Paul C. Jorgensen
3. Software Testing by Hambling, Samaroo & Williams.
4. Software Testing Practice: Test Management by Spillner, Rossner, Winter & Linz

# Shell Programming (I Semester 3P)

## Lab Description

This is first independent lab course in programming tools which intends to introduce shell programming skills. UNIX is popular alternative to the Windows environment, especially in high-performance PC Linux servers and other UNIX-based web servers. Topics include: Unix utilities and file structure, Links and symbolic links, Data processing and process control in the Unix shell, Shell programming, Regular expressions, Exposure to different shells like bash, csh, ksh. Introduction to the Python/Perl programming in the Unix environment.

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# Object Oriented Programming (II Semester 3P)

## Syllabus

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## Course Description

This is an introductory course, where students learn and practice essential programming skills using the Java programming language. This course provides an overview of Object Oriented Programming (OOP) concepts using Java. It helps to understand basic OOP concepts and assist in applying these concepts for real world application development.

**Note:** Lab is associated with respective theory course and hence do not require explicit description.

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# Web Programming (III Semester 3P)

## Lab Description

This is third independent lab course in programming tools which intends to introduce web programming skills. The web is an integral part of society and our lives. This course provides an in depth knowledge of web application development using Java technology. It helps students to understand the art of industry strength application development.

This course will follow the course tradition of "looking under the hood," exploring ways to create web content and applications.

**Note:** Other labs are associated with respective theory courses and hence do not require explicit description.