

**L. N. MISHRA INSTITUTE OF ECONOMIC  
EVELOPMENT AND SOCIAL CHANGE,  
PATNA**



**SYLLABUS  
*for*  
MASTER OF COMPUTER APPLICATIONS-INTEGRATED  
(MCA-INTEGRATED) PROGRAMME**

*Based on*

**Choice Based Credit System (CBCS)  
(2024-2029 onwards)**

**[www.lnmipat.ac.in](http://www.lnmipat.ac.in)**

## **Introduction to Choice Based Credit System (CBCS):**

The CBCS provides an opportunity to the students for choosing the courses from the prescribed list of courses comprising the core, elective/minor or skill-based courses. The courses can be evaluated on the basis of grading system, which is considered to be better than the conventional marking or evaluation system. Grading system provides uniformity in the evaluation and computation of the **Cumulative Grade Point Average (CGPA)** based on student's performance in examinations which enables the student to move across institutions of higher learning. The uniformity in the evaluation system also enables the potential employers to assess the performance of the candidates.

### **Basic connotation of various terms commonly used in Choice Based Credit System CBCS:**

**Academic Program** - means an entire course of study comprising its program structure, course details, evaluation schemes etc. designed to be taught and evaluated in a teaching Department/Centre or jointly under more than one such Department/Centre.

**Course** - means a segment of a subject that is part of an Academic Program.

**Program Structure** - means a list of courses (Core, Elective, Practical, Project, etc.) that makes up an Academic Program, specifying the syllabus, Credits, hours of teaching, evaluation and examination schemes.

**Core Course** - means a course that a student admitted to a particular program must successfully complete to receive the degree and which cannot be substituted by any other course.

**Elective Course** - means an optional course to be chosen or selected by a student out of such courses offered in the same or any other Department/Centre.

**Credit** - means the value assigned to a course which indicates the level of instruction; One-hour lecture per week equals 1 Credit, 2 hours practical class per week equals 1 credit. Credit for a practical class could be proposed as part of a course or as a separate practical course.

**SGPA** - means **Semester Grade Points Average** calculated for the courses of a particular semester.

**CGPA** - is **Cumulative Grade Points Average** calculated for all courses completed by the students at any point of time. CGPA is calculated each year for both the semesters clubbed together.

**Grand CGPA** - is calculated in the last year of the course by clubbing together of CGPA of three years, i.e., six semesters.

### **Conversion of Marks into Grades**

In each course, numeric scores will be awarded to both the evaluation components: Internal Assessment and End-semester Examination. Internal assessment score will be based on the average of the numeric scores of the various components such as quizzes, assignments, class participation,

discipline, etc. The total score in a paper is obtained by adding the internal assessment marks and the End-semester Examination marks. The total score obtained in a paper is converted to a letter grade on the basis of the grading scale given below:

| <b>Marks</b>   | <b>Grade</b> | <b>Grade Points</b> |
|----------------|--------------|---------------------|
| <b>90+</b>     | <b>A+</b>    | <b>10</b>           |
| <b>80+</b>     | <b>A</b>     | <b>9</b>            |
| <b>70+</b>     | <b>B</b>     | <b>8</b>            |
| <b>60+</b>     | <b>C</b>     | <b>7</b>            |
| <b>50+</b>     | <b>D</b>     | <b>6</b>            |
| <b>40+</b>     | <b>P</b>     | <b>5</b>            |
| <b>&lt; 40</b> | <b>F</b>     | <b>0</b>            |

**Grade Points:** To be considered on the basis of the grading scale table given above.

**CWP (Credit Weightage Point) =** Grade Point x Credit Point

**SGP (Semester Grade Point) =**  $\sum$  CWP

**SGPA (Semester Grade Point Average) =**  $\frac{\sum \text{CWP}}{\sum \text{Credit Points}}$

**CGPA (Cumulative Grade Point Average) =**  $\frac{\sum \text{SGP}}{\sum \text{Credit Points}}$

## **MCA-INTEGRATED (Five-Year Full-Time) Program Details:**

### **Program Structure:**

The Master of Computer Application (Integrated) is a full time Program of Five years and each year consists of two semesters which are given in the table below.

| <b>Years</b> | <b>Semester - Odd</b> | <b>Semester - Even</b> |
|--------------|-----------------------|------------------------|
| First Year   | <b>Semester - I</b>   | Semester - II          |
| Second Year  | Semester - III        | Semester - IV          |
| Third Year   | Semester - V          | Semester - VI          |
| Fourth Year  | Semester - VII        | Semester - VIII        |
| Fifth Year   | Semester - IX         | Semester - X           |

### **Program Learning Outcomes (PLOs):**

**PLO – 1:** Ability to apply mathematical foundations, algorithmic principles, and computer science theory in the modelling and design of computer-based systems.

**PLO – 2:** Ability to apply the engineering knowledge in all domains, viz., health care, banking and finance, other professions such as medical, law, etc.

**PLO – 3:** Ability to design and conduct experiments as well as to analyze and interpret data.

**PLO – 4:** Ability to analyze the problem, subdivide into smaller tasks with well-defined interface for interaction among components, and complete within the specified time frame and financial constraints.

**PLO – 5:** Ability to propose original ideas and solutions, culminating into a modern, easy to use tool, by a larger section of the society with longevity.

**PLO – 6:** Ability to design, implement, and evaluate secure hardware and/or software systems with assured quality and efficiency.

**PLO – 7:** Ability to communicate effectively the engineering solution to customers/users or peers.

**PLO – 8:** Ability to understand contemporary issues and to get engaged in lifelong learning by independently and continually expanding knowledge and abilities.

### Semester-wise Course Credit Scheme:

| Semester          | No. of courses offered | Total marks (Semester-wise) | Total credits (Semester-wise) |
|-------------------|------------------------|-----------------------------|-------------------------------|
| I                 | 6                      | 600                         | 26                            |
| II                | 6                      | 600                         | 26                            |
| III               | 6                      | 600                         | 27                            |
| IV                | 7                      | 700                         | 33                            |
| V                 | 7                      | 700                         | 33                            |
| VI                | 2                      | 300                         | 13                            |
| <b>TOTAL (UG)</b> | <b>34</b>              | <b>3500</b>                 | <b>158</b>                    |
| VII               | 8                      | 800                         | 28                            |
| VIII              | 8                      | 800                         | 28                            |
| IX                | 8                      | 800                         | 28                            |
| X                 | 1                      | 500                         | 20                            |
| <b>TOTAL (PG)</b> | <b>25</b>              | <b>2900</b>                 | <b>104</b>                    |

| SEMESTER - I             |                            |             |            |              |           |          |          |           |
|--------------------------|----------------------------|-------------|------------|--------------|-----------|----------|----------|-----------|
| Course Code              | Course Name                | ESE (Marks) | IA (Marks) | Full (Marks) | L         | T        | P        | Credit    |
| <b>THEORY COURSES</b>    |                            |             |            |              |           |          |          |           |
| MCI101                   | Mathematical Foundation    | 70          | 30         | 100          | 3         | 1        | -        | 4         |
| MCI 102                  | Business Communication     | 70          | 30         | 100          | 3         | 1        | -        | 4         |
| MCI103                   | Computer Fundamentals & IT | 70          | 30         | 100          | 3         | 1        | -        | 4         |
| MCI104                   | Programming in C           | 70          | 30         | 100          | 3         | 1        | -        | 4         |
| <b>PRACTICAL COURSES</b> |                            |             |            |              |           |          |          |           |
| MCI105                   | Lab on Windows & MS Office | 70          | 30         | 100          | -         | 2        | 3        | 5         |
| MCI106                   | Lab on Programming in C    | 70          | 30         | 100          | -         | 2        | 3        | 5         |
| <b>Total</b>             |                            |             |            | <b>600</b>   | <b>12</b> | <b>8</b> | <b>6</b> | <b>26</b> |

\*\*\* All six courses (Theory and Practical) are compulsory.

L–Lecture    T–Tutorial    P–Practical    ESE–End Semester Examination  
IA–Internal Assessment

| SEMESTER - II            |                               |             |            |              |           |          |          |           |
|--------------------------|-------------------------------|-------------|------------|--------------|-----------|----------|----------|-----------|
| Course Code              | Course Name                   | ESE (Marks) | IA (Marks) | Full (Marks) | L         | T        | P        | Credit    |
| <b>THEORY COURSES</b>    |                               |             |            |              |           |          |          |           |
| MCI201                   | Discrete Mathematics          | 70          | 30         | 100          | 3         | 1        | -        | 4         |
| MCI202                   | Data Structure using C        | 70          | 30         | 100          | 3         | 1        | -        | 4         |
| MCI203                   | Database Management System    | 70          | 30         | 100          | 3         | 1        | -        | 4         |
| MCI204                   | Business Accounting           | 70          | 30         | 100          | 3         | 1        | -        | 4         |
| <b>PRACTICAL COURSES</b> |                               |             |            |              |           |          |          |           |
| MCI205                   | Lab on Data Structure Using C | 70          | 30         | 100          | -         | 2        | 3        | 5         |
| MCI206                   | Lab on DBMS (Oracle)          | 70          | 30         | 100          | -         | 2        | 3        | 5         |
| <b>Total</b>             |                               |             |            | <b>600</b>   | <b>12</b> | <b>8</b> | <b>6</b> | <b>26</b> |

\*\*\* All six courses (Theory and Practical) are compulsory.

| SEMESTER - III           |                                       |             |            |              |           |          |          |           |
|--------------------------|---------------------------------------|-------------|------------|--------------|-----------|----------|----------|-----------|
| Course Code              | Course Name                           | ESE (Marks) | IA (Marks) | Full (Marks) | L         | T        | P        | Credit    |
| <b>THEORY COURSES</b>    |                                       |             |            |              |           |          |          |           |
| MCI301                   | Computer Organization & Architecture  | 70          | 30         | 100          | 4         | 1        | -        | 5         |
| MCI302                   | Statistical Methods                   | 70          | 30         | 100          | 4         | -        | -        | 4         |
| MCI303                   | Object Oriented Programming using C++ | 70          | 30         | 100          | 3         | 1        | -        | 4         |
| MCI304                   | Fundamentals of Management            | 70          | 30         | 100          | 3         | 1        | -        | 4         |
| <b>PRACTICAL COURSES</b> |                                       |             |            |              |           |          |          |           |
| MCI305                   | Lab on Statistical Methods            | 70          | 30         | 100          | -         | 2        | 3        | 5         |
| MCI306                   | Lab on C++                            | 70          | 30         | 100          | -         | 2        | 3        | 5         |
| <b>Total</b>             |                                       |             |            | <b>600</b>   | <b>14</b> | <b>7</b> | <b>6</b> | <b>27</b> |

\*\*\* All six courses (Theory and Practical) are compulsory.

| SEMESTER - IV                     |                         |             |            |              |           |          |          |           |
|-----------------------------------|-------------------------|-------------|------------|--------------|-----------|----------|----------|-----------|
| Course Code                       | Course Name             | ESE (Marks) | IA (Marks) | Full (Marks) | L         | T        | P        | Credit    |
| <b>THEORY COURSES</b>             |                         |             |            |              |           |          |          |           |
| MCI401                            | Java Programming        | 70          | 30         | 100          | 3         | 1        | -        | 4         |
| MCI402                            | Operating System        | 70          | 30         | 100          | 4         | 1        | -        | 5         |
| MCI403                            | Web Designing           | 70          | 30         | 100          | 3         | -        | 2        | 5         |
| MCI404                            | Computer Network        | 70          | 30         | 100          | 4         | -        | -        | 4         |
| <b>PRACTICAL COURSES</b>          |                         |             |            |              |           |          |          |           |
| MCI405                            | Lab on Java Programming | 70          | 30         | 100          | -         | 2        | 3        | 5         |
| MCI406                            | Lab on Web Designing    | 70          | 30         | 100          | -         | 2        | 3        | 5         |
| <b>ELECTIVE COURSES (ANY ONE)</b> |                         |             |            |              |           |          |          |           |
| MCI407                            | Machine Learning        | 70          | 30         | 100          | 4         | 1        | -        | 5         |
| MCI408                            | Network Programming     | 70          | 30         | 100          | 4         | 1        | -        | 5         |
| MCI409                            | Web Based Programming   | 70          | 30         | 100          | 4         | 1        | -        | 5         |
| <b>Total</b>                      |                         |             |            | <b>700</b>   | <b>18</b> | <b>7</b> | <b>8</b> | <b>33</b> |

\*\*\* All six courses (Theory and Practical) are compulsory.

**SEMESTER - V**

| Course Code | Course Name | ESE (Marks) | IA (Marks) | Full (Marks) | L | T | P | Credit |
|-------------|-------------|-------------|------------|--------------|---|---|---|--------|
|-------------|-------------|-------------|------------|--------------|---|---|---|--------|

**THEORY COURSES**

|        |                              |    |    |     |   |   |   |   |
|--------|------------------------------|----|----|-----|---|---|---|---|
| MCI501 | Software Engineering         | 70 | 30 | 100 | 4 | 1 | - | 5 |
| MCI502 | Front End Design Tool VB.Net | 70 | 30 | 100 | 4 | 1 | - | 5 |
| MCI503 | Numerical Methods            | 70 | 30 | 100 | 3 | 1 | - | 4 |
| MCI504 | Python Programming           | 70 | 30 | 100 | 3 | 1 | - | 4 |

**PRACTICAL COURSES**

|        |                           |    |    |     |   |   |   |   |
|--------|---------------------------|----|----|-----|---|---|---|---|
| MCI505 | Lab on Numerical Methods  | 70 | 30 | 100 | - | 2 | 3 | 5 |
| MCI506 | Lab on Python Programming | 70 | 30 | 100 | - | 2 | 3 | 5 |

**ELECTIVE COURSES (ANY ONE)**

|        |   |    |    |     |   |   |   |   |
|--------|---|----|----|-----|---|---|---|---|
| MCI507 | Computer Graphics                         | 70 | 30 | 100 | 3 | - | 2 | 5 |
| MCI508 | Computer Network and Information Security | 70 | 30 | 100 | 3 | - | 2 | 5 |
| MCI509 | Mobile Computing                          | 70 | 30 | 100 | 3 | - | 2 | 5 |

|              |  |  |  |            |           |          |          |           |
|--------------|--|--|--|------------|-----------|----------|----------|-----------|
| <b>Total</b> |  |  |  | <b>700</b> | <b>17</b> | <b>8</b> | <b>8</b> | <b>33</b> |
|--------------|--|--|--|------------|-----------|----------|----------|-----------|

\*\*\* All the Theory and Practical courses are compulsory and one elective course will be offered if minimum 1/3<sup>rd</sup>. of BCA-IV and BCA-V Semester students will opt for the same or it will be decided by the concerned department or authority.

\*\* The totaling of BCA-IV and BCA-V semesters is on the basis of six compulsory (four theory and two practical) courses and one elective course opted by the students of BCA-IV and BCA-V semesters.

**SEMESTER - VI**

| Course Code                  | Course Name                | ESE (Marks) | IA (Marks) | Full (Marks) | L        | T        | P        | Credit    |
|------------------------------|----------------------------|-------------|------------|--------------|----------|----------|----------|-----------|
| <b>PROJECTS AND SEMINARS</b> |                            |             |            |              |          |          |          |           |
| MCI601                       | Project Report & Viva Voce | 100         | 100        | 200          | -        | -        | -        | 8         |
| MCI602                       | Seminar Presentation       | 70          | 30         | 100          | -        | -        | -        | 5         |
| <b>Total</b>                 |                            |             |            | <b>300</b>   | <b>-</b> | <b>-</b> | <b>-</b> | <b>13</b> |

\*\*\* All two courses (Projects & Viva-Voce and Seminars) are compulsory.

**Note:**

After successful completion of Semester -I to Semester -VI, students will be facilitated by BCA Degree and Certificate.



| SEMESTER - VII                  |  |             |            |              |           |          |          |           |
|---------------------------------|--|-------------|------------|--------------|-----------|----------|----------|-----------|
| Course Code                     | Course Name                                      | ESE (Marks) | IA (Marks) | Full (Marks) | L         | T        | P        | Credit    |
| <b>CORE COURSES (THEORY)</b>    |  |             |            |              |           |          |          |           |
| MCI701                          | Computational Mathematics                        | 70          | 30         | 100          | 4         | -        | -        | 4         |
| MCI702                          | Computer Organization and Architecture           | 70          | 30         | 100          | 4         | -        | -        | 4         |
| MCI703                          | Object-Oriented Programming, Analysis and Design | 70          | 30         | 100          | 4         | -        | -        | 4         |
| MCI704                          | Modern Operating Systems                         | 70          | 30         | 100          | 4         | -        | -        | 4         |
| MCI705                          | Advance Database Design Concepts                 | 70          | 30         | 100          | 4         | -        | -        | 4         |
| MCI706                          | Computer Network                                 | 70          | 30         | 100          | 4         | -        | -        | 4         |
| <b>CORE COURSES (PRACTICAL)</b> |  |             |            |              |           |          |          |           |
| MCI707                          | LAB – 1  | 70          | 30         | 100          | -         | 2        | 4        | 2         |
| MCI708                          | LAB – 2  | 70          | 30         | 100          | -         | 2        | 4        | 2         |
| <b>**Total</b>                  |  |             |            | <b>800</b>   | <b>24</b> | <b>4</b> | <b>8</b> | <b>28</b> |

\*\*\* All the Theory and Practical courses are compulsory.

| SEMESTER - VIII                 |   |             |            |              |           |          |          |           |
|---------------------------------|---|-------------|------------|--------------|-----------|----------|----------|-----------|
| Course Code                     | Course Name   | ESE (Marks) | IA (Marks) | Full (Marks) | L         | T        | P        | Credit    |
| <b>CORE COURSES (THEORY)</b>    |   |             |            |              |           |          |          |           |
| MCI801                          | Fundamentals of Management & Organization Behaviour | 70          | 30         | 100          | 4         | -        | -        | 4         |
| MCI802                          | Data Analytics                                      | 70          | 30         | 100          | 4         | -        | -        | 4         |
| MCI803                          | Java Programming                                    | 70          | 30         | 100          | 4         | -        | -        | 4         |
| MCI804                          | Data Structures and Algorithms                      | 70          | 30         | 100          | 4         | -        | -        | 4         |
| MCI805                          | Artificial Intelligence and Knowledge Management    | 70          | 30         | 100          | 4         | -        | -        | 4         |
| <b>ELECTIVE COUSES</b>          |   |             |            |              |           |          |          |           |
| MCI806                          | Program Elective -1                                 | 70          | 30         | 100          | 4         | -        | -        | 4         |
| <b>CORE COURSES (PRACTICAL)</b> |   |             |            |              |           |          |          |           |
| MCI807                          | LAB – 1   | 70          | 30         | 100          | -         | 2        | 4        | 2         |
| MCI808                          | LAB – 2   | 70          | 30         | 100          | -         | 2        | 4        | 2         |
| <b>**Total</b>                  |   |             |            | <b>800</b>   | <b>24</b> | <b>4</b> | <b>8</b> | <b>28</b> |

\*\*\* All the Theory and Practical courses are compulsory and one elective course will be offered if minimum 1/3<sup>rd</sup> of MCA-II Semester students will opt for the same or it will be decided by the concerned department or authority.

\*\* Totaling is on the basis of seven compulsory (five core courses theory and two core courses practical) courses and one elective course opted by the students of MCA-II semester.

| SEMESTER - IX                   |                                 |             |            |              |           |          |          |           |
|---------------------------------|---------------------------------|-------------|------------|--------------|-----------|----------|----------|-----------|
| Course Code                     | Course Name                     | ESE (Marks) | IA (Marks) | Full (Marks) | L         | T        | P        | Credit    |
| <b>CORE COURSES (THEORY)</b>    |                                 |             |            |              |           |          |          |           |
| MCI901                          | Software Engineering Principles | 70          | 30         | 100          | 4         | -        | -        | 4         |
| MCI902                          | Machine Learning                | 70          | 30         | 100          | 4         | -        | -        | 4         |
| MCI903                          | Visual Programming              | 70          | 30         | 100          | 4         | -        | -        | 4         |
| MCI904                          | Web Technologies                | 70          | 30         | 100          | 4         | -        | -        | 4         |
| <b>ELECTIVE COUSES</b>          |                                 |             |            |              |           |          |          |           |
| MCI905                          | Program Elective -2             | 70          | 30         | 100          | 4         | -        | -        | 4         |
| MCI906                          | Program Elective -3             |             |            |              |           |          |          |           |
| <b>CORE COURSES (PRACTICAL)</b> |                                 |             |            |              |           |          |          |           |
| MCI907                          | LAB – 1                         | 70          | 30         | 100          | -         | 2        | 4        | 2         |
| MCI908                          | LAB – 2                         | 70          | 30         | 100          | -         | 2        | 4        | 2         |
| <b>**Total</b>                  |                                 |             |            | <b>800</b>   | <b>24</b> | <b>4</b> | <b>8</b> | <b>28</b> |

\*\*\* All the Theory and Practical courses are compulsory and two elective courses will be offered if minimum 1/3<sup>rd</sup> of MCA-III Semester students will opt for the same or it will be decided by the concerned department or authority.

