



**HINDUSTAN
UNIVERSITY**
HINDUSTAN INSTITUTE OF TECHNOLOGY & SCIENCE

Department of Computer Applications

**M.C.A. with specialization in
Cloud Computing**

Curriculum & Syllabus

2014 Regulations

ACADEMIC REGULATIONS

(M.TECH/ M.B.A. / M.C.A.)

(Full - Time / Part – Time)

(Effective 2014-15)

1. Vision, Mission and Objectives

1.1 The Vision of the Institute is “To make every man a success and no man a failure”.

In order to progress towards the vision, the Institute has identified itself with a mission to provide every individual with a conducive environment suitable to achieve his / her career goals, with a strong emphasis on personality development, and to offer quality education in all spheres of engineering, technology, applied sciences and management, without compromising on the quality and code of ethics.

1.2 Further, the institute always strives

- To train our students with the latest and the best in the rapidly changing fields of Engineering, Technology, Management, Science & Humanities.
- To develop the students with a global outlook possessing, state of the art skills, capable of taking up challenging responsibilities in the respective fields.
- To mould our students as citizens with moral, ethical and social values so as to fulfill their obligations to the nation and the society.
- To promote research in the field of science, Humanities, Engineering, Technology and allied branches.

1.3 Our aims and objectives are focused on

- Providing world class education in engineering, technology, applied science and management.
- Keeping pace with the ever changing technological scenario to help our students to gain proper direction to emerge as competent professionals fully aware of their commitment to the society and nation.
- To inculcate a flair for research, development and entrepreneurship.

2. Admission

2.1. The admission policy and procedure shall be decided from time to time by the Board of Management (BOM) of the Institute, following guidelines issued by Ministry of Human Resource Development (MHRD), Government of India. The number of seats in each branch of the (M.TECH / M.B.A. / M.C.A.) programme will be decided by BOM as per the directives from Ministry of Human Resource Development (MHRD), Government of India and taking into account the market demands. Some seats for Non Resident Indians and a few seats for foreign nationals shall be made available.

2.2. The selected candidates will be admitted to the (M.TECH / M.B.A. / M.C.A.) programme after he/she fulfills all the admission requirements set by the Institute and after payment of the prescribed fees.

2.3. Candidates for admission to the first semester of the Master's Degree Programme shall be required to have

passed an appropriate Degree Examination recognized by Hindustan University.

2.4. In all matters relating to admission to the (M.TECH /M.B.A. / M.C.A.). Programme, the decision of the Institute and its interpretation given by the Chancellor of the Institute shall be final.

2.5. If at any time after admission, it is found that a candidate has not fulfilled any of the requirements stipulated by the Institute, the Institute may revoke the admission of the candidate with information to the Academic Council.

3. Structure of the programme

3.1. The programme of instruction will have the following structure

- i) Core courses of Engineering / Technology / Management.
- ii) Elective courses for specialization in areas of student's choice.

3.2. The minimum durations of the programmes are as given below:

Program	No. of Semesters
M.Tech.(Full-Time)	4
M.Tech.(Part -Time)	6
M.B.A. (Full - Time)	4
M.B.A. (Part - Time)	6
M.C.A.(Full - Time)	6
M.C.A.(Part -Time)	8

Every (M.TECH / M.B.A. / M.C.A.) programme will have a curriculum and syllabi for the courses approved by the Academic Council.

3.3. Each course is normally assigned certain number of credits. The following norms will generally be followed in assigning credits for courses.

- One credit for each lecture hour per week per semester;
- One credit for each tutorial hour per week per semester;
- One credit for each laboratory practical (drawing) of three (two) hours per week per semester.
- One credit for 4 weeks of industrial training and
- One credit for 2 hours of project per week per semester.

3.4. For the award of degree, a student has to earn certain minimum total number of credits specified in the curriculum of the relevant branch of study. The curriculum of the different programs shall be so designed that the minimum prescribed credits required for the award of the degree shall be within the limits specified below.

Program	Minimum prescribed credit range
M.Tech. (Full time / Part time)	75 - 85
M.B.A. (Full time / Part time)	85 - 95
M.C.A (Full time / Part time)	115 - 125

3.5. The medium of instruction, examination and the language of the project reports will be English.

4. Faculty Advisor

4.1. To help the students in planning their courses of study and for getting general advice on the academic programme, the concerned Department will assign a certain number of students to a Faculty member who will be called their Faculty Advisor.

5. Class Committee

5.1 A Class Committee consisting of the following will be constituted by the Head of

Range of Marks	Letter Grade	Grade points
95-100	S	10
85 - 94	A	09
75- 84	B	08
65-74	C	07
55-64	D	06
50-54	E	05
< 50	U	00
	I (Incomplete)	--

the Department for each class:

- (i) **A Chairman, who is not teaching the class.**
- (ii) **All subject teachers of the class.**
- (iii) **Two students nominated by the department in consultation with the class.**

The Class Committee will meet as often as necessary, but not less than three times during a semester.

The functions of the Class Committee will include:

- (i) Addressing problems experienced by students in the classroom and the laboratories.
- (ii) Analyzing the performance of the students of the class after each test and finding ways and means of addressing problems, if any.
- (iii) During the meetings, the student members shall express the opinions and suggestions of the class students to improve the teaching / learning process.

6. Grading

6.1 A grading system as below will be adhered to.

6.2 GPA & CGPA

GPA is the ratio of the sum of the product of the number of credits C_i of course "i" and the grade points P_i earned for that course taken over all courses "i" registered by the student to the sum of C_i for all "i". That is,

$$GPA = \frac{\sum_i C_i P_i}{\sum_i C_i}$$

CGPA will be calculated in a similar manner, at any semester, considering all the courses enrolled from first semester onwards.

6.3. For the students with letter grade I in certain subjects, the same will not be included in the computation of GPA and CGPA until

after those grades are converted to the regular grades.

6.4 Raw marks will be moderated by a moderation board appointed by the Vice Chancellor of the University. The final marks will be graded using an absolute grading system. The Constitution and composition of the moderation board will be dealt with separately.

7. Registration and Enrollment

7.1 Except for the first semester, registration and enrollment will be done in the beginning of the semester as per the schedule announced by the University.

7.2 A student will be eligible for enrollment only if he/she satisfies regulation 10 (maximum duration of the programme) and will be permitted to enroll if (i) he/she has cleared all dues in the Institute, Hostel & Library up to the end of the previous semester and (ii) he/she is not debarred from enrollment by a disciplinary action of the University.

7.3. Students are required to submit registration form duly filled in.

8. Registration requirement

8.1. (i) A Full time student shall not register for less than 16 credits or more than 26 credits in any given semester.

8.1. (ii) A part time student shall not register for less than 10 credits or more than 20 credits in any given semester.

8.2 If a student finds his/her load heavy in any semester, or for any other valid reason, he/she may withdraw from the courses within three weeks of the commencement of the semester with the written approval of his/her Faculty Advisor and HOD. However the student should ensure that the total number of credits registered for in any semester should enable him/her to earn the minimum number of credits per semester for the completed semesters.

9. Minimum requirement to continue the programme

9.1. For those students who have not earned the minimum required credit prescribed for that particular semester examination, a warning letter to the concerned student and also to his parents regarding the shortage of his credit will be sent by the HOD after the announcement of the results of the university examinations.

10. Maximum duration of the programme

The minimum and maximum period for the completion of various programs are given below.

Program	Min. No. of Semesters	Max. No. of Semesters
M.Tech (Full - time)	4	8
M.Tech (Part - time)	6	10
M.B.A. (Full Time)	4	8
M.B.A. (Part Time)	6	10
M.C.A. (Full - Time)	6	12

M.C.A (Part –Time)	8	14
-----------------------	---	----

11. Temporary discontinuation

11.1. A student may be permitted by the Director(Academic) to discontinue temporarily from the programme for a semester or a longer period for reasons of ill health or other valid reasons. Normally a student will be permitted to discontinue from the programme only for a maximum duration of two semesters.

12. Discipline

12.1. Every student is required to observe discipline and decorum both inside and outside the campus and not to indulge in any activity which will tend to bring down the prestige of the University.

12.2. Any act of indiscipline of a student reported to the Director(Academic) will be referred to a Discipline Committee so constituted. The Committee will enquire into the charges and decide on suitable punishment if the charges are substantiated. The committee will also authorize the Director(Academic) to recommend to the Vice - Chancellor the implementation of the decision. The student concerned may appeal to the Vice Chancellor whose decision will be final. The Director(Academic) will report the action taken at the next meeting of the Council.

12.3. Ragging and harassment of women are strictly prohibited in the University campus and hostels.

13. Attendance

13.1. A student whose attendance is less than 75% is not eligible to appear for the end semester examination for that semester. The details of all students who have attendance less than 75% will be announced by the teacher in the class. These details will be sent to the concerned HODs and Dean.

13.2. Those who have less than 75% attendance will be considered for condonation of shortage of attendance. However a condonation of 10% in attendance will be given on medical reasons. Application for condonation recommended by the Faculty Advisor, concerned faculty member and the HOD is to be submitted to the Director(Academic) who, depending on the merits of the case, may permit the student to appear for the end semester examination. A student will be eligible for this concession at most in two semesters during the entire degree programme. Application for medical leave, supported by medical certificate with endorsement by a Registered Medical Officer, should reach the HOD within seven days after returning from leave or, on or before the last instructional day of the semester, whichever is earlier.

13.3. As an incentive to those students who are involved in extra curricular activities such as representing the University in Sports and Games, Cultural Festivals, and Technical Festivals, NCC/ NSS events, a relaxation of up to 10% attendance will be given subject to the condition that these students take prior approval from the officer –in-charge. All such applications should be recommended by the concerned HOD and forwarded to Director(Academic) within seven instructional days after the programme/activity.

14. Assessment Procedure

14.1. The Academic Council will decide from time to time the system of tests and examinations in each subject in each semester.

14.2. For each theory course, the assessment will be done on a continuous basis as follows:

Test / Exam	Weightage	Duration of Test / Exam
First Periodical Test*	10%	2 Periods
Second Periodical Test*	10%	2 Periods
Model exam	20%	3 hours
Seminar/ Assignments/Quiz	20%	
End – semester examination	50%	3 Hours

* **Best out of the two tests will be considered.**

14.3. For practical courses, the assessment will be done by the subject teachers as below:

(i) Weekly assignment/Observation note book / lab records – weightage 60%.

(ii) End semester examination of 3 hours duration including viva – weightage 40%.

15. Make up Examination/model examination

15.1. Students who miss the end-semester examinations / model examination for valid reasons are eligible for make-up examination /model examination. Those who miss the end-semester examination / model examination should apply to the Head of the Department concerned within five days after he / she

missed examination, giving reasons for absence.

15.2 Permission to appear for make-up examination / model exam will be given under exceptional circumstances such as admission to a hospital due to illness. Students should produce a medical certificate issued by a Registered Medical Practitioner certifying that he/she was admitted to hospital during the period of examination / model exam and the same should be duly endorsed by parent / guardian and also by a medical officer of the University within 5 days.

16. Project evaluation

16.1. For Project work, the assessment will be done on a continuous basis as follows:

Review / Examination	Weightage
First Review	10%
Second Review	20%
Third Review	20%
End semester Examination	50%

For end semester exam, the student will submit a Project Report in a format specified by the Director(Academic). The first three reviews will be conducted by a Committee constituted by the Head of the Department. The end – semester examination will be conducted by a Committee constituted by the Controller of Examinations. This will include an external expert.

17. Declaration of results

17.1 A candidate who secures not less than 50% of total marks prescribed for a course with a minimum of 50% of the marks prescribed for the end semester examination shall be declared to have

passed the course and earned the specified credits for the course.

17.2 After the valuation of the answer scripts, the tabulated results are to be scrutinized by the Result Passing Boards of PG programmes constituted by the Vice-Chancellor. The recommendations of the Result Passing Boards will be placed before the Standing Sub Committee of the Academic Council constituted by the Chancellor for scrutiny. The minutes of the Standing Sub Committee along with the results are to be placed before the Vice-Chancellor for approval. After getting the approval of the Vice-Chancellor, the results will be published by the Controller of Examination/Registrar.

17.3 If a candidate fails to secure a pass in a course due to not satisfying the minimum requirement in the end semester examination, he/she shall register and re-appear for the end semester examination during the following semester. However, the sessional marks secured by the candidate will be retained for all such attempts.

17.4 If a candidate fails to secure a pass in a course due to insufficient sessional marks though meeting the minimum requirements of the end semester examination, wishes to improve on his/her sessional marks, he/she will have to register for the particular course and attend the course with permission of the HOD concerned and the Registrar. The sessional and external marks obtained by the candidate in this case will replace the earlier result.

