

AC 7/6/2014  
Item 4.27

# **UNIVERSITY OF MUMBAI**



## **Bachelor of Engineering**

Computer Engineering (Final Year – Sem. VII & VIII),  
Revised course

(REV- 2012) from Academic Year 2015 - 16,  
Under

## **FACULTY OF TECHNOLOGY**

(As per Semester Based Credit and Grading System)

## **Preamble**

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited. In line with this Faculty of Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty of Technology, University of Mumbai, in one of its meeting unanimously resolved that, each Board of Studies shall prepare some Program Educational Objectives (PEO's) and give freedom to affiliated Institutes to add few (PEO's) and course objectives and course outcomes to be clearly defined for each course, so that all faculty members in affiliated institutes understand the depth and approach of course to be taught, which will enhance learner's learning process. It was also resolved that, maximum senior faculty from colleges and experts from industry to be involved while revising the curriculum. I am happy to state that, each Board of studies has adhered to the resolutions passed by Faculty of Technology, and developed curriculum accordingly. In addition to outcome based education, semester based credit and grading system is also introduced to ensure quality of engineering education.

Semester based Credit and Grading system enables a much-required shift in focus from teacher-centric to learner-centric education since the workload estimated is based on the investment of time in learning and not in teaching. It also focuses on continuous evaluation which will enhance the quality of education. University of Mumbai has taken a lead in implementing the system through its affiliated Institutes and Faculty of Technology has devised a transparent credit assignment policy and adopted ten points scale to grade learner's performance. Credit and grading based system was implemented for First Year of Engineering from the academic year 2012-2013. Subsequently this system will be carried forward for Second Year Engineering in the academic year 2013-2014, for Third Year and Final Year Engineering in the academic years 2014-2015 and 2015-2016 respectively.

**Dr. S. K. Ukarande**

**Dean,**

**Faculty of Technology,**

**Member - Management Council, Senate, Academic Council**

**University of Mumbai, Mumbai**

## **Preamble:**

The engineering education in India in general is expanding in manifolds. Now, the challenge is to ensure its quality to the stakeholders along with the expansion. To meet this challenge, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education and reflects the fact that in achieving recognition, the institution or program of study is committed and open to external review to meet certain minimum specified standards. The major emphasis of this accreditation process is to measure the outcomes of the program that is being accredited. In line with this Faculty of Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

The Program Educational Objectives finalized for undergraduate program in Computer Engineering are listed below:

1. To prepare Learner's with a sound foundation in the mathematical, scientific and engineering fundamentals
2. To prepare Learner's to use effectively modern tools to solve real life problems
3. To equip Learner's with broad education necessary to understand the impact of computer Technology in a global and social context
4. To encourage , motivate and prepare Learner's for Lifelong-learning
5. To inculcate professional and ethical attitude, good leadership qualities and commitment to social responsibilities

In addition to above 2 to 3 more program educational objectives of their own may be added by affiliated Institutes.

The Program outcomes are the skills and ability that Learner will demonstrate upon completion of undergraduate degree program in Computer Engineering. Few may be listed as follows:

1. Ability to effectively apply knowledge of computing and mathematics to computer science problems.
2. Ability to design, implement and evaluate computer-based components, systems, processes or programs to meet desired needs and specifications.
3. Ability and skills to effectively use state-of-the-art techniques and computing tools for analysis, design, and implementation of computing systems.
4. Ability to function effectively as a member of a team assembled to undertake a common goal.
5. An understanding of professional, ethical, legal, security, and social issues and responsibilities.

6. Ability to communicate effectively to both technical and non-technical audiences.
7. The ability to successfully pursue professional development thru lifelong learning

In addition to Program Educational Objectives, for each course of undergraduate program, Course Objectives and expected outcomes from learner's point of view are also included in the curriculum to support the philosophy of outcome based education. I believe strongly that small step taken in right direction will definitely help in providing quality education to the stake holders.

Dr. Prachi Gharpure

Chairperson, Adhoc Board of Studies in Computer Engineering,

University of Mumbai, Mumbai

**Program Structure B.E. Computer Engineering**  
**Fourth Year (Computer) ( Semester VII)**  
**( REV 2012)**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	TW/ Pract	Tut	Total
CPC701	Digital Signal Processing	4	2	-	4	1	-	5
CPC702	Cryptography and System Security	4	2	-	4	1	-	5
CPC703	Artificial Intelligence	4	2	-	4	1	-	5
CPE7042X	Elective-II	4	2	-	4	1	-	5
CPP701	Project I	-	6#	-	-	3	-	3
CPL701	Network Threats and Attacks Laboratory	-	4	-	-	2	-	2
<b>Total</b>		<b>16</b>	<b>18</b>	<b>-</b>	<b>16</b>	<b>9</b>	<b>-</b>	<b>25</b>

Course Code	Course Name	Examination Scheme									
		Internal Assessment					End Sem Exam	Exam Duration ( in Hrs)	TW	oral	Total
		Internal Assessment			Test 1	Test 2					
		Test 1	Test 2	Avg							
CPC701	Digital Signal Processing	20	20	20	20	20	80	03	25	-	125
CPC702	Cryptography and System Security	20	20	20	20	20	80	03	25	25	150
CPC703	Artificial Intelligence	20	20	20	20	20	80	03	25	25	150
CPE7042X	Elective-II	20	20	20	20	20	80	03	25	25	150
CPP701	Project I	-	-	-	-	-	-	-	50	50	100
CPL701	Network Threats and Attacks Laboratory	-	-	-	-	-	-	-	25	50	75
<b>Total</b>		<b>-</b>	<b>-</b>	<b>80</b>	<b>320</b>	<b>-</b>	<b>320</b>	<b>-</b>	<b>175</b>	<b>175</b>	<b>750</b>

Course Code	Course/Subject Name	Credits
CPC701	<b>Digital Signal Processing</b>	5

**Objectives:**

1. To learn the fundamental concepts of Digital Signal Processing.
2. To explore the properties of DFT in mathematical problem solving.
3. To illustrate FFT calculations mathematically and develop FFT based DSP algorithms.
4. To introduce DSP processor for real time signal processing application

**Outcomes:** Learner will be able to...

1. To understand the concept of DT Signal and perform signal manipulation
2. To perform analysis of DT system in time domain
3. To develop FFT flow-graph and Fast DSP Algorithms.
4. To design DSP system for Real Time Signal Processing.