\*\* Totaling is on the basis of six compulsory (four core courses theory and two core courses practical) courses and two elective courses opted by the students of MCA-III semester.

| SEMESTER - X                  |              |             |            |              |          |          |          |           |
|-------------------------------|--------------|-------------|------------|--------------|----------|----------|----------|-----------|
| Course Code                   | Course Name  | ESE (Marks) | IA (Marks) | Full (Marks) | L        | T        | P        | Credit    |
| <b>CORE COURSES (PROJECT)</b> |              |             |            |              |          |          |          |           |
| MCI1001                       | Project Work | 500         | -          | 500          | -        | -        | -        | 20        |
| <b>**Total</b>                |              |             |            | <b>500</b>   | <b>-</b> | <b>-</b> | <b>-</b> | <b>20</b> |

Project is a compulsory course for all MCA(Integrated) – Xth Semester Students.

L/T//P – Lecture/Tutorial/Practical ESE – End Semester Examination  
IA –Internal Assessment

| <b>List of Program Elective- 1</b> |                                     |          |          |          |           |             |              |               |
|------------------------------------|-------------------------------------|----------|----------|----------|-----------|-------------|--------------|---------------|
| <b>Course Code</b>                 | <b>Name Of Program Electives</b>    | <b>L</b> | <b>T</b> | <b>P</b> | <b>IA</b> | <b>Exam</b> | <b>Total</b> | <b>Credit</b> |
| MCPE101                            | Internet Of Things                  | 4        | -        | -        | 30        | 70          | 100          | 4             |
| MCPE102                            | Management Information System       | 4        | -        | -        | 30        | 70          | 100          | 4             |
| MCPE103                            | Principle Of Compiler Design        | 4        | -        | -        | 30        | 70          | 100          | 4             |
| MCPE104                            | Micro Processors and Application    | 4        | -        | -        | 30        | 70          | 100          | 4             |
| MCPE105                            | Client / Server Technology          | 4        | -        | -        | 30        | 70          | 100          | 4             |
| MCPE106                            | Neural Networks                     | 4        | -        | -        | 30        | 70          | 100          | 4             |
| MCPE107                            | Marketing Management                | 4        | -        | -        | 30        | 70          | 100          | 4             |
| MCPE108                            | Parallel Computing                  | 4        | -        | -        | 30        | 70          | 100          | 4             |
| MCPE109                            | Computer Graphics and Multimedia    | 4        | -        | -        | 30        | 70          | 100          | 4             |
| MCPE110                            | Accounting and Financial Management | 4        | -        | -        | 30        | 70          | 100          | 4             |

| <b>List of Program Elective- 2</b> |  |          |          |          |           |             |              |               |
|------------------------------------|--|----------|----------|----------|-----------|-------------|--------------|---------------|
| <b>Course Code</b>                 | <b>Name Of Program Electives</b>           | <b>L</b> | <b>T</b> | <b>P</b> | <b>IA</b> | <b>Exam</b> | <b>Total</b> | <b>Credit</b> |
| MCPE201                            | Operation Research                         | 4        | -        | -        | 30        | 70          | 100          | 4             |
| MCPE202                            | Data Warehousing and Mining                | 4        | -        | -        | 30        | 70          | 100          | 4             |
| MCPE203                            | Software Architecture and Software Testing | 4        | -        | -        | 30        | 70          | 100          | 4             |
| MCPE204                            | Systems Programming                        | 4        | -        | -        | 30        | 70          | 100          | 4             |
| MCPE205                            | Big Data Analytics                         | 4        | -        | -        | 30        | 70          | 100          | 4             |
| MCPE206                            | Human Resources Management                 | 4        | -        | -        | 30        | 70          | 100          | 4             |
| MCPE207                            | Cryptography and Network Security          | 4        | -        | -        | 30        | 70          | 100          | 4             |
| MCPE208                            | Natural Language Processing                | 4        | -        | -        | 30        | 70          | 100          | 4             |
| MCPE209                            | Image Processing                           | 4        | -        | -        | 30        | 70          | 100          | 4             |
| MCPE210                            | High Performance Computing                 | 4        | -        | -        | 30        | 70          | 100          | 4             |

### List of Program Elective- 3

| Course Code | Name Of Program Electives           | L | T | P | IA | Exam | Total | Credit |
|-------------|-------------------------------------|---|---|---|----|------|-------|--------|
| MCPE301     | Embedded System                     | 4 | - | - | 30 | 70   | 100   | 4      |
| MCPE302     | Modeling and Computer Simulation    | 4 | - | - | 30 | 70   | 100   | 4      |
| MCPE303     | Principles Of Programming Languages | 4 | - | - | 30 | 70   | 100   | 4      |
| MCPE304     | Soft Computing                      | 4 | - | - | 30 | 70   | 100   | 4      |
| MCPE305     | Cloud Computing And Grid Computing  | 4 | - | - | 30 | 70   | 100   | 4      |
| MCPE306     | Android Application Development     | 4 | - | - | 30 | 70   | 100   | 4      |
| MCPE307     | Mobile Computing                    | 4 | - | - | 30 | 70   | 100   | 4      |
| MCPE308     | E-Commerce                          | 4 | - | - | 30 | 70   | 100   | 4      |

# SEMESTERWISE COURSE CONTENTS

## SEMESTER – I

### MCI101: MATHEMATICAL FOUNDATION

#### Course Contents:

#### UNIT– I

**DETERMINANTS:** Definition, Minors, Cofactors, Properties of Determinants, **MATRICES:** Definition, Types of Matrices, Addition, Subtraction, Scalar Multiplication and Multiplication of Matrices, Adjoint, Inverse, Cramer’s Rule, Rank of Matrix Dependence of Vectors, Eigen - Vectors of a Matrix, Caley-Hamilton Theorem (without proof)

#### UNIT – II

**LIMITS & CONTINUITY:** Limit at a Point, Properties of Limit, Computation of Limits of Various Types of Functions, Continuity at a Point, Continuity Over an Interval, Intermediate Value Theorem, Type of Discontinuities.

#### UNIT – III

**DIFFERENTIATION:** Derivative, Derivatives of Sum, Differences, Product &quotquotients, Chain Rule, Derivatives of Composite Functions, Logarithmic Differentiation, Rolle’s Theorem, Mean Value Theorem, Expansion of Functions (Maclaurin’s & Taylor’s), Indeterminate Forms, L’ Hospitals Rule, Maxima & Minima, Asymptote, Successive Differentiation & Liebnitz Theorem.

#### UNIT – IV

**INTEGRATION:** Integral as Limit of Sum, Riemann Sum, Fundamental Theorem of Calculus, Indefinite Integrals, Methods of Integration Substitution, By Parts, Partial Fractions, Integration of Algebraic and transcendental Functions, Reduction Formulae for Trigonometric Functions, Gamma and Beta Functions.

#### TEXT BOOKS:

- [1] Kresyig E., “Advanced Engineering Mathematics”, John Wiley & Sons.
- [2] Babu Ram, “Engineering Mathematics”, Pearson Education.
- [3] Apostol Tom M, Calculus, Vol I and II John Wiley.

#### REFERENCE BOOKS:

- [1] B.S. Grewal, “Elementary Engineering Mathematics”.
- [2] H.K. Dass, “Advanced Engineering Mathematics”, S. Chand & Company.
- [3] Shanti Narayan, “Differential Calculas”, S.Chand & Company.

## **MCI102: BUSINESS COMMUNICATION**

### **Course Contents:**

#### **UNIT – I**

**Concepts and Fundamentals:** Introduction to Technical Communication, meaning of communication, Importance of communication, Communication scope, types, Process of communication, Communication models and theories, Essentials of good communication - The seven Cs of communication, Factors responsible for growing importance of communication, Channels of communication, Verbal and Non-Verbal communication, Formal and Informal communication, Barriers of, and aids to communication.

#### **UNIT – II**

**Written Communication:** Objectives of written communication, Media of written communication, Merits and demerits of written communication, Planning and preparing of effective business messages. Persuasive writing, Overview of Technical Research and Report Writing: Definition and Nature of Technical Writing, Properties/features and process of Technical Writing, Basic Principles of Technical Writing, Styles in Technical Writing, The Role of Technical Writing, The Wholistic Guide of Technical Writing, End-products of Technical Writing. Writing Proposals.

#### **UNIT-III**

**Oral & Interactive Communication:** Importance in Modern Era

**Writing Letters:** Business letters, Office memorandum, Good news and bad news letters, Persuasive letters, Sales letters, Letter styles/ layout.

**Report Writing:** Meaning & Definition, Types of report (Business report & Academic report), Format of report, Drafting the report, Layout of the report, Essential requirement of good report writing.

#### **UNIT – IV**

**Project Presentations:** Advantages & Disadvantages, Executive Summary, Charts, Distribution of time (presentation, questions & answers, summing up), Visual presentation, Guidelines for using visual aids, Electronic media (power-point presentation).

**Language Skills:** Improving command in English, improving vocabulary, choice of words, Common problems with verbs, adjectives, adverbs, pronouns, tenses, conjunctions, punctuations, prefix, suffix, idiomatic use of prepositions. Sentences and paragraph construction, improve spellings, introduction to Business English.

#### **TEXTBOOKS:**

- [1] Kavita Tyagi and Padma Misra , “Advanced Technical Communication”, PHI.
- [2] P.D.Chaturvedi and Mukesh Chaturvedi, “Business Communication – Concepts, Cases and Applications”, Pearson.
- [3] Rayudu, “C.S- Communication”, Himalaya Publishing House.
- [4] Asha Kaul , “Business Communication”, PHI.

#### **REFERENCE BOOKS:**

- [1] Raymond Murphy, “Essential English Grammar- A self-study reference and practice book for elementary students of English”, Cambridge University Press, second edition.
- [2] Manalo, E. & Fermin. Technical and Report Writing. ECC Graphics. Quezon City.
- [3] Kavita Tyagi and Padma Misra , “Basic Technical Communication”, PHI.
- [4] Herta A Murphy, Herbert W Hildebrandt and Jane P Thomas, “Effective Business Communication”, McGraw Hill.

## **MCI103: COMPUTER FUNDAMENTALS & IT**

### **Course Contents:**

#### **UNIT – I**

**Introduction to Computers:** The evolution of computers: Computer Generation from First Generation to Fifth Generation. Classifications of Computers: Micro, Mini, Mainframe and super computers, Distributed Computer System, Parallel Computers.

**Computer Hardware:** Major Components of a digital computer, Block Diagram of a computer Input-output devices, Description of Computer Input Units, Output Units. CPU.

**Computer Memory:** Memory Cell, Memory Organization, Read Only Memory, Serial Access Memory, Physical Devices Used to construct Memories, Magnetic Hard disk, floppy Disk Drives, Compact Disk Read Only Memory, Magnetic Tape Drives.

#### **UNIT – II**

**Interaction With Computers:** Computer Software: System software, assemblers, compilers, interpreters, linkers Elementary Operating System concepts, different types of operating systems, Application Software: Introduction to MS Office (MS-Word, MS Powerpoint, MS-Excel) Computer Programming and Languages: Algorithms, flow chart, decision tables, pseudo code, Low level languages and introduction to high level languages.

#### **UNIT – III**

**Computer Number System:** Decimal, Binary, Octal, Hexa-decimal.

**Conversion:** Decimal to all other number systems, Binary to octal and hexadecimal, Addition of binary numbers, Binary subtraction, use of complements to represent negative numbers, Conversion of a binary fraction to a decimal fraction and decimal to binary fraction, Binary Coded Decimal(BCD), ASCII Codes, EBCDIC codes, Gray codes, Unicode.

#### **UNIT – IV**

**Computer Network & Internet:** Basic elements of a communication system, Data transmission modes, Data Transmission speed, Data transmission media, Digital and Analog Transmission, Network topologies, Network Types (LAN, WAN and MAN), Client and Servers, Intranet, Extranet.

**Internet:** Terminologies related to Internet: Protocol, Domain name, IP address, URL, World Wide Web. Overview of various services on Internet: E-mail, FTP, Telnet, Chat, Instant Messaging.

### **TEXT BOOKS:**

- [1] P. K. Sinha & Priti Sinha, “Computer Fundamentals”, BPB Publications.
- [2] Anita Goel “Computer Fundamentals”, Pearson.

### **REFERENCE BOOKS:**

- [1] B. Ram Computer Fundamentals Architecture and Organization, New Age Intl.
- [2] Alex Leon & Mathews Leon, “Introduction to Computers”, Vikas Publishing.
- [3] Norton Peter, “Introduction to computers”, TMH.
- [4] Vikas Gupta, “Comdex Computer Kit”, Wiley Dreamtech, Delhi.



## **MCI104: PROGRAMMING IN C**

### **Course Contents:**

#### **UNIT – I**

**C basics:** C character set, Identifiers and keywords, Data types, constants, variables and arrays, declarations, expressions statements, symbolic constants, compound statements, arithmetic operators, unary operators, relational and logical operators, assignment operators, conditional operators, bit operators. C constructs: If statement, if... else statement, if... else if... else statement, while statement, do...while statement, for statement, switch statement, nested control statement, break operator, continue operator, comma operator, goto statement.

#### **UNIT-II**

**Arrays:** Arrays, pointers, array & pointer relationship, pointer arithmetic, dynamic memory allocation, pointer to arrays, array of pointers, pointers to functions, array of pointers to functions, Preprocessor directives: #include, #define, macro's with arguments, the operators # and ##, conditional compilations.

**String Manipulation** functions and other standard library functions from stdio.h, stdlib.h, conio.h, ctype.h, math.h, string.h, process.h. Usage of command line arguments.

#### **UNIT – III**

**C Functions:** Functions: declaration, definition & scope, recursion, call by value, call by reference.

**Storage Classes:** automatic, external (global), static & registers.

#### **UNIT – IV**

**Structures:** Structures, unions, passing structure to functions, bit fields, file handling [text (ASCII), binary].

#### **TEXTBOOKS:**

- [1] Ashok N. Kamthane, "Computer Basics and C Programming", Pearson Education.
- [2] E. BalaGuruswamy, "Programming in ANSI C".
- [3] V Rajaraman, "Computer Basics and C Programming", PHI.

#### **REFERENCE BOOKS:**

- [1] Herbert Schildt, "C The Complete Reference".
- [2] Yashwant Kanetkar, "Let us C".
- [3] Kernighan and d. Ritchie, "The ANSI C Programming Language".
- [4] StephennPrata, "C Primer Plus".
- [5] Schaum's Outline Series, "Programming with C".

### **MCI105: LAB ON WINDOWS & MS OFFICE**

Lab would be based on the Course BCA – 103: Computer Fundamentals & IT. The objective of this lab is to help the students to understand the various types of computers, programming language, memory, etc. The students should develop flowcharts and they must understand the various types of O.S. especially MS – Windows & Office.

### **MCI106: LAB ON PROGRAMMING C**

Lab would be based on the Course BCA – 104: Programming in C. The objective of this lab is to help the students to understand the basics of C- Programming. The lab should help the students to develop their capability on C-functions, Arrays, String Manipulation, etc.

## SEMESTER – II

### **MCI201: DISCRETE MATHEMATICS**

#### **Course Contents:**

#### **UNIT – I**

**SETS:** Sets, Subsets, Equal Sets Universal Sets, Finite and Infinite Sets, Operation on Sets, Union, Intersection and Complements of Sets, Cartesian Product, Cardinality of Set, Simple Applications.

**RELATIONS AND FUNCTIONS:** Properties of Relations, Equivalence Relation, Partial Order Relation Function: Domain and Range, Onto, Into and One to One Functions, Composite and Inverse Functions, Hashing functions, Recursive function.

#### **UNIT – II**

**PARTIAL ORDER RELATIONS AND LATTICES:** Partial Order Sets, Representation of POSETS using Hasse diagram, Chains, Maximal and Minimal Point, glb, lub, Principle of Duality, Basic Properties, Sublattices, Distributed & Complemented Lattices.

#### **UNIT – III**

**Graphs:** types and operations (bipartite graph. Subgraph, distance of a graph, cut-edges & cut vertices, isomorphic and homomorphic graphs), degree of graphs, adjacent and incidence matrices, path circuit (Floyd's and Warshall algorithms), hamiltonian graph, graph colouring.

#### **UNIT – IV**

**Propositional Logic:** Proposition, First order logic, Basic logical operation, truth tables, tautologies, contradictions, Algebra of Proposition, logical implications, logical equivalence.

#### **TEXT BOOKS:**

- [1] Rosen, K.H., Discrete Mathematics and its Applications, McGraw Hill,
- [2] Kolman, Busby and Ross, "Discrete Mathematical Structure", PHI.
- [3] Babu Ram, "Discrete Mathematics", Pearson Education.

#### **REFERENCE BOOKS:**

- [1] S.K. Sarkar, "Discrete Maths"; S. Chand & Co.
- [2] Tremblay, J.P. and Manohar, R., Discrete Mathematical Structures with Applications to Computer Science, Tata McGraw Hill.

## MCI202: DATA STRUCTURE USING C

### Course Contents:

#### UNIT – I

**Introduction to Data Structures:** Basic Terminology, Elementary Data Organizations, Classification of data structures and its operations.

**Arrays:** Representation of single and multidimensional arrays (up to three dimensions); sparse arrays - lower and upper triangular matrices and Tri-diagonal matrices; addition and subtraction of two sparse arrays. (Multidimensional, and, sparse arrays, to be given elementary treatment.)

**Stacks and Queues:** Introduction and primitive operations on stack; Stack application: Polish Notations; Evaluation of postfix expression; Conversion from infix to postfix; Introduction and primitive operations on queues; D-queues, priority queues and Circular Queue.

#### UNIT – II

**Lists:** Introduction to linked lists; Sequential and linked lists, operations such as traversal, insertion, deletion, searching, two-way lists and Use of headers

**Trees:** Introduction and terminology; Traversal of binary trees; Recursive algorithms for tree operations such as traversal, insertion and deletion;

#### UNIT – III

Introduction to and creation of AVL trees and m-way search trees - (elementary treatment to be given); Multilevel indexing and B-Trees: Introduction; Indexing with binary search trees; Multilevel indexing, a better approach to tree indexes; Example for creating a B-tree.

#### UNIT – IV

**Sorting Techniques:** Insertion sort, selection sort bubble sort and merge sort.

**Searching Techniques:** linear search, binary search and hashing. (Complexities NOT to be discussed for sorting and searching)

#### TEXT BOOKS:

- [1] Ashok N. Kamthane, “Introduction to Data Structures in C”, Pearson Edu.
- [2] Y. Langsam, Tananbaum, et. al., “Data Structures using C and C++”, PHI.
- [3] Schaum’s outline series, “Data Structure”, TMH.

#### REFERENCE BOOKS:

- [1] Yashwant Kanetkar, “Data Structures Through C”, BPB Publications.
- [2] A.K. Sharma, “Data Structure Using C”, Pearson
- [3] P. S. Deshpande and O.G. Kakde, “C & Data Structure”, Wiley Dreamtech.
- [4] Richard F. Gilberg& Behrouz A. Forouzan, “Data Structures – A Pseudocode Approach with C”, COURSE TECHNOLOGY, CENGAGE Learning
- [5] E. Horowitz and S. Sahani, “Fundamentals of Data Structures”, GalgotiaBooksSource Pvt. Ltd.