17.5 A candidate can apply for the revaluation of his/her end semester examination answer paper in a theory course within 2 weeks from the declaration of the results, on payment of a prescribed fee through proper application to the Registrar/Controller of Examinations through the Head of the Department. The Registrar/ Controller of Examination will arrange for the revaluation and the results will be intimated to the candidate concerned through the Head of the Department. Revaluation is not permitted for practical courses and for project work.

18. Grade Card

18.1. After results are declared, grade sheet will be issued to each student, which will contain the following details:

- (i) Program and branch for which the student has enrolled.
- (ii) Semester of registration.
- (iii) List of courses registered during the semester and the grade scored.
- (iv) Semester Grade Point Average (GPA)
- (v) Cumulative Grade Point Average (CGPA).

19. Class / Division

19.1 Classification is based on CGPA and is as follows:

CGPA \geq 8.0: **First Class with distinction**

6.5 \leq CGPA < 8.0: **First Class**

5.0 \leq CGPA < 6.5: **Second Class.**

19.2 (i) Further, the award of 'First class with distinction' is subject to the candidate becoming eligible for the award of the

degree having passed the examination in all the courses in his/her first appearance within the minimum duration of the programme.

(ii) The award of 'First Class' is further subject to the candidate becoming eligible to the award of the degree having passed the examination in all the courses within the below mentioned duration of the programme.

Program	No. of Semesters
M.Tech (Full - time)	5
M.Tech (Part - time)	7
M.B.A. (Full Time)	5
M.B.A. (Part Time)	7
M.C.A. (Full - Time)	7
M.C.A (Part –Time)	9

(iii) The period of authorized discontinuation of the programme (vide clause 11.1) will not be counted for the purpose of the above classification.

20. Transfer of credits

20.1. Within the broad framework of these regulations, the Academic Council, based

on the recommendation of the transfer of credits committee so constituted by the Chancellor may permit students to earn part of the credit requirement in other approved institutions of repute and status in the country or abroad.

21. Eligibility for the award of (M.TECH / M.B.A. / M.C.A.) Degree

21.1. A student will be declared to be eligible for the award of the (M.TECH / M.B.A. / M.C.A.) Degree if he/she has

- i) registered and successfully credited all the core courses,
- ii) successfully acquired the credits in the different categories as specified in the curriculum corresponding to the discipline (branch) of his/her study within the stipulated time,
- iii) has no dues to all sections of the Institute including Hostels, and
- iv) has no disciplinary action pending against him/her.

The award of the degree must be recommended by the Academic Council and approved by the Board of Management of the University.

22. Power to modify

22.1. Notwithstanding all that has been stated above, the Academic Council has the right to modify any of the above regulations from time to time subject to approval by the Board of Management.

SEMESTER – I

S. No	Code No.	Course Title	L	T	P	C	TCH
THEORY							
1	PMA108	Discrete Mathematics & Finite State Automata	3	1	0	4	4
2	PBA160	Accounting And Financial Management	3	1	0	4	4
3	PCA101	Computer Organization	3	1	0	4	4
4	PCA102	Problem Solving and Programming	3	1	0	4	4
5	PCA103	Introduction to Information Technology	3	1	0	4	4
PRACTICAL							
6	PCA104	Programming Lab	0	0	3	1	3
7	PCA105	Accounting and Financial Management Lab	0	0	3	1	3
		TOTAL				22	26

SEMESTER – II

S. No	Code No	Course Title	L	T	P	C	TC H
THEORY							
1	PCA201	Operating Systems	3	0	2	4	5
2	PCA202	Object Oriented Programming	3	1	0	4	4
3	PCA203	Database Management Systems	3	0	0	3	3
4	PCA204	Data Structures	3	1	0	4	4
5	PCA205	Design and Analysis of Algorithms	3	1	0	4	4
PRACTICAL							
6	PCA206	Object Oriented Programming Lab	0	0	3	1	3
7	PCA207	Database Management Systems Lab	0	0	3	1	3
8	PCA208	Data Structures Lab	0	0	3	1	3
		TOTAL				22	29

SEMESTER - III

S.No	Code No.	Course Title	L	T	P	C	TC H
THEORY							
1	PCA301	Computer Networks	3	0	0	3	3
2	PCA302	Microprocessors and its Applications	3	1	0	4	4
3	PCA303	Java Programming	3	1	0	4	4
4	PCA304	Computer Graphics and Multimedia Systems	3	0	0	3	3
5	*****	Elective-I	3	0	0	3	3
PRACTICAL							
6	PCA305	Microprocessors Lab	0	0	3	1	3
7	PCA306	Java Programming Lab	0	0	3	1	3
8	PCA307	Computer Graphics and Multimedia Lab	0	0	3	1	3
TOTAL						20	26

SEMESTER – IV

S.No	Code No.	Course Title	L	T	P	C	TCH
THEORY							
1	PCA401	Advanced Java Programming	3	1	0	4	4
2	PCA402	Object Oriented Analysis and Design	3	0	2	4	5
3	PCA403	Visual Programming	3	1	0	4	4
4	PCA404	Software Engineering	3	0	0	3	3
5	*****	Elective-II	3	0	0	3	3
PRACTICAL							
6	PCA405	Advanced Java Programming Lab	0	0	3	1	3
7	PCA406	Visual Programming Lab	0	0	3	1	3
8	EL1331	Communication Skills Lab	2	0	2	3	4
TOTAL						23	29

SEMESTER – V

S.No.	Code No.	Course Title	L	T	P	C	TCH
THEORY							
1	PCA501	Service oriented Architecture	3	0	0	3	3
2	*****	Elective-III	3	0	0	3	3
3	*****	Elective- IV	3	0	0	3	3
4	*****	Elective- V	3	0	0	3	3
5	*****	Elective-VI	3	0	0	3	3
PRACTICAL							
6	PCA502	XML and Web Services Lab	0	0	3	1	3
7	PCA503	Software Development Lab	0	0	3	1	3
8	PCA504	Project Work - Phase – I	0	0	3	1	3
		TOTAL				18	24

SEMESTER – VI

S. No.	Code No.	Course Title	L	T	P	C	TC H
1	PCA601	Project Work - Phase –II	0	0	24	12	24
		TOTAL				12	24

SEMESTER – I

PMA108 DISCRETE MATHEMATICS & FINITE STATE AUTOMATA

LTPC
3104

Goal

To know about mathematical logic grammars and languages and basic set theory concepts.

Objectives

The course should enable the students

- To learn about the matrix algebra
- To learn about set theory.
- To learn about various logical operators
- To study about grammars and formal languages
- To learn about automata theories

Outcomes

The student should be able to

- Know about the matrix algebra.
- Know about working with sets
- Know about various type of logical operators
- Know about grammars and formal languages.
- Know about various automata theories

UNIT I MATRIX ALGEBRA

12

Matrices - Rank of Matrix - Solving System of Equations - Consistent and Inconsistent systems -Eigen Values and Eigen Vectors - Inverse of a Matrix - Cayley Hamilton Theorem.

UNIT II BASIC SET THEORY

12

Basic Definitions - Venn Diagrams and set operations - Laws of set theory - Principle of inclusion and exclusion - partitions- Permutation and Combination - Relations- Properties of relations - Matrices of relations - Closure operations on relations - Functions - injective, surjective and bijective functions.

UNIT III MATHEMATICAL LOGIC

12

Propositions and logical operators - Truth table - Propositions generated by a set, Equivalence and implication - Basic laws- Some more connectives - Functionally complete set of connectives- Normal forms - Proofs in Propositional calculus - Predicate calculus.

UNIT IV FORMAL LANGUAGES AND FINITE STATE AUTOMATA

12

Languages and Grammars - Phrase Structure Grammar - Classification of Grammars -Pumping Lemma for Regular Languages (Statement only)-Context Free Languages. Finite State Automata-Deterministic Finite State Automata (DFA) - Non Deterministic Finite State Automata (NFA)-Equivalence of DFA and NFA.

UNIT V PROBABILITY AND RANDOM VARIABLE

12

Probability - addition and multiplication theorem - Baye's theorem - Random variables - Moments -Moment generating function - Standard distributions - Binomial, Poisson and Normal (Simple problems with no derivation).

Total No. of Periods: 60

TEXT BOOKS:

- 1) T.Veerarajan, "Discrete Mathematics for Computer Science", Tata McGraw Hill, 2007.
- 2) Dr.A.Singaravelu, Dr.S.Siva Subramanian and Dr.C.Ramachandran, "Probability and Queuing Theory", Meenakshi agency,(Unit I and II), 4th edition, December 2006.

REFERENCES:

- 1) M.K.Venkataraman,N.Sridharan and N.Chandrasekaran "Discrete Mathematics", National Publishing Company, 2003.
- 2) A.Tamilarasi&A.M.Natarajan, "Discrete Mathematics and its Application", Khanna Publishers,2nd Edition 2005.
- 3) Kenneth H.Rosen, "Discrete Mathematics and Its Applications", Tata McGraw Hill, 5th Edition,(Unit 1, 2 & 3), 2003.
- 4) M.K.Venkataraman "Engineering Mathematics", Volume II, National Publishing Company, 1986.

Goal

To learn about financial accounting along with the preparation of final accounts.

Objectives

The course should enable the students:

- To learn about principles of Accounting for various domains and prepare a final account.
- To learn about Various types of accounts and to generate a balance sheet
- To learn about various types of Budgets
- To study about capital Management
- To learn about dividend policy

Outcome

The student should able be to

- Know about the various principles of Accounting and prepare a final account
- Generate a balance sheet
- Know about working with budgets
- Have knowledge about capital management
- Understand the concepts of dividend policy

UNIT I FINANCIAL ACCOUNTING

9

Meaning and Scope of Accounting-Principles-Concepts-Conventions-Accounting Standards-FinalAccounts-Trail Balance-Trading Account-Profit and Loss Account-Balance Sheet-Accounting RatioAnalysis-Funds Flow Analysis-Cash Flow Analysis.

UNIT II ACCOUNTING

9

Meaning-Objectives-Elements of Cost-Cost Sheet-Marginal Costing and Cost Volume Profit Analysis-Break Even Analysis-Applications-Limitations-Standard Costing and Variance Analysis-Material-Labor-Overhead-Sales-Profit Variances.

UNIT III BUDGETS AND BUDGETING CONTROL

9

Budgets and Budgetary Control-Meaning-Types-Sales Budget-Production Budget-Cost of ProductionBudget-Flexible Budgeting-Cash Budget-Master Budget-Zero Base Budgeting-ComputerizedAccounting.

UNIT IV INVESTMENT DECISION AND COST OF CAPITAL

9

Objectives and Functions of Financial Management-Risk-Return Relationship-Time Value of MoneyConcepts-Capital Budgeting-Methods of Appraisal-Cost of Capital Factors Affecting Cost of Capital-Computation for Each Source of Finance and Weighted Average Cost of Capital.

UNIT V FINANCING DECISION AND WORKING CAPITAL MANAGEMENT

9

Capital Structure-Factors Affecting Capital Structure-Dividend Policy-Types of Dividend Policy-Conceptsof Working Capital-Working Capital Policies-Factors affecting Working Capital-Estimation of WorkingCapital Requirements.

Total No. of Periods: 45

TEXT BOOKS:

1. S.N.Maheswari, "Financial and Management Accounting", Sultan Chand & Sons, 2003.
2. I.M.Pandey, "Financial Management", 9th Edition, Vikas Publications, 2005.

REFERENCES:

1. S.P.Iyengar, "Cost and Management Accounting", Sultan Chand & Co., 2002.
2. I.M.Pandey, "Elements of Management Accounting", Vikas Publishing House, 2003

PCA101 COMPUTER ORGANIZATION

L T P C
3 1 0 4

Goal

To study various data representation using diverse computer arithmetic, register and I/O organization.

Objectives

The course should enable the students:

- To learn the various data types, its representation, different logic gates and digital circuits
- To learn about various digital components like Decoders, Multiplexers and their associated register transfer micro operations.
- To learn the diverse instruction codes existing in different computer registers and the machine language representation with assembler as an example.
- To learn about various peripheral devices, I/O interface, asynchronous and serial communication interface.
- To focus on effective memory organization and CPU advanced algorithms.

Outcome

The student should be able to:

- Apply and represent the various data types in different logic gate design employing 1's and 2's complement nature.
- Understand the design of different digital components, its applications, merits and the implementational challenges.
- Understand the application of different instruction codes in various computer register and appreciate its merits.
- Implement and interpret the peripheral devices direct access to primary memory.
- Understand memory organization and the advanced algorithm for CPU.