Module	Detailed Contents	Hrs.
<b>01</b>	<b>Discrete Time Signal</b> 1.1 Introduction to Digital Signal Processing, Discrete Time Signals, Sampling and Reconstruction, Standard DT Signals, Concept of Digital Frequency, Representation of DT signal using Standard DT Signals, Signal Manipulations(shifting, addition, subtraction, multiplication), Classification of Signals, Linear Convolution formulation(without mathematical proof), Circular Convolution formulation(without mathematical proof), Matrix Representation of Circular Convolution, Linear by Circular Convolution. Auto and Cross Correlation formula evaluation,	12
<b>02</b>	<b>Discrete Time System</b> 2.1 Introduction to Discrete Time System, Classification of DT Systems (Linear/Non Linear, Causal/Non Causal, Time Invariant/Time Variant Systems, Stable/ Unstable), BIBO Time Domain Stability Criteria. LTI system, Concept of Impulse Response and Step Response. 2.2 Concept of IIR System and FIR System, Output of IIR and FIR DT system using Time Domain Linear Convolution formula Method.	08
<b>03</b>	<b>Discrete Fourier Transform</b> 3.1 Introduction to DTFT, DFT, Relation between DFT and DTFT, Properties of DFT without mathematical proof (Scaling and Linearity, Periodicity, Time Shift and Frequency Shift, Time Reversal, Convolution Property and Parsevals' Energy Theorem). DFT computation using DFT properties. 3.2 Transfer function of DT System in frequency domain using DFT. Linear and Circular Convolution using DFT. Response of FIR system calculation in frequency domain using DFT.	08
<b>04</b>	<b>Fast Fourier Transform</b> 4.1 Radix-2 DIT-FFT algorithm, DIT-FFT Flowgraph for N=4, 6 & 8, Inverse	06

	FFT algorithm. Spectral Analysis using FFT, Comparison of complex and real, multiplication and additions of DFT and FFT.	
<b>05</b>	<b>DSP Algorithms</b> 5.1 Carls' Correlation Coefficient Algorithm, Fast Circular Convolution Algorithm, Fast Linear Convolution Algorithm, Linear FIR filtering using Fast Overlap Add Algorithm and Fast Overlap Save Algorithm,	08
<b>06</b>	<b>DSP Processors and Application of DSP</b> 6.1 Need for Special architecture of DSP processor, Difference between DSP processor & microprocessor, A general DSP processor TMS320C54XX series, Case study of Real Time DSP applications to Speech Signal Processing and Biomedical Signal Processing.	06

### List of Experiments:

Implementation of programs must be either in C or C++ only. Application can be developed using open source simulation software such as Scilab. A List of compulsory eight experiments is given below. Additional experiments within the scope of the syllabus can be added.

#### 1. Sampling and Reconstruction

##### Aim:

To study sampling and reconstruction of signal

##### Objective:

Develop a program to sample a continuous time signal and convert it to Discrete Time Signal.

##### Problem Definition:

1. Sample the input signal and display first 50 samples. Calculate data rate and bit rate.
2. Reconstruct the original signal and display the original and reconstructed signals.
3. Vary the sampling frequency and observe the change in the quality of reconstructed signal.

#### 2. To perform Discrete Correlation

##### Aim:

To study mathematical operation Correlation and measure degree of similarity between two signals

##### Objective:

1. Write a function to find correlation operation.
2. Calculate correlation of a DT signals and verify the results using mathematical formulation.
3. Measure the degree of similarity using Carl's Correlation Coefficient formula in time domain.

### Input Specifications:

1. Length of first Signal L and signal values.
2. Length of second Signal M and signal values.

**Problem Definition:**

1. Find auto correlation of input signal. What is the significance of value of output signal value at  $n=0$ ?
  2. Find auto correlation of delayed input signal.
  3. Find cross correlation of input signal and delayed input signal,
  4. Find cross correlation of input signal and scaled delayed input signal.
  5. Compare the resultant signals. Give your conclusion.
  6. Take two input finite length DT signals and develop a function to find Carl's Correlation Coefficient value. Determine the degree of similarity of two signals from the calculated Carl's Correlation Coefficient value.
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**3. To perform Discrete Convolution**

**Aim:**

The aim of this experiment is to study mathematical operation such as Linear convolution, Circular convolution, Linear convolution using circular convolution.

**Objective:**

1. Develop a function to find Linear Convolution and Circular Convolution
2. Calculate Linear Convolution, Circular Convolution, Linear Convolution using Circular Convolution and verify the results using mathematical formulation.
3. Conclude on aliasing effect in Circular convolution

**Input Specifications:**

1. Length of first Signal L and signal values.
2. Length of second Signal M and signal values.

**Problem Definition:**

1. Find Linear Convolution and Circular Convolution of L point sequence  $x[n]$  and M point sequence  $h[n]$ .
  2. Find Linear Convolution of L point sequence  $x[n]$  and M point sequence  $h[n]$  using Circular convolution.
  3. Give your conclusion about No of values in linearly convolved signal, and Aliasing effect in Circular Convolution.
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#### 4. To perform Discrete Fourier Transform

**Aim:**

The aim of this experiment is to study magnitude spectrum of the DT signal.

**Objective:**

1. Develop a function to perform DFT of N point signal
2. Calculate DFT of a DT signal and Plot spectrum of the signal.
3. Conclude the effect of zero padding on magnitude spectrum.
4. Calculate the number of real multiplications and real additions required to find DFT.

**Input Specifications:**

1. Length of Signal N
2. Signal values

**Problem Definition:**

1. Take any four-point sequence  $x[n]$ .
    - Find DFT  $X[k]$ .
    - Compute number of real multiplications and real additions required to find  $X[k]$ .
    - Plot Magnitude Spectrum of the signal.
  2. Append the input sequence by four zeros. Find DFT and plot magnitude spectrum. Repeat the same by appending the sequence by eight zeros. Observe and compare the magnitude spectrum. Give your conclusion.
- 

#### 5. To perform Fast Fourier Transform

**Aim:**

To implement computationally fast algorithms.

**Objective:**

1. Develop a program to perform FFT of N point signal.
2. Calculate FFT of a given DT signal and verify the results using mathematical formulation.
3. Illustrate the computational efficiency of FFT.

**Input Specifications:**

- Length of Signal N
- Signal values

**Problem Definition:**

Take any eight-point sequence  $x[n]$ .

- Find FFT  $X[k]$ .
  - Write number of real multiplications and real additions involved in finding  $X[k]$ .
- 

## **6. Filtering of long Data Sequence**

### **Aim:**

To perform filtering of Long Data Sequence using Overlap Add Method and Overlap Save Method.

### **Objective:**

Develop a function to implement Fast Overlap Add and Fast Overlap Save Algorithm using FFT.

### **Input Specifications:**

1. Length of long data sequence and signal values.
2. Length of impulse response  $M$  and coefficient values of  $h[n]$ .

### **Problem Definition:**

Find the output of a Discrete Time system using Fast Overlap Add Method OR Fast Overlap Save Method.

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## **7. Real Time Signal Processing**

### **Aim:**

To perform real time signal processing using TMS320 Processor.

### **Objective:**

Study real time signal processing.

### **Input Specifications:**

1. Real Time Speech Signal

### **Problem Definition:**

- 1) Capture the real time audio signal.
  - 2) Filter it by convolving input signal with the impulse response of FIR filter using Fast Overlap Add filtering Algorithm OR Fast Overlap Save Filtering Algorithm.
  - 3) Observe the quality of output signal.
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## **8. Application of Digital Signal Processing**

### **Aim:**

To implement any Signal Processing operation on one dimensional signal.

**Objective:**

To develop application of signal processing.

**Input Specifications:**

One dimensional signal.