## MCI203: DATABASE MANAGEMENT SYSTEM

### Course Contents:

#### UNIT – I

**Introduction:** An overview of database management system, database system Vs file system, Characteristics of database approach, DBMS architecture, data models, schema and instances, data independence.

**Data Modeling using Entity Relationship Model:** Entity, Entity types, entity set, notation for ER diagram, attributes and keys, Concepts of composite, derived and multivalued attributes, Super Key, candidate key, primary key, relationships, relation types, weak entities, enhanced E-R and object modeling, Sub Classes: Super classes, inheritance, specialization and generalization.

#### UNIT – II

**Relational Data Model:** Relational model terminology domains, Attributes, Tuples, Relations, characteristics of relations, relational constraints domain constraints, key constraints and constraints on null, relational DB schema. Codd's Rules.

**Relational algebra:** Basic operations selection and projection, Set Theoretic operations Union, Intersection, set difference and division.

**Join operations:** Inner, Outer, Left outer, Right outer and full outer join.

**ER to relational Mapping:** Data base design using ER to relational language.

**Data Normalization:** Functional dependencies, Armstrong's inference rule, Normal form up to 3<sup>rd</sup> normal form.

#### UNIT – III

**Introduction to SQL:** Overview, Characteristics of SQL. Advantage of SQL, SQL data types and literals.

**Types of SQL commands:** DDL, DML, DCL. Basic SQL Queries.

**Logical operators:** BETWEEN, IN, AND, OR and NOT.

**Null Values:** Disallowing Null Values, Comparisons Using Null Values

**Integrity constraints:** Primary Key, Not NULL, Unique, Check, Referential keyIntroduction to Nested Queries, Correlated Nested Queries, Set-Comparison Operators, Aggregate Operators: The GROUP BY and HAVING Clauses.

**Joins:** Inner joins, Outer Joins, Left outer, Right outer, full outer joins.Overview of views and indexes.

#### UNIT – IV

**Transaction processing and Concurrency Control:** Definition of Transaction, Desirable ACID properties, overview of serializability, serializable and non-serializable transactions

**Concurrency Control Techniques:** Definition of concurrency, lost update, dirty read and incorrect summary problems due to concurrency. Overview of Locking,2PL,Timestamp ordering, multi-versioning, validation

**Elementary concepts of Database security:** system failure, Backup and Recovery Techniques, authorization and authentication.

### TEXT BOOKS:

- [1] R. Elmarsri and SB Navathe, "Fundamentals of Database Systems", Pearson.
- [2] Singh S.K., "Database System Concepts, design and application", Pearson Education
- [3] Ramakrishnan and Gherke, "Database Management Systems", TMH.

### REFERENCE BOOKS:

- [1] Abraham Silberschatz, Henry Korth, S. Sudarshan, "Database Systems Concepts", McGraw Hill.
- [2] Jim Melton, Alan Simon, "Understanding the new SQL: A complete Guide", Morgan Kaufmann Publishers.
- [3] A. K. Majumdar, P. Battacharya, "Data Base Management Systems", TMH.
- [4] Bipin Desai, "An Introduction to database Systems", Galgotia Publications.

## **MCI204: BUSINESS ACCOUNTING**

### **Course Contents:**

#### **UNIT – I**

**Meaning and nature of accounting**, Scope of financial accounting, Interrelationship of Accounting with other disciplines, Branches of Accounting, Accounting concepts and convention, Accounting standards in India.

#### **UNIT – II**

**Journal**, Rules of Debit and Credit, Sub Division of Journal: Cash Journal, Petty Cash Book, Purchase Journal, Purchase Return, Sales Journal, Sales Return Journal, Ledger, Trial Balance

#### **UNIT – III**

**Preparation of Final Accounts**, Profit & Loss Account, Balance Sheet-Without adjustments and with adjustments. Preparation Of Receipt and Payment Account. Income and Expenditure Account and Balance Sheet.

#### **UNIT – IV**

**Meaning of Inventory**, Objectives of Inventory Valuation, Inventory Systems, Methods of Valuation of Inventories-FIFO, LIFO and Weighted Average Method, Concept of Depreciation, Causes of Depreciation, Meaning of Depreciation Accounting, Method of Recording Depreciation, Methods of Providing Depreciation.

### **TEXT BOOKS:**

- [1] Maheshwari, S.N. and Maheshwari, S. K., An Introduction to Accountancy, Vikas Publishing House.
- [2] Tulsian, P.C., Financial Accountancy, Pearson Education.

### **REFERENCE BOOKS:**

- [1] Gupta R. L., & Gupta V.K., “Principles & Practice of Accounting”, Sultan Chand & Sons.
- [2] Monga J R, “Introduction to Financial Accounting”, Mayur Paperbacks.
- [3] Raja Sekaran/Lalitha, “Financial Accounting”, Pearson Education.

### **MCI205: LAB ON DATA STRUCTURE USING C**

Lab would be based on the Course **MCI – 202: Data Structure using C**. The objective of this lab is to help the students to understand the sequential and linked lists. They should be able to deal with traversal, insertion, deletion and searching operation. The lab should help the students to develop their capability for AVL trees, m-way search trees, multi-level indexing and B-trees.

### **MCI206: LAB ON DBMS (ORACLE)**

Lab would be based on the Course **MCI – 203: Database Management System**. The objective of this lab is to help the students to understand the data modeling using entity relationship model and Relational data model. They should be equipped to apply SQL commands – DDL, DML and DCL

## SEMESTER – III

### **MCI301: COMPUTER ORGANIZATION & ARCHITECTURE**

#### **Course Contents:**

#### **UNIT – I**

**Register Transfer and Micro-operations:** Register Transfer Language, Register Transfer, Bus and Memory Transfers, Arithmetic Micro-operations, Logic Micro-operations, Shift Microoperations, Arithmetic logic shift unit.

**Basic Computer Organizations and Design:** Instruction Codes, Computer Registers, Computer Instructions, Timing and Control, Instruction Cycle, Memory-Reference Instructions, Register reference instructions, Input - Output Instructions, Design of Accumulator Logic.

#### **UNIT – II**

#### **Design of Microprogrammed Control Unit**

**Central Processing Unit:** Introduction, General Register Organization, Stack Organization, Instruction Formats, Addressing Modes. Difference between RISC and CISC.

**Pipeline and Vector Processing:** Arithmetic and Instruction pipeline, Vector operations, Matrix Multiplication, memory interleaving.

#### **UNIT – III**

**Computer Arithmetic:** Introduction, Multiplication Algorithms, Division Algorithms, for fixed point-members.

**Input-Output Organization:** Peripheral Devices, Input-Output Interfaces, Asynchronous Data Transfer, Modes of Transfer, Priority Interrupt, Direct Memory Access (DMA)

#### **UNIT – IV**

**Memory Organization:** Memory Hierarchy, Main Memory, Auxiliary Memory, Associative Memory, Cache Memory, Virtual Memory, Memory Management Hardware.

#### **TEXT BOOKS:**

- [1] Morris Mano, Computer System Architecture, 3rd Edition, Prentice-Hall of India Private Limited.

#### **REFERENCE BOOKS:**

- [1] William Stallings, Computer Organization and Architecture, 4th Edition, Prentice Hall of India Private Limited.  
[2] Subrata Ghosal, "Computer Architecture and Organization", Pearson.  
[3] Malvino, "Digital Computer Electronics: An Introduction to Microcomputers", McGraw Hill,



## **MCI302: STATISTICAL METHODS**

### **Course Contents:**

#### **UNIT - I**

Statistics and its role in decision making, Internal and external source of data. Methods of collecting primary data. Sampling and its different techniques. Uses of secondary data.

Formation of a frequency distribution. Types of frequency distributions. Graphical and diagrammatical representation of business data. Histogram, frequency polygon and frequency curves.

#### **UNIT - II**

Uses of average in analyzing business data. Simple and weighted mean, mode, median, geometric and harmonic mean, properties and limitations of average. Measuring variability of business data by quartile deviation, mean deviation and standard deviation. Application of the concept of skewness and kurtosis for measuring the symmetry of business data.

#### **UNIT - III**

Significance of the study of correlation. Types of correlation, Coefficient of correlation by Karl Pearson and rank order method. Use of regression analysis. Regression equations as a predicting tool.

#### **UNIT - IV**

Analysis of time series, different components of a time series. Measurement of secular trend of business data by moving average method.

### **TEXT BOOKS:**

1. S.P. Gupta : Statistical Methods
2. Shukla & Gulsan : Statistics
3. S.P. Gupta & M.P. Gupta : Business Statistics

### **REFERENCE BOOKS:**

1. S.C. Gupta : Fundamentals of Statistics
2. R.P. Hooda : Statistics for Business
3. G. V. Shenoy & Madan Pant : Statistical Methods

## **MCI303: OBJECT ORIENTED PROGRAMMING USING C++**

### **Course Contents:**

#### **UNIT – I**

**Introduction:** Introducing Object-Oriented Approach, Relating to other paradigms (functional, data decomposition). Features of Procedure oriented programming, Basic Concepts of Object Oriented Programming, Benefits of OOP, Applications of OOP, Difference between C and C++, cin, cout, new, delete operators.

**C++ Environment:** Program development environment, the language and the C++ language standards. C++ standard libraries. Introduction to various C++ compilers, C++ standard libraries, Testing the C++ program in Turbo C++/Borland C++/Microsoft VC++/GNU C++ compiler.

#### **UNIT – II**

**Classes and Objects:** Encapsulation, information hiding, abstract data types, Object & classes, attributes, methods, C++ class declaration, references, this pointer, Function Overloading, Constructors and destructors, instantiation of objects, Default parameter value, C++ garbage collection, dynamic memory allocation, Metaclass/abstract classes.

#### **UNIT – III**

**Inheritance and Polymorphism:** Inheritance, Class hierarchy, derivation – public, private & protected, Agrégation, composition v/s classification hiérarchies, Polymorphism, Categorization of polymorphism techniques, Method polymorphism, Polymorphism by parameter, Operator overloading, Parametric polymorphism, Virtual Function, Early v/s Late Binding.

#### **UNIT – IV**

**Generic Programming** – Introduction, templates, template functions, Overloading of template functions, Overriding inheritance methods.

**Files and Exception Handling:** Persistent objects, Streams and files, Namespaces, The basic stream classes: C++ predefined streams, Error handling during file operations, Command Line Arguments. Types of Exception, Catching and Handling Exceptions.

### **TEXT BOOKS:**

- [1] Ashok N. Kamthane, “Object-Oriented Programming WithAnsi And Turbo C++”, Pearson Education.
- [2] A.R.Venugopal, Rajkumar, T. Ravishanker “Mastering C++”, TMH.
- [3] E. Balguruswamy, “**C++** ”, TMH Publication.

### **REFERENCE BOOKS:**

- [1] Mahesh Bhawe, “Object Oriented Programming with C++”, Pearson Education.
- [2] D. Parasons, “Object Oriented Programming with C++”, BPB Publication.
- [3] Steven C. Lawlor, “The Art of Programming Computer Science with C++”, Vikas Publication.
- [4] Schildt Herbert, “C++: The Complete Reference”, Tata McGraw Hill.
- [5] R. Lafore, “Object Oriented Programming using C++”, Galgotia Publications.

## **MCI304: FUNDAMENTALS OF MANAGEMENT**

### **Course Contents:**

#### **UNIT – I**

**Management:** Meaning & concept, Management principles (Fayol & Taylor), Management process (in brief), Managerial levels, Roles & skills of a manager.

#### **UNIT – II**

**Planning:** Meaning, Purpose & process, Decision making: Concept & process,

**Organizing:** Process, Departmentation, Authority & Responsibility relationships, Decentralization. Staffing: Nature & Importance,

#### **UNIT – III**

**Staffing:** Concept, nature & importance of staffing.

**Directing:** Motivation: concept & theories (Maslow's, Herzberg Two factor, McGregor's theory X & Y), Leadership: Concepts & styles.

**Controlling:** Nature, Importance, significance & Process of control.

#### **UNIT – IV**

**Managing People:** Meaning, Need of understanding human behavior in organization, Models of OB, **Major concepts in OB (elementary)**- Personality, Learning, Perception & Attitude Building.

### **TEXT BOOKS:**

[1] Dr. C.B Gupta "Management concepts & practices" S.Chand& Sons.

### **REFERENCE BOOKS:**

[1] Stoner, Freeman & Gilbert, "Management" 6<sup>th</sup> Edition, Pearson International.

[2] Ankur Chhabra, "Organisational Behaviour", Sun India Publications.

[3] Robbins, Stephen P, "Organisational Behaviour". PHI.

### **MCI305: LAB ON STATISTICAL METHODS**

The lab would be based on the course 302 – Statistical Methods. The objective of this lab is to help the students to do the graphical diagrammatical representation of business data. They should be equipped to apply Histogram, Frequency Polygon and frequency curves. They should know the application of the concept of skewness and kurtosis for measuring the symmetry of business data.

### **MCI306: LAB ON C++**

The lab would be based on the course 303 – Object Oriented Programming using C++. The objective of this lab is to help the students to understand the basic Concepts of Object-Oriented Programming, numerous benefits of applications of OOP and difference between C and C++, cin, cout, new, delete operators. They should be capable to apply polymorphism techniques. Students should know the application of Overriding inheritance methods.

## SEMESTER – IV

### **MCI401: JAVA PROGRAMMING**

#### **Course Contents:**

##### **UNIT – I**

**Java Programming:** Introduction, Data types, access specifiers, operators, control statements, arrays.

**Classes:** Fundamentals, objects, methods, constructors.

**Inheritance:** Super class, sub class, this and super operator, method overriding, use of final, packages, abstract class, interface.

**Polymorphism:** Method overloading, constructor overloading.

##### **UNIT – II**

**Exception Handling:** Exception Class, built in checked and unchecked exceptions, user defined exceptions, use of try, catch, throw, throws, finally.

**Multi-threaded programming:** Overview, comparison with multiprocessing, Thread class and runnable interface, life cycle, creation of single and multiple threads, thread priorities, overview of Synchronization.

**Java Library:** String handling (only main functions), String Buffer class.

Elementary concepts of Input/Output: byte and character streams, System-in and System-out, print and println, reading from a file and writing in a file.

##### **UNIT – III**

#### **Software Development using Java:**

**Applets:** Introduction, Life cycle, creation and implementation,

**AWT controls:** Button, Label, TextField, TextArea, Choice lists, list, scrollbars, check boxes, Layout managers,

**Elementary concepts of Event Handling:** Delegation Event Model, Event classes and listeners, Adapter classes, Inner classes.

**Swings:** Introduction and comparison with AWT controls.

##### **UNIT – IV**

**Networking Basics:** Socket (datagram and TCP/IP based client and server socket), factory methods, InetAddress

**JDBC:** JDBC Architecture, JDBC Drivers, Connecting to the Database

**Introduction to Java Servlets:** Life cycle, Interfaces and classes in javax. Servlet package (only description) Creating a simple servlet.

#### **TEXT BOOKS:**

- [1] Patrick Naughton and Herbert Schildt, “Java-2 The Complete Reference”, TMH.
- [2] Y. Daniel Liang, “Introduction to Java Programming, Comprehensive Version, Pearson.

#### **REFERENCE BOOKS:**

- [1] Krishnamoorthy R., Prabhu S., “Internet and Java Programming”, New Age Intl.
- [2] David Flanagan, Jim Farley, William Crawford and Kris Magnusson, “Java Enterprise in a Nutshell”, O’Reilly.

## **MCI402: OPERATING SYSTEM**

### **Course Contents:**

#### **UNIT – I**

**Introduction:** Introduction, Simple Batch Systems, Multi-programmed Batches systems, Time-Sharing Systems, Personal-computer systems, Parallel systems, Distributed Systems, Real-Time Systems

**Processes:** Process Concept, Process Scheduling, Operation on Processes

**CPU Scheduling:** Basic Concepts, Scheduling Criteria, Scheduling Algorithms, Multiple-Processor Scheduling,

#### **UNIT-II**

**Memory Management:** Background, Logical versus Physical Address space, swapping, Contiguous allocation, Paging, Segmentation

**Virtual Memory:** Demand Paging, Page Replacement, Page-replacement Algorithms, Performance of Demand Paging, Allocation of Frames, Thrashing, Other Considerations

#### **UNIT – III**

**Deadlocks:** System Model, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock

**Process Synchronization:** Background, The Critical-Section Problem, Synchronization Hardware, Semaphores, Classical Problems of Synchronization

#### **UNIT – IV**

**Device Management:** Techniques for Device Management, Dedicated Devices, Shared Devices, Virtual Devices; Input or Output Devices, Storage Devices, Buffering, Secondary-Storage Structure: Disk Structure, Disk Scheduling, Disk Management, Swap-Space Management, Disk Reliability

### **TEXT BOOKS:**

- [1] Silberschatz and Galvin, “Operating System Concepts”, John Wiley & Sons.
- [2] Haldar/Aravind, “Operating System”, Pearson Edu.

### **REFERENCE BOOKS:**

- [1] Madnick E., Donovan J., “Operating Systems”, Tata McGraw Hill.
- [2] Tannenbaum, “Operating Systems”, PHI.
- [3] An Introduction to Operating Systems: Concepts & Practice, Bhatt, PHI

## **MCI403: WEB DESIGNING**

### **Course Contents:**

#### **UNIT – I**

**History of the Internet and World Wide Web**, Search Engines, News-group, E-mail and its Protocols, Web Portal, Browsers and their versions, Its functions, URLs, web sites, Domain names, Portals.

**Static Web Development: HTML** - Introduction to HTML, HTML Document structure tags, HTML comments, Text formatting, inserting special characters, anchor tag, adding images and Sound, lists types of lists, tables, frames and floating frames, Developing Forms, Image maps.

#### **UNIT – II**

**Introduction to Java Script:** Data Types, Control Statements, operators, Built in and User Defined Functions, Objects in Java Script, Handling Events.

**Cascading Style Sheet:** Types of Style Sheets – Internal, inline and External style sheets, creating styles, link tag.

#### **UNIT – III**

**DHTML:** Introduction to DHTML, JavaScript & DHTML, Document Object Model, Filters and Transitions, DHTML Events, dynamically change style to HTML Documents.

#### **UNIT – IV**

**Introduction to WYSIWYG** Design tools, Introduction to Dreamweaver, Website Creation and maintenance, Web Hosting and Publishing Concepts, XML: Introduction to XML-Mark up languages, Features of Markup languages, XML Naming rules, Building block of XML Document, Difference between HTML & XML

Components of XML, XML Parser, DTD's Using XML with HTML and CSS

### **TEXT BOOKS:**

- [1] The complete reference HTML, by Thomas A Powell, TMH publication.
- [2] Mastering HTML by Deborah S. Ray and Erich J. Ray. BPB Publication.
- [3] Internet and World Wide Web Deitel HM, Deitel, Goldberg.

### **REFERNECE BOOKS:**

- [1] HTML Black Book, Stephen Holzner, Wiley Dreamtech.
- [2] Rajkamal, “Web Technology”, Tata McGraw-Hill.
- [3] Jeffrey C. Jackson, “Web Technologies: A Computer Science Perspective”, Pearson.
- [4] XML How to Program by DeitelDeitel Nieto.

## **MCI404: COMPUTER NETWORK**

### **Course Contents:**

#### **UNIT - I**

**Basic Concepts:** Components of data communication, distributed processing, Line configuration, topology, transmission mode, and categories of networks. OSI and TCP/IP Models: Layers and their functions, comparison of models. Digital Transmission: Interfaces and Modems: DTE-DCE Interface, modems, cable modems. Transmission Media: Guided and unguided, Attenuation, distortion, noise, throughput, propagation speed and time, wavelength, Shannon Capacity.

#### **UNIT – II**

**Telephony:** Multiplexing, error detection and correction: Many to one, one to many, WDM, TDM, FDM, circuit switching, packet switching and message switching. Data Link control protocols: Line discipline, flow control, error control, synchronous and asynchronous protocols overview.

**ISDN:** Services, historical outline, subscriber's access, ISDN, Layers, and broadband ISDN.

#### **UNIT – III**

**Devices:** Repeaters, bridges, gateways, routers, The Network Layer, Design Issues, Network Layer Addressing and Routing concepts (Forwarding Function, Filtering Function); Routing Methods (Static and dynamic routing, Distributed routing, Hierarchical Routing); Distance Vector Protocol, Link State protocol.