UNIT I INTRODUCTION TO DIGITAL DESIGN

9

Data Representation - Data Types - Complements - Arithmetic Operations - Representations - Fixed-Point, Floating-Point, Decimal Fixed-Point - Binary Codes- Logic Gates, Boolean Algebra, Map Simplification - Combinational Circuits: Half-Adder, Full Adder- Flip Flops - Sequential Circuits

UNIT II DIGITAL COMPONENTS - REGISTER TRANSFER & MICRO OPERATIONS

9

ICs - Decoders - Multiplexers - Registers - Shift Registers - Binary Counters - Memory Unit - Register Transfer Language - Register Transfer - Bus And Memory Transfers - Arithmetic, Logic And Shift Micro Operations, Arithmetic Logic Shift Unit.

UNIT III COMPUTER ORGANIZATION AND PROGRAMMING

9

Instruction Codes - Computer Registers - Computer Instructions - Timing And Control - Instruction Cycle - Memory Reference Instructions - I/O And Interrupt - Machine Language - Assembly Language- Assembler - Program Loops - Programming Arithmetic And Logic Operations - Subroutines - I/O Programming.

UNIT IV INPUT - OUTPUT ORGANIZATION

9

Peripheral Devices - Input-Output Interface - Asynchronous Data Transfer - Modes of Transfer - Priority Interrupt - DMA - IOP - Serial Communication.

UNIT V MEMORY ORGANIZATION AND CPU

9

Memory Hierarchy - Main Memory - Auxiliary Memory - Associative Memory - Cache

Memory -Virtual Memory - Memory Management Hardware - CPU: General Register Organization –ControlWord - Stack Organization - Instruction Format - Addressing Modes - Data Transfer And Manipulation- Program Control.

Total No. of Periods: 45

TEXT BOOKS:

- 1 .M.Morris Mano, "Computer System Architecture", 3rd Edition, Prentice Hall of India,2005.
2. John P.Hayes, "Computer Architecture and Organization", 3rd Edition, Tata McGraw Hill,1998.

REFERENCES:

1. William Stallings, "Computer Organization and Architecture", 5th Edition, Pearson Education,2001.
2. V.C.Hamatcher, et al, "Computer Organization", 5th Edition, Tata McGraw Hill, 2002.

Goal

The student should understand the basic structure and operations of programming.

Objectives

The course should enable the students:

- To learn the problem solving aspects using top down design and implementation of efficient algorithms.
- To learn the basic fundamental algorithms.
- To learn the nitty gritty of C language.
- To learn various data structures.
- To study pointers and file management.

Outcome

The student should be able to:

- Understand the problem solving aspects using top down design.
- Understand the basic fundamental algorithms.
- Appreciate the fundamentals of C language by solving real world problems.
- Understand and implement various data structures.
- Manage the file using pointers.

UNIT I INTRODUCTION TO COMPUTER PROBLEM SOLVING**9**

Introduction - The Problem Solving aspect - Top down Design - Implementation of Algorithms – Program Verification - Efficiency of Algorithms - Analysis of Algorithms

UNIT II FUNDAMENTAL ALGORITHMS**9**

Introduction - Exchanging the values - Counting - Factorial Computation - SINE computation – Base Conversion - Factoring Methods - Array Techniques.

UNIT III INTRODUCTION TO C LANGUAGE**9**

Overview of C - Constants, Variables and Data Types - Operators and Expressions - Managing Input/Output Operations - Formatted I/O - Decision Making - Branching -- IF, Nested IF - Switch - goto - Looping- While, do, for statements.

UNIT IV ARRAYS, FUNCTIONS, STRUCTURES AND UNIONS**9**

Arrays - dynamic and multi-dimensional arrays - Character arrays and Strings - String handling Functions - User defined Functions - Categories of Functions - Recursion - Structures and Unions - Array of Structures - Structures and Functions

UNIT V POINTERS AND FILE MANAGEMENT**9**

Pointers - Declaration, Accessing a variable, character strings, pointers to functions and structures- File Management in C - Dynamic Memory allocation - Linked Lists - Preprocessors.

Total No. of Periods: 45**TEXT BOOKS:**

1. R.G.Dromey, "How to Solve it by Computer", PHI, 2007
2. Deitel and Deitel, "C How to Program", AddisonWesley , 2005.

REFERENCES:

1. Brian W.Kernighan & Dennis Ritchie, "C Programming Language", PHI, 1990
2. Byron.S.Gottfried, "Schaum's Outline of Programming with C ", 2nd Edition, Tata McGraw Hill Edition, 2005.

Goal

To study about all basic and advanced concepts in the computer science and information technology

Objectives

The course should enable the students:

- To learn the advancement in information technology in various domains.
- To learn about working of various input and output devices
- To learn the different types of storage devices.
- To study about Network applications
- To learn about Programming Techniques to solve computer and cyber crimes.

Outcome

The student should be able to:

- Know about the various applications of information technology in various domains.
- Know about working of various input and output devices.
- Know about various type of storage devices and how the data is stored and retrieved from the storage area
- Know about various network topologies and how data is transmitted over the network.
- Know about various programming solving techniques.

UNIT I INTRODUCTION

9

IT - an Introduction - Information systems - S/W and Data - IT in Business, Industry, Home, at Play, Education, Training, Entertainment, Arts, Science, Engineering and Maths - Computers in Hiding -GPS - Types of Computer - Anatomy of a Computer - Foundation of modern IT - CPU - Memory -Buses - Communication with Peripherals.

UNIT II I/O DEVICES

9

I/O Devices - Inputting Text and Graphics - Pointing devices - Foundation of modern output – Displayscreens - Printers - Foundation of Modern storage - Storage media -Increasing data storage capacities- The smart Card.

UNIT III S/W INTERFACES

9

S/W Interfaces - Application programs - OS - Document centric computing - S/W issues – Network computing - Editing Documents - Word processing - Features - Formatting documents –Desktop Publishing - Spreadsheet Applications - Database Applications - Queries - Internet Connectivity.

UNIT IV NETWORK APPLICATIONS

9

Network applications - Foundation of Modern Networks - LAN - WAN - Links between Networks -High Bandwidth Connections - Multimedia - Tools of Multimedia - Delivering Multimedia –Multimedia on the Web - Corporate Computing - Transaction Processing - Management Control - Marketing -Advertising, Sales, Design, Production and Manufacturing - Business on the Internet –Outsourcing - Careers - Keeping up to date.

UNIT V PROGRAMMING TECHNIQUES

9

Programs - Concepts of Programming - Programming Techniques - Corporate Development – Computers and Health - Viruses - Computer Crime - Cryptography - Business issue.

Total No. of Periods: 45

TEXT BOOKS:

1. D.P. Curtin, K. Foley, K.Sen and C. Morin, "Information Technology - The Breaking Wave", TMH Edition, 1998

2. ITL ESL, "Introduction to Information Technology", Pearson Education, 2005.

REFERENCES:

1. Alexis Leon & Mathews Leon, "Fundamentals of Information Technology", Vikas Publishing House Pvt. Ltd., 1999.
2. Sawyer, Williams and Hutchinson, "Using Information Technology - Brief Version", 3rd edition, McGrawHill International edition, 1999.

Goal

To make the students to perform programming using "C".

Objectives

The course should enable the students:

- To develop a program for manipulation of the numbers
- To learn to develop program for manipulating strings
- To learn to develop program for summation of sine ,cosine and exponential series
- To learn to develop an application program
- To learn to develop a program using Structures.

Outcome

The student should be able to:

- Develop program for manipulation of the numbers
- Develop program for manipulating strings
- Develop program for summation of sine, cosine and exponential series
- Develop an application program
- Develop a program using Structures.

List of Experiments

1. Display the following:
 - i) Floyd's triangle
 - ii) Pascal Triangle
2. Generate the following series of numbers:
 - i) Armstrong numbers between 1 to 100
 - ii) Prime numbers between 1 to 50
 - iii) Fibonacci series up to N numbers
3. Manipulate the strings with following operations.
 - (i) Concatenating two strings
 - (ii) Reversing the string
 - (iii) Finding the substring
 - (iv) Replacing a string
 - (v) Finding length of the string
4. Find the summation of the following series:
 - i) Sine
 - ii) Cosine
 - iii) Exponential
5. Create a sales report for M sales person and N products using two dimensional array.
6. Simulate following Banking operations using functions.
 - i) Deposit
 - ii) Withdrawal
 - iii) Balance Enquiry
7. Implement using Recursion
 - i) Find the solution of Towers of Hanoi problem using Recursion.
 - ii) Fibonacci number generation.
 - iii) Factorial
8. Generate Student mark sheets using structures.
9. Create a collection of books using arrays of structures and do the following:
 - i) Search a book with title and author name
 - ii) Sort the books on title.

Goal

To formulate a software program for Accounting and business problems.

Objectives

The course should enable the students:

- To learn about budget preparation.
- To learn about ledger preparation
- To prepare balance sheet
- To prepare profit and loss account
- To estimate working capital requirements

Outcome

The student should be able to:

- Prepare budget for the company
- Prepare ledger
- Prepare a balance sheet
- Prepare profit and loss account
- Understand the estimation of working capital requirements

List of Experiments

1. Budget Preparation.
2. Ledger Preparation
3. Balance Sheet Preparation.
4. Generate reports on monthly and daily basis.
5. Estimation of working capital requirements.
6. Preparation of profit/Loss account.
7. Ratio analysis.

SEMESTER - II
PCA201 OPERATING SYSTEMS

L T P C
3 0 2 4

Goal

To learn different types of operating system, memory management and I/O systems.

Objectives

The course should enable the students:

- To learn about designing the components of operating systems
- To learn about process management
- To learn about Process synchronization and deadlock handling
- To learn about various types of memory management techniques
- To learn about Disk scheduling and file system

Outcome

The student should be able to:

- Design the components of operating systems
- Understand Process management
- Understand Process synchronization, deadlock handling
- Understand the various types of memory management techniques
- Appreciate the various disk scheduling techniques existing in file system.

UNIT I INTRODUCTION

7

Definition of OS-Mainframe System-Desktop Systems-Multi processor System-Distributed-Clustered-Real time Systems-Handheld Systems-Operating System Structure-System Components-Services-System Calls-System Programs-System Design and Implementation.

UNIT II PROCESS MANAGEMENT

8

Concepts-Process Scheduling-Operations on Processes-Co-operating Processes-Inter Process Communication-CPU Scheduling-Scheduling Concepts-Criteria-Scheduling Algorithms-MultiprocessorScheduling-Real time Scheduling.

UNIT III PROCESS SYNCHRONIZATION

10

Critical Section-Synchronization Hardware-Semaphores-Problems of Synchronization-Critical Regions-Monitors-Deadlocks-Characterization-Handling Deadlocks-Deadlock Prevention-Avoidance-Detection-Deadlock Recovery

UNIT IV MEMORY MANAGEMENT

10

Storage Hierarchy-Storage Management Strategies-Contiguous-Non Contiguous Storage Allocation-Single User-Fixed Partition-Variable Partition-Swapping-Virtual Memory-Basic Concepts-MultilevelOrganization-Block Mapping-Paging-Segmentation-Page Replacement Methods-Locality-Working Sets.

UNIT V I/O AND FILE SYSTEMS

10

Disk Scheduling-File Concepts-File System Structure-Access Methods-Directory Structure-Protection-Directory Implementation-Allocation Methods-Free Space Management-Case Study: Linux System.

Total No. of Periods: 45

TEXT BOOKS:

1. Silberschatz and Galvin, "Operating System Concepts", 6th Edition, John Wiley & Sons, Inc., 2004.
2. Milankovic M., "Operating System Concepts and Design", 2nd Edition, Tata McGraw Hill, 2001.

REFERENCES:

1. P.C.Bhatt, "An Introduction to Operating Systems-Concepts and Practice", Prentice Hall Of India, 2004
2. H.M.Deitel, "An Introduction to Operating Systems", 2nd Edition, Pearson Education, 2002.

Goal

To understand the structure and operations of object oriented programming.

Objectives

The course should enable the students:

- To learn about class and object paradigm.
- To learn about function and operator overloading.
- To learn about inheritance
- To learn about virtual function and friend functions
- To study about exception handling mechanisms, roles and kinds of classes and application

frameworks.

Outcome

The student should be able to:

- Understand and implement various classes and object
- Understand about the different types of overloading
- Understand about virtual function and friend function and its use.
- Understand about the roles and kinds of classes
- Understand about application frameworks.

UNIT I OOP PARADIGM

8

Programming Paradigms - Procedural Programming - Modularity - Exception Handling - Data Abstraction - User Defined Types - Concrete Types - Abstract Types - Virtual Functions – ObjectOriented Programming - Generic Programming - Containers -Algorithms.

UNIT II INTRODUCTION TO C++

11

Overview of C++ - Classes and Objects - Friend Functions - Friend Classes - Inline Function – StaticMembers - Arrays - Pointers - References - Dynamic Allocation.

UNIT III OVERLOADING

7

Function Overloading - Overloading Constructor Functions - Copy Constructors - Default Argument -Operator Overloading - Member Operator Overloading - Overloading new and delete.

UNIT IV ADDITIONAL FEATURES

10

Inheritance - Base Class - Access Control - Virtual Functions - Pure Virtual Functions - Templates -Generic Functions - Applying Generic Functions - Generic Classes -Exception Handling - C++ I/OStreams - File I/O-STL - Overview - Container Classes -Lists - Maps - Algorithms Using Functionsand Objects - String Class

UNIT V DESIGN CONCEPTS

9

Role of Classes - Kinds of Classes - Concrete Types - Abstract Types - Nodes -Changing Interfaces- Object I/O - Actions - Interface Classes - Handles - Use Counts Applications frame works.

Total No. of Periods: 45

TEXT BOOKS:

1. Herbert Schildt, "C++ The Complete Reference", Tata McGraw Hill Edition, 2003 (Unit 2, 3,4)
2. BjanneStroustrup, "The C++ Programming Language", 3rd Edition, Addison Wesley, 2000 (Unit 1 & 5)

REFERENCES:

1. Robert Lafore, "Waite Groups OOP in Turbo C++", Galgotia Publications, 2001
2. Stanley, B.Lippman, Jove Lagrie, "C++Primer", 4th Edition, Addison Wesley, 2007.

Goal

To understand how to create and manage a database for any given application.

Objectives

The course should enable the students to:

- Introduce how to represent data in a database for a given application.
- Provide with a detailed theoretical knowledge of how database management systems are implemented
- Understand how efficient applications are designed and implemented to work on DBMS.
- Understand how queries are evaluated
- Helps understand transaction management and recovery systems.

Outcome

The student should be able to:

- Describe fundamental elements of a relational database management system
- Explain the basic concepts of relational data model, ER model, relational database design and database language SQL
- Design ER diagrams to represent simple database application scenarios
- Convert ER diagrams into relational tables, populate a relational database and formulate SQL queries on the data
- Criticize a database design and improve the design by normalization.

UNIT I INTRODUCTION**9**

Database Systems vs. File Systems-View of Data- Data Models-Database Languages-Transaction Management-Database Systems Structure-History of Database Systems-Database Systems Applications-Entity Relationship Model.

UNIT II RELATIONAL DATABASES**9**

SQL-Basic Structure-Set Operations-Complex Queries-Joined Queries-DDL-Embedded SQL-Dynamic SQL-Other SQL Functions-Query by Example-Integrity and Security of searching-Relational Database Design

UNIT III DATA STORAGE AND INDEXING**9**

Storage & File Structure-Disks-RAID-File Organization-Indexing & Hashing-B+ TREE-B Tree-Static Hashing-Dynamic Hashing-Multiple Key Access.

UNIT IV QUERY EVALUATION & OPTIMIZATION**9**

Query Processing-Selection Operation-Sorting-Join Operation-Evaluation of Expressions-Query Optimization.

UNIT V TRANSACTION MANAGEMENT**9**

Transaction Concept-Static Implementation-Concurrency Control-Protocols-Deadlock Handling-Recovery Systems-Recovery with Concurrent Transactions-Shadow Paging-Buffer Management-Case Studies-Oracle-Microsoft SQL Server.

Total No.of Periods: 45**TEXT BOOKS:**

1. Abraham Silberschatz, Henry F. Korth and S. Sudharssan, "Database System Concepts", 5th Edition, Tata McGraw Hill, 2006.
2. Raghuram Ramakrishnan & Johannes Gehrke, "Database Management Systems", 3rd Edition, Tata McGraw Hill International Edition, 2003.

REFERENCES:

1. Elmasri ,Navathe, "Fundamentals of Database System" 3rd edition, Pearson Education, 2008.
2. JeffereyA.Hoffer, Mary Prescott, "Modern Database Management" 8th edition, PHI,2008.

Goal

To learn various types of data structures and their functions.

Objectives

The course should enable the students:

- To learn about various data structures.
- To learn about trees, associated operations and representation.
- To learn various sorting and searching techniques.
- To learn about graph and its application.
- To learn effective storage management using different techniques.

Outcome

The student should be able to:

- Implement and interpret various data structures and its representation.
- Understand and appreciate the trees and the associated merits of executing different operations on it.
- Understand the different sorting and searching techniques.
- Implement various graph techniques and witness its merits and applications.
- Understand effective storage management.

UNIT I DATA STRUCTURES

9

Introduction - Arrays - Structures - Stack: Definition and examples, Representing Stacks – Queues and lists: Queue and its Representation, lists - Applications of Stack, Queue and Linked Lists.

UNIT II TREES

9

Binary Trees - Operations on Binary trees - Binary Tree Representations - node representation, internal and external nodes, implicit array representation - Binary tree Traversals - Huffman Algorithm- Representing Lists as Binary Trees.

UNIT III SORTING AND SEARCHING

9

General Background - Exchange sorts - Selection and Tree Sorting - Insertion Sorts - Merge and Radix Sorts - Basic Search Techniques - Tree Searching - General Search Trees - Hashing.

UNIT IV GRAPHS AND THEIR APPLICATIONS

9

Graphs - An application of graphs - Representation - Transitive closure - Warshall's algorithm - Shortest path algorithm - a flow Problem - Dijkstra's algorithm - An application of scheduling – Linked representation of Graphs - Graph Traversals

UNIT V STORAGE MANAGEMENT

9

General Lists: Operations, linked list representation, using lists, Freeing list nodes - Automatic list Management: Reference count method, Garbage Collection, Algorithms, Collection and compaction

Total No.of Periods: 45

TEXT BOOKS:

1. Tanenbaum A.S., Langsam Y. Augestein M.J," Data Structures using C", Pearson Education, 2004
2. Robert Kruse & Clovis L.Tondo, "Data Structures and Program Design in C", Prentice Hall , 2nd edition., 2003

REFERENCES:

1. Weiss, "Data Structures and Algorithm Analysis in C", Addison Wesley, Second Edition, 2005.
2. Y.Langsam, M.J.Augestein, A.M.Tanenbaum, "Data Structures Using C and C++", 2nd Edition, Prentice Hall of India, 2000.

3104

Goal

To design and analyze the complexities of algorithms.

Objectives

The course should enable the students:

- To learn about the time and space complexity of algorithms.
- To learn about various sorting algorithms.
- To learn the different types of searching algorithms
- To study various algorithm design techniques
- To learn the advanced algorithms.

Outcome

The student should be able to:

- Calculate the time complexity and space complexity of algorithms and express it using appropriate notations
- Compare and implement the different types of search structures.
- Implement the real life problems using suitable algorithm design technique.
- Understand advanced algorithms
- Understand the method of applying various algorithm in real time.

UNIT I INTRODUCTION**10**

Fundamentals of algorithmic problem solving - Important problem types - Fundamentals of the analysis of algorithm efficiency - analysis frame work - Asymptotic notations - Mathematical analysis for recursive and non-recursive algorithms.

UNIT II DIVIDE AND CONQUER METHOD AND GREEDY METHOD**12**

Divide and conquer methodology - Merge sort - Quick sort - Binary search - Binary tree traversal - Multiplication of large integers - Strassen's matrix multiplication - Greedy method - Prim's algorithm - Kruskal's algorithm - Dijkstra's algorithm.

UNIT III DYNAMIC PROGRAMMING**12**

Computing a binomial coefficient - Warshall's and Floyd's algorithm - Optimal binary search tree - Knapsack problem - Memory functions.

UNIT IV BACKTRACKING AND BRANCH AND BOUND**14**

Backtracking - N-Queens problem - Hamiltonian circuit problem - Subset sum problem - Branch and bound - Assignment problem - Knapsack problem - Traveling salesman problem.

UNIT V NP-HARD AND NP-COMPLETE PROBLEMS**12**

P & NP problems - NP-complete problems - Approximation algorithms for NP-hard problems - Traveling salesman problem - Knapsack problem.

Total No. of periods : 60**TEXT BOOKS:**

1. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", Pearson Education, 2003.
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, "Introduction to Algorithms", 2nd Edition, Prentice Hall of India, 2004.

REFERENCES:

1. Schweiz, "Introduction to the Design & Analysis of Algorithms", 2nd Edition, 2008 Pearson Education.
2. Baase Van Geldin, "Computer Algorithms", 3rd edition, Pearson Education, 2006.

Goal

To learn to program using object oriented concepts and techniques.

Objectives

The course should enable the students:

- To learn about working with classes and objects
- To learn about the use of constructor and destructor
- To develop programs using concepts of inheritance and polymorphism
- To develop program using friend function, virtual function and exception handling mechanism
- To develop program using files.

Outcome

The student should be able:

- To develop program using classes and objects
- To develop program using constructor and destructor
- To develop program using the concepts of inheritance and polymorphism
- To develop program using friend function, virtual function and exception handling mechanism
- To develop program using files

List of Experiments

1. Programs using Constructor and Destructor.
2. Creation of classes and use of different types of functions.
3. Count the number of objects created for a class using static member function.
4. Write programs using function overloading and operator overloading.
5. Programs using inheritance.
6. Program using friend functions.
7. Program using virtual function.
8. Write a program using exception handling mechanism.
9. Programs using files.
10. Programs using function templates.

Goal

To learn designing of relational database systems and querying relational databases.

Objectives

The course should enable the students:

- To execute DML ,DDL and TCL commands
- To create views, partitions and locks for a particular DB
- To write and execute a procedure in PL/SQL for an application using exception handling and cursors
- To write and execute a procedure in PL/SQL for an application using functions and triggers.
- To write and execute a procedure in PL/SQL for an application using package

Outcome

The student should be able to:

- Execute DDL,DML and TCL commands
- Creating views ,partitions and locks for a particular data base.
- Create and execute procedure for an application using exception handling and cursors
- Create and execute procedure for an application using triggers
- Create and execute procedure for an application using package.

List of Experiments

1. Execute a single line and group functions for a table.
2. Execute DCL and TCL Commands.
3. Create and manipulate various DB objects for a table.
4. Create views, partitions and locks for a particular DB.
5. Write PL/SQL procedure for an application using exception handling.
6. Write PL/SQL procedure for an application using cursors.
7. Write a DBMS program to prepare reports for an application using functions.
8. Write a PL/SQL block for transaction operations of a typical application using triggers.
9. Write a PL/SQL block for transaction operations of a typical application using package.
10. Design and develop an application using any front end and back end tool (make use of ER diagram and DFD).

Typical Applications - Banking, Electricity Billing, Library Operation, Pay roll, Insurance, Inventory, etc.

PCA208 DATA STRUCTURES LAB

L T P C
0 0 3 1

Goal

To help the students gain a knowledge and insight on various data structures and its applications, usage and challenges.

Objectives

The course should enable the students:

- To represent the sparse matrix, stack and queue using arrays and linked lists.
- To implement the operations on singly linked list, doubly linked list and circular linked list.
- To perform traversals on binary search tree and operations of node addition and deletion.
- To sort the given list of numbers using heap and quick sort.
- To perform graph operations like depth first search and breadth first search, shortest path
- Using Dijkstra algorithm.

Outcome

The student should be able to:

- Implement sparse matrix, stack and queue using arrays and linked lists.
- Implement the various operations on singly linked list, doubly linked list and circular linked list.
- Appreciate the different traversal on binary search tree.
- Implement the sorting of numbers using heap and quick sort.
- Implement search operations on graph using Dijkstra algorithm.

List of Experiments

1. Represent the given sparse matrix using one dimensional array and linked list.
2. Create a Stack and do the following operations using arrays and linked lists
(i) Push (ii) Pop (iii) Peep
3. Create a Queue and do the following operations using arrays and linked lists
(i) Add (ii) Remove
4. Implement the operations on singly linked list, doubly linked list and circular linked list.
5. Create a binary search tree and do the following traversals
(i) In-order (ii) Pre order (iii) Post order
6. Implement the following operations on a binary search tree.
(i) Insert a node (ii) Delete a node
7. Sort the given list of numbers using heap and quick sort.
8. Perform the following operations in a given graph
(i) Depth first search (ii) Breadth first search
9. Find the shortest path in a given graph using Dijkstra algorithm.

SEMESTER - III

PCA301 COMPUTER NETWORKS

L T P C
3 0 0 3

Goal

To learn about computer networks and its layers.

Objectives

The course should enable the students:

- To learn about ISO -OSI reference model
- To learn about network topologies
- To learn about functions of network layer
- To learn about functions of Transport layer
- To learn about functions of Presentation layer

Outcome

The students should be able to understand about

- ISO -OSI reference model
- Network topologies
- Functions of network layer
- Functions of Transport layer
- Functions of Presentation layer.

UNIT I INTRODUCTION

9

Building a network - Requirements - Network Architecture - OSI - Internet - Direct Link Networks -Hardware building blocks - Framing - Error detection - Reliable transmission.

UNIT II NETWORK FUNDAMENTALS

9

LAN Technology - LAN Architecture - Bus - Tree - Ring - Star - Ethernet - Token Rings - Wireless.

UNIT III NETWORK LAYER

9

Packet Switching - Switching and Forwarding - Bridges and LAN switches - Internetworking – SimpleInternetworking - Routing.

UNIT IV TRANSPORT LAYER

9

Reliable Byte Stream (TCP) - Simple Demultiplexer (UDP) - TCP Congestion Control – CongestionAvoidance Mechanisms.

UNIT V PRESENTATION LAYER AND APPLICATIONS

9

Presentation formatting - Data compression - Cryptographic Algorithms: RSA - DES - Applications -Domain Name Service - Email - SMTP - MIME - HTTP - SNMP.

Total No. of Periods: 45

TEXT BOOKS:

1. Larry L. Peterson & Bruce S. Davie, "Computer Networks - A Systems Approach", 4th Edition, Harcourt Asia/Morgan Kaufmann, 2007.
2. James F. Kurose and Keith W. Ross, "Computer Networking - A Top Down approach Featuring the Internet", 1st Edition, Addison Wesley Publishing Company, 2001.

REFERENCES:

1. William Stallings, "Data and Computer Communications", 7th Edition, PHI, 2005.
2. Andrew S. Tanenbaum, "Computer Networks", Tata Mcgraw Hill, 3rd Edition, 2001.

Goal

To learn about assembly level languages.

Objectives

The course should enable the students:

- To learn about evolution of microprocessor and INTEL 8085 microprocessor
- To learn about the architecture of INTEL 8086 microprocessor
- To learn about 8086 microprocessor interfacing
- To learn about the architecture of INTEL 80386 microprocessor
- To learn about the peripheral interfacing.

Outcome

The student should be able to understand:

- About evolution of microprocessor and INTEL 8085 microprocessor
- About the architecture of INTEL 8086 microprocessor
- About 8086 microprocessor interfacing
- About the architecture of INTEL 80386 microprocessor
- About the peripheral interfacing.

UNIT I INTRODUCTION TO 8085 MICROPROCESSOR 12

Evolution of the Microprocessor - INTEL 8085- Introduction- Register Architecture - Memory Addressing- 8085 Addressing Modes -8085 Instruction Set -Timing Methods 8085 Pins and Signals -8085 Instruction Timing and Execution -Interrupts-DMA- Serial port-8085 Based System Design

UNIT II INTRODUCTION TO 8086 MICROPROCESSOR 12

Introduction -8086 Architecture -8086 Addressing Modes -8086 Instruction Set -Data Movement Instructions Arithmetic and Logic Instructions - Program Control Instructions

UNIT III 8086 MICROPROCESSOR INTERFACING 12

System Design Using 8086- Basic System concepts-Bus Cycle - Address and data bus concepts-interfacing with memories-RAM - EPROM - DRAMs - Programmed I/O : 8086-Based Microcomputer.

UNIT IV 80386 AND PENTIUM MICROPROCESSORS 12

Introduction to Intel 80386- Basic Programming model - Memory Organization - I/O Space – 80386 pins and signals- Bus transfer techniques - 80386 Modes - Introduction to Intel Pentium Microprocessor:Block diagram and Registers.

UNIT V PERIPHERAL INTERFACING 12

Keyboard Display Interface-Hex key and display interface to 8085, 8279 Keyboard display controllerchip- Printer Interface: LR 7040 Printer interface using 8295 printer controller-CRT controller interface:CRT Fundamentals, 8275 CRT Controller- Coprocessors.

Total No. of Periods: 60

TEXT BOOKS:

1. Mohamed Rafiquzzaman, "Introduction to Microprocessors and Microcomputer- Based SystemDesign", 2nd edition, CRC Press, 2008.
2. Walter A.Triebel, Avtar Singh, "The 8088 and 8086 Microprocessors Programming, Interfacing, Software, Hardware and Applications", Prentice Hall of India Pvt.Ltd.,2002.

REFERENCES:

1. Mohamed Rafiqzaman, "Microprocessor - Theory & Applications : Intel, Motorola", PHI, 2003
2. Barry B.Brey, "The INTEL Microprocessors 8086/8088, 80186, 80286, 80386 and 80486 Architecture, Programming and Interfacing", Prentice Hall of India, 2001.

PCA303 JAVA PROGRAMMING

L T P C
3 1 0 4

Goal

To learn about JAVA Programming and its fundamentals.

Objectives

The course should enable the students:

- To learn about Java fundamentals
- To learn about Classes and Objects with simple programs
- To learn about Java data structures, packages & Inheritance concepts.
- To learn about Window & Graphics (applets)
- To learn about GUI based component using awt.

Outcome

The student should be able to:

- Understand the fundamental Concepts of Java
- Understand about classes, objects & able to write simple program using classes and objects
- in java
- Understand the Java data structures, packages and inheritance concepts.
- Understand about windows and graphics (applets)
- Understand the GUI component using awt controls, packages etc.,

UNIT I JAVA FUNDAMENTALS

12

Introduction to Java Characteristics of Java -A Brief History of Java -Types of Java Programs – JavaApplication Programs - Command Line Arguments - Java Applets - Java Runtime Environment (JRE)-Java Virtual Machine-Java Developer's Kit (JDK)-Some Java Terminology- Java Developer's Kit Elements of the Java Language - Structure of a Java Program - Data Types -Java Variables (Identifiers) –JavaLiteral -Comments in a Program-Operators

UNIT II CLASSES AND OBJECTS

12

Objects and Classes - Defining a Class -Constructors - Multiple Constructors -Inner Classes- AbstractClasses -Wrapper Classes - Conversion of Data Types -Command Line Input of Numeric Data-Input from Keyboard-Attributes and Methods - Attributes- Method Overriding - Objects as Parameters -Date Class -College System-A Simple Case Study- Control Structures - if Structure - Break Statement and Labeled Break -Switch Structure - Loop Structures -While Structure -do-While Structure –ForLoop - Nested Loops - Continue Statement.

UNIT III JAVA LANGUAGE

12

Data Structures -Arrays -Recursion -Multidimensional Array- Vectors and ArrayList Classes – StackClass - BitSet Class - HashTable Class - String Classes- Inheritance, Interfaces and Packages-Inheritance -Types of Inheritance -Example of Inheritance Implementations - Polymorphism –EmployeeExample - Inheritance Used in Geometry - Interfaces - Packages.

UNIT IV WINDOWS AND GRAPHICS

12

Windows and Applets - Frame Class - Creating and Displaying a Frame - Adapter Classes – DisplayingMessages in a Window - Font Class -Font Metrics Class - Color Class - Component Class Methods-Dialog Box-File Dialog- Applets - Graphics Class -Graphics Class and Creation of Graphics Objects- Font Settings-Line Drawing - Rectangles - Circle and Oval - Arc Drawing -Point Class Example -Rectangle Class Example- Polygon Class.

UNIT V GRAPHICAL USER INTERFACES USING JAVA – AWT

12

AWT GUI Components Button, Label, Checkbox, Choice and List - Buttons - Label Class – Checkbox and Radio Button (Checkbox Group)- Choice Class and List Class AWT Text Components and Menu- Text Component Class - Text Field Class - Scrollbar Class- Text Area Class -MenuBar and MenuClass

Total No. of Periods: 60

TEXT BOOK:

1. C. Xavier, Java Programming: A practical approach, McGraw Hill India Education 2011.

REFERENCES:

1. Keyur Shah, "Gateway to Java Programmer Sun Certification", Tata McGraw Hill 2007.
2. Deitel&Deitel, "Java How to Program", Prentice Hall, 5th edition 2005.
3. Herbert Schildt, "The Complete Reference - Java 2", 5th Edition, Tata McGraw Hill, 2007.

PCA304 COMPUTER GRAPHICS AND MULTIMEDIA SYSTEMS

L T P C
3 0 0 3

Goal

To learn the basics of computer graphics and various dimensional transformations.

Objectives

The course should enable the students:

- To learn the overview of graphic systems
- To learn about the 2D Transformations
- To learn about the 3D Transformations
- To learn about the Multimedia Concepts
- To learn the Systems and Applications of Multimedia.

Outcome

The student should be able to:

- Understand overview of graphic systems
- Understand the types of Transformations and 2D Transformations Concepts
- Understand the 3D Transformation Concepts
- Understand the various surface detection methods & multimedia concepts
- Understand the Applications of multimedia.

UNIT I INTRODUCTION

12

Overview of Graphics System - Bresenham technique - Line Drawing and Circle Drawing Algorithms- DDA - Line Clipping - Text Clipping.

UNIT II 2D TRANSFORMATIONS

12

Two dimensional transformations - Scaling and Rotations - Interactive Input methods - Polygons -Splines - Bezier Curves - Window view port mapping transformation.

UNIT III 3D TRANSFORMATIONS

12

3D Concepts - Projections - Parallel Projection - Perspective Projection - Visible Surface DetectionMethods - Visualization and polygon rendering - Color models - XYZ-RGB-YIQ-CMY-HSV Models -animation - Key Frame systems - General animation functions - morphing.

UNIT IV OVERVIEW OF MULTIMEDIA

12

Multimedia hardware & software - Components of multimedia - Text, Image - Graphics - Audio -Video - Animation - Authoring.

UNIT V MULTIMEDIA SYSTEMS AND APPLICATIONS

12

Multimedia communication systems - Data base systems - Synchronization Issues - Presentation requirements - Applications - Video conferencing - Virtual reality - Interactive video - video on demand

Total No. of Periods : 60

TEXT BOOKS:

1. Hearn D and Baker M.P, "Computer graphics - C Version", 2nd Edition, Pearson Education, 2006(unit 1, 2 &3)
2. Ralf Steinmetz, Klara Steinmetz, "Multimedia Computing, Communications and Applications",Pearson Education, 2004(unit 4 & 5)

REFERENCES:

1. John Villamil, Casanova and LeonyFernanadez, Eliar, "Multimedia Graphics",PHI, 2002.
2. Siamon J. Gibbs and Dionysios C. Tsichritzis, "Multimedia Programming", Addison Wesley. 1995.

Goal

To write assembly level program for various arithmetic and string operations.

Objectives

The course should enable the students:

- To write an assembly level language programme for performing arithmetic operations and string manipulation.
- To write an assembly level program to interface Programmable Peripheral Interface, Programmable Timer.
- To write an assembly level program to perform power on self test
- To write an assembly level program for floppy disk trouble shooting
- To write an assembly level program for printer trouble shooting.

Outcome

The students should be able to:

- Understand various arithmetic operations and string manipulation
- Understand the operation required to interface Programmable Peripheral Interface and Programmable Timer
- Know the method for performing power on self test
- Understand the activities required for floppy disk trouble shooting
- Understand the operations needed for printer trouble shooting

List of Experiments

1. Write an assembly language program to perform arithmetic operations on block of data using Hexadecimal numbers.
2. Write an assembly language program to perform arithmetic operations on block of data using BCD numbers.
3. Write an assembly language program to perform byte and string manipulation.
4. Write an assembly language program to interface Programmable Peripheral Interface.
5. Write an assembly language program to interface Programmable Timer.
6. Write an assembly language program to interface Programmable Communication Interface.
7. Write an assembly language program to interface Keyboard/Display Controller.
8. Write a program to Perform Power on Self Test.
9. Write a program for floppy disk trouble shooting.
10. Write a program for printer trouble shooting.

Goal

To learn about JAVA programming techniques.

Objectives

The course should enable the students:

- To learn about simple java programming, overloading and overriding
- To learn about interfaces and packages, exception handling mechanisms & Thread concepts
- To learn the implementation of I/O packages & file operations.
- To learn about applets and swings
- To learn about util packages & JDBC connectivity.

Outcome

The student should be able to:

- Understand the simple java programming, overloading and overriding
- Understand about interfaces and packages, exception handling mechanisms & Thread concepts
- Understand the I/O packages & file operations.
- Understand about applets and swings
- Understand the util packages & JDBC connectivity.

List of Experiments

1. Program to illustrate the use of overloading and overriding.
2. Program to implement the concept of Interfaces and packages.
3. Generate the program using exceptions handling mechanism.
4. Program to achieve Inter thread communication and deadlock avoidance.
5. Implement the file operations.
6. Program using Applets.
7. Program using JDBC.
8. Program using JNI concepts.
9. Program to illustrate the use of Remote Method Invocation.
10. Program using Servlets.

Goal

To develop program using graphics functions and basic multimedia techniques.

Objectives

The course should enable the students:

- To develop program for fundamental graphics function
- To develop program for line and circle drawing algorithm
- To develop program for clipping algorithm
- To develop program for 2D and 3D transformation
- To create animation sequence using the required software.

Outcome

The student should be able to:

- Develop and implement a program for fundamental graphics function
- Develop and implement a program for line and circle drawing algorithm
- Develop and implement a program for clipping algorithm
- Develop and implement a program for 2D and 3D transformation
- Do animation process with required software.

List of Experiments

1. Write a C program with Fundamental Graphics Function
2. Write a C program for Line drawing using Bresenham, DDA Line Drawing Algorithms.
3. Write a C program for Circle Drawing using Bresenham Circle Drawing Algorithm.
4. Write a C program for Clipping Algorithm using Line Clipping.
5. Write a C program for 2D Transformations like Translations and Scaling and Rotations.
6. Write a C program for 3D Transformations like Translations and Scaling and Rotations.
7. Create Frame by Frame Animations using multimedia authoring tools.
8. Develop a presentation for a product using techniques like Guide Layer, masking and onion Skin using authoring tools.
9. Create a Jpeg image which demonstrates the various features of an image editing tool.
10. Demonstrate Rasterization and filtering of layers and give blending effects for a logo.

SEMESTER - IV
PCA401 ADVANCED JAVA PROGRAMMING

L T P C
3 1 0 4

Goal

To learn about advanced JAVA programming.

Objectives

The course should enable the students:

- To learn about advanced GUI development using java
- To learn about JDBC concepts
- To learn about Threading and Multithreading.
- To learn about Servlet based application development
- To learn about RMI and network programming.

Outcome

The student should be able to:

- Understand the advanced GUI development using java
- Understand about JDBC concepts.
- Understand the Threading and Multithreading
- Understand about Servlet based application development
- Understand the RMI and network programming.

UNIT I ADVANCED GUI DEVELOPMENT USING JAVA 12

Swings - Summary of Swing Classes - Buttons, Labels, Checkbox, Text Components and Menu Components in Swings-Some Working Examples of Swing Classes - JTree Class - JTable Class -Events and Exception Handling - Event Classes - Event Generators - Event Listener - Key Events -Mouse Event - Exception Class - Try and Catch -Multiple Catch-Exception Types - Throw and Throws- User Defined Exceptions

UNIT II JDBC 12

Java Database Connectivity JDBC Drivers - Statements - Caching Database Results - Storing Classes,Images and Other Large Objects - Controlling Transactions - Escaping Characters - Mapping DatabaseTypes - Mapping Date Types -Review Questions - Lab Projects-Industry Projects.

UNIT III THREAD AND MULTITHREADING 12

Multithreading - Multitasking and Multithreading - The Thread Class - Defining and Running a Thread-Methods of Thread Class Review Questions - Lab Projects-Industry Projects.

UNIT IV SERVLET BASED APPLICATION DEVELOPMENT 12

Java Servlet -Servlet Environment and Role - Protocol Support -HTML Support -Replacing CGI Scripts- Installing Servlets Using Java Web Server -Servlet API - The Servlet Life Cycle- Welcome Servlet -Servlet Context - HTTP Support - HTML to Servlet Communication -Review Questions-Lab Projects-Industry Projects

UNIT V RMI AND NETWORK PROGRAMMING 12

Remote Method Invocation - Introduction - Define the Functions of the Remote Class as an Interface- Write the Implementation and Server Classes - Implement a Remote Interface -Define the Constructorfor the Remote Object - Provide an Implementation for each Remote Method –

Register the RemoteObject - A Client Program that Uses the Remote Service - Network Programming –NetworkingBasics -Java.net Package Overview- Socket Classes -Socket Programming.

Total No of periods: 60

TEXT BOOK:

1. C. Xavier, Java Programming: A practical approach, McGraw Hill India Education 2011.

REFERENCES:

1. Herbert Schildt, "The Complete Reference - Java 2", 5th Edition, Tata McGraw Hill, 2007.
2. Robert Orfali, Dan Harkey and Jeri Edwards, "The Essential Client/Server Survival Guide", Galgotia Publications Pvt. Ltd., 2002.
3. Tom Valesky, "Enterprise Java Beans", Pearson Education, 2002.

PCA402 OBJECT ORIENTED ANALYSIS AND DESIGN

L T P C
3 0 2 4

Goal

To make the students appreciate the development of software using object oriented techniques and paradigms.

Objectives

The course should enable the students:

- To educate them about the object basics, class and Meta class.
- To learn about UML and various methodologies.
- To give a perspective on object oriented analysis.
- To orient and give the students an insight about object oriented design and its features.
- To learn about various testing strategies for developing a quality software.

Outcome

The student should be able to:

- Understand and implement object instantiation with pertinent attributes and methods.
- Perform a business process modeling using UML and various methodologies.
- Understand the nuances and knack of object oriented analysis.
- Implement and deploy various object oriented design and its axioms.
- Understand the modus operandi of developing quality software.

UNIT I INTRODUCTION

12

An overview - Object basics - Object state and properties - Behavior - Methods - Messages – Information hiding - Class hierarchy - Relationships - Associations - Aggregations- Identity - Dynamic binding -Persistence - Meta classes - Object oriented system development life cycle.

UNIT II METHODOLOGY AND UML

12

Introduction - Survey - Rumbaugh, Booch, Jacobson methods - Patterns - Frameworks - Unified approach - Unified modeling language - Static and Dynamic models - UML diagrams - Class diagram- Usecase diagrams - Dynamic modeling - Model organization - Extensibility.

UNIT III OBJECT ORIENTED ANALYSIS

12

Identifying Usecase - Business object analysis - Use case driven object oriented analysis – Usecasemodel - Documentation - Classification - Identifying object, relationships, attributes, methods - Super-sub class - A part of relationships Identifying attributes and methods - Object responsibility

UNIT IV OBJECT ORIENTED DESIGN

12

Design process - Axioms - Corollaries - Designing classes - Class visibility - Refining attributes -Methods and protocols - Object storage and object interoperability - Databases - Object relational systems - Designing interface objects - Macro and Micro level processes - The purpose of a viewlayer interface.

UNIT V SOFTWARE QUALITY

12

Quality assurance - Testing strategies - Object orientation testing - Test cases - Test Plan – Debugging principles - Usability - Satisfaction - Usability testing - Satisfaction testing

Total No of Periods: 60

TEXT BOOKS:

1. Ali Bahrami, "Object Oriented System Development", McGraw Hill International Edition, 1999.
2. Stephan R. Schach, "Introduction to Object Oriented Analysis and Design with UML and the Unified Process", TMH, 2003

REFERENCES:

1. Craig Larman, "Applying UML and Patterns", 2nd Edition, Pearson Education, 2002.
2. Grady Booch, James Rumbaugh, Ivar Jacobson, "The Unified Modeling Language User Guide", Addison Wesley Longman, 1999, Reprint 2002.
3. Bernd Bruegge, Allen H. Dutoit, "Object Oriented Software Engineering using UML", Patterns and Java, Pearson Education, 2004.

PCA403 VISUAL PROGRAMMING

L T P C

3 1 0 4

Goal

To learn to use the VB IDE, .NET CLR, CLS and class library to develop windows desktop applications.

Objectives

The course should enable the students:

- To learn about the Windows programming and Visual C++ programming techniques.
- To learn the nuances of creating application framework.
- To give an insight on document and view architecture.
- To assimilate the ACTIVEX controls and OLE objects.
- To highlight the database connection and management using Microsoft ODBC.

Outcome

The student should be able to:

- Understand the Windows programming and Visual C++ programming techniques
- Understand the nuances of creating application framework.
- Appreciate the document and view architecture.
- Understand the ACTIVEX controls and OLE objects.
- Understand the database connection and management using Microsoft ODBC.

UNIT I WINDOWS PROGRAMMING

12

Windows environment - a simple windows program - windows and messages - creating the window- displaying the window - message loop - the window procedure - message processing - text output- painting and repainting - introduction to GDI - device context - basic drawing - child window controls

UNIT II VISUAL C++ PROGRAMMING – INTRODUCTION

12

Application Framework - MFC library - Visual C++ Components - Event Handling - Mapping modes- colors - fonts - modal and modeless dialog - windows common Controls bitmaps

UNIT III THE DOCUMENT AND VIEW ARCHITECTURE

12

Menus - Keyboard accelerators - rich edit control - toolbars - status bars - reusable frame windowbase class - separating document from its view - reading and writing SDI and MDI documents -splitter window and multiple views - creating DLLs - dialog based applications

UNIT IV ACTIVEX AND OBJECT LINKING AND EMBEDDING (OLE)

12

ActiveX controls Vs. Ordinary Windows Controls - Installing ActiveX controls - Calendar Control -ActiveX control container programming - create ActiveX control at runtime - Component Object Model(COM) - containment and aggregation vs. inheritance - OLE drag and drop - OLE embedded componentand containers - sample applications

UNIT V ADVANCED CONCEPTS

12

Database Management with Microsoft ODBC - Structured Query Language - MFC ODBC classes -sample database applications - filter and sort strings - DAO concepts - displaying database recordsin scrolling view - Threading - VC++ Networking issues - Winsock - WinInet - building a web client -Internet Information Server - ISAPI server extension - chat application - playing and multimedia(sound and video) files

Total No. of Periods: 60

TEXT BOOKS:

1. Charles Petzold, "Windows Programming", Microsoft press, 1996 (Unit I - Chapter 1- 9)
2. David J.Kruglinski, George Shepherd and Scot Wingo, "Programming Visual C++",Microsoftpress, 1999 (Unit II - V)

REFERENCES:

1. Steve Holtzner, "Visual C++ 6 Programming", Wiley Dreamtech India Pvt. Ltd., 2003.

Goal

To study about steps and various concepts involved in developing software.

Objectives

The course should enable the students:

- To learn about various process models.
- To learn about how to draw the requirements.
- To learn the different types of software designing methods.
- To study various software testing methods.
- To learn about quality control and the software configuration management.

Outcome

The student should be able to:

- Understand and implement various process models
- Understand about the requirement analysis.
- Understand about the Software design.
- Understand about different types of testing methods.
- Understand about the methods of quality checking and software configuration management.

UNIT I INTRODUCTION

9

A Generic View of Process - Process Models-The Waterfall Model-Incremental Model-Evolutionary Model-Specialized Model-The Unified Process-Agile Process - Agile Models - Software Cost Estimation- Planning - Risk Analysis - Software Project Scheduling.

UNIT II REQUIREMENT ANALYSIS

9

System Engineering Hierarchy - System Modeling - Requirements Engineering: Tasks-Initiating the Process-Eliciting Requirements-Developing Use Cases-Negotiating Requirements-Validating Requirements - Building the Analysis Models: Concepts

UNIT III SOFTWARE DESIGN

9

Design Concepts - Design Models - Pattern Based Design - Architectural Design - Component Level Design - Component - Class Based And Conventional Components Design - User Interface –Analysis And Design

UNIT IV SOFTWARE TESTING

9

Software Testing - Strategies: Conventional - Object Oriented - Validation Testing - Criteria - Alpha -Beta Testing- System Testing - Recovery - Security - Stress - Performance - Testing Tactics -Testing Fundamentals-Black Box - White Box - Basis Path-Control Structure.

UNIT V SCM AND QUALITY ASSURANCE

9

Software Configuration And Management-Features-SCM Process-Software Quality Concepts – Quality Assurance - Software Review-Technical Reviews - Formal Approach To Software Quality Assurance- Reliability - Quality Standards - Software Quality Assurance Plan

Total No. of periods: 45

TEXT BOOKS:

1. Roger Pressman.S., "Software Engineering: A Practitioner's Approach", 6th Edition, Tata Mcgraw Hill, 2005.

2. PankajJalote, "An Integrated Approach to Software Engineering", 3rd Edition,NarosaPublishingHouse, 2005.

REFERENCES:

1. P. Fleeger, "Software Engineering", Prentice Hall, 2001, Reprint 2002
2. Carlo Ghezzi, Mehdi Jazayari, Dino Mandrioli, "Fundamentals Of Software Engineering", Second Edition, Prentice Hall Of India 1991, Reprint 2003.
3. I. Sommerville, "Software Engineering", 5th Edition: Addison Wesley, 2001.

Goal

To learn the concepts of Advanced JAVA programming.

Objectives

The course should enable the students to

- Create a distributed application to download various files from different servers using RMI
- Create various graphical shapes and display it using or without using Java Bean and BDK.
- Develop enterprise java bean for various business operations.
- Create an Active-X control and component for currency conversion, encryption and decryption, retrieving information from message box using DCOM/.NET
- Develop middleware components for retrieving stock market exchange information and weather forecast information using CORBA.

Outcome

The student should be able to

- Understand the creation of distributed application to download various files from different servers using RMI
- Decipher the Creation of various graphical shapes and display it using or without using JavaBean and BDK.
- Appreciate the development of enterprise java bean for various business operations.
- Implement the creation of an Active-X control and component for currency conversion, encryption and decryption, retrieving information from message box using DCOM/.NET
- Understand the development of middleware components for retrieving stock market exchange information and weather forecast information using CORBA.

List of Experiments

1. Create a distributed application to download various files from various servers using RMI
2. Create a Java Bean to draw various graphical shapes and display it using or without using BDK
3. Develop an Enterprise Java Bean for Banking operations
4. Develop an Enterprise Java Bean for Library operations
5. Create an Active-X control for File operations
6. Develop a component for converting the currency values using COM / .NET
7. Develop a component for encryption and decryption using COM / .NET
8. Develop a component for retrieving information from message box using DCOM / .NET
9. Develop a middleware component for retrieving Stock Market Exchange information using CORBA
10. Develop a middleware component for retrieving Weather Forecast information using CORBA

PCA406 VISUAL PROGRAMMING LAB

L T P C
0 0 3 1

Goal

To learn to use the VB IDE, .NET CLR, CLS and class library to develop windows desktop applications.

Objectives

The course should enable the students to:

- Develop programs using Application wizard.
- Develop programs to handle basic events like message map, saving a view's state.
- Develop programs to display modal and modeless dialog box, GDI.
- Create programs using static and dynamic controls, document view architecture, tool bar and status bar.
- Develop programs using SDI and MDI serialization, creating DLL using MFC and ways to interface with database.

Outcome

The student should be able to:

- Understand the technique of creating a application wizard
- Create programs to handle basic events like message map, saving a view's state.
- Employ techniques to develop program using modal and modeless dialog box.
- Implement programs using static and dynamic controls, document view architecture, toolbar and status bar.
- Employ mechanism to interface with database using SDI and MDI serialization and createDLL using MFC.

List of Experiments

1. Program using application wizard :

SDI, MDI, Drawing Inside the View Window, Device Context

2. Program to handle basic events:

The message map, saving the view's state, initializing a view class data member

3. Program using graphical device interface objects

4. Program to display model and modaless dialogs.

5. Program using static and dynamic controls

6. Program using document - view architecture

7. Program with tool bars and status bars

8. Program using SDI and MDI serialization

9. Program to create dynamic link libraries using MFC

10. Program to interface with database

EL 2431 COMMUNICATION SKILLS AND PERSONALITY DEVELOPMENT

L T P C
2 0 2 3

Goal

The goal of the programme is to provide the learners with the methods and materials required for becoming accomplished personalities through the medium of English.

Objectives

The course should enable the students to:

- Be aware of self-knowledge by exposure to soft skills, values, behaviour, attitudes, temperamental changes, and a positive attitude to life.
- Learn personality traits and undergo personality tests to determine their own personality characteristics and the scope for improvement.
- Cultivate the art of speaking fluently by making use of proper gestures, tone and voice modulation, adding humour to the speech.
- Figure out the need to work in teams, adorn or accept team leadership, and make use of body language to enhance team spirit.
- Be familiar with the art of managing self, people, work and time, keeping in mind problems like time-wasters and stress-builders.

Outcome

The student should be able to:

- Apply the knowledge gained to improve upon their values, behaviour, attitude, and develop the soft skills required for home, workplace and the society.
- Employ the concept of personality traits and build up an accomplished personality that would be pleasing to people around so as to influence them positively.
- Develop a personal style and communicate fearlessly and effectively in a convincing manner so as to impress listeners or the audience.
- Participate in presentations, group discussions, debates and mock interviews making good use of language skills and interpersonal relationships.
- Comprehend stress-management tips to overcome stress-prone habits and develop a career plan with personal, familial and societal goals for success.

UNIT I

12

Values and attitudes - Value-formation - Values & education - Terminal & Instrumental values - Civic responsibilities - The power of Personal/ Cultural/ Social values -- Behaviour and attitudes - Features of attitudes - Developing positive attitude - Overcoming negative attitude -- People skills - Soft skills as per the Work Force Profile - The four temperaments - Sanguine - Choleric - Melancholic - Phlegmatic -- Tests for Personal Chemistry.

UNIT II

12

What is personality development? - Types of personalities as per (i) Heredity (ii) Environment (iii) Situation - the 16 personality factors - MBTI Tests - Personality types - Increasing self awareness: Assessing one's locus of control, Machiavellianism, self-esteem, self-monitoring, risk-taking, Type A, Type B personality elements - Intellectual and physical abilities for jobs -- Personality tests.

UNIT III

12

Developing the art of speaking - How to get rid of stage fright? - Enhancing fluency? - Modulating voice - Enunciation - Positive and negative gestures - Preparation - How to begin? - How to convince the listeners? - How to wind up the speech? - Adding humour and illustration -

Developing one's own style - Types of style - How to influence the audience? - How to become an effective speaker? --Tests for effective speaking.

UNIT IV

12

Team work - Team building - Team leadership -- How to face an interview? -- How to participate in a group discussion? - How to argue for or against in a debate? - Body language - Non-verbal communication - Personal appearance - Facial expression - Posture - Gestures - eye contact - Etiquette - Voluntary and involuntary body language - Gender implications -- Tests.

UNIT V

12

Managing self, people, work, situations - Time-management - Secrets of time-management - Time-wasters - Stress -- Kinds of stress - Spotting stress - Stress-builders - Stress-management tips - Stress-prone habits -- Goals - Career planning - Interpersonal interaction - Interpersonal relationships-- Tests.

Total No of Periods:45

TEXT BOOKS:

1. Burlington, V.T. Group Interaction in High Risk Environments. Ashgate Publication, 2004.
2. Fisher, Kimball. Leading Self-directed Work Teams: A Guide to Developing New Team Leadership Skills. New York, NY: McGraw Hill, 2000.

REFERENCES:

1. Ted W. Engstrom and R. Alec Mackenzie. Managing Your Time: Practical Guidelines on the Effective Use of Time. 2008.
2. Burnard, Philip. Training Games for Interpersonal Skills. McGraw Hill, Inc., New York, 1992. Greenwich, Carolyn. The Fun Factor, McGraw Hill, Inc., New York, 1997.

SEMESTER -V
PCA501 SERVICE ORIENTED ARCHITECTURE

L T P C
3 0 0 3

Goal

To Learn about Service Oriented Architecture.

Objectives

The course should enable the students:

- To learn about SOA architecture and its components
- To know about Service oriented Analysis and design
- Learn about SOA implementation and governance
- Learn about SOA in mobile and research issues
- Learn about Meta data management and security in web service frame work.

Outcome

The student should be able to understand:

- About SOA architecture and its components
- About Service oriented Analysis and design
- About SOA implementation and governance
- About SOA in mobile and research issues
- About Meta data management and security in web service frame work.

UNIT I ARCHITECTURE

9

Software Architecture - Types of IT Architecture - SOA - Evolution - Key components - erspectiveofSOA - Enterprise-wide SOA - Architecture - Enterprise Applications - Solution Architecture for enterpriseapplication - Software platforms for enterprise Applications - attens for SOA - SOA programmingmodels

UNIT II ANALYSIS AND DESIGN

9

Service-oriented Analysis and Design - Design of Activity, Data, Client and business process services- Technologies of SOA - SOAP - WSDL - JAX - WS - XML WS for .NET - Service integration with ESB- Scenario - Business case for SOA - stakeholder objectives - benefits of SPA - Cost Savings

UNIT III IMPLEMENTATION

9

SOA implementation and Governance - strategy - SOA development - SOA governance - trends inSOA - event-driven architecture - software s a service - SOA technologies - proof-of-concept –processorchestration - SOA best practices

UNIT IV DATA MANAGEMENT

9

Meta data management - XML security - XML signature - XML Encryption - SAML - XACML – XKMS- WS-Security - Security in web service framework - advanced messaging

UNIT V TRANSACTION PROCESSING

9

Transaction processing - paradigm - protocols and coordination - transaction specifications - SOA inmobile - research issues.

Total No of Periods:45

TEXT BOOKS:

1. Shankar Kambhampaly, "Service -Oriented Architecture for Enterprise Applications", Wiley India Pvt Ltd, 2008.
2. Eric Newcomer, Greg Lomow, "Understanding SOA with Web Services", Pearson Education.

REFERENCE:

1. Mark O' Neill, et al. , "Web Services Security", Tata McGraw-Hill Edition, 2

Goal

To provide web services architecture designed for highly dynamic program-to-program interactions with grid systems, and peer-to-peer environments and to build autonomous distributed applications.

Objectives

The course should enable the students to:

- Create an XML document for storing information about books using DTD and XML schema
- Create an XML document for presenting the information using CSS.
- Write an XSLT programme for extracting the information from the XML document
- Write a programme using microsoft DOM to navigate and extract information from the XML document.
- Create a Web service for various applications and using microsoft DSO to connect HTML form to XML document and display the information.

Outcome

The student should be able to understand:

- The creation of XML document for storing information about books using DTD and XML schema.
- The creation of XML document for presenting the information using CSS.
- The creation of XSLT programme for extracting the information from the XML document
- The creation of programme using microsoft DOM to navigate and extract information from the XML document.
- In creating a Web service for various applications and using microsoft DSO to connect HTML form to XML document and display the information.

List of Experiments

1. Create an XML document to store an address book.
2. Create an XML document to store information about books and create the DTD files.
3. Create an XML schema for the book's XML document from exercise 2.
4. Create an XML document to store resumes for a job web site and create the DTD file
5. Present the book's XML document using cascading style sheets (CSS).
6. Write an XSLT program to extract book titles, authors, publications, book rating from the book's XML document and use formatting.
7. Use Microsoft DOM to navigate and extract information from the book's XML document.
8. Use Microsoft DSO to connect HTML form or VB form to the book's XML document and display the information.
9. Create a web service for temperature conversion with appropriate client program.
10. Create a web service for currency conversion (at five currencies) with appropriate client program.

PCA503 SOFTWARE DEVELOPMENT LAB

L T P C
0 0 3 1

Goal

To be able to develop software using CASE tools for the applications.

Objective

- Learn the nuances of developing customized software for several applications like online railway reservation system, payroll processing, banking process etc.

Outcome

- Develop robust tailor made software for various real world business applications.

Develop Software for the following applications:

1. Online railway reservation system
2. Payroll processing application
3. Inventory system
4. Automating the banking process
5. Software for game
6. Library management system
7. Create a dictionary
8. Text editor
9. Telephone directory
10. Create an E-Book of your choice

Software required:

Languages: C/C++/Java/JSDK/Web browser.

Any front end tool (like VB, VC++, Developer 2000) etc

Any backend tool (Oracle, Ms-Access, SQL) etc.

Any CASE tool.

SPECIALIZATION ON CLOUD COMPUTING

Code no	Course Title	L	T	P	C	TC H
SEMESTER III						
PCA733	Cloud Architecture	3	0	0	3	3
SEMESTER IV						
PCA734	Cloud Storage Infrastructure	3	0	0	3	3
SEMESTER V						
PCA735	Cloud Security	3	0	0	3	3
PCA736	Application Development Framework	3	0	0	3	3
PCA737	Cloud Application Development	3	0	0	3	3
PCA738	Cloud Strategy Planning & Management	3	0	0	3	3
	TOTAL				18	18

PCA733 - CLOUD ARCHITECTURE

L T P C

3 0 0 3

UNIT I CLOUD COMPUTING FUNDAMENTAL

9

Cloud Computing definition, private, public and hybrid cloud. Cloud types; IaaS, PaaS, SaaS. Benefits and challenges of cloud computing, public vs private clouds, role of virtualization in enabling the cloud; Business Agility: Benefits and challenges to Cloud architecture. Application availability, performance, security and disaster recovery; next generation Cloud Applications.

UNIT II CLOUD APPLICATIONS

9

Technologies and the processes required when deploying web services; Deploying a web service from inside and outside a cloud architecture, advantages and disadvantages

UNIT III CLOUD SERVICES MANAGEMENT

9

Reliability, availability and security of services deployed from the cloud. Performance and scalability of services, tools and technologies used to manage cloud services deployment; Cloud Economics : Cloud Computing infrastructures available for implementing cloud based services. Economics of choosing a Cloud platform for an organization, based on application requirements, economic constraints and business needs (e.g Amazon, Microsoft and Google, Salesforce.com, Ubuntu and Redhat)

UNIT IV APPLICATION DEVELOPMENT

9

Service creation environments to develop cloud based applications. Development environments for service development; Amazon, Azure, Google App.

UNIT V BEST PRACTICE CLOUD IT MODEL

9

Analysis of Case Studies when deciding to adopt cloud computing architecture. How to decide if the cloud is right for your requirements. Cloud based service, applications and development platform deployment so as to improve the total cost of ownership (TCO)

Total Periods: 45

TEXT BOOKS:

1. GautamShroff, Enterprise Cloud Computing Technology Architecture Applications [ISBN: 978-0521137355]
2. Toby Velte, Anthony Velte, Robert Elsenpeter, Cloud Computing, A Practical Approach [ISBN: 0071626948]
3. Dimitris N. Chorafas, Cloud Computing Strategies [ISBN: 1439834539]

PCA734 -CLOUD STORAGE INFRASTRUCTURE

L T P C

3 0 0 3

UNIT I VIRTUALIZED DATA CENTER ARCHITECTURE

9

Cloud infrastructures; public, private, hybrid. Service provider interfaces; Saas, Paas, Iaas.VDC environments; concept, planning and design, business continuity and disaster recovery principles.Managing VDC and cloud environments and infrastructures.

UNIT II INFORMATION STORAGE SECURITY & DESIGN

9

Storage strategy and governance; security and regulations. Designing secure solutions; the considerations and implementations involved. Securing storage in virtualized and cloud environments.Monitoring and management; security auditing and SIEM.

UNIT III STORAGE NETWORK DESIGN

9

Architecture of storage, analysis and planning. Storage network design considerations; NAS and FC SANs, hybrid storage networking technologies (iSCSI, FCIP, FCoE), design for storage virtualization in cloud computing, host system design considerations.

UNIT IV CLOUD OPTIMIZED STORAGE

9

Global storage management locations, scalability, operational efficiency.Global storage distribution; terabytes to petabytes and greater. Policy based information management; metadata attitudes; file systems or object storage.

UNIT V INFORMATION AVAILABILITY DESIGN

9

Designing backup/recovery solutions to guarantee data availability in a virtualized environment. Design a replication solution, local remote and advanced. Investigate Replication in NAS and SAN environments. Data archiving solutions; analyzing compliance and archiving design considerations.

Total Periods: 45

TEXT BOOKS:

1. Greg Schulz 2011, Cloud and Virtual Data Storage Networking, Auerbach Publications [ISBN: 978-1439851739]
2. Marty Poniatowski, Foundations of Green IT [ISBN: 978-0137043750]
3. EMC, Information Storage and Management [ISBN: 978-0470294215]
4. Volker Herminghaus, Albrecht Scriba,, Storage Management in Data Centers [ISBN: 978-3540850229]
5. Klaus Schmidt, High Availability and Disaster Recovery [ISBN: 978-3540244608]

UNIT I SECURITY CONCEPTS 9

Confidentiality, privacy, integrity, authentication, non-repudiation, availability, access control, defence in depth, least privilege, how these concepts apply in the cloud, what these concepts mean and their importance in PaaS, IaaS and SaaS. e.g. User authentication in the cloud; Cryptographic Systems: Symmetric cryptography, stream ciphers, block ciphers, modes of operation, public-key cryptography, hashing, digital signatures, public-key infrastructures, key management, X.509 certificates, OpenSSL.

UNIT II MULTI-TENANCY ISSUES 9

Isolation of users/VMs from each other. How the cloud provider can provide this; Virtualization System Security Issues: e.g. ESX and ESXi Security, ESX file system security, storage considerations, backup and recovery; Virtualization System Vulnerabilities: Management console vulnerabilities, management server vulnerabilities, administrative VM vulnerabilities, guest VM vulnerabilities, hypervisor vulnerabilities, hypervisor escape vulnerabilities, configuration issues, malware (botnets etc).

UNIT III VIRTUALIZATION SYSTEM-SPECIFIC ATTACKS 9

Guest hopping, attacks on the VM (delete the VM, attack on the control of the VM, code or file injection into the virtualized file structure), VM migration attack, hyperjacking.

UNIT IV TECHNOLOGIES FOR VIRTUALIZATION-BASED SECURITY ENHANCEMENT 9

IBM security virtual server protection, virtualization-based sandboxing; Storage Security: HIDPS, log management, Data Loss Prevention. Location of the Perimeter.

UNIT V LEGAL AND COMPLIANCE ISSUES 9

Responsibility, ownership of data, right to penetration test, local law where data is held, examination of modern Security Standards (eg PCIDSS), how standards deal with cloud services and virtualization, compliance for the cloud provider vs. compliance for the customer.

Total Periods: 45

TEXT BOOKS:

1. Tim Mather, SubraKumaraswamy, ShahedLatif, Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance [ISBN: 0596802765]
2. Ronald L. Krutz, Russell Dean Vines, Cloud Security [ISBN: 0470589876]
3. John Rittinghouse, James Ransome, Cloud Computing [ISBN: 1439806802]
4. J.R. ("Vic") Winkler, Securing the Cloud [ISBN: 1597495921]

PCA736 - APPLICATION DEVELOPMENT FRAMEWORK

L T P C

3 0 0 3

UNIT I SPRING FRAMEWORK 9

Overview of Java frameworks, introduction to Spring. Using Spring to configure an application, the bean life-cycle, simplifying application configuration, annotation-based dependency injection, testing a Spring-based application.

UNIT II EFFECTIVE MIDDLE-TIER ARCHITECTURE 9

Adding behavior to an application using aspects, data access with Spring, simplifying JDBC-based data access, driving database transactions in a Spring environment.

UNIT III IMPLEMENTING ENTERPRISE INFORMATION CONNECTIVITY 9

Object-to-relational mapping (ORM), Hibernate in a Spring environment, effective web application architecture, Spring MVC, RESTful web services with Spring MVC.

UNIT IV INTEGRATION WITH ENTERPRISE SERVICES 9

Securing web applications, emoting framework, simplifying message applications with Spring JMS, adding manageability to an application with Spring JMX.

UNIT V ENTERPRISE INTEGRATION 9

Integration Foundations Essential concurrency, tasks and scheduling, serialisation and remoting. Working with Web Services Advanced XML, SOAP web services, RESTful web services, web service security. Messaging and Transactions Messaging, working with JMS, transactional JMS, distributed transaction management. Spring Batch and Integration Spring batch, advanced Spring integration, Service-Oriented Architecture (SOA)

Total Periods: 45

TEXT BOOKS:

1. Rod Johnson... [et al.] 2005, Professional Java development with the Spring Framework, Wiley Pub. Indianapolis, IN [ISBN: 978-0764574832]
2. Mark Fisher 2011, Spring Integration in Action, 1st Ed., Manning Publications [ISBN: 978-1935182436]
3. Craig Walls, Ryan Breidenbach, Spring in Action[ISBN: 978-1933988139]
4. Paul Fisher, Solomon Duskis, Spring Persistence with Hibernate[ISBN: 978-1430226321]
5. Website: SpringSource<http://www.springsource.com/>
6. Website: Sun - Oracle <http://www.oracle.com/us/technologies/java/index.html>
7. Website: IBM <http://www.ibm.com/developerworks/java/>

PCA737 - CLOUD APPLICATION DEVELOPMENT

L T P C

3 0 0 3

UNIT I CLOUD BASED APPLICATIONS

9

Introduction, Contrast traditional software development and development for the cloud. Public v private cloud apps. Understanding Cloud ecosystems – what is SaaS/PaaS, popular APIs, mobile.

UNIT II DESIGNING CODE FOR THE CLOUD

9

Class and Method design to make best use of the Cloud infrastructure; Web Browsers and the Presentation Layer: Understanding Web browsers attributes and differences. Building blocks of the presentation layer: HTML, HTML5, CSS, Silverlight, and Flash.

UNIT III WEB DEVELOPMENT TECHNIQUES AND FRAMEWORKS

9

Building Ajax controls, introduction to Javascript using JQuery, working with JSON, XML, REST. Application development Frameworks e.g. Ruby on Rails , .Net, Java API's or JSF; Deployment Environments – Platform As A Service (PAAS) ,Amazon, vmForce, Google App Engine, Azure, Heroku, AppForce

UNIT IV USE CASE 1

9

Building an Application using the LAMP stack: Setting up a LAMP development environment. Building a simple Web app demonstrating an understanding of the presentation layer and connectivity with persistence.

UNIT V USE CASE 2

9

Developing and Deploying an Application in the Cloud : Building on the experience of the first project students will study the design, development, testing and deployment of an application in the cloud using a development framework and deployment platform.

Total Periods: 45

TEXT BOOKS:

1. Chris Hay, Brian Prince, Azure in Action [ISBN: 978-1935182481]
2. Henry Li, Introducing Windows Azure [ISBN: 978-1-4302-2469-3]
3. Eugenio Pace, Dominic Betts, Scott Densmore, Ryan Dunn, Masashi Narumoto, Matias Woloski, Developing Applications for the Cloud on the Microsoft Windows Azure Platform [ISBN: 9780735656062]
4. Eugene Ciurana, Developing with Google App Engine [ISBN: 978-1430218319]
5. Charles Severance, Using Google App Engine [ISBN: 978-0596800697]

UNIT I ACHIEVING BUSINESS VALUE FROM IT TRANSFORMATION 9

Moving to a cloud architecture and strategy to achieve business value. BPM, IS, Porter's Value chain model and BPR as a means of delivering business value; Developing Business Strategy: Investigate business strategy models to gain competitive advantage for organizations, SWOT/PEST, Economies of scale, Porter's 3 Strategies and 5 Competitive Forces, D'Aveni's hypercompetition models.

UNIT II STRATEGIC IT LEADERSHIP IN THE ORGANIZATION 9

Emphasize the roles of the strategic IS/IT leaders such as Chief Information Officer (CIO) and the Chief Technology Officer (CTO) in planning and managing IT Strategic development in the organization.

UNIT III PLANNING A CLOUD COMPUTING BASED IT STRATEGY 9

Develop an IT strategy to deliver on strategic business objectives in the business strategy. IT Project planning in the areas of ITaaS, SaaS, PaaS and IaaS are essential in delivering a successful strategic IT Plan.

UNIT IV SOA AND BUSINESS AGILITY 9

Shared services delivered by a Service Oriented Architecture (SOA) in a Private or Public Cloud. Services, Databases and Applications on demand. The effect on Enterprise Architecture and its traditional frameworks such as Zachman and The Open Group Architecture Framework (TOGAF).

UNIT V BENEFIT REALIZATION AND IT GOVERNANCE 9

Managing resources (people, process, technology), to realize benefit from Private/Public Cloud IT services (IaaS, PaaS, SaaS), Gartner's 5 pillars of benefit realization. IT governance as a service in measuring the delivery of IT Strategy from Cloud IT Services using Sarbanes Oxley (CobIT) and other commonly-used approaches.

Total Periods: 45

TEXT BOOKS:

1. Arnold J Cummins, Easiest Ever Guide to Strategic IT Planning
2. Andy Mulholland, Jon Pyke, Peter Finger, Enterprise Cloud Computing - A Strategy Guide for Business and Technology Leaders, Meghan Kiffer [ISBN: 0929652290]
3. David S. Linthicum, Cloud Computing and SOA Convergence in Your Enterprise, Addison Wesley [ISBN: 0136009220]
4. Charles Babcock, Management Strategies for the Cloud Revolution, 1st Ed., McGraw/Hill [ISBN: 0071740759]
5. Mark I. Williams, A Quick Start Guide to Cloud Computing: Moving Your Business into the Cloud [ISBN: 0749461306]
6. Website: Whitepapers and news for the CIO www.cio.com
7. Website: Gartner Research Website www.gartner.com