**Rules:**

1. Number of students in one Group : min - 2 max -3
2. Decide one DSP application of your choice. Collect the information related to the application from the published granted patents. Download the related published papers from the standard refereed journals and conferences.
3. Develop a block diagram of the proposed system and flowchart of proposed system algorithm, implement it using Scilab/C, C++ language and obtain the appropriate results.
4. Prepare the three to four pages report on the mini project in IEEE paper format. Report should include Abstract, Introduction, Related Theory, Proposed System Design/Algorithm, Experimentation & Result Analysis, Conclusion, and References.
- 5.

**Term Work:**

- Term work shall consist of minimum **08** assignments and course project.
- Journal must include at least 1 assignment on each module and two quiz.
- The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work.

The distribution of marks for term work shall be as follows:

- |  |             |               |
|--|-------------|---------------|
| • Laboratory work (experiments): ..... | (15)        | Marks.        |
| • Assignment:.....                     | (05)        | Marks.        |
| • Attendance (Theory+ Practical).....  | (05)        | Marks         |
| <b>TOTAL: .....</b>                    | <b>(25)</b> | <b>Marks.</b> |

**Text Books :**

1. Ashok Ambardar, 'Digital Signal Processing', Cengage Learning, 2007, ISBN : 978-81-315-0179-5.

2. Emmanuel C. Ifeachor, Barrie W. Jervis, "Digital Signal Processing: A Practical Approach", Pearson Education ISBN 0-201-59619-9
3. S. Salivahanan, A. Vallavaraj, C. Gnanapriya, 'Digital Signal Processing' TataMcgraw Hill Publication First edition (2010). ISBN 978-0-07-066924-6.
4. Avtar Signh, S.Srinivasan,"Digital Signal Processing', Thomson Brooks/Cole, ISBN : 981-243-254-4

### **Reference Books :**

1. B. Venkatramani, M. Bhaskar ,"Digital Signal Processor', TataMcGraw Hill, Second Edition, (2001). ISBN : 978-0-07-070256-1.
2. Sanjit Mitra, 'Digital Signal Processing : A Computer Based Approach' , TataMcGraw Hill, Third Edition
3. Dr, Shaila Apte, "Digital Signal Processing," , Wiley India, Second Edition,2013 ISBN : 978-81-2652142-5
4. Proakis Manolakis, 'Digital Signal Processing : Principles, Algorithms and Applications' Fourth 2007, Pearson Education, ISBN 81-317-1000-9.
5. Monson H. Hayes, "Schaums Outline of Digital Signal Processing' McGraw Hill International second edition. ISBN : 978-00-7163509-7

Course Code	Course/Subject Name	Credits
CPC702	<b>Cryptography and System Security</b>	5

**Objectives:**

1. To provide students with contemporary knowledge in Cryptography and Security.
2. To understand how crypto can be used as an effective tools in providing assurance concerning privacy and integrity of information.
3. To provide skills to design security protocols for recognize security problems.

**Outcomes:** Learner will be able to...

1. Understand the principles and practices of cryptographic techniques.
2. Understand a variety of generic security threats and vulnerabilities, and identify & analyze particular security problems for given application.
3. Appreciate the application of security techniques and technologies in solving real-life security problems in practical systems.
4. Apply appropriate security techniques to solve security problem
5. Design security protocols and methods to solve the specific security problems.
6. Familiar with current research issues and directions of security.

Module	Detailed Contents	Hrs
<b>01</b>	<b>Introduction</b> 1.1 Security Attacks, Security Goals, Computer criminals, Methods of defense, Security Services, Security Mechanisms	06
<b>02</b>	<b>Basics of Cryptography</b> 2.1 Symmetric Cipher Model, Substitution Techniques, Transportation Techniques, Other Cipher Properties- Confusion, Diffusion, Block and Stream Ciphers.	06
<b>03</b>	<b>Secret Key Cryptography</b> 3.1 Data Encryption Standard(DES), Strength of DES, Block Cipher Design Principles and Modes of Operations, Triple DES, International Data Encryption algorithm, Blowfish, CAST-128.	06
<b>04</b>	<b>Public Key Cryptography</b> 4.1 Principles of Public Key Cryptosystems, RSA Algorithm, Diffie-Hellman Key Exchange	04
<b>05</b>	<b>Cryptographic Hash Functions</b> 5.1 Applications of Cryptographic Hash Functions, Secure Hash Algorithm, Message Authentication Codes – Message Authentication Requirements and Functions, HMAC, Digital signatures, Digital Signature Schemes, Authentication Protocols, Digital Signature Standards.	06
<b>06</b>	<b>Authentication Applications</b> 6.1 Kerberos, Key Management and Distribution, X.509 Directory Authentication service, Public Key Infrastructure, Electronic Mail Security: Pretty Good Privacy, S/MIME.	06

07	<p><b>7.1 Program Security</b> Secure programs, Nonmalicious Program Errors, Malicious Software – Types, Viruses, Virus Countermeasures, Worms, Targeted Malicious Code, Controls against Program Threats.</p> <p><b>7.2 Operating System Security</b> Memory and Address protection, File Protection Mechanism, User Authentication.</p> <p><b>7.3 Database Security</b> Security Requirement, Reliability and Integrity, Sensitive data, Inference, Multilevel Databases</p> <p><b>7.4 IDS and Firewalls</b> Intruders, Intrusion Detection, Password Management, Firewalls-Characteristics, Types of Firewalls, Placement of Firewalls, Firewall Configuration, Trusted systems.</p>	08
08	<p><b>8.1 IP Security</b> Overview, Architecture, Authentication Header, Encapsulating Security Payload, Combining security Associations, Internet Key Exchange, Web Security: Web Security Considerations, Secure Sockets Layer and Transport Layer Security, Electronic Payment.</p> <p><b>8.2 Non-cryptographic protocol Vulnerabilities</b> DoS, DDoS, Session Hijacking and Spoofing, Software Vulnerabilities-Phishing, Buffer Overflow, Format String Attacks, SQL Injection.</p>	06

**Term Work:**

Term work should consist of at least 10experiments, 2 assignments based on above theory syllabus.

The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work.

The distribution of marks for term work shall be as follows:

- Laboratory work (experiments): ..... (15) Marks.
- Assignment:..... (05) Marks.
- Attendance (Theory+ Practical)..... (05) Marks
- TOTAL: ..... (25) Marks.**

**Practical/Oral examination:**

Practical Exam will be based on above syllabus.

**Syllabus for Practical**

Suggested topics for experiment but not limited to:

1. RSA and MD5 algorithms.
2. Packet Analyzer.

3. IPSec
4. Spoofing
5. PGP(Pretty Good Privacy)
6. Port Scanning
7. Vulnerability scanner
8. Buffer Overflow
9. Intrusion Detection System
10. Password cracking
11. Firewall
12. SSL

### **Theory Examination:**

1. Question paper will comprise of total 6 questions, each of 20 Marks.
2. Only 4 questions need to be solved.
3. Question 1 will be compulsory and based on maximum part of the syllabus.
4. Remaining questions will be mixed in nature (for example suppose Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)

**In question paper, weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.**

### **Text Books:**

1. Cryptography and Network Security: Principles and Practice 5th edition, William Stallings, Pearson.
2. Network Security and Cryptography 2nd edition, Bernard Menezes, Cengage Learning.
3. Cryptography and Network, 2nd edition, Behrouz A Fourouzan, Debdeep Mukhopadhyay, TMH.

### **Reference Books:**

1. Cryptography and Network Security by Behrouz A. Forouzan, TMH
2. Security in Computing by Charles P. Pfleeger, Pearson Education.
3. Computer Security Art and Science by Matt Bishop, Addison-Wesley.

Course Code	Course/Subject Name	Credits
CPC703	<b>Artificial Intelligence</b>	5

**Objectives:**

1. To conceptualize the basic ideas and techniques underlying the design of intelligent systems.
2. To make students understand and Explore the mechanism of mind that enable intelligent thought and action.
3. To make students understand advanced representation formalism and search techniques.
4. To make students understand how to deal with uncertain and incomplete information.

**Outcomes:** Learner will be able to

1. Ability to develop a basic understanding of AI building blocks presented in intelligent agents.
2. Ability to choose an appropriate problem solving method and knowledge representation technique.
3. Ability to analyze the strength and weaknesses of AI approaches to knowledge– intensive problem solving.
4. Ability to design models for reasoning with uncertainty as well as the use of unreliable information.
5. Ability to design and develop the AI applications in real world scenario.

Module	Detailed Contents	Hrs
<b>01</b>	<b>Introduction to Artificial Intelligence</b> 1.1 Introduction , History of Artificial Intelligence, Intelligent Systems: Categorization of Intelligent System, Components of AI Program, Foundations of AI, Sub-areas of AI, Applications of AI, Current trends in AI.	04
<b>02</b>	<b>Intelligent Agents</b> 2.1 Agents and Environments, The concept of rationality, The nature of environment, The structure of Agents, Types of Agents, Learning Agent.	04
<b>03</b>	<b>Problem solving</b> 3.1 Solving problem by Searching : Problem Solving Agent, Formulating Problems, Example Problems. 3.2 Uninformed Search Methods: Breadth First Search (BFS), Depth First Search (DFS) , Depth Limited Search, Depth First Iterative Deepening(DFID), Informed Search Methods: Greedy best first Search ,A* Search , Memory bounded heuristic Search. 3.3 Local Search Algorithms and Optimization Problems: Hill-climbing search Simulated annealing, Local beam search,	14



	Genetic algorithms. 3.4 Adversarial Search: Games, Optimal strategies, The minimax algorithm , Alpha-Beta Pruning.	
<b>04</b>	<b>Knowledge and Reasoning</b> 4.1 Knowledge based Agents, The Wumpus World, The Propositional logic, First Order Logic: Syntax and Semantic, Inference in FOL, Forward chaining, backward Chaining. 4.2 Knowledge Engineering in First-Order Logic, Unification, Resolution, Introduction to logic programming (PROLOG). 4.3 <b>Uncertain Knowledge and Reasoning:</b> Uncertainty, Representing knowledge in an uncertain domain, The semantics of belief network, Inference in belief network.	12
<b>05</b>	<b>Planning and Learning</b> 5.1 The planning problem, Planning with state space search, Partial order planning, Hierarchical planning, Conditional Planning. 5.2 Learning: Forms of Learning, Inductive Learning, Learning Decision Tree. 5.3 Expert System: Introduction, Phases in building Expert Systems, ES Architecture, ES vs Traditional System.	10
<b>06</b>	<b>Applications</b> 6.1 Natural Language Processing(NLP), Expert Systems.	04

### Term Work:

The distribution of marks for term work shall be as follows:

- Laboratory work (experiments/case studies): ..... (15) Marks.
- Assignment:..... (05) Marks.
- Attendance ..... (05) Marks
- TOTAL: ..... (25) Marks.**

There will be at least two assignments covering the above syllabus.

### Practical/Oral examination:

Practical examination based on the above syllabus will be conducted.

### List of AI Practical / Experiments

**All the programs should be implemented in C/C++/Java/Prolog under Windows or Linux environment. Experiments can also be conducted using available open source tools.**

1. One case study on NLP/Expert system based papers published in IEEE/ACM/Springer or any prominent journal.
2. Program on uninformed and informed search methods.
3. Program on Local Search Algorithm.
4. Program on Optimization problem.
5. Program on adversarial search.
6. Program on Wumpus world.
7. Program on unification.
8. Program on Decision Tree.

Any other practical covering the syllabus topics and subtopics can be conducted.

### **Reference Books (Practicals):**

1. Ivan Bratko "PROLOG Programming for Artificial Intelligence", Pearson Education, Third Edition.
2. Elaine Rich and Kevin Knight "Artificial Intelligence "Third Edition
3. Davis E.Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning", Addison Wesley, N.Y., 1989.
4. Han Kamber, "Data Mining Concepts and Techniques", Morgann Kaufmann Publishers.

### **Text Books:**

1. Stuart J. Russell and Peter Norvig, "Artificial Intelligence A Modern Approach "Second Edition" Pearson Education.
2. Saroj Kaushik "Artificial Intelligence" , Cengage Learning.
3. George F Luger "Artificial Intelligence" Low Price Edition , Pearson Education., Fourth edition.

### **Reference Books:**

1. Ivan Bratko "PROLOG Programming for Artificial Intelligence", Pearson Education, Third Edition.
2. Elaine Rich and Kevin Knight "Artificial Intelligence" Third Edition
3. Davis E.Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning", Addison Wesley, N.Y., 1989.
4. Hagan, Demuth, Beale, "Neural Network Design" CENGAGE Learning, India Edition.
5. Patrick Henry Winston , "Artificial Intelligence", Addison-Wesley, Third Edition.
6. Han Kamber, "Data Mining Concepts and Techniques", Morgann Kaufmann Publishers.
7. N.P.Padhy, "Artificial Intelligence and Intelligent Systems", Oxford University Press.

Course Code	Course/Subject Name	Credits
CPE7021	<b>Advanced Algorithms</b>	5

**Objectives:**

1. To teach fundamentals of analysis of algorithm at depth
2. To provide in depth study of advanced data structures and its uses
3. To teach analysis of problems from different domains

**Outcomes:** Learner will be able to...

1. Identify and use suitable data structures for given problem from different domains
2. Appreciate the role of Graph algorithms in solving variety of problems
3. Appreciate the role of Optimization by using linear programming
4. Analyze the various algorithms from different domains

Module	Detailed Contents	Hrs
01	<b>Introduction</b> 1.1 Asymptotic notations Big O, Big $\Theta$ , Big $\Omega$ , $\omega$ notations, Proofs of master theorem, applying theorem to solve problems	03
02	<b>Advanced Data Structures</b> 2.1 Red-Black Trees: properties of red-black trees, Insertions, Deletions 2.2 B-Trees and its operations 2.3 Binomial Heaps: Binomial trees and binomial heaps, Operation on Binomial heaps	09
03	<b>Dynamic Programming</b> 3.1 matrix chain multiplication, cutting rod problem and its analysis	06
04	<b>Graph algorithms</b> 4.1 Bellman ford algorithm, Dijkstra algorithm, Johnson's All pair shortest path algorithm for sparse graphs	06
05	<b>Maximum Flow</b> 5.1 Flow networks, the ford Fulkerson method, max bipartite matching, push Relabel Algorithm, The relabel to front algorithm	08
06	<b>Linear Programming</b> 6.1 Standard and slack forms, Formulating problems as linear programs, simplex algorithm, Duality, Initial basic feasible solution	08
07	<b>Computational Geometry</b> 7.1 Line Segment properties, Determining whether any pair of segment intersects, finding the convex hull, Finding the closest pair of points.	08

## **Term Work:**

Term work should consist of at least 6 experiments, 2 assignments based on above theory syllabus.

The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work.

The distribution of marks for term work shall be as follows:

• Laboratory work (experiments): .....	(15)	Marks.
• Assignment:.....	(05)	Marks.
• Attendance (Theory+ Practical).....	(05)	Marks
<b>TOTAL: .....</b>	<b>(25)</b>	<b>Marks.</b>

## **Practical/Oral examination:**

Oral examination based on above syllabus will be conducted

### **Syllabus for Practical**

Suggested topics for experiment but not limited to:

1. Red – black trees and its various operations
2. Binomial Heaps and its various operations
3. Dynamic programming: matrix chain multiplication , cutting rod example
4. Bellman ford , Johnson’s algorithm for sparse graphs
5. Ford Fulkerson algorithm , push relabel to front methods
6. Finding closest pair of points, Determining the convex hull
7. Implementation of Simplex algorithm

## **Text Books:**

1. T.H. Cormen , C.E. Leiserson, R.L. Rivest, and C. Stein, “Introduction to algorithms”,2nd edition , PHI publication 2005
2. Ellis Horowitz , Sartaj Sahni , S. Rajsekar. “Fundamentals of computer algorithms” University press

Course Code	Course/Subject Name	Credits
CPE7023	<b>Image Processing</b>	5

**Objectives:**

1. To learn the fundamental concepts of Digital Image Processing and Video Processing .
2. To understand basic image enhancement and segmentation techniques.
3. To illustrate Image Transform calculations mathematically and develop fast transform algorithm
4. To learn Image Compression and Decompression Techniques

**Outcomes:** Learner will be able to...

1. Understand the concept of Digital Image and Video Image.
2. Explain image enhancement and Segmentation technique.
3. Develop fast image transform flowgraph
4. Solve Image compression and decompression techniques
5. Perform Binary Image Processing Operations

Module	Detailed Contents	Hrs.
<b>01</b>	<b>Digital Image and Video Fundamentals</b> 1.1 Introduction to Digital Image, Digital Image Processing System, Sampling and Quantization, Representation of Digital Image, Connectivity, Image File Formats : BMP, TIFF and JPEG. Colour Models (RGB, HSI, YUV) Introduction to Digital Video, Chroma Sub-sampling, CCIR standards for Digital Video	06
<b>02</b>	<b>Image Enhancement</b> 2.1 Gray Level Transformations, Zero Memory Point Operations, Histogram Processing, Neighbourhood Processing, Spatial Filtering, Smoothing and Sharpening Filters. Homomorphic Filtering	09
<b>03</b>	<b>Image Segmentation and Representation</b> 3.1 Detection of Discontinuities, Edge Linking using Hough Transform, Thresholding, Region based Segmentation, Split and Merge Technique, Image Representation and Description, Chain Code, Polygonal Representation, Shape Number, Moments.	09
<b>04</b>	<b>Image Transform</b> 4.1 Introduction to Unitary Transform, Discrete Fourier Transform(DFT), Properties of DFT, Fast Fourier Transform(FFT), Discrete Hadamard Transform(DHT), Fast Hadamard Transform(FHT), Discrete Cosine Transform(DCT), Discrete Wavelet Transform(DWT),	09
<b>05</b>	<b>Image Compression</b> 5.1 Introduction, Redundancy, Fidelity Criteria, 5.2 Lossless Compression Techniques : Run Length Coding, Arithmetic Coding, Huffman Coding, Differential PCM,	09

	5.3 Lossy Compression Techniques: Improved Gray Scale Quantization, Vector Quantization, JPEG, MPEG-1.	
<b>06</b>	<b>Binary Image Processing</b> 6.1 Binary Morphological Operators, Hit-or-Miss Transformation, Boundary Extraction, Region Filling, Thinning and Thickening, Connected Component Labeling, Iterative Algorithm and Classical Algorithm	06

### Term Work:

Term work should consist of at least 08 experiments.

Journal must include at least 1 assignment on each module and two quiz.

The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work.

The distribution of marks for term work shall be as follows:

- Laboratory work (experiments): ..... (15) Marks.
- Assignment:..... (05) Marks.
- Attendance (Theory+ Practical)..... (05) Marks
- TOTAL: ..... (25) Marks.**

### Practical/Oral examination:

Oral exam will be based on the above syllabus

### Practicals

Implementation of programs must be either in C or C++ only. A List of experiments is given below. Input can be Monochrome OR Colour Image. Additional experiments within the scope of the syllabus can be added.

1. Image Enhancement [ Any two techniques ]
  - (1) using Zero Memory Point Operations.
  - (2) using Histogram Processing Technique
  - (3) using Spatial Filtering [ Smoothing Filters/ Sharpening Filters]
  - (4) using Homomorphic Filtering
  
2. Image Segmentation [ Any two techniques ]
  - (1) Horizontal and Vertical Line Detection
  - (2) Edge Detection
  - (3) Split and Merge Technique
  - (4) Edge Linking using Hough Transform

3. Image Compression and De-compression [ Any two techniques ]
  - (1) Arithmetic Coding and Decoding
  - (2) Huffman Coding and Decoding
  - (3) IGS Quantization/ Vector Quantization based Compression and De-compression
  - (4) Transform based Image Compression and De-compression [FFT/ FHT/DCT/ DWT]
  
4. Binary Image Processing [ Any two techniques ]
  - (1) Opening followed by Closing
  - (2) Hit or Miss Transform
  - (3) Thinning/Thickening/ Region Filling / Boundary Extraction
  - (4) Connected Component Algorithm

### **Text Books :**

1. Rafel C. Gonzalez and Richard E. Woods, 'Digital Image Processing', Pearson Education Asia, Third Edition, 2009,
2. S. Jayaraman, E.Esakkirajan and T.Veerakumar, "Digital Image Processing" TataMcGraw Hill Education Private Ltd, 2009,
3. Anil K. Jain, "Fundamentals and Digital Image Processing", Prentice Hall of India Private Ltd, Third Edition
  4. S. Sridhar, "Digital Image Processing", Oxford University Press, Second Edition, 2012.
  5. Robert Haralick and Linda Shapiro, "Computer and Robot Vision", Vol I, II, Addison Wesley, 1993.

### **Reference Books:**

1. Dwayne Phillips, "Image Processing in C", BPB Publication, 2006
2. B. Chandra and D.Dutta Majumder, "Digital Image Processing and Analysis", Prentice Hall of India Private Ltd, 2011
3. Malay K. Pakhira, "Digital Image Processing and Pattern Recognition", Prentice Hall of India Private Ltd, Third Edition
4. Fred Halshall, "Multimedia Communications: Applications, Networks Protocols and Standards,", Pearson Education 2001
5. David A. Forsyth, Jean Ponce, "Computer Vision: A Modern Approach", Pearson Education, Limited, 2011

Course Code	Course/Subject Name	Credits
CPE7024	<b>Software Architecture</b>	5

**Outcomes:**

Software architecture is foundational to the development of large, practical software-intensive applications.

After successful completion of this course learner will be able to:

- Visualize the architectural concepts in development of large, practical software-intensive applications.
- Rather than focusing on one method, notation, tool, or process, this new course widely surveys software architecture techniques, enabling us to choose the right tool for the job at hand.

Module	Detailed Contents	Hrs.
01	<b>Basic Concepts</b> 1.1 Concepts of Software Architecture 1.2 Models. 1.3 Processes. 1.4 Stakeholders	03
02	<b>Designing Architectures</b> 2.1 The Design Process. 2.2 Architectural Conception. 2.3 Refined Experience in Action: Styles and Architectural Patterns. 2.4 Architectural Conception in Absence of Experience.	02
03	<b>Connectors</b> 3.1 Connectors in Action: A Motivating Example. 3.2 Connector Foundations. 3.3 Connector Roles. 3.4 Connector Types and Their Variation Dimensions. 3.5 Example Connectors.	06
04	<b>Modeling</b> 4.1 Modeling Concepts. 4.2 Ambiguity, Accuracy, and Precision. 4.3 Complex Modeling: Mixed Content and Multiple Views. 4.4 Evaluating Modeling Techniques. 4.5 Specific Modeling Techniques.	04
05	<b>Analysis</b> 5.1 Analysis Goals. 5.2 Scope of Analysis. 5.3 Architectural Concern being Analyzed. 5.4 Level of Formality of Architectural Models.	08



	5.5 Type of Analysis. 5.6 Analysis Techniques.	
<b>06</b>	<b>Implementation and Deployment</b> 6.1 Concepts. 6.2 Existing Frameworks. 6.3 Software Architecture and Deployment. 6.4 Software Architecture and Mobility.	04
<b>07</b>	<b>Conventional Architectural styles</b> 7.1 Pipes and Filters 7.2 Event- based, Implicit Invocation 7.3 Layered systems 7.4 Repositories 7.5 Interpreters 7.6 Process control	05
<b>08</b>	<b>Applied Architectures and Styles</b> 8.1 Distributed and Networked Architectures. 8.2 Architectures for Network-Based Applications. 8.3 Decentralized Architectures. 8.4 Service-Oriented Architectures and Web Services.	08
<b>09</b>	<b>Designing for Non-Functional Properties</b> 9.1 Efficiency. 9.2 Complexity. 9.3 Scalability and Heterogeneity. 9.4 Adaptability. 9.5 Dependability.	04
<b>10</b>	<b>Domain-Specific Software Engineering</b> 10.1 Domain-Specific Software Engineering in a Nutshell. 10.2 Domain-Specific Software Architecture. 10.3 DSSAs, Product Lines, and Architectural Styles.	04

### Term Work:

The distribution of marks for term work shall be as follows:

- Laboratory work (experiments):..... (20) Marks.
- Attendance:..... (05) Marks.
- TOTAL: ..... (25) Marks.**

### Practical/Oral examination:

An Oral examination is to be conducted based on the above syllabus

## **Topics For Experiment:**

1. Modeling using xADL
2. Analysis - Case study
3. Visualization using xADL 2.0
4. Integrate software components using a middleware
5. Use middleware to implement connectors
6. Wrapper to connect two applications with different architectures
7. Creating web service
8. Architecture for any specific domain

## **Books:**

### **Text Books:**

1. "Software Architecture: Foundations, Theory, and Practice" by Richard N. Taylor, Nenad Medvidovic, Eric Dashofy, ISBN: 978-0-470-16774-8
2. M. Shaw: Software Architecture Perspectives on an Emerging Discipline, Prentice-Hall.
3. Len Bass, Paul Clements, Rick Kazman: Software Architecture in Practice, Pearson.

### **References:**

1. "Pattern Oriented Software Architecture" by Frank Buchnan et al, Wiley India.
2. "The Art of Software Architecture" by Stephen T. Albin.

Course Code	Course/Subject Name	Credits
CPE7025	<b>Soft Computing</b>	5

**Objectives:**

1. To Conceptualize the working of human brain using ANN.
2. To become familiar with neural networks that can learn from available examples and generalize to form appropriate rules for inference systems.
3. To introduce the ideas of fuzzy sets, fuzzy logic and use of heuristics based on human experience.
4. To provide the mathematical background for carrying out the optimization and familiarizing genetic algorithm for seeking global optimum in self-learning situation.

**Outcomes:** Learner will be able to...

1. Ability to analyze and appreciate the applications which can use fuzzy logic.
2. Ability to design inference systems.
3. Ability to understand the difference between learning and programming and explore practical applications of Neural Networks (NN).
4. Ability to appreciate the importance of optimizations and its use in computer engineering fields and other domains.
5. Students would understand the efficiency of a hybrid system and how Neural Network and fuzzy logic can be hybridized to form a Neuro-fuzzy network and its various applications.

Module	Detailed Contents	Hours
<b>01</b>	<b>Introduction to Soft Computing</b> 1.1 Soft computing Constituents, Characteristics of Neuro Computing and Soft Computing, Difference between Hard Computing and Soft Computing, Concepts of Learning and Adaptation.	<b>04</b>
<b>02</b>	<b>Neural Networks</b> <b>2.1 Basics of Neural Networks:</b> Introduction to Neural Networks, Biological Neural Networks, McCulloch Pitt model, <b>2.2 Supervised Learning algorithms:</b> Perceptron (Single Layer, Multi layer), Linear separability, Delta learning rule, Back Propagation algorithm, <b>2.3 Un-Supervised Learning algorithms:</b> Hebbian Learning, Winner take all, Self Organizing Maps, Learning Vector Quantization.	<b>14</b>

<b>03</b>	<b>Fuzzy Set Theory</b> 3.1 Classical Sets and Fuzzy Sets, Classical Relations and Fuzzy Relations, Properties of membership function, Fuzzy extension principle, Fuzzy Systems- fuzzification, defuzzification and fuzzy controllers.	<b>14</b>
<b>04</b>	<b>Hybrid system</b> 4.1 Introduction to Hybrid Systems, Adaptive Neuro Fuzzy Inference System(ANFIS).	<b>04</b>
<b>05</b>	<b>Introduction to Optimization Techniques</b> <b>5.1 Derivative based optimization-</b> Steepest Descent, Newton method. <b>5.2 Derivative free optimization-</b> Introduction to Evolutionary Concepts.	<b>06</b>
<b>06</b>	<b>Genetic Algorithms and its applications:</b> 6.1 Inheritance Operators, Cross over types, inversion and Deletion, Mutation Operator, Bit-wise Operators, Convergence of GA, Applications of GA.	<b>06</b>

### Term Work:

The distribution of marks for term work shall be as follows:

- Laboratory work (experiments/case studies): ..... (15) Marks.
- Assignments:..... (05) Marks.
- Attendance ..... (05) Marks
- TOTAL: ..... (25) Marks.**

### Practical/Oral examination:

Oral examination will be based on the above syllabus.

### PRACTICALS:

All the programs should be implemented in C/C++/Java/MATLAB under Windows or Linux environment. Experiments can also be conducted using available open source tools like OCTAVE and SCILAB

### LIST OF SC PRACTICAL / EXPERIMENTS

1. One case study on Fuzzy/Neural/GA based papers published in IEEE/ACM/Springer or any prominent journal.
2. To implement Fuzzy Sets.

3. To implement Fuzzy Relations.
4. To implement Fuzzy Controllers.
5. To implement Basic Neural Network learning rules.
6. To implement any Supervised Learning algorithm.
7. To implement any Unsupervised Learning algorithm.
8. To implement a simple application using Genetic Algorithm.

Any other practical covering the syllabus topics and subtopics can be conducted.

**Reference Books (for practicals) :**

1. S.N.Sivanandam, S.N.Deepa "Principles of Soft Computing" Second Edition, Wiley Publication.
2. S.Rajasekaran and G.A.Vijayalakshmi Pai "Neural Networks, Fuzzy Logic and Genetic Algorithms" PHI Learning.
3. Hagan, Demuth, Beale, "Neural Network Design" CENGAGE Learning, India Edition.
4. Satish Kumar, "Neural Networks –A classroom approach", Second Edition, TMH Publication.

**Text Books:**

1. Timothy J.Ross "Fuzzy Logic With Engineering Applications" Wiley.
2. S.N.Sivanandam, S.N.Deepa "Principles of Soft Computing" Second Edition, Wiley Publication.
3. S.Rajasekaran and G.A.Vijayalakshmi Pai "Neural Networks, Fuzzy Logic and Genetic Algorithms" PHI Learning.
4. J.-S.R.Jang "Neuro-Fuzzy and Soft Computing" PHI 2003.
5. Jacek.M.Zurada "Introduction to Artificial Neural Systems" Jaico Publishing House.

**Reference Books:**

1. Satish Kumar "Neural Networks A Classroom Approach" Tata McGrawHill.
2. Zimmermann H.S "Fuzzy Set Theory and its Applications" Kluwer Academic Publishers.
3. Davis E.Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning", Addison Wesley, N.Y., 1989.
4. Hagan, Demuth, Beale, "Neural Network Design" CENGAGE Learning, India Edition.

Course Code	Course/Subject Name	Credits
CPE7026	<b>Enterprise Resource Planning and Supply Chain Management (ERP &amp; SCM)</b>	5

**Objectives:**

1. To understand the technical aspects of ERP and SCM systems.
2. To understand the steps and activities in the ERP and SCM life cycle.
3. To identify and describe typical functionality in an ERP and SCM system.
4. To understand tools and methodology used for designing ERP and SCM for an Enterprise.

**Outcomes:** Learner will be able to...

1. To conceptualize the basic structure of ERP and SCM
2. To identify implementation strategy used for ERP and SCM.
3. To apply design principles for various business module in ERP and SCM.
4. To apply different emerging technologies for implementation of ERP and SCM.

Module	Detailed Contents	Hours
<b>Enterprise Resource Planning</b>		
<b>01</b>	<b>Introduction</b> 1.1 What is an Enterprise, Introduction to ERP, Need for ERP, Structure of ERP, Scope and Benefits, Typical business processes.	02
<b>02</b>	<b>ERP and Technology</b> 2.1 ERP and related technologies, Business Intelligence, E-business and E-commerce, Business Process Reengineering,	04
<b>03</b>	<b>ERP and Implementation</b> 3.1 ERP implementation and strategy, Implementation Life cycle, Pre-implementation task, requirement definition, implementation methodology.	06
<b>04</b>	<b>ERP Business Modules</b> 4.1 Modules: Finance, manufacturing, human resources, quality management, material management, marketing. Sales distribution and service.	08
<b>05</b>	<b>Extended ERP</b> 5.1 Enterprise application Integration (EAI), open source ERP, cloud ERP.	04
<b>Supply Chain Management (SCM)</b>		
<b>06</b>	<b>Introduction and strategic decisions in SCM</b>	08

	6.1 Introduction to SCM, Generic Types of supply chain, Major Drivers of Supply chain, Strategic decisions in SCM, Business Strategy, CRM strategy, SRM strategy, SCOR model.	
<b>07</b>	<b>Information Technology in SCM</b> 7.1 Types of IT Solutions like Electronic Data Inter change (EDI), Intranet/ Extranet, Data Mining/ Data Warehousing and Data Marts, E-Commerce, E- Procurement, Bar coding, RFID, QR code.	06
<b>08</b>	<b>Mathematical modelling for SCM</b> 8.1 Introduction, Considerations in modelling SCM systems, Structuring the logistics chain, overview of models: models on transportation problem, assignment problem, vehicle routing problem, Model for vendor analysis, Make versus buy model.	06
<b>09</b>	<b>Agile Supply Chain</b> 9.1 Introduction, Characteristics of Agile Supply Chain, Achieving Agility in Supply Chain.	02
<b>10</b>	<b>Cases of Supply Chain</b> 10.1 Cases of Supply Chain like, News Paper Supply Chain, Book Publishing, Mumbai Dabbawala, Disaster management, Organic Food, Fast Food.	02

### Term Work:

The distribution of marks for term work shall be as follows:

- Mini project:..... (20) Marks.
- Attendance ..... (05) Marks
- TOTAL: ..... (25) Marks.**

### Practical/Oral examination:

**Oral examination will be based on the above syllabus.**

The lab will be conducted on mini project which may be conducted on the following:

- 1) Simulating business processes of an Enterprise.
- 2) Designing a web portal for an Enterprise using E-business Models.
- 3) E-procurement model.
- 4) Open source ERP
- 5) Cloud ERP
- 6) Business process agility
- 7) SCM model.
- 8) Implementing Business Intelligence
- 9) Any other relevant topics covering the syllabus.

**Text Books:**

1. Enterprise Resource Planning : concepts & practices, by V.K. Garg & N.K. Venkatakrisnan ; PHI.
2. Supply Chain Management Theories & Practices: R. P. Mohanty, S. G. Deshmukh, - Dreamtech Press.
3. ERP Demystified: II Edition, by Alexis Leon, McGraw Hill .
4. Enterprise wide resource planning: Theory & practice: by Rahul Altekar, PHI.

**Reference Books:**

1. ERP to E<sup>2</sup>ERP: A Case study approach, by Sandeep Desai, Abhishek Srivastava, PHI.
2. Managerial Issues of ERP system, by David Olson, McGraw Hill.



Course Code	Course/Subject Name	Credits
CPE7022	<b>Computer Simulation and Modeling</b>	5

**Course Objectives:**

This course presents an introduction to discrete event simulation systems. Emphasis of the course will be on modeling and the use of simulation languages/software to solve real world problems in the manufacturing as well as services sectors. The course discusses the modeling techniques of entities, queues, resources and entity transfers in discrete event environment. The course will teach the students the necessary skills to formulate and build valid models, implement the model, perform simulation analysis of the system and analyze results properly. The “theory” of simulation involves probability and statistics, thus a good background in probability and statistics is a required prerequisite

**Course Outcomes:**

1. Apply simulation concepts to achieve in business, science, engineering, industry and services goals
2. Demonstrate formulation and modeling skills.
3. Perform a simulation using spreadsheets as well as simulation language/package
4. Generate pseudorandom numbers using the Linear Congruential Method
5. Evaluate the quality of a pseudorandom number generator using statistical tests
6. Analyze and fit the collected data to different distributions

Module	Detailed Contents	Hours
<b>Computer Simulation and Modeling</b>		
<b>01</b>	Introduction to Simulation. Simulation Examples. General Principles	15
<b>02</b>	Statistical Models in simulation. Queuing Models	08
<b>03</b>	Random Number Generation. Testing random numbers (Refer to Third edition) Random Variate Generation: Inverse transform technique, Direct Transformation for the Normal Distribution, Convolution Method, Acceptance-Rejection Technique (only Poisson Distribution).	09

<b>04</b>	Analysis of simulation data : Input Modeling ,Verification, Calibration and Validation of Simulation , Models , Estimation of absolute performance.	12
<b>05</b>	Application : Case study on 1. Processor and Memory simulation 2. Manufacturing & Material handling	04

**Text Books:**

Discrete Event System Simulation; Third Edition, Jerry Banks, John Carson, Barry Nelson, and David M. Nicol, Prentice-Hall

Discrete Event System Simulation; Fifth Edition, Jerry Banks, John Carson, Barry Nelson, and David M. Nicol, Prentice-Hall

**References:**

4. System Modeling & Analysis; Averill M Law, 4<sup>th</sup> Edition TMH.
5. Principles of Modeling and Simulation; Banks C M , Sokolowski J A; Wiley
6. System Simulation ; Geoffrey Gordon ; EEE
7. System Simulation with Digital Computer; Narsing Deo, PHI

**Term work:**

Laboratory work: 10 marks

Mini Simulation Project presentation: 10 marks

Attendance : 5 marks

**Suggested Practical List (If Any):**

Perform simulation exercises given in the text book (third edition) using spreadsheets and/or simulation language/package

5. Queue- single server, multi-server, classic case- dump truck
6. Inventory – Lead time=0, lead time fixed, lead time probabilistic
7. Reliability problem
8. Tutorials on statistical models
9. Random number generate and test
10. Goodness of fit test
11. Output analysis – Point estimate and Confidence Interval

Simulation: Real World Examples – can be in the field of business, transportation, medical, computing, manufacturing and material handling- Presentation to be taken.

**Practical/Oral examination:**

**Oral examination will be based on the above syllabus.**

Course Code	Course/Subject Name	Credits
CPL701	<b>Network threats and attacks Laboratory</b>	02

**Outcomes: After completion of this Laboratory course learner will be able To**

1. Use network-based tools for network analysis
2. Use techniques for Network scanning
3. Identify network vulnerability
4. Use tools to simulate intrusion detection system
5. To understand and install a firewall

Module	Detailed Contents
<b>01</b>	<p><b>1.1 Title:</b> Study the use of network reconnaissance tools like WHOIS, dig, traceroute, nslookup to gather information about networks and domain registrars.</p> <p><b>Objective:</b> Objective of this module to how to gather information about the networks by using different n/w reconnaissance tools.</p> <p><b>Scope:</b> Network analysis using network based tools</p> <p><b>Technology:</b> Networking</p>
<b>02</b>	<p><b>2.1 Title:</b> Study of packet sniffer tools like wireshark, ethereal, tcpdump etc. You should be able to use the tools to do the following</p> <ol style="list-style-type: none"> <li>1. Observer performance in promiscuous as well as non-promiscuous mode.</li> <li>2. Show that packets can be traced based on different filters.</li> </ol> <p><b>Objective:</b> Objective of this module is to observer the performanance in promiscuous &amp; non-promiscuous mode &amp; to find the packets based on different filters.</p> <p><b>Scope:</b> Packet grapping, message and protocol analysis</p> <p><b>Technology:</b> Networking</p>
<b>03</b>	<p><b>3.1 Title:</b> Download and install nmap. Use it with different options to scan open ports, perform OS fingerprinting, do a ping scan, tcp port scan, udp port scan, etc.</p> <p><b>Objective:</b> objective of this module to learn nmap installation &amp; use this to scan different ports.</p> <p><b>Scope:</b> used for ip spoofing and port scanning</p> <p><b>Technology:</b> Networking</p>

04	<p><b>4.1 Title:</b> Detect ARP spoofing using open source tool ARPWATCH.</p> <p><b>Objective:</b> Objective of the module to find ARP spoofing using open source.</p> <p><b>Scope:</b> Ip spoofing using arp packaging tool</p> <p><b>Technology:</b> Networking</p>
05	<p><b>5.1 Title:</b> Use the Nessus tool to scan the network for vulnerabilities.</p> <p><b>Objective:</b> Objective of the module is scan system and network analysis.</p> <p><b>Scope:</b> It used for system analysis, security and process analysis</p> <p><b>Technology:</b> Networking</p>
06	<p><b>6.1 Title:</b> Implement a code to simulate buffer overflow attack.</p> <p><b>Objective:</b> Objective of the module Is to check buffer overflow in an NS2 environment</p> <p><b>Scope:</b> It uses to analyse memory overflow attack</p> <p><b>Technology:</b> Networking</p>
07	<p><b>7.1 Title:</b> Set up IPSEC under LINUX</p> <p><b>Objective:</b> Objective of the module for implementing security vulnerabilities</p> <p><b>Scope:</b> to study different ipsec tools.</p> <p><b>Technology:</b> Networking</p>
08	<p><b>8.1 Title:</b> Install IDS (e.g. SNORT) and study the logs.</p> <p><b>Objective:</b> Simulate intrusion detection system using tools such as snort</p> <p><b>Scope:</b> It is used for intrusion detection system vulnerability scans</p> <p><b>Technology:</b> Networking</p>
09	<p><b>9.1 Title:</b> Use of iptables in linux to create firewalls.</p> <p><b>Objective:</b> To study how to create and destroy firewall security parameters.</p> <p><b>Scope:</b> system security and network security</p> <p><b>Technology:</b> Networking</p>
10	<p><b>10.1 Title:</b> Mini project</p> <p><b>Objective:</b> To implement Networking concepts</p>

	<p><b>Scope:</b> To understand Network &amp; system tools</p> <p><b>Technology:</b> Networking</p>
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**Term Work:**

The distribution of marks for term work shall be as follows:

- Lab Assignments:..... (10)
- Mini project:..... (10) Marks.
- Attendance ..... (05) Marks
- TOTAL: ..... (25) Marks.**

**Oral examination:**

Oral examination is to be conducted by pair of internal and external examiners based on above syllabus and the mini projects done.

**References:**

1. Network Security Assessment by Chris McNab, O'Reilly
2. Network Security Hacks, Andrew Lockhart, O'Reilly
3. The Web Application Hacker's Handbook 2<sup>nd</sup> Edition by Dafydd Stuttard & Marcus Pinto, Wiley Publication(2014).
4. Securing the Virtual Environment by Davi Ottenheimer & Matthew Wallace, Wiley Publication(2012).