#### **UNIT – IV**

**Transport and upper layers in OSI Model:** Transport layer functions, connection management, Functions of session layers, Presentation layer, and Application layer.

### **TEXT BOOKS:**

- [1] A. S. Tenenbaum, "Computer Networks"; Pearson Education Asia.
- [2] Behrouz A. Forouzan, "Data Communication and Networking", Tata McGraw Hill.

### **Reference Books**

- [1] D. E. Comer, "Internetworking with TCP/IP", Pearson Education Asia.
- [2] William Stallings, "Data and computer communications", Pearson education Asia.



### **MCI405: LAB ON JAVA PROGRAMMING**

The lab would be based on the course 401 – Java Programming. The objective of this lab is to help the students to understand the basic Concepts of Java Programming. They should know the main functions of string handling. Students should have elementary concepts of Java Library. Students should know the application of JDBC Architecture, JDBC Drivers.

### **MCI406: LAB ON WEB DESIGNING**

The lab would be based on the course 403 – Web Designing. The objective of this lab is to help the students to understand the HTML Document structure tags, HTML comments, Text formatting, inserting special characters, anchor tag, adding images and Sound, types of lists, tables, frames and floating frames, Developing Forms, Image maps. The students should be having clear concept of Components of XML, XML Parser, DTD's Using XML with HTML and CSS.

## **MCI407: MACHINE LEARNING**

### **Course Contents:**

#### **UNIT-I**

**Introduction:** Learning theory, Hypothesis and target class, Inductive bias and bias-variance tradeoff, Occam's razor, Limitations of inference machines, Approximation and estimation errors, Curse of dimensionality, dimensionality reduction, feature scaling, feature selection methods.

#### **UNIT-II**

**Regression:** Linear regression with one variable, Linear regression with multiple variables, Gradient Descent, Logistic Regression, Polynomial regression, over-fitting, regularization, performance evaluation metrics, validation methods.

#### **UNIT-III**

**Classification:** Decision trees, Naive Bayes classifier, k-nearest neighbor classifier, Perceptron, multilayer perceptron, Neural network, back-propagation Algorithm, Support Vector Machine, Kernel functions.

#### **UNIT-IV**

**Evaluation:** Performance evaluation metrics, ROC Curves, Validation methods, Bias variance decomposition, Model complexity.

#### **UNIT-V**

**Unsupervised learning:** Clustering, distance metrics, Mixture models, Expectation Maximization, Cluster validation methods.

### **Readings:**

1. Alpaydin, Ethem, Introduction to machine learning, MIT press, 2014.
2. Christopher, M. Bishop, Pattern Recognition And Machine Learning, Springer-Verlag, 2016.
3. Shai Shalev-Shwartz, Shai Ben-David, Understanding Machine Learning: From Theory to Algorithms, Cambridge Press, 2014.
4. Michalski, Ryszard S., Jaime G. Carbonell, and Tom M. Mitchell, eds. Machine learning: An artificial intelligence approach, Springer Science & Business Media, 2013.

## **MCI408: NETWORK PROGRAMMING**

### **Course Contents:**

#### **UNIT-I**

##### **Introduction to Network Programming:**

OSI model, Unix standards, TCP and UDP & TCP connection establishment and Format, Buffer sizes and limitation, standard internet services, Protocol usage by common internet application.

#### **UNIT-II**

##### **Sockets:**

Address structures, value – result arguments, Byte ordering and manipulation function and related functions Elementary TCP sockets – Socket, connect, bind, listen, accept, fork and exec function, concurrent servers. Close function and related function.

#### **UNIT-III**

##### **TCP client server:**

Introduction, TCP Echo server functions, Normal startup, terminate and signal handling server process termination, Crashing and Rebooting of server host shutdown of server host. I/O Multiplexing and socket options: I/O Models, select function, Batch input, shutdown function, poll function, TCP Echo server, getsockopt and setsockopt functions. Socket states, Generic socket option.

#### **UNIT-IV**

##### **Elementary UDP sockets:**

Introduction UDP Echo server function, lost datagram, summary of UDP example, Lack of flow control with UDP, determining outgoing interface with UDP. Elementary name and Address conversions: DNS, get-host by Name function, Resolver option.

### **TEXT BOOKS:**

1. UNIX Network Programming, Vol. I, Sockets API, 2nd Edition. - W.Richard Stevens, Pearson Edn. Asia.
2. UNIX Network Programming, 1st Edition, - W.Richard Stevens. PHI.

### **REFERENCES:**

1. NIX Systems Programming using C++, T CHAN, PHI.
2. UNIX for Programmers and Users, 3rd Edition Graham GLASS, King abls, Pearson Education Advanced UNIX Programming 2nd Edition M. J. ROCHKIND, Pearson Education

## **MCI409: WEB BASED PROGRAMMING**

### **Course Contents:**

#### **Unit – I**

Introduction to web applications, HTML, Client-Side Scripting Vs Server-Side Scripting, Web Servers: Local Servers and Remote Servers, Installing Web servers, Internet Information Server (IIS) and Personal Web Server (PWS). Static website vs Dynamic website development.

#### **Unit – II**

Introduction to PHP, Start and End Tags of PHP, Data types in PHP, Variables, Constants, operators and Expressions, printing data on PHP page, Control statements – if, switch case, for, while, do while.

Arrays: Initialization of an array, iterating through an array, Sorting arrays, Array Functions, Functions: Defining and Calling Functions, Passing by Value and passing By references, Inbuilt Functions.

#### **Unit – III**

Working with Forms: Get and Post Methods, Query-strings, HTML form controls and PHP, Maintaining User State: Cookies, Sessions, Application State.

Working with Files: Opening and Closing Files, Reading and Writing to Files, Getting Information on Files.

#### **Unit – IV**

PHP Database Connectivity: Introduction to MYSQL, Creating database and other operations on database, connecting to a database, Use a particular database, Sending query to database, Parsing of the query results, Checking data errors.

### **TEXT BOOKS:**

1. Programming PHP. Rasmus Lerdorf, Kevin Tatroe. (O'Reilly, ISBN 1565926102).
2. PHP, MySQL, and JavaScript: A Step-By-Step Guide to Creating Dynamic Websites by Robin Nixon O'Reilly Media; 1 edition.

### **REFERNCE BOOKS:**

1. Core PHP Programming. Leon Atkinson (Prentice Hall, ISBN 0130463469).
2. Beginning PHP5 and MySQL: From Novice to Professional, W. Jason Gilmore, 2004, Apress, ISBN: 1-893115-51-8

## SEMESTER – V

### **MCI501: SOFTWARE ENGINEERING**

#### **Course Contents:**

##### **UNIT – I**

**Introduction:** Software Crisis, Software Processes & Characteristics, Software life cycle models, Waterfall, Prototype, Evolutionary and Spiral Models

**Software Requirements analysis & specifications:** Requirement engineering, requirement elicitation techniques like FAST, QFD, Requirements analysis using DFD(with case studies), Data dictionaries & ER Diagrams, Requirements documentation, Nature of SRS, Characteristics & organization of SRS.

##### **UNIT – II**

**Software Project Management Concepts:** The Management spectrum, The People, The Problem, The Process, The Project.

**Software Project Planning:** Size Estimation like lines of Code & Function Count, Cost Estimation Models, COCOMO, Risk Management.

##### **UNIT – III**

**Software Design:** Cohesion & Coupling, Classification of Cohesiveness & Coupling, Layered arrangement of modules, Function Oriented Design, Object Oriented Design.

**Software Metrics:** Software measurements: What & Why, Token Count, Halstead Software Science Measures, Design Metrics, Data Structure Metrics.

##### **UNIT – IV**

**Software Testing:** Code Review, Testing Process, Types of Testing, Functional Testing, Structural Testing, Test Activities, Unit Testing, Integration Testing and System Testing(Performance Testing and Error Seeding), Debugging Activities.

**Software Maintenance:** Management of Maintenance, Maintenance Process, Reverse Engineering, Software Re-engineering, Configuration Management, Documentation.

#### **TEXT BOOKS:**

- [1] K. K. Aggarwal & Yogesh Singh, “Software Engineering”, New Age International.
- [2] Rajib Mall, “Fundamental of Software Engineering”, PHI Learning Private Limited
- [3] I. Sommerville, “Software Engineering”, Pearson Edu.
- [4] PankalJalote, “Software Engineering”, Narosa Publication

#### **REFERENCE BOOKS:**

- [1] Jibitesh Mishra and Ashok Mohanty, “Software Engineering”, Pearson
- [2] R. S. Pressman, “Software Engineering – A practitioner’s approach”, McGraw Hill Int. Ed.
- [3] James Peter, W. Pedrycz, “Software Engineering: An Engineering Approach”, John Wiley & Sons.

## **MCIS02: FRONT END DESIGN TOOL VB. NET**

### **Course Contents:**

#### **UNIT - I**

Introduction: Introduction to .Net, Two tier and Three tier client server model, .Net Architecture, Features of .Net, Advantages of .Net, .Net Framework, CLR, CTS, CLS, Assemblies, Memory management issues – Garbage Collector and collection process, Exception Handling, Code Access Security.

#### **UNIT - II**

Introduction to Visual Basic.Net IDE: Creating a project, Types of project in .Net, Exploring and coding a project, Solution explorer, toolbox, properties window, Output window, Object Browser.

**VB.Net Programming Language:** Similarities and Differences with Visual Basic, Variables, Comments, Data Types, Working with Data Structures – Arrays, Array Lists, Enumerations, Constants, Structures; Introduction to procedures, calling procedures, argument passing mechanisms, scope of variable. **Control Flow Statements** – conditional statement, Loops, Nesting of Loops, MsgBox and Input Box.

#### **UNIT – III**

**GUI Programming:** Introduction to Window Applications, Using Form – Common Controls, Properties, Methods and Events. Interacting with controls - Textbox, Label, Button, Listbox, Combobox, Checkbox, Picture Box, Radio Button, Panel, scroll bar, Timer, ListView, TreeView, toolbar, Status Bar. Dialog Controls, Creating and Using MDI applications, Toolbar, Status Bar, creating custom controls, Creating Menus.

**Object Oriented Features:** Classes and Objects, Access Specifiers: Private, Public and Protected, Building Classes, Reusability, Constructors, Inheritance, Overloading, Overriding, Creating and Using Namespaces.

#### **UNIT – IV**

**Introduction to ADO:** ADO vs ADO.Net, ADO.Net data namespaces, ADO.Net Object Model, accessing data from Server Explorer, Creating Connection, Command, Data Adapter, Data Reader and Data Set with OLEDB and SQLDB, Data Binding.

**Crystal Report:** Connection to Database, Table, Queries, Building Report, Modifying Report, Formatting Fields, Publishing and exporting reports.

### **TEXT BOOKS:**

- [1] Visual Basic 2010 programming Black Book, by Kogent Learning Solutions, Wiley India.
- [2] Visual Basic 2010 Step by Step, Michael Halvorson, PHI.

### **REFERENCE BOOKS:**

- [1] Mastering Microsoft Visual Basic 2010, Evangelos Petroutsos, Wiley Publications.
- [2] Beginning Visual Basic 2010 (Wrox)

## **MCI503: NUMERICAL METHODS**

### **Course Contents:**

#### **UNIT - I**

Representation of floating-point numbers, Computer arithmetic, Normalization, Concept of error.

Transcendental equations. Bisection method, false position method, Newton-Raphson method and Method of successive approximation. Rate of Convergence.

#### **UNIT - II**

Gauss elimination method, Gauss Jordan method, Jacobi method and Gauss Siedel method. Pivotal condensation, Matrix Inversion.

#### **UNIT - III**

Polynomial Interpolation, Lagrange's method, Difference table, Newton's forward, backward and divide difference methods.

Numerical differentiation up to second order, Trapezoidal rule and Simpson's rule.

#### **UNIT - IV**

Method of least square, fitting of straight lines, polynomials and exponential curves.

### **TEXTS BOOKS:**

1. V. Rajaraman : Computer Oriented Numerical Methods
2. R.S. Salaria : Computer Oriented Numerical Methods –  
A Programming Approach

### **REFERENCE BOOKS:**

1. E. Balaguruswamy : Numerical Methods
2. Jain & Narang : Numerical Methods Techniques

## MCI504: PYTHON PROGRAMMING

### Course Contents:

#### UNIT – I

**Python Programming basics:** Introduction to Python, features, Structure of a Python Program, Elements of Python, Interpreter, Python shell, Indentation, Identifiers and keywords, Data types, Literals, Strings-operations on strings, Operators (Arithmetic operator, Relational operator, Logical or Boolean operator, Assignment, Operator, Ternary operator, Bit wise operator, Increment and Decrement operator).

#### UNIT – II

**Creating Python Programs:** Input and Output Statements, Control statements (Branching, Looping, Conditional Statement, Exit function, Difference between break, continue and pass, Iteration and Recursion.), Tables- Two-dimensional tables, Functions Defining Functions, default arguments, Profiling, Modules- Defining and Creating, exploring, importing of modules, Arrays, Lists–operation on lists, set and Dictionaries, pattern matching and searching using regular expression. File handling and I O methods, Errors and Exceptions handling, Threads Understanding threads, forking threads, synchronizing the threads, Programming using multithreading.

#### UNIT – III

**Object-Oriented Programming:** Introduction to Classes, Objects and Methods, Constructor, class attributes and destructors overlapping and overloading, Inheritance. Namespaces and Packages in Python.

#### UNIT – IV

**Databases:** Creating database, Database connection, DDL, DML, DTL commands.

#### UNIT – V

**GUI Programming and Graphics:** HTML Prerequisites-Basic GUI construction-Form Elements-Textbox, Label, Button, Checkbox, list, Option - python integration with web forms. Graphics introduction sample graphics programming-pie chart, bar chart, histograms.

### TEXT BOOKS:

- [1] Practical Programming- An Introduction To Computer Science Using Python Byjeniffer Campbell, Paulgries, Jasonmanioja.
- [2] T. Budd, Exploring Python, TMH.
- [3] Python Tutorial/Documentation [www.python.org](http://www.python.org)
- [4] Allen Downey, Jeffrey Elkner, Chris Meyers. How to think like a computer scientist learning with Python – Freely available online.
- [5] <http://docs.python.org/3/tutorial/index.html>



### **MCI505: LAB ON NUMERICAL METHODS**

The lab would be based on the course 503 – Numerical Methods. The objective of this lab is to help the students to understand the Computer arithmetic, Normalization and Concept of error. The students should be enabled to apply Newton's forward, backward and divide difference methods. The students must be equipped to apply Polynomial Interpolation and Numerical differentiation up to second order.

### **MCI506: LAB ON PYTHON PROGRAMMING**

1. Program to convert the given temperature from Fahrenheit to Celsius and vice versa depending upon user's choice.
2. Program to calculate total marks, percentage and grade of a student. Marks obtained in each of the three subjects are to be input by the user. Assign grades according to the following criteria: Grade A: Percentage  $\geq 80$   
Grade B: Percentage  $\geq 70$  and  $\leq 60$   
Grade C: Percentage  $\geq 60$  and  $\leq 40$  and  
Grade D: Percentage  $\geq 40$  and  $\leq 0$ .
3. Program, using user-defined functions to find the area of rectangle, square, circle and triangle by accepting suitable input parameters from user.
4. Program to generate Pythagorean triplets.
5. Program to display the first n terms of Fibonacci series.
6. Program to check whether a given number is Armstrong number or not.
7. Program to find sum of the following series for n terms:  $1 - 2/2! + 3/3! - \dots - n/n!$
8. Program to calculate the sum of two compatible matrices.
9. Program to calculate the product of two compatible matrices.
10. Program to calculate the mass m in a chemical reaction. The mass m (in gms) disintegrates according to the formula  $m=60/(t+2)$ , where t is the time in hours. Sketch a graph for t vs. m, where  $t \geq 0$ .
11. A population of 1000 bacteria is introduced into a nutrient medium. The population p grows as follows:  $P(t) = (15000(1+t))/(15+ e)$  where the time t is measured in hours. WAP to determine the size of the population at given time t and plot a graph for P vs t for the specified time interval.
12. Input initial velocity and acceleration, and plot the following graphs depicting equations of motion:
  - I. velocity wrt time ( $v=u+at$ )
  - II. distance wrt time ( $s=u*t+0.5*a*t*t$ )
  - III. distance wrt velocity ( $s=(v*v-u*u)/2*a$ )
13. A population of 1000 bacteria is introduced into a nutrient medium. The population p grows as follows:  $P(t) = (15000(1+t))/(15+ e)$  where the time t is measured in hours. WAP to determine the size of the population at given time t and plot a graph for P vs t for the specified time interval.

## **MCI507: COMPUTER GRAPHICS**

### **Course Contents:**

#### **UNIT – I**

**Introduction:** The Advantages of Interactive Graphics, Representative Uses of Computer Graphics, Classification of Applications, Development of Hardware and Software for Computer Graphics, Conceptual Framework for Interactive Graphics.

Overview, Scan Converting Lines, Scan Converting Circles, Scan Converting Ellipses.

**Graphics Hardware:** Hardcopy Technologies, Display Technologies, Raster-Scan Display Systems, The Video Controller, Random-Scan Display Processor, Input Devices for Operator Interaction, Image Scanners, Antialiasing.

**Clipping:** Cohen-Sutherland Algorithm, Cyrus-Beck Algorithm, Midpoint Subdivision algorithm.

#### **UNIT – II**

**Geometrical Transformations:** 2D Transformations, Homogeneous Coordinates and Matrix Representation of 2D Transformations, Composition of 2D Transformations, The Window-to-Viewport Transformation, Efficiency, Matrix Representation of 3D Transformations, Transformations as a Change in Coordinate System.

#### **UNIT – III**

**Representing Curves & Surfaces:** Polygon Meshes, Parametric Cubic Curves

**Solid Modeling:** Representing Solids, Regularized Boolean Set Operations, Primitive Instancing, Sweep Representations, Boundary Representations, Spatial Partitioning Representations, Constructive Solid Geometry, Comparison of Representations, User Interfaces for Solid Modeling.

#### **UNIT – IV**

**Three-Dimensional Viewing:** Introduction, Representation of Three-dimensional objects, Projections, Parallel projections: Orthographic Projections, Oblique Projections. Perspective Projection, three-dimensional clipping, Three-dimensional Cohen-Sutherland clipping algorithm.

**Hidden Surface Removal:** Depth-Buffer (Z-buffer) method, Depth-sorting Method (Painter's algorithm)

### **TEXT BOOKS:**

- [1] D. Hearn & Baker: Computer Graphics with OpenGL, Pearson Education.
- [2] Chennakesava R. Alavla "Computer Graphics", PHI Learning Pvt. Limited

### **REFERENCE BOOKS:**

- [1] Foley, Van Dam, Feiner, Hughes, Computer Graphics Principles & Practice, Pearson
- [2] Foley, J.D. & Van Dam, A: Fundamentals of Interactive Computer Graphics.
- [3] Rogers & Adams, "Mathematical Elements for Computer Graphics", McGraw Hill.

## **MCI508: COMPUTER NETWORK AND INFORMATION SECURITY**

### **Course Contents:**

#### **Unit – I**

**Information security: Attributes of Information Security** - Confidentiality, Integrity, Availability. Threats & Vulnerabilities: Unauthorized Access, Impersonation, Denial of Service, Malicious Software; Trap Doors, Logic Bomb, Trojan Horses; Viruses, Worms & Bacteria; Cryptography Basics: Plain Text, Cipher Text, Encryption Algorithm, Decryption Algorithm; Requirements for Cryptography, Symmetric vs Asymmetric, Block and Stream ciphers, DES.

#### **Unit – II**

##### **Public Key Infrastructure & Message Authentication:**

Public Key Cryptography Principles & Applications, Algorithms: RSA, Message Authentication: One-way Hash Functions: Message Digest, MD5, SHA1. Public Key Infrastructure: Digital Signatures, Digital Certificates, Certificate Authorities.

#### **Unit-III**

##### **Network Security Network Attacks:**

Buffer Overflow, IP Spoofing, TCP Session Hijacking, Sequence Guessing, Network Scanning: ICMP, TCP sweeps, Basic Port Scans; Denial of Service Attacks: SYN Flood, Teardrop attacks, land, Smurf Attacks.

IP security Architecture: Overview, Authentication header, Encapsulating Security Pay Load, combining Security Associations, Key Management. Virtual Private Network Technology: Tunneling using IPSEC.

#### **Unit – IV**

##### **Web Security**

Requirements, Secure Socket Layer, and Secure Electronic Transactions, Network Management Security: Overview of SNMP Architecture- SNMPV1, SNMPV3. Firewall Characteristics & Design Principles, Types of Firewalls: Packet Filtering Router, Application Level Gateway or Proxy, Content Filters, Bastion Host.

### **TEXTBOOKS:**

1. W. Stallings, Networks Security Essentials: Application & Standards, Pearson Education, 2000.
2. TCP/IP Protocol Suite, Behrouz A. Forouzan, “Data Communication and Networking”, Tata Mc Graw Hill.

### **REFERENCE BOOKS:**

1. W. Stallings, Cryptography and Network Security, Principles and Practice, Pearson Education, 2000.

## MCI509: MOBILE COMPUTING

### Course Contents:

#### UNIT – I

**Introduction to wireless communications:** Applications, Short History of Wireless Communications, Market of Mobile Communications, Elementary Knowledge on Wireless Transmission: Frequency of Radio Transmission, Signals, Antennas, Signal Propagation: Path Loss of Radio Signals, Additional Signal Propagation Effects, Multipath Propagation, Multiplexing: Space Division Multiplexing, Frequency Division Multiplexing, Time Division Multiplexing, Code Division Multiplexing, Modulation: Amplitude Shift Keying, Frequency Shift Keying, Phase Shift Keying, Advanced Frequency Shift Keying, Advanced Phase Shift Keying, Multicarrier Modulation, Spread Spectrum: Direct Sequence Spread Spectrum, Frequency Hopping Spread Spectrum, Cellular Systems.

#### UNIT – II

**Elementary Knowledge on Medium Access Control:** Motivation for a specialized MAC, Hidden and exposed terminals, Near and far terminals, Introduction to SDMA, FDMA, TDMA: Fixed TDM, Classical Aloha, Slotted Aloha, Carrier sense multiple access, Demand assigned multiple access, PRMA packet reservation multiple access, Reservation TDMA, Multiple access with collision avoidance, Polling, Inhibit sense multiple access, CDMA, Spread Aloha multiple access, Mobile communications, Comparison of S/T/F/CDMA.

Elementary Knowledge on Telecommunications Systems: GSM: Mobile services, System architecture, Radio interface, Protocols, Localization and calling, Handover, Security, New data services, DECT: System architecture, Protocol architecture. Elementary Knowledge on Satellite systems: History, Applications, Basics: GEO, LEO, MEO, Routing, Localization, Handover.

#### UNIT – III

**Mobile Internet:** Introducing the Mobile Internet, Services for the mobile Internet, Business opportunities. Implementing WAP Services: WML: WML Variables and Contexts: Variable Substitution, Setting Variables, Browser Contexts, WML Tasks and Events, WML User Interaction: Problems with Web Interaction, Interaction in WAP, Elements: <input>, <select>, <option>, <optgroup>, <do>, <anchor>, <a>, The tabindex Attribute, WML Timers, WML Decks, Templates, and Cards: Elements: <wml>, <head>, <access>, <meta>, <card>, <template>, WML Text and Text Formatting, Elements: <p>, <br>, Character Formatting, Tables, WML Images: <img> Element, The WBMP Format.

#### UNIT -IV

**WAP:** The Mobile Internet Standard, Making the Internet Mobile: Challenges and Pitfalls, Overview of the Wireless Application Protocol.

**Implementing WAP Services:** WML Script: Datatypes, Variables, and Conversions, Operators and Expressions: Operand Conversions, Assignment Operators, Arithmetic Operators, Bitwise Operators, Shift Operators, Logical Operators, Increment and Decrement Operators, Comparison Operators, Type Operators, The Conditional Operator, The Comma Operator, Precedence and Associativity, WMLScript Statements: Expressions as Statements, Blocks of Statements, Conditions, Loops, Returning from a Function, Other Statements, WML Script.

**Functions:** Function Declarations, Function Calls, Calls to Other Script Units, Calling WML Script from WML, Standard Libraries, WML Script Pragmas: The access Pragma, The meta Pragma, Elementary Knowledge on Libraries: Lang, Float, String, URL, WML Browser, Dialogs.

#### TEXT BOOKS:

1. Jochen Schiller, “Mobile Communications”, PHI/Pearson Education.
2. Sandeep Singhal, “The Wireless Application Protocol, Writing Applications for Mobile Internet”, Pearson Education.
3. Learning WML, and WML Script, Programming the Wireless Web, Martin Frost, Publisher: O'Reilly.

#### REFERENCE BOOKS:

1. William Stallings, “Wireless Communications and Networks”, PHI/Pearson Education.
2. Theodore S Rappaport, “Wireless Communication Principles and Practice”, Pearson Education.
3. C. Y. Lee and William, “Mobile Cellular Telecommunications”, McGraw Hill.

## **SEMESTER - VI**

### **MCI601: PROJECT REPORT & VIVA-VOCE**

Each student shall undergo practical training of eight weeks during the vacations after fifth semester in an approved business / industrial / service organization and submit at least two copies of the Project Report along with CD to the concerned Department or Faculty of the Institution before the commencement of the End-term Examination. The Project Report & Viva-Voce carries 200 marks. The Project Report shall be evaluated for 100 marks by internal faculty/faculties appointed by the Director / Examination Controller of the Institution and the Viva-Voce will be taken for 100 marks by External Examiner(s) to be appointed by the Director / Examination Controller of the Institution.

### **MCI602: SEMINAR PRESENTATION**

## Semester –VII

### **MCI 701: Computational Mathematics**

**Objective: To develop logical thinking and introduce basic concepts.**

#### **Unit – I**

**Graph Theory:** Basic terminology, multigraphs and weighted graphs, paths and circuits, searching techniques: BFS, DFS and their applications, shortest paths in weighted graphs, Eulerian paths and circuits, Hamiltonian paths and circuits, Traveling Salesperson problem, planar graphs, trees and rooted trees, prefix codes, minimal spanning trees, cut sets, directed graphs.

#### **Unit – II**

**Finite Automata and Regular Languages:** Deterministic and non-deterministic finite automata, regular expressions, regular languages and their relationship with finite automata, pumping lemma and closure properties of regular languages.

#### **Unit – III**

**Context Free Grammars and Pushdown Automata:** Context free grammars (CFG), parse trees, ambiguities in grammars and languages, pushdown automaton (PDA) and the language accepted by PDA, deterministic PDA, Non- deterministic PDA, properties of context free languages; normal forms, pumping lemma, closure properties, decision properties.

#### **Unit – IV**

**Turing Machines:** Turing machine as a model of computation, programming with a Turing machine, variants of Turing machine and their equivalence.

#### **Unit – V**

**Undecidability:** Recursively enumerable and recursive languages, undecidable problems about Turing machines: halting problem, Post Correspondence Problem, and undecidability problems about CFGs.

#### Reference Books

1. Narsingh Deo, “**Graph Theory and application to Engineering and Computer sciences**“, 1986 PHI.
2. J.A Anderson , “ **Automata Theory Of Modern Application**” Cambridge University Press, 2006
3. H.R Lewis, C.H Papadimitriou, C. Papadimitriou, “**Elements Of The Theory Of Computation (2<sup>nd</sup> edition)**” Prentice Hall NJ 1997.
4. Thomas Koshy, **Discrete Mathematics with Applications**, Academic Press, Reprint 2005.
5. Kenneth H Rosen, **Discrete Mathematics & its Applications with Combinatorics and Graph Theory**, 6<sup>th</sup> Edition, McGraw Hill, 2007.

## MCI702: Computer Organization and Architecture

**Objective:** To introduce the nature and characteristics of modern-day Computers

### Unit – I

**Digital Logic Circuit:** Number Systems – Binary, Octal, Hexadecimal, Boolean Algebra, Map Simplification, Logic gates, Combinational Circuits, Adder, Subtractor, Multiplexer, Decoders, Sequential Circuits, Flip Flops, Registers, Counters.

### Unit – II

**Memory:** Internal Memory – RAM and ROM CHIPS, External Memory – Magnetic Tape, Magnetic Disk, RAID, Optical Memory, Memory Organization- Associative Memory, Virtual memory, Cache Memory

### Unit – III

**Central Processing Unit:** Arithmetic and Logic Unit- Instruction sets, Characteristics and function, Machine Instruction Characteristics, Type of operands, Type of operations, Addressing Modes and Format, Processor Organization, Instruction Cycle, Instruction Pipelining

### Unit – IV

**Peripherals:** External devices, I/O Modules, Programmed I/O, Interrupt driven I/O, Direct Memory Access, I/O Channels and Processors, The external Interface, Asynchronous Data transfer

### Unit – V

**Advanced Architecture:** Reduced Instruction Sets Computers, RISC Pipelining, The RISC Versus CISC, Super Scalar Processors- Design issues, Parallel Processing, Multi-Processing Vector Computation, Parallel Processors,

### Reference Books

1. M. Morris Mano, **Computer System Architecture** (3<sup>rd</sup> ed.), Prentice –Hall of India, 2007.
2. W. Stallings, **Computer Organization and Architecture: Designing for Performance** (7<sup>th</sup> ed.), Pearson Education, 2006
3. A.S. Tanenbaum, **Structured Computer Organization** (4<sup>th</sup> ed.), Prentice–Hall of India, 1999.
4. J.P. Hayes, **Computer Architecture and Organization** (2<sup>nd</sup> ed.), McGraw-Hill Book Company, 1988.

## MCI 703: Object Oriented Programming, Analysis and Design

**Objective:** To Study the Programming analysis and design aspects of Object-Oriented Methodology.

### Unit – I

**Concepts, Operator Overloading, Friends:** Concepts in object-oriented programming, Classes and Objects, C++programming basics, Object-oriented analysis, Object-oriented Design methods, Operator Overloading, Friend functions and operators.

### Unit – II

**Arrays, Pointers and Inheritance:** Arrays, Pointers and inheritance: Derived classes, the protected access specifier, Derived class constructors, Overriding Member functions, Class Hierarchies, Public and Private inheritance, Multiple Inheritance and other types of inheritance.

### Unit – III

**Polymorphism, Virtual Functions Files:** Polymorphism: Virtual Functions, Abstract base classes and Pure Virtual Functions, File and Streams, Templates, Generic Programming

### Unit – IV

**Concepts:** Object Oriented Analysis, Object Oriented Design Method, Object Model, Classes and Object, Nature Relationship among Objects, Nature of a class, Nature of Class, Relationship among classes, Identifying Classes and Object, Key abstraction and mechanism, Module and Process diagram UML

### Unit – V

**Methods:** Notational elements- Class, State Transition Object, Interaction, OMT analysis (James & Rumbaugh), Comparison of various Object Oriented Analysis of Design Methodologies, Case Studies.

### Reference Books

1. Neill Graham, “**Learning C++**” 1991 Mc Graw Hill Inc. Intl. Edition.
2. Robert Lafore, “**Object Oriented Programming in Turbo C++**”,1992 Galgotia Publications.
3. Grady Booch, ”**Object Oriented Analysis and Design With Application**”,1994 Benjamin Cummings Publishing Company Inc.
4. Strastroup, “**C++ Programming Language** “.
5. Roger S. Pressman “**Software Engineering a Practiton Approach**”, McGraw-Hill Book Company.



## MCI 704: Modern Operating Systems

**Objective:** To understand the concept of OS and its various function, to impart knowledge of various strategies and techniques used to realize these functions and to enable the students understand and appreciate the design principles involved in some of current OS.

### Unit – I

**Operating System Overview:** What is an Operating System (OS), Goals of an Operating System, Generations of Operating Systems, Types of Operating Systems, Functions of OS.

### Unit – II

**Processes:** Concept of Process, System Calls for Process Management, Process Scheduling, Scheduling Algorithms, scheduling, Performance evaluation of the Scheduling Algorithms, Interprocess Communication, Interprocess Synchronization, Semaphores, Classical problems in concurrent programming, Deadlock detection and recovery, deadlock avoidance, Deadlock prevention and other issues.

### Unit – III

**Memory Management:** Overlays and Swapping, Logical and Physical Address Space, Single Process Monitor, Contiguous Memory Methods, Paging, Principles of operation, Page allocation, Hardware Support for Paging, Protection and Sharing, Segmentation, Principles of operation, Address Translation Protection and Sharing. Virtual Memory, Principles of operation, Virtual Memory management, Protection and sharing, Demand paging, Page Replacement policies, Thrashing, Working Set Model, Page Fault Rate, Demand Segmentation, Combined Systems, Segmented paging, Paged segmentation

### Unit – IV

**I/O and File Management:** Organization of the I/O function, I/O Buffering, Disk Organization, Disk Scheduling, RAID, Disk Cache, Command language user's view of File System, The System programmer's view of the file, System, The Operating systems' view of file Management, Directories, Disk Space Management, Disk address translation, File related system services, Asynchronous Input / Output.

### Unit – V

**Distributed Operating Systems:** History of Distributed Computing, Distributed Systems, Key features and Advantages of a Distributed System, Design Goals of Distributed Systems, Design Issues Involved in Distributed Systems, Distributed System Structure, Mutual Exclusion in Distributed Systems, Remote Procedure Calls Other Middleware Technologies.

### Reference Books

1. William Stallings: **Operating Systems: Internals and Design Principles**, Prentice Hall, 2013, 6th Edition.
2. Gary Nutt: **Operating Systems**, Pearson, 2014, 3rd Edition.
3. Silberschatz, Galvin, Gagne: **Operating System Concepts**, Wiley, 2008, 8th Edition.
4. Andrew S. Tanenbaum, Albert S. Woodhull: **Operating Systems, Design and Implementation**, Prentice Hall, 2006, 3rd Edition.
5. Pradeep K Sinha: **Distributed Operating Systems, Concept and Design**, PHI, 2007.

## MCI 705: Advanced Database Management Systems

**Objective:** To introduce the concepts of database systems and to study in detail about relational databases.

### Unit – I

**Review on Fundamentals of Databases:** Concepts, Architecture, ER Modelling, Relational Databases, Fundamental and extended operations in Relational Database Model, SQL, basic and Complex queries in SQL. **Database Normalization and Security:** Normalization of Database Tables, Transaction and concurrency control, Database security, Authorization and Encryption.

### Unit – II

**Object Relational Database Systems:** Objects, Object Identity, and Reference Types, Inheritance, Features of Object-relational Systems, Database Design for an ORDBMS, New Challenges in Implementing an ORDBMS, OODBMS, Comparing RDBMS with OODBMS and ORDBMS.

**Emerging Database Technologies:** Active Database Concepts and Triggers, Temporal Database, Multimedia Databases, Spatial Databases, Geographic Information Systems (GIS) and Deductive Databases.

### Unit – III

**Distributed Databases:** Introduction to Distributed DBMS, Client-Server Model, Data Fragmentation, Replication, and Allocation Techniques for Distributed Database Design. Types of distributed database systems: - Federated database systems, Multi-database systems; Query processing in distributed databases. **XML and Internet Databases:** Structured, unstructured and semi structured data, XML Hierarchical data model, XML document, DTD and XML Schema XML documents and databases, and XML query.

### Unit – IV

**Data Warehousing:** Characteristics of data warehouses, Data warehousing Components – Building a Data warehouse, Typical functionality of a data warehouse: Mapping the Data Warehouse to a Multiprocessor Architecture – DBMS Schemas for Decision Support – Data Extraction, Cleanup, and Transformation Tools – Metadata.

### Reference Books

1. Raghu Ramakrishnan and Jhannes Gehrke: Database Management Systems, McGrawHill 2000, Second Edition.
2. Elmasri and Navathe: Fundamentals of Database Systems, Addison-Wesley, 1999, Sixth Edition.

## MCI706: Computer Networks

**Objective:** To impart Knowledge of various topology and layers associated with computer network.

### Unit – I

**Introduction to computer Networking concepts:** Local, Metropolitan and Wide Area Networks; Telecommunications and Cellular Networks Overview, Physical Layer - Basics of communications, Transmission Media, Protocols and standards, Standards Organizations, Line Configuration, Topology, Transmission mode, Networks Signals, Wired and Wireless media including copper cables, optical fiber and Wireless, Multiplexing and switching methods.

### Unit – II

**Data Link Layer and Logical Link Control (LLC) sub-Layer:** Framing, Error control including Bit-parity, CRC and Hamming Codes, Reliable transmission and Automatic Repeat Request (ARQ) protocols including Stop-and-Wait, Go-back-N, Selective Repeat. Performance analysis of ARQ protocols. Example protocols such as HDLC and PPP.

### Unit – III

**Medium Access Control (MAC) sub-layer:** Shared media systems, Bus, Star and Ring topologies, TDMA, FDMA, CSMA, CSMA/CD, Ethernet, related protocols such as ICMP, NAT, ARP and RARP.

### Unit – IV

**Network Layer:** Internet Protocol (IP) suite, Hierarchical network architectures, IPv4 and IPv6 addressing and headers, Routing protocols including distance-vector and link-state approaches, Interior and Exterior Gateway Protocol concepts, Routing Algorithms including Dijkstra's algorithm and distributed Bellman – Ford algorithm; Example protocols : OSPF, RIP, BGP.

### Unit – V

**Transport Layer:** Reliable end –to–end transmission protocols, UDP header; Details of TCP header and operation including options headers and congestion control, TCP variants such as Reno, Tahoe, Vegas, Compound and CUBIC.

### Unit – VI

**Application Layer:** Socket Interface, Socket programming; Example Protocols such as DNS, SMTP, FTP and HTTP.

### Reference Books

1. William Stallings– **Data & Computer Communications**, PHI, 6<sup>th</sup>ed.
2. Behrouz A Forouzan-**Data Communication & Networking**, McGrawHill, 2000, 2<sup>nd</sup> edition
3. Forouzan, B.A., “**TCP/IP Protocol**”, TMH
4. Laura Chappell (ed), “**Introduction to Cisco Router Configuration**”, Techmedia, 1999.
5. Tananbaum A.S., “**Computer Networks**”, PHI .
6. Black U., “**Computer Networks-Protocols, Standards and Interfaces**”, PHI, 1996.

## **MCI707: PROGRAMMING LAB – 1**

Object Oriented Programming in C++

## **MCI 708: PROGRAMMING LAB – 2**

DBMS

## Semester – VII

### **MCI801: Fundamentals of Management and Organization Behavior**

#### **Unit – I**

**Concepts of Management:** Definition, Nature and Scope; An overall View of Man. Relation with other social sciences and industry Evolution of Management Thought Classical theory of Management, Bureaucracy- Introduction by Max Weber, Scientific Management -PW Taylor and his followers, Process Management- introduced by H. Fayol and others.

#### **Unit – II**

**Neo-Classical Theory of Management:** Human Relations - E. Mayo and Roethlisberger. Behavioral Science approach - by McGregor, Maslow and others, Modern Management theories: Peter Drucker.

Management Functions: Planning, Staffing, Directing and Controlling. Executive Functions: Production, Marketing. finance, Personnel. Planning: Concept, Nature, Importance, Procedure, Strategies and Method of Decision Making.

Organizations: Definitions, Theories of Organization, Forms of Organization. Forms of Organization. Formal and Informal Organization, Types of Formal Organization, Line and Staff Relationship, Span of Management, Authority, Responsibility, Delegation, Centralization, Decentralization. Committees.

#### **Unit – III**

**Organization Behavior:** Introduction to Organization Behavior: Historical roots of Organizational Behavior, Fundamental concepts, Nature, Emerging trends in the organizational behavior, Limitation of Organization Behavior, Challenges & Opportunities for Organization Behavior Motivation- Importance of motivation at work, approaches to motivation, content theories, process theories, motivation and its effects, McGeorge theory X and Y, Maslow's need hierarchy, Herzberg's two factor theory, Vroom expectancy theory, OB modification.

#### **Unit – IV**

**Power and Politics:** Definition and nature of Power, Types of Power, Contingencies of Power, Organizational Politics, where does it occur, Types of political activity, Political strategies for power acquisition in modern organization, Coping with organizational politics. Empowerment. Organizational politics and its effects, Organizational politics and ethics. Conflicts and Negotiation.

Leadership: Concept and style, Fiedler's contingency mode, path-goal theory, leadership effectiveness.

#### **Reference Books**

1. Narender. K. Chadha, **Perspectives in Organizational Behavior**, Galgotia Publications Pvt. Ltd., New Delhi, 2007
2. F. Luthans, **Organizational Behavior** (9<sup>th</sup> ed.), McGraw-Hill companies Inc., 2002
3. J. Greenberg, R.A. Baron, **Behavior in Organizations** (8<sup>th</sup> ed.), Pearson Education Inc, 2005
4. Masse, •Essentials of Management u, 4th edition, Prentice Hall of India, 1996.
5. Agarwal, R.D., Organization and Management Tata McGraw Hill, 1986.

## **MCI 802: Data Analytics**

**Objective:** To discuss various real-world scenarios where analytics has been used to solve problem and also explains as to how it helps in different domains.

### **Unit – I**

**Introduction:** data science, need for analytics, steps in data analysis projects, Data-sources of data, data sets, data warehouses, data types, privacy, and confidentiality, samples vs. population, Data summarization and visualization: tables and graphs.

### **Unit – II**

**Data Preprocessing:** cleaning, transformation, dimensionality reduction, Data Analysis and Visualization: descriptive, inferential statistics, uni-variate and multi-variate analysis

### **Unit – III**

**Grouping:** Cluster Analysis: distance measures, partitioning, hierarchical, density-based methods,

### **Unit – IV**

Market Basket Analysis, Association Analysis, Market Basket Analysis, Classifiers: Bayesian, k-nearest neighbor, neural network, Support Vector Machine, Decision Trees,

### **Unit – V**

**Prediction:** Regression models, Evaluating Classification and Predictive performance, ensemble methods, Anomaly Detection, Forecasting models

### **Unit – VI**

**Applications in Data Analytics:** Case studies, Web Mining, Text Mining, Business Intelligence, Supply Chain Analytics, Time series, Spatial Data Analysis.

### **Reference Books**

1. Glenn J. Myatt, Wayne P. Johnson, *Making Sense of Data I: A Practical Guide to Exploratory Data Analysis and Data Mining*, 2nd Edition, John Wiley & Sons Publication, 2014.
2. Glenn J. Myatt, Wayne P. Johnson, *Making Sense of Data II: A Practical Guide to Data Visualization, Advanced Data Mining, and Applications*, John Wiley & Sons Publication, 2009.
3. Galit Shmueli, Nitin R. Patel, and Peter C. Bruce, *Data Mining for Business Intelligence*, John Wiley and Sons, 2014.
4. Ian H. Witten, Eibe Frank, Mark A. Hall, *Data Mining: Practical Machine Learning Tools and Techniques*, Morgan Kaufmann, 2011.

## MCI 803: Java Programming

**Objectives:** To learn and write programs in Java using object-oriented paradigm. Approach in this Course is to take Java as a language that is used as a primary tool in many different areas of programming work

### Unit – I

**Introduction:** Java and Java Applications, Features, Bytecode and Interpretation, JDK, JVM; Object-Oriented Programming, Simple Programs; Data Types, Variables, Arrays and Type Conversions; Operators and Expressions; Control Statements: Selection Statements, Iteration Statements and Jump Statements. **Classes and Objects:** Classes in Java, Declaring a Class, Creating Instances of Class, Members of a Class, Method Overloading; Different Types of Constructors, Inner Class; Uses of this Keyword; Garbage Collection; Recursion; Access Control; Static Members.

### Unit – II

**Inheritance:** Introduction; Method Overriding and Dynamic Method Dispatch; Uses of super and final Keywords; Command Line Arguments; Varargs; Enumerations;

**Exception Handling:** Exception Handling in Java.

**Packages and Interfaces:** Packages, Importing Packages; Interfaces.

**I/O:** Basics, Console I/O, Reading and Writing Files;

**Generics:** Overview, Examples, Multiple Generic Parameters, Bounds, Wildcards, Generic Methods, Interfaces and Classes.

**Collections:** Overview, Interfaces, Classes – Array List, Linked List, Hash Set and Map. Applets: What are Applets? The Applet Class; The Applet and HTML; Life Cycle of an Applet; The Graphics Class; Painting the Applet; User Interfaces for Applet; Adding Components to user interface; AWT Controls.

### Unit – III

**Multi-threaded Programming:** Introduction; Creating Threads: Extending Threads; Implementing Runnable; Synchronization, Priorities, Inter-Thread Communication, Thread States and Methods on Thread Objects.

**Event Handling:** Two Event Handling Mechanisms; The Delegation Event Model; Event Classes; Sources of Events; Event Listener Interfaces; Using the Delegation Event Model; Adapter Classes; Inner Classes.

**Java Database Connectivity (JDBC):** The Concept of JDBC; JDBC Driver Types; JDBC Packages; A Brief Overview of the JDBC Process; Database Connection; Statement Objects; Result Set; Transaction Processing; Metadata, Data Types; Exceptions.

### Unit – IV

**Networking:** Basics, Useful Classes and Interfaces, Inet Address, Sockets, URI, URL, URL Connection, Http URL Connection, Datagrams.

**Java Beans:** Introduction, Advantages, Introspection, Bound and Constrained Properties, Persistence, Customizers, Java Beans API.

### Unit – V

**Servlets:** Background, Life Cycle, Development Options, Tomcat, Example, Servlet API, Reading Parameters, javax. servlet. http Package, Handling HTTP Requests and Responses, Using Cookies, Session Tracking.

**Java Server Pages (JSP):** JSP; JSP Tags; Tomcat; Request String; User Sessions; Cookies; Session Objects.

### Reference Books

1. Jim Keogh, **J2EE - The Complete Reference**, Tata McGraw Hill, 2008.
2. Herbert Schildt, **Java - The Complete Reference**, McGraw Hill Education, 2014, 9<sup>th</sup> Edition.
3. Gavin King et.al., **Java Persistence with Hibernate**, Manning Publications, 2016, 2<sup>nd</sup> Edition.
4. Cameron McKenzie, **Hibernate Made Easy**, Pulpjava, 2008
5. Phil Hanna, **JSP 2.0: The Complete Reference**, Osborne

## MCI804: Data Structures and Algorithms

**Objectives:** To impart knowledge in fundamentals of programming elements with a view to developing professional software development skills.

### Unit – I

**Introduction to Data Structures:** Elementary Data Structures - Stacks, Queues, and Linked Lists with Applications Implementing Pointers and Objects, Representing Rooted Trees - Hash Tables - Direct Address Tables, Hash Tables, Hash Functions, Open Addressing - Binary Search Trees - Querying a Binary Search Tree, Insertion and Deletion.

### Unit – II

**Advanced Data Structures:** Red-Black Trees - Properties, Rotations, Insertion and Deletion - B-Trees - Definition, Basic Operations, Deleting a key from B-Tree - Graphs - Representations, Breadth-First and Depth-First Searches - Data Structures for Disjoint Sets - Operations and Representations.

### Unit – III

**Introduction to Algorithms:** Algorithms - Definition, Complexity Concepts, Asymptotic Notations, Recurrences and Solutions - Design Strategies - Recursion, Divide-and-Conquer, Greedy and Dynamic Programming -Complexity Analysis of Sorting Algorithms - Insertion, Selection, Bubble, Quick and Heap Sorting Techniques. - Searching Algorithms - Linear and Binary Search Selection in Linear Time.

### Unit – IV

**Graph Algorithms:** Greedy Strategy - Elements of the Strategy, Explanation with Huffman Coding as Example - Minimum Spanning Trees – Kruskal's and Prim's Algorithms - Single-Source Shortest Paths - All-Pairs Shortest Paths - Topological Sort.

### Unit – V

**Selected Topics and Tractability:** Polynomials and FFT, Probabilistic Algorithms Introduction, Probabilistic Methods for Selection, Sorting and Searching - Algorithms for Random Number Generation - Basic Concepts of NP-Hard and NP-Complete Problems - Cook's Theorem (Without Proof) - Reduction - Clique Decision Problem.

### Reference Books

1. Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", Second Edition, 2001 , PHI.
2. Ellis Horowitz, Sartaj Shani, and S.Rajasekaran, "Fundamentals Of Computer Algorithms" 2000, Galgotia.
3. G. Brassard and P.Bratley, "Fundamentals of Algorithmics", 1995, PHI.
4. E.Horowitz, S.Sahni, and S. Anderson, "Fundamentals of Data Structures in C." 1992, W.H.Freeman and Co.
5. M.A. Weiss and i. Thompson, "Data Structures and Algorithm Analysis", Second Edition, 1991, Pearson Publishers.



## **MCI805: Artificial Intelligence and Knowledge Management**

**Objectives:** To study the concepts of artificial Intelligence and methods of solving problems using Artificial Intelligence and introduce the concepts of Knowledge Management.

### **Unit – I**

**Introduction and Problem Solving:** Various definitions of AI, Introduction to AI applications and AI techniques, Production systems, control strategies, reasoning - forward & backward chaining

Intelligent Agents - Definitions of a rational agent, reflex, model-based, goal-based, and utility-based agents, the environment in which a particular agent operates

### **Unit – II**

**Search and Game Playing:** Breadth first search, depth first search, iterative deepening, uniform cost search, hill climbing, simulated annealing, genetic algorithm search, heuristic search, Best first search, A\* algorithm, AO\* algorithm, Minmax & game trees, refining minmax, Alpha – Beta pruning, constraint satisfaction

### **Unit – III**

**Knowledge Representation:** First order predicate calculus, resolution, unification, natural deduction system, refutation, logic programming, PROLOG, semantic networks, frame system, value inheritance, conceptual dependency, Ontologies

### **Unit – IV**

**Planning:** basic representation for planning, symbolic-centralized vs. reactive-distributed, partial order planning algorithm

Uncertainty: different types of uncertainty - degree of belief and degree of truth, various probability constructs - prior probability, conditional probability, probability axioms, probability distributions, and joint probability distributions, Bayes' rule, other approaches to modeling uncertainty such as Dempster-Shafer theory and fuzzy sets/logic

### **Unit – V**

**Natural language processing:** component steps of communication, contrast between formal and natural languages in the context of grammar, parsing, and semantics

### **Reference Books**

1. Elaine Rich, “Artificial Intelligence”, 1985, McGraw Hill.
2. Nilsson N.J., “Principles of Artificial Intelligence”, 1992, Narosa.
3. Hayes & Roth, “building Expert Systems”, 1982, Narosa

### **MCI806: Program Elective – 1**

One elective course from the list will be offered if minimum 1/3<sup>rd</sup> of MCA-II Semester students will opt for the same or it will be decided by the concerned department or authority.

### **MCI807: Programming Lab – 1**

Java Programming

### **MCI808 Programming Lab – 2**

Data Structures and Algorithms

## Semester – IX

### **MCI 901: Software Engineering Principles**

**Objective:** To know the software engineering methodologies for the development of quality, cost effective and schedule meeting software.

#### **Unit – I**

**Software Engineering and its models:** Evolution of Software Engineering, Software development models, Capability maturity models, Software process technology

#### **Unit – II**

**Principles of Software Requirements Analysis, Design and Testing:** Engineering the product, Modeling the system architecture, Software prototyping and specification, Different types of project metrics, Software project estimation, Models for estimation, Automated tools for estimation, Data design, Architectural design, Interface design, HCI design, Modular design, Testing techniques, Testing for specialized environments, Debugging

#### **Unit – III**

**Software Project Planning:** Different types of project metrics, Software project estimation, Models for estimation, Automated tools for estimation

#### **Unit – IV**

**Risk management and Project Scheduling:** Identification of Software risks, monitoring of risks, Management of risks, formulating a task set for the project, Choosing the tasks of software engineering, Scheduling methods, The Software project plan Software Quality Assurance, Formal technical reviews, Software reliability, Software quality standards

#### **Unit – V**

**Software change management and Advance Software Engineering:** Baselines, Version control, change control, Auditing and reporting, Web Software Engineering, Mobile Software Engineering, CASE Tools, Clean room Software engineering, Component based Software engineering, Re-engineering, Reverse engineering

#### **Reference Books**

1. **Ian Sommerville**, Software Engineering, Pearson Education, 2012, 9th Edition.
2. **Roger.S.Pressman**, Software Engineering - A Practitioners approach, Tata McGraw Hill, 7<sup>th</sup> Edition.
3. **PankajJalote**: An Integrated Approach to Software Engineering, Wiley India

## MCI 902: Machine Learning

**Objective:** To Study the **machine learning** Concepts to discover patterns in our data and then make predictions based on often complex patterns to answer business questions, detect and analyze trends and help solve problems.

### Unit – I

**Python for Machine Learning :** Introduction to python, the concept of data types; variables, assignments; immutable variables; numerical types; arithmetic operators and expressions; understanding error messages; Conditions, Boolean logic, logical operators; ranges; Control statements: if-else, loops (for, while); short circuit evaluation; Strings and text files; manipulating files and directories, os and sys modules; text files: reading/writing text and Numbers from/to a file; creating and reading a formatted file (csv or tab-separated).

**String manipulations:** subscript operator, indexing, slicing a string; strings and number System: converting strings to numbers and vice versa. Binary, octal, hexadecimal numbers Lists, tuples, and dictionaries; basic list operators, replacing, inserting, removing an element; searching and sorting lists; dictionary literals, adding and removing keys, accessing and Replacing values, Oops, Python Numpy and Pandas, Data Preprocessing, Data Manipulation, Data Visualization

### Unit – II

**Overview and Introduction to Bayes Decision Theory:** Machine intelligence and applications, pattern recognition concepts classification, regression, feature selection, supervised learning class conditional probability distributions, Examples of classifiers bayes optimal classifier and error, learning classification approaches.

**Linear machines:** General and linear discriminants, decision regions, single layer neural network, linear separability, general gradient descent, perceptron learning algorithm, mean square criterion and widrow-Hoff learning algorithm; multi-Layer perceptions: two-layers universal approximators, backpropagation learning, on-line, off-line error surface, important parameters.

### Unit – III

**Learning decision trees:** Inference model, general domains, symbolic decision trees, consistency, learning trees from training examples entropy, mutual information, ID3 algorithm criterion, C4.5 algorithm continuous test nodes, confidence, pruning, learning with incomplete data.

**Instance-based Learning:** Nearest neighbor classification, k-nearest neighbor, nearest neighbor error probability,

### Unit – IV

**Machine learning concepts and limitations:** Learning theory, formal model of the learnable, sample complexity, learning in zero-bayes and realizable case, VC-dimension, fundamental algorithm independent concepts, hypothesis class, target class, inductive bias, occam's razor, empirical risk, limitations of inference machines, approximation and estimation errors, Tradeoff.

### Unit – V

**Machine learning assessment and Improvement:** Statistical model selection, structural risk minimization, bootstrapping, bagging, boosting.

### Reference Books

1. E. Alpaydin, **Introduction to Machine Learning**, Prentice Hall of India, 2006.
2. T. M. Mitchell, **Machine Learning**, McGraw-Hill, 1997.
3. C. M. Bishop, **Pattern Recognition and Machine Learning**, Springer, 2006.
4. R. O. Duda, P. E. Hart, and D.G. Stork, **Pattern Classification**, John Wiley and Sons, 2001.
5. Vladimir N. Vapnik, **Statistical Learning Theory**, John Wiley and Sons, 1998.
6. Shawe-Taylor J. and Cristianini N., Cambridge, **Introduction to Support Vector Machines**, University Press, 2000.

## **MCI903: Visual Programming**

**Objective:** It aims to teach basic of visual programming concepts and to design object oriented visual programs with Visual Studio programming development environment and coding.

### **Unit – I**

GUI concept - Data types - GUI Architecture - Message Processing - Keyboard and Mouse Handling Displaying Text and Graphics - File and Printer Handling - DDE – DDL ODBC COM/DCOM / CORBA

### **Unit – II**

NET Namespaces, Assemblies, .NET Memory Management, Process Management, Interoperation with COM. Transactions in NET, Structures Exception Handling, Code Access Security, Web Controls using the .NET framework, The NET Framework Class Library.

### **Unit – III**

VB.NET - Variables and Operators, functions, Decision and Loop statements, Inheritance, Value Types, Operator Overloading, Exception Handling, Arrays and Collections, Properties, Delegates and Events, Windows Forms, Dialog Boxes and Controls, Graphical Output, Files, DATA ACCESS.

### **Unit – IV**

C#.NET - Variables, Operators and Expressions, Writing Methods and Applying Scope, Decision statements, Iteration statements, Managing errors and Exceptions values and references, Value types with enumerations and Structures, Arrays and Collections parameter arrays, Inheritance, Garbage collection and Resource management.

### **Unit – V**

Introducing ASP.NET - Understanding validation controls - Accessing Data with web forms- Building ASP.NET applications Building and XML web service handling XML.

### **Reference Books**

1. Jeff Prosise, Programming Microsoft .NET, Microsoft Press
2. David S Plat, Introducing Microsoft .NET, 3 Edition, Microsoft Press
3. Jesse Liberty, Programming Visual Basic .NET 2" Edition, O'Reilly & Associates
4. Jesse Liberty, Programming C#, 3rd Edition, O'Reilly & Associates
5. Jesse Liberty. Dan Hurwitz, Programming ASP.NET, O'Reilly & Associates

## **MCI904: Web Technologies**

**Objective:** - To study the World Wide Web as a platform for interactive applications, content publishing and social services. The development of web-based applications requires knowledge about the underlying technology and the formats and standards the web is based upon.

### **Unit – I**

**Introduction:** Web Publishing, Web Browsers, Web Servers, URL; Essential Web Developer Tools; Web hosting. **HTML5 and CSS3:** Introduction, Basics – Structure, Essential Tags, Lists, Links; Formatting Text with HTML and CSS, Including Style Sheets in a Page, Varieties of Selectors, Units of Measure, Box Model, Using Images on Web Pages, Image Formats, Using Images – Basics, Text Alignments, Links, Scale, Backgrounds, Bullets; Image-map, Image Etiquettes. Tables, Creating Table, Parts of Table; Formatting Tables – Size, Borders, Cells; Alignment and Spacing; Spanning; Advanced Enhancements.

### **Unit – II**

**Using CSS to Position Elements:** Positioning Schemes, Absolute Positioning, Fixed Positioning, Controlling Stacking, Creating Drop-Down Menus. **Designing HTML5 Forms:** Basics; Creating Controls, Buttons and Fields; Grouping Controls; Displaying Updates; Applying Styles. **Structuring a Page with HTML5:** History, Laying Out a Page, Structural Tags, Page Outline, Structural Elements. **Advanced CSS Page Layouts:** Laying Out Page, The Role of CSS in Web Design.

### **Unit – III**

**JavaScript and jQuery:** JavaScript – Significance, Basics, Environment, Events, Validating Forms, Hiding and Showing Content, Adding New Content to a Page. **Using jQuery:** Introduction, JavaScript Libraries, Selecting Elements from the Document, Binding Events, Modifying Styles on the Page, Modifying Content on the Page, Special Effects, AJAX and jQuery.

### **Unit – IV**

**PHP:** Introduction, Basics, Loops, Built-In Functions, User-Defined Functions, Processing Forms, Using PHP Includes, Database Connectivity, Regular Expressions, Sending Mail, Object-Oriented PHP, Cookies and Sessions, File Uploads.

### **Reference Books**

1. Laura Lemay et.al., **Sams Teach Yourself HTML, CSS & JavaScript Web Publishing in One Hour a Day**, Pearson Education, 2016, 7<sup>th</sup> Edition.
2. Jon Duckett, **Web Design with HTML, CSS, JavaScript and jQuery** (set), Wiley, 2014
3. Robert W. Sebesta, **Programming the World Wide Web**, Pearson Education

### **MCI905: Program Elective – 2**

Two elective courses from the list will be offered if minimum 1/3<sup>rd</sup> of MCA-II Semester students will opt for the same or it will be decided by the concerned department or authority.

### **MCI906: Program Elective – 3**

Two elective courses from the list will be offered if minimum 1/3<sup>rd</sup> of MCA-II Semester students will opt for the same or it will be decided by the concerned department or authority.

### **MCI 907: Programming Lab – 1**

Visual Programming  
Python

### **MCI 908: Programming Lab – 2**

Web technology

## **Semester – X**

### **MCI 1001: Project Work**

Project is a compulsory course for all MCA (Integrated)- Xth Semester Students.



## LIST OF COURSES WITH CONTENTS FOR ELECTIVE - 1

### **MCPE – 101: Internet of Things**

**Objective:** - Students will be explored to the interconnection and integration of the physical world and the cyber space. They are also able to design & develop IOT Devices.

#### **Unit – I**

**Introduction to Internet of Things** –Definition and Characteristics of IoT, Physical Design of IoT–IoT Protocols, IoT communication models, IoT Communication APIs IoT enabled Technologies– Wireless Sensor Networks, Cloud Computing, Bigdata analytics, Communication protocols, Embedded Systems, IoT Levels and Templates Domain. Specific IOTs – Home, City, Environment, Energy, Retail, Logistics, Agriculture, Industry, health and Lifestyle.

#### **Unit – II**

**IoT and M2M** – Software defined networks, network function virtualization, difference between SDN and NFV for IoT Basics of IoT System Management with NETCOZF, YANGNETCONF, YANG, SNMP NETOPEER

#### **Unit – III**

**Introduction to Python** - Language features of Python, Data types, data structures, Control of flow, functions, modules, packaging, file handling, data/time operations, classes, Exception handling Python packages - JSON, XML, HTTPLib, URLLib, SMTPLib

#### **Unit – IV**

**IoT Physical Devices and Endpoints** - Introduction to Raspberry PI-Interfaces (serial, SPI, I2C) Programming – Python program with Raspberry PI with focus of interfacing external gadgets, controlling output, reading input from pins. IoT Physical Servers and Cloud Offerings – Introduction to Cloud Storage models and communication APIs Webserver – Web server for IoT, Cloud for IoT, Python web application framework Designing a RESTful web API

### **Reference Books**

1. ArshdeepBahga and Vijay Madiseti,Internet of Things - A Hands-on Approach, Universities Press, 2015.
2. Matt Richardson & Shawn Wallace, O'Reilly (SPD), Getting Started with Raspberry Pi, 2014.

### **MCPE – 102: Management Information System**

**Objective:** It aims to teach to help executives of an organization make decisions that advance the organization's strategy and to implement the organizational structure and dynamics of the enterprise for the **purpose** of managing the organization in a better way for a competitive advantage.

#### **Unit – I**

Foundations of information systems: - Decision Making Process – Simon’s Model – Global business Environment and organizations – Introduction to IS in business – Solving problems with IS – Introduction to MIS.

#### **Unit – II**

Information Technology: A managerial overview - Computer Software – hardware – Database Management-normalization Process – Types of Data Model.

#### **Unit – III**

Business Application of information Technology: Internet – intranet and Extranets – Decision Support System – Transaction Processing System – EJS – Enterprise wide Information Systems.

#### **Unit – IV**

Building Information systems and Implementation – Tools and Techniques for Building System Analysis and Design – Methodologies – Implementation Techniques.

#### **Unit – V**

Management of Information system: functional Subsystems of MIS – marketing, finance, URD, Manufacturing – strategic Information Systems.

#### **Reference Books**

1. O'Brien, J.A, “Management Information Systems”, 4<sup>th</sup> Edition, TMFI, 1999.
2. Landon K.C, & Landon J.P., MIS – Macmillan – New York, 1998.
3. Davis G.D and Olson M.H, “Management Information System”, 2<sup>nd</sup> edition, TMH,

## MCPE – 103: Principles of Compiler Design

**Objective:** To study the general features of Compilers.

### Unit – I

**Lexical Analysis:** Introduction on the phase of the compiler - Lexical Analysis, Regular Expression, Automata, Deterministic Automata equivalent to NFA's. Minimizing the states of DFA, Implementation of Lexical Analyzer.

### Unit – II

**Syntax Analysis:** Top-down Parsing Concepts, Recursive Descent Parsing, Predictive Parsers, Non-recursive Predictive Parsing - Bottom Up Parsing, Handle pruning, Shift reduce parsing - Operator Precedence Parsing - Error recovery in Parsing, LR Parsers, Parser Generators - YACC.

### Unit – III

**Intermediate Code Generation:** Syntax directed Definitions, Construction of Syntax trees - Top down Translation, Bottom up Evaluation of Inherited Attributes, Recursive Evaluators, Assigning Space at Computer Construction time - Type checking - Overloading of functions and operators, polymorphic function.

### Unit – IV

**Storage Organization:** Storage Organization, Storage Allocation strategies, Parameter Passing, Symbol tables, Dynamic Storage Allocation, Intermediate Languages - Representation of Declarations, Assignment statement, Boolean Expression, Back Patching, Procedure calls.

### Unit – V

**Code Generation and Optimization:** Design of the code generators, Runtime storage management, Basic blocks and Flow graphs, Register Allocation and Assignment, DAG representation of Basic blocks, Peephole optimization, Code optimization - The principle Sources of Optimization, Optimization of basic blocks, Global data flow Analysis, Loop optimizations.

### Reference Books

1. Alfred Aho, Ravi Sethi, Jeffrey D Ullman, "Compilers Principles, Techniques and Tools" 1986 Addison Wesley.
2. Dhamdhere D.M, "Compiler Construction Principles and Practice 1981 ,Macmillan India.
3. Reinhard Wilhelm, Dieter Mauser , " Compiler Design", 1995, Addison Wesley.

## **MCPE – 104: Microprocessors and Applications**

**Objective:** To study the basic concepts of 8085 microprocessor and to interface various peripherals with it.

### **Unit – I**

Introduction to Micro Computers: Micro computers, Microprocessors and Assembly Language Microprocessors Architecture and Micro Computer Systems - 8085 Microprocessor, Architecture -Instruction and Timings.

### **Unit – II**

Programming 8085: 8085 Basic Instructions. Programming Techniques with Additional Instructions -Counters and Timing Delays - Stack and Subroutines.

### **Unit – III**

Interfacing Peripherals (I/O'S): Parallel & Serial: Parallel I/O & interfacing Applications - Interrupts:8085 interrupts. Serial I/O: Basic Concepts - 8085, Serial I/O lines: SOD and SID.

### **Unit – IV**

Data Transfer Techniques Using Programming Devices: Basics in programmable I/Os - Data Transfer using 8155 - Programmable keyboard display controller 8279 - Programmable interrupt controller 8259A.

### **Unit – V**

Interfacing DMA & Data Converters: Direct Memory Access - 8257 DMA - Interfacing Data Converters - 8257 DMA controller - Interfacing Data Converters: DIA converter - A/D converters - Comparative study of microprocessors. Microprocessors - 8086, 80286, 80386, 80486 & Pentium.

### **Reference Books:**

1. Ramesh S. Gaonkar," Microprocessor, Architecture, Programming and Applications", 1989, Wiley Eastern Ltd.,
2. Douglas V Hall, "Microprocessors and Interfacing ', 1997, Tata McGraw Hill Edition.
3. Hany Fainhead, "The 386/486 PC - A Paver Users Guide".
4. Yu - Cheng Liu, Glenn A Gibsen, "Microcomputer Systems", 1986, Prentice - Hall Of India PVT Ltd.

## MCPE – 105: Client / Server Technology

**Objective:** To provide knowledge of developing systems in distributed environments.

### Unit – I

**Overview of Client/Server Computing:** What is Client/Server Computing Application Tasks: Rightsizing, Benefits of Client/Server Computing, Evolution of Client Server Computing, Hardware and Software Trends, Evolution of operating systems, Networking Trends, Business considerations.

### Unit – II

**Client/Server Applications:** Components, Classes, Categories Understanding client/Server Computing: Obstacles, Open Systems and Standards, Standards setting organizations. Factors for success, RPC messaging Peer to Peer.

### Unit – III

**Client Hardware and Software:** Client Components, Client Operating Systems, GUI, Database Access, Application Logic. Server Hardware and Environment, Categories of Servers. SQL DB Servers, Network management and Network Computing Environment, Network operating systems, Loadable Module, Middleware, Data warehousing.

### Unit – IV

**Client/Server requirements:** GUI Design standards interface Independence, Platform independence, Transaction Processing, Connectivity, Reliability, Back up and Recovery mechanisms, TP Monitors, Groupware, and Distributed Object Components.

### Unit – V

Future Trends - CORBA, COM, OLE, WEB Server, Mobile Computing, Net Management Standard, intelligent Wiring Hubs, Wireless LANS, ATM Switching, Object Technology, CASE Tools, Repositories, Multimedia, Workgroup Computing.

### Reference Books

1. Dawna Travis Dewire, 'Client/SerVer Computing', 1993, McGraw Hill
2. Bruce Elbert & Bobby Martyna, "Client/Server Computing:Architecture. Applications and Distributed Systems Management", 1994, Artech House.
3. Robert Orgall, Dan Harkay & Jeri Edwards, "The Essential Client/Server Survival Guide".

## MCPE – 106: Neural Networks

**Objective:** To study the algorithms and physical components applied in neural networks.

### Unit – I

**Introduction:** Artificial Neural Network - Principles and promises - Pattern and Pattern Recognition tasks - Conventional methods Promises of neural networks - Scope.

### Unit – II

**Characteristics, Neuron Models:** Basics of ANNs - Characteristics of biological neural networks - Artificial neural networks - Terminology - Models of neuron - Topology - Activation and Syntactic Dynamics.

### Unit – III

**Pattern Recognition Methods and Concepts in ANN:** Functional units of ANN for pattern recognition tasks - Pattern recognition by feedforward and feed backward ANNs - Pattern Association Pattern classifier - Perception Pattern Mapping Backpropagation learning algorithm.

### Unit – IV

**Storage, Clustering and Mapping:** Pattern storage (STM) - Pattern Clustering Competitive learning feature mapping Kohonen 's Self-organizing networks.

### Unit – V

**Architecture, Memory and Applications:** Neural Architecture for complex pattern recognition task - Associative memory Data and Image compression Pattern Classification - Spatio temporal patterns (Avalanche) - Pattern variability (Neocognitron) - Other Applications.

### Reference Books

1. J.Hertz, A.Korth and R.G.Palmer, "An Introduction to the Theory of Neural Computation", Addison Wesley, 1991.
2. Philip D. Wassermann, "Neural Computing Theory and Practice", Van Nostran Reinhold.
3. James A.Freeman and David M.Skapura, "Neural Networks; Algorithms and Applications", Addison Wesley, 1991.
4. B.Muller and J.Reinhardt, "Neural Networks: An Introduction", Addison Wesley 1990.
- 5 L.B.Almedia and C.J. Wel. Lekans, "Neural Networks", Addison Wesley, 1990.

## MCPE – 107: Marketing Management

**Objective:** To gain a basic understanding about the marketing function and about the marketing strategy formulation.

### Unit – I

**Introduction Buyer Behavior:** Core concepts of marketing: Needs, wants and demands, product, value, satisfaction. Marketing and markets. Evolution of marketing: production concept, product concepts, selling concepts and marketing concepts. Buyer behavior: Model, influencing factors, buying decision process, buying roles and buying stages.

### Unit – II

**Segmentation - N.P.D-P.L.C.:** Segmentation: Approach, factors and procedure. Targeting and Positioning. New Product de NPD model, reasons for success and failures. Product Life Cycle: PLC concepts and strategies to be followed in various stages.

### Unit – III

**Product and Pricing Strategies:** Product: Classification, mix decisions and line decisions, branding decisions and packaging. Pricing: Objectives, influencing factors, methods and strategies.

### Unit – IV

**Channel and Promotion Strategies:** Channel: Nature, function, dynamics, design and management decisions. Promotion: Advertising decisions objectives, budget, message, media and evaluation of advertisements. Personal selling principles. Sales Promotion - objectives and types.

### Unit – V

**Marketing Control and Strategies:** Marketing control: Annual plan control, Profitability control, Efficiency control and strategies control. Marketing strategies: for leaders, followers, challengers, niche players and global markets.

### Reference Books

1. Kotler, Philip, Marketing Management: The Millennium edition, PHI pvt. Ltd: New Delhi. 10<sup>th</sup> edition, 1999.
2. Ramaswamy V.S. and Namakumari .S, "Marketing Management: Planning, implementation and control", Macmillan, New Delhi, 2 edition, 1997.
3. Kotter, Philip and Armstrong, Gary, "Principles of Marketing" PHIpvt. Ltd.: New Delhi. 7L edition. 1996.

## **MCPE – 108: Parallel Computing**

**Objective:** To study the concepts and ideas in **parallel computing** and its applications.

### **Unit – I**

**Introduction:** Advent of practical parallel processing. Parallel Processing terminology, The sieve of Eratosthenes.

**PRAM Algorithms:** The PRAM model of parallel computation, PRAM algorithms, reducing the number of processors, problems defying fast solutions on PRAMS.

### **Unit – II**

Processor Arrays, multiprocessors, Multicomputer, Processor organizations, processor arrays, Multiprocessors, multicomputer, Flynn's taxonomy, speed up and parallelizability.

### **Unit – III**

Mapping Scheduling and Algorithms; Data Mapping on processor arrays and multicomputer, classifying parallel algorithms, reduction, broadcast, prefix sums matrix multiplication, solving linear system of equations.

### **Unit – IV**

sorting, Searching and Graph Algorithms; Enumeration sort, Lower bounds on parallel sorting, Odd – Even transposition sort, bitonic merge, quick sort based algorithms, complexity of parallel search, searching on graph, connected components, all pairs shortest path, single source shortest path, minimum cost spanning tree.

### **Reference Books**

1. Hwang, Kai: "Advance Computer Architecture", McGraw Hill.
2. Hwang, K. , Briggs, F.A. : "Computer Architecture and Parallel Processing", McGraw Hill.
3. Evans, D.J. : "Parallel Processing System", Cambridge University.



## MCPE – 109: Computer Graphics and Multimedia

**Objective:** To study the software and hardware aspects of computer graphics,

**Prerequisite:** Mathematics, Matrix Theory, Analytical Geometry, Trigonometry

### Unit – I

**Graphics Devices** – Line and Circle Drawing Algorithms: Overview of Graphic Systems - Display Devices Hard copy Devices - Interactive Input devices -- Display Processors, graphics Software - Line drawing various algorithms and comparisons Circle drawing algorithms.

### Unit – II

**Filling Transformation and Segments:** Attributes - Area filling algorithms - Scan conversion algorithms - Transformations Two dimensional - Basic Composite and Other Transformations - Matrix representations Windowing and Clipping - Viewport Transformations - Segments.

### Unit – III

**Graphics and 3D Graphics: Interactive input methods** - Input Devices - Input Functions - Three Dimensional Concepts - 3D Transformations-Curves Projections - Hidden Surface Elimination algorithms.

### Unit – IV

**Multimedia Introduction:** Multimedia applications - System architecture - Objects of Multimedia Systems -Multimedia databases Compression and File formats Image compression CCIT'I - JPEG-Video image compression - MPEG DVI Technology - Audio compression - RTF format TIFF file format -- RIFF FILE format - MIDI - JPEG DIB - TWAIN, Video & Audio Codecs.

### Unit – V

**Application Classes:** Types of systems Virtual reality design - Components Databases Authoring Systems - Hyper media - User interface design Display/Playback issues - Hypermedia linking and embedding - Production of Multimedia systems.

### Reference Books

1. Donald Hearn, M.Pauline Baker, 'Computer Graphics', 1992, PHI,
- 2 William M.New Man, Robert F. Sproull," Principles of Interactive Graphics", 1979, McGraw Hill.
3. Fred Hofsterrn, Multimedia Literacy", 1995, McGraw Hill.
4. Burger, "Desktop Multimedia Bible", 1993, Addison Wesley.
5. Matthew E.Hodges and Russell M.Sasnett, "Multimedia Computing", 1990, Addison
6. John F. Koegel Beford, "Multimedia Systems", 1994, Addison Wesley, University of Massachusetts, Lowell.
7. Simon Gibbs, Dennis Tschritzis, "Multimedia Programming", 1995, Addison Wesley, University of Geneva.

## MCPE – 110: Accounting and Financial Management

Objective: To present the whole range of book-keeping concepts and to give a comprehensive coverage to management accounts.

### Unit – I

**Basic Concepts:** Assets Current assets, Fixed assets - Liabilities, Current liabilities - other liabilities Owner's equity - Trading account - Accounting records and Systems - Control accounts and Subsidiary Ledgers Limitations. Preparation of income statement - Interpretation and use of these fixed statements by Management.

### Unit – II

**Depreciation:** Fixed assets and Depreciation - Methods for Depreciation, Assets Acquisition, Disposal, Intangible. assets, Inventory methods, Sources of working capital, Fund flows, Cash flows.

### Unit –III

**Financial Statement Analysis:** Ratio analysis - Use of ratios in interpreting Trading Accounts and Financial Statements, Limitations.

### Unit – IV

**Management Accounting:** Variable costs - Fixed costs - Cost Volume Profit Analysis - Break even marginal and full costing contribution, Standard costing Analysis of variance computer accounting and algorithms.

### Unit – V

**Budgets and Capital Budgeting:** Characteristics of Budgets, Definition, Advantages, Preparation, Forecasting - Long term, Short term - Methods of capital investment decision making, Discounted cash flows, Internal rate of return, Payback, Rate of return, Sensitivity Analysis, Cost of capital.

### Reference Books

1. Maheswari S.N. and Maheswari 5K., "An Introduction to Accountancy", 5 edition. Vikas Publishing, New Delhi.
2. Manmohan and Goyal, " Principles of Management and Accounting", 5 Edn., Sahirva Bhawan,Agra
3. J.Batty,' Management Accountancy%', 3 Edn., 1970, Macdonald & Evan Ltd., London
4. Hampton,"Financial Management", 1980, PHI
- 5 S.C.Kuchhal, "Financial Management", 1979, Chaitanya Pub. House
- 6 Anthony R.N., " Management Accounting", 1970, Homewood Illion

## LIST OF COURSES WITH CONTENTS FOR ELECTIVE - 2

### **MCPE – 201: Operation Research**

Objective: To understand the general concept of operations research relating to the optimization criteria in computer applications and helps software in this area.

#### **Unit – I**

**Constrained and Unconstrained Optimization:** Use of Optimization Techniques in computer applications. One dimensional unconstrained optimization - Fibonacci method - Golden section method - Quadratic approximation method - constrained optimization with Lagrangian multipliers - simple problems.

#### **Unit – II**

**Linear Programming:** Formulation of linear programming problems - Simplex method - BIG M method Two Phase method - Primal Dual problems, Sensitivity Analysis, Transportation problem Assignment problem.

#### **Unit – III**

**Dynamic Programming:** DPP Formulation Investment problem General allocation problem - Stage coach problem - Production scheduling - LPR

#### **Unit – IV**

**Inventory Control:** Functions of inventories - Infinite delivery rate with no backordering - Finite delivery rate with no backordering - Infinite delivery rate with ordering - Finite delivery rate with backordering Probabilistic models - Single period models.

#### **Unit – V**

**Queuing Theory:** Notation and assumption - Characteristics of Queue - Poisson input process - exponential service times - Queuing models - M/M/C MIM/St MIMI 1 .IN - MIM/SIN - Simple problems.

#### **Reference Books**

1. Billy.E.Gillet, "Introduction to Operations Research - A Computer Oriented Algorithmic Approach", 1976, McGraw Hill.
2. Rao.S.S, "Optimization Theory and Applications", 1981 , Wisely Eastern.
3. Taha .H.A, "Operations Research an Introduction", 3 Edition, 1982, Macmillan Pub.
4. Ackoff Sasieni M.V, "Fundamentals of Operations Research", 1968, Wisely Eastern.
5. Bunday D.Bruab, "Basic Optimization on Methods", 1984, Edward Arnold Pub.
6. Kanti Swaroop et al, "Operations Research", 1995, Sultan Chand.

## **MCPE – 202: Data Warehousing and Data Mining**

**Objective:** To understand the general concept of Data Warehousing and Data Mining.

### **Unit – I**

**Introduction:** Data Mining-motivation, importance-DM Functionalities, Basic Data Mining Tasks. DM Vs KDD, DM Metrics, DM Applications, Social implications.

### **Unit – II**

**Data Warehousing:** Difference between Operational Database and Data warehouse-Multidimensional Data Model: From tables to data Cubes, Schemas, Measures-DW

**Architecture:** Steps for design and construction of DW, 3-tier DW Architecture-DW

**Implementation:** Efficient computation of DATA Cubes, Efficient Processing of OLAP queries, Metadata repository.

### **Unit – III**

Data processing, Data Mining Primitives, Languages, Data cleaning, Data Integration and Transformation, Data Reduction. Discretization and concept Hierarchy Generation. Task-relevant data, Background Knowledge, Presentation and Visualization of Discovered Patterns. Data Mining Query Language-other languages for data mining

### **Unit – IV**

**Data Mining Algorithms:** Association Rule Mining: MBA Analysis, The Apriori Algorithm, Improving the efficiency of Apriori. Mining Multidimensional Association rules from RDBMS and DXV. Classification and Predication: Decision Tree. Bayesian Classification back propagation, Cluster Analysis: Partitioning Methods. Hierarchical Method, Grid-based methods, Outlier Analysis.

### **Unit – V**

**Web, Temporal and Spatial Data Mining:** Web content Mining, Web Structure Mining, Web usage mining. Spatial Mining: Spatial DM primitives, Generalization and Specialization, Spatial rules, spatial classification and clustering algorithms. Temporal Mining: Modeling Temporal Events, Times series, Pattern Detection, Sequences.

### **Reference Books**

1. Jiawei I-Ian, & Micheline Kamber, "data Mining: Concepts and Techniques". Harcourt India Private Limited, First Indian Reprint,2001
2. Margaret H.Dunham,"Data Mining: Introductory and Advanced Topics". Pearson Education, First Indian Reprint,2003
3. Arun K. Pujari," Data Mining Techniques", University Press (India ) Limited, First Edition,2001
4. Efrim O. Mallach,"Decision Support and Data Warehouse Systems", Mcgraw-Hill International Edition, 2000.

## **MCPE – 203: Software Architecture and Software Testing**

**Objective:** To Study an introduction to methods and theory for development of data warehouses and data analysis using data mining.

### **Unit – I**

Definition - software components, COTS and infrastructure - Moving from project. centric to architecture-centric software engineering - software variability management.

### **Unit - II**

**Software architecture design method:** Top-down versus bottom-up design - functionality-based architecture design - variability analysis - architecture evaluation and assessment - scenario-based evaluation simulation-based evaluation - experience-based evaluation architectural styles architectural patterns applying design patterns - convert quality requirements to functionality.

### **Unit – III**

**Design Patterns-Evolution Patterns-Software artifact evolution processes:** Interdependence, dependence or Independence - Case studies: examples and experiences Use of Java Beans.

### **Unit – IV**

**History of Software Testing:** Overview of Verification and Validation With the Software Life-Cycle- Formal Methods as Opposed to Software Testing- Importance of Systematic Methods for Testing- Techniques for Program Analysts- Software Testing Techniques Test Data Generation- Software Quality Assurance- Software Metrics- Comparison of Software Testing Techniques.

### **Unit – V**

**Software Reliability:** Comparison of Software and Hardware Reliability- Development of Software Reliability Models- Parameter Estimation of Models and Prediction of Reliability Levels- Comparison of Models- Relation Between Software Reliability and Software Testing Techniques- Application of Software Testing and Reliability to Safety Critical Systems.

### **Reference Books**

1. Len Bass, Paul Clements, and Rick Kazman, Software Architecture in Practice. 2nd Ed. Addison-Wesley Longman, Inc., Reading, MA. 2003.
2. Jacobson, Ivar, Griss, Martin, Jonsson, Patrik, Software Reuse. Architecture, Process and Organization for Business Success. Addison-Wesley Longman, Inc., Harlow. UK, 1997
3. Mary Shaw and David Garian, Software Architecture, Perspectives on an Emerging Discipline. Prentice Hall, 1996
4. J. Bosch, Product-oriented Architectures in Industry: A Case Study, Proceedings of the 21st International Conference on Software Engineering, pp. 544-554, May 1999.
5. J. Bosch, Design & Use of Software Architectures - Adopting and Evolving a Product -Line Approach, Addison Wesley, ISBN 0-201-6749

## MCPE – 204: Systems Programming

**Objective:** To study the components and concepts of System Programming.

### Unit – I

**Introduction:** Language Processing - Its activities, Fundamentals of Language Processing Development Tools- System Software and Machine Architecture - Hypothetical Computer - CISC and RISC Machines.

### Unit – II

**Assembler and Macro Processors:** Basic Assembler functions - Machine-dependent and Machine-independent Assembler features - Assembler Design options - Implementation Examples - Basic Macro Processor Functions Machine- independent Macro Processor features - Design options and Examples.

### Unit – III

**Loaders and Linkers:** Basic Loader Functions - Machine-dependent and Machine-independent Loader features Design options - Linkage Editors, Dynamic Linking and Bootstrap Loaders. Implementation Examples -MS-DOS linker, SUN-OS linkers and Cray MPP linker.

### Unit – IV

**Translators and Software Tools:** Comparison of Compilers and Interpreters - Software Tools - Tools for Programming Development - Editors - Debug monitors Programming Environments - User Interfaces.

### Unit – V

**Case Studies:** Introduction to Device Drivers Windows NT internals - UNIX Shell Programming and Batch Processing in MS-DOS.

### Reference Books

1. Leland L. Beck, " System Software - An Introduction to Systems Programming", 3rd Edition, 1999, Addison Wesley.
2. D.M.Dhamdhore, "Systems Programming and Operating Systems", 2 Edition, 1997. TMH.
3. Donovan J.J. "Systems Programming", 1972, McGraw Hill.
4. David K I-Hsiao, u Systems Programming - Concepts of Operating & Database Systems 1975, Addis On Wesley.

## MCPE – 205: Big Data Analytics

**Objective:** Ability to pursue new business models or to achieve a significant competitive advantage on the company's traditional business.

### Unit – I

Introduction to Big Data: Introduction – distributed file system – Big Data and its importance, Four Vs, Drivers for Big data, Big data analytics, Big data applications. Algorithms using map reduce, Matrix-Vector Multiplication by Map Reduce.

### Unit – II

**Introduction Hadoop:** Big Data – Apache Hadoop & Hadoop Eco System – Moving Data in and out of Hadoop – Understanding inputs and outputs of Map Reduce - Data Serialization. Hadoop Architecture: Hadoop Architecture, Hadoop Storage: HDFS, Common Hadoop Shell commands, Anatomy of File Write and Read., Name Node, Secondary Name Node, and Data Node, Hadoop Map Reduce paradigm, Map and Reduce tasks, Job, Task trackers - Cluster Setup – SSH & Hadoop Configuration – HDFS Administering –Monitoring & Maintenance.

### Unit – III

**Hadoop Ecosystem and Yarn:** Hadoop ecosystem components - Schedulers - Fair and Capacity, Hadoop 2.0 New Features Name Node High Availability, HDFS Federation, MRv2, YARN, Running MRv1 in YARN.

### Unit – IV

**Hive and Hiveql, Hbase:** Introduction to No Query Language, Hive Architecture and Installation, Comparison with Traditional Database, HiveQL - Querying Data - Sorting And Aggregating, Map Reduce Scripts, Joins & Sub queries, HBase concepts Advanced Usage, Schema Design, Advance Indexing - PIG, Zookeeper - how it helps in monitoring a cluster, Hbase uses Zookeeper and how to Build Applications with Zookeeper.

### Reference Books

1. Boris lublinsky, Kevin t. Smith, Alexey Yakubovich, “Professional Hadoop Solutions”, Wiley, 2015.
2. Chris Eaton, Dirk deroos et al. , “Understanding Big data ”, McGraw Hill, 2012.
3. Tom White, “HADOOP: The definitive Guide” , O Reilly, 2012.
4. VigneshPrajapati, “Big Data Analytics with R and Haoop”, Packet Publishing 2013.
5. Tom Plunkett, Brian Macdonald et al, “Oracle Big Data Handbook”, Oracle Press, 2014.
6. JyLiebowitz, “Big Data and Business analytics”,CRC Press, 2013.

## MCPE – 206: Human Resource Management

**Objective:** The objective of the course is to sensitize students to the systems and strategies in managing people professionally in view of the rapidly evolving aspirations of individuals, and changing business contexts.

### Unit – I

**Foundations and Principles of Managing People in Organizations:** Concepts and Perspectives; Contemporary issues and challenges in managing human resources;

### Unit – II

Job Analysis; Human Resource Planning: Demand and Supply Forecasting, Downsizing and Retention; Talent Acquisition: Recruitment, Selection and Induction; Performance Management: Systems and Strategies; Learning, Training and Development: Process and methods; Compensation and Rewards Management;

### Unit – III

**Industrial Relations:** Dynamics of Employer, Employee and the State; Trade Unions: Past, present and the future; Industrial Harmony: Workers' Participation, Collective Bargaining, Grievance, Discipline; Dispute Resolution and Conflict Management; Employee Engagement; International Dimensions of HRM.

### Reference Books

1. Armstrong, M. & S. Taylor. (2017). *Armstrong's Handbook of Human Resource Management Practice* (14<sup>th</sup>ed.). London: Kogan Page.
2. Aswathappa, K. (2017) *Human Resource Management: Text and Cases*. (8<sup>th</sup>ed.) New Delhi: McGraw Hill.
3. Bohlander, G.W., & Snell, S.A. (2016) *Principles of Human Resource Management* (16<sup>th</sup> ed.). New Delhi: Cengage India.
4. Carbonara, S. (2013) *Manager's Guide to Employee Engagement*. New York: McGraw Hill.
5. Cascio, W. (2015). *Managing Human Resources: Productivity, Quality of Work Life, Profits* (10<sup>th</sup>ed.). New York: McGraw Hill.



## **MCPE – 207: Cryptography and Network Security**

**Objective:** To give an exposure on symmetric key cryptosystems, stream ciphers, public key cryptosystem, factoring and related topics.

### **Unit – I**

Introduction to information systems, Types of information Systems, Development of Information Systems, Introduction to information security, Need for Information security, Threats to Information Systems, Information Assurance, Cyber Security, and Security Risk Analysis.

### **Unit – II**

Application security (Database, E-mail and Internet), Data Security Considerations-Backups, Archival Storage and Disposal of Data, Security Technology-Firewall and VPNs, Intrusion Detection, Access Control. Security Threats -Viruses, Worms, Trojan Horse, Bombs, Trapdoors, Spoofs, E-mail viruses, Macro viruses, Malicious Software, Network and Denial of Services Attack, Security Threats to E-Commerce- Electronic Payment System, e- Cash, Credit/Debit Cards. Digital Signature, public Key Cryptography.

### **Unit – III**

Developing Secure Information Systems, Application Development Security, Information Security Governance & Risk Management, Security Architecture & Design Security Issues in Hardware, Data Storage & Downloadable Devices, Physical Security of IT Assets, Access Control, CCTV and intrusion Detection Systems, Backup Security Measures

### **Unit – IV**

Security Policies, Why Policies should be developed, WWW policies, Email Security policies, Policy Review Process-Corporate Policies-Sample Security Policies, Publishing and Notification Requirement of the Policies. Information Security Standards-ISO, IT Act, Copyright Act, Patent Law, IPR. Cyber Laws in India; IT Act 2000 Provisions, Intellectual Property Law: Copy Right Law, Software License, Semiconductor Law and Patent Law.

### **Reference Books**

1. Charles P. Pfleeger, Shari LawrancePfleeger, “Analysing Computer Security”, Pearson.
2. V.K. Pachghare, “Cryptography and information Security”, PHI Learning Private Limited, Delhi India.
3. Dr. Surya Prakash Tripathi, RitendraGoyal, Praveen Kumar Shukla, “Introduction to Information Security and Cyber Law”, Willey.
4. Schou, Shoemaker, “Information Assurance for the Enterprise”, Tata McGraw Hill.
5. Chander, Harish, “Cyber Laws And It Protection”, PHI.

## **MCPE – 208: Natural Language Processing**

### **Unit – I**

**Overview and Language Modeling:** Origins and challenges of NLP-Language and Grammar-Processing Indian Languages- NLP Applications-Information Retrieval. Language Modeling: Various Grammar- based Language Models-Statistical Language Model.

### **Unit – II**

**Word Level and Syntactic Analysis:** Word Level Analysis: Regular Expressions-Finite-State Automata-Morphological Parsing-Spelling Error Detection and correction- Words and Word Classes-Part-of Speech Tagging. Syntactic Analysis: Context-free Grammar-Constituency-Parsing-Probabilistic Parsing.

### **Unit – III**

**Semantic Analysis and Discourse Processing: Semantic Analysis:** Meaning Representation-Lexical Semantics- Ambiguity-Word Sense Disambiguation. Discourse Processing: cohesion-Reference Resolution- Discourse Coherence and Structure.

### **Unit – IV**

**Natural Language Generation and Machine Translation:** Natural Language Generation: Architecture of NLG Systems- Generation Tasks and Representations- Application of NLG. Machine Translation: Problems in Machine Translation- Characteristics of Indian Languages- Machine Translation Approaches-Translation involving Indian Languages.

### **Reference Books**

1. Edward Loper, Ewan Klein, and Steven Bird, Natural Language Processing with Python, , O'Reilly Publication 2009.;
2. Christopher D. Manning, Hinrich Schütze ,Foundations of Statistical Natural Language Processing , MIT press,1999.
3. Dan Jurafsky, James H. Martin, Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition, Prentice Hall, 2009.

## MCPE – 209: Image Processing

### Unit – I

**Introduction:** -Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Image Sensing and Acquisition, Image Sampling and Quantization. **Image**

**Enhancement in the Spatial Domain:** - Basic Gray Level Transformations, Histogram Processing, Enhancement Using Arithmetic/Logic Operations. Basics of Spatial Filtering: Smoothing Spatial Filters, Sharpening Spatial Filters.

### Unit – II

**Image Transforms** such as FT, DCT, and HAAR Transform etc.

**Image Enhancement in the Frequency:** Introduction to the Fourier Transform and the Frequency Domain, Smoothing Frequency- Domain Filters, Sharpening Frequency Domain Filters.

### Unit – III

**Image Restoration:** Model Of the Image Degradation/Restoration Process, Restoration in the Presence of Noise Only Spatial Filtering, Periodic Noise Reduction by Frequency Domain Filtering, Linear, Position-Invariant Degradations, Estimating the Degradation Function.

**Image Compression:** Fundamentals, Image Compression Models, Error Free Compression, Lossy Compression.

**Morphological Image Processing** Preliminaries, Dilation and Erosion, Opening and Closing the Hit – or Morphological Algorithms

### Unit – IV

**Image Segmentation:** Detection of Discontinuities, Edge Linking and Boundary Detection, Thresholding, Region-Based Segmentation, The Use of Motion in Segmentation.

**Representation and Description:** Representation, Descriptors, Use Of principal Components for description, Relational Descriptors.

### Reference Books

1. R.C.Gonzalez and R.E. Woods, **Digital Image Processing**, Prentice Hall.
2. B.Chanda, and D.Dutta Majumder, **Digital Image Processing and Analysis**, Prentice-Hall Pvt. Ltd, 2000

## MCPE – 210: High Performance Computing

**Objective:** To introduce various High-performance computing environments and implementation issues.

### Unit – I

Introduction to Parallel Computing Introduction Computational Demands - Two real-time needs - Parallel Processing Terminology - Data, Temporal and Control Parallelisms - Flynn's Taxonomy Processor arrays, Multiprocessors, Multicomputer - Fundamental Algorithms - Broadcasting and All-prefix-sums Criteria for Complexity Analyses.

### Unit – II

**Parallel Algorithms:** Parallel algorithms on various models with complexity analyses for selection, merging sorting and searching problems. Introduction to Parallel Programming Languages - CS and Sequent C - Comparison of Parallel Computing with Supercomputing and Distributed Computing.

### Unit – III

Introduction to Distributed Computing Message Passing Model - Message passing, general programming models and PVM-Remote Procedure Call - Parameter passing, locating the server, Semantics in the presence of failures, security, Problem Areas.

### Unit – IV

Grid Computing: Introduction - Definition, Evolution and Elements - Current Perspective - Definition, block Diagram, Grid Computing Business areas and Applications - Grid Computing Infrastructure and vulnerability security Issues-Resource Management.

### Unit – V

**Cluster Computing:** Introduction - Cluster Computer and its Architecture, Parallel Applications and Their Development - Strategies for Developing Parallel Applications - Code Granularity and Levels of Parallelism - Parallel Programming Models and Tools Parallel Languages, Message Passing, Virtual Shared Memory, Parallel Object-Oriented Programming, Programming Skeletons - Methodical Design of Parallel Algorithms - Partitioning, Communication, Agglomeration or Mapping.

### Reference Books

1. A.Y.Zomaya, "Parallel and Distributed Computing handbook", 1995, McGrawHill Professional.
2. Michael J.Quinn, "Parallel Computing: Theory and Practice", Second Edition, 1994, Tata McGrawHill, Inc
3. M. Sasaikumar, Dinesh Shikhare, P.Ravi Praksh , "Introduction to Parallel Processing", 2000, PHI.
4. Joshy Joseph, Creig Fellenstein, "Grid Computing", 2003, PHI

## **LIST OF COURSES WITH CONTENTS FOR ELECTIVE - 3**

### **MCPE – 301: Embedded Systems**

#### **Unit – I**

Introduction to embedded systems hardware needs; typical and advanced, timing diagrams, memories (RAM, ROM, and EPROM) Tri state devices, Buses, DMA, UART and PLD's Built-in on the microprocessor. Interrupts basics, ISR; Context saving, shared data problem. Atomic and critical section, Interrupt latency.

#### **Unit – II**

Survey of software architectures, Round Robin, Function queue scheduling architecture, Use of real time operating system. RTOS, Tasks, Scheduler, Shared data reentrancy, priority inversion, mutex binary semaphore and counting semaphore. Inter task communication, message queue, mailboxes and pipes, timer functions, events Interrupt routines in an RTOS environment.

#### **Unit – III**

Embedded systems of forwarded sign RTOS Hard real-time and soft real time system principles, Task division, need of interrupt routines, shared data. Embedded Software development tools.

#### **Unit – IV**

Host and target systems, cross compilers, linkers, locators for embedded systems. Getting embedded software into the target system. Debugging techniques. Testing on host machine, Instruction set emulators, logic analyzers In-circuit emulators and monitors.

#### **Reference Books**

1. David A . Simon, An Embedded Software Primer, Pearson Education.
2. Daniel W. Ewis, Fundamentals of Embedded Software Where C and Assembly Meet, Pearson Education.
3. Oliver H. Baileg, Embedded System: Desktop Integrations, Wordware Publishing Inc.
4. Tammy Noergaard Newnes, Embedded System Architecture.

## MCPE – 302: Modeling and Computer Simulation

**Objective:** To introduce the concept of System Modeling and Computer Simulation.

### Unit – I

**Introduction to simulation and simulation Software:** Systems - Models - Types, Components, Steps in Modeling - Simulation – Definition Examples - Steps in Computer Simulation - Advantages and Disadvantages of Simulation -Techniques - Monte Carlo Simulation - Types of Simulation - Lag Models - Cobweb Models - Simulation Languages - GPSS, DYNAMO.

### Unit – II

**Simulation of Statistical Queuing Manufacturing and Material Handling:** Useful Statistical Models - Discrete Distribution - Continuous Distributions Poisson Empirical Distribution - Manufacturing and Material Handling System - Models - Goals and Performances Measure - Issues in Simulating - Queuing System Characteristics Transient and Steady-State Behavior of Queues - Long-Run Measures - Infinite Population Markovian Models.

### Unit – III

**Random Numbers:** Generation of Pseudo Random Numbers - Mid-Square Method - Linear Congruential Generators - Generating Random Variates from Continuous and Discrete Probability Distributions.

### Unit – IV

**System Dynamics and Object-Oriented Approach in Simulation:** Generalization of Growth Models - System Dynamics Diagram Decision Function Multi Segment Model - Representation of Time Delays \* Inventory and Flow Distribution Systems - World Model - Object Oriented Approach - Rule Based Approaches for Simulation - Casual Loops - Flow Diagrams- Levels and Rates <sup>m</sup>- Simple examples of Animation.

### Unit – V

**Analysis of Simulation:** Analysis of Simulation - Input - Output - Verification and Validation of Simulation Models Comparison and Evaluation of Alternative System Design.

### Reference Books

1. J.Banks, John.S.Carson and B.L.Nelson, "Discrete Event System Simulation",
2. Geoffrey Gordon, "System Simulation", 2<sup>nd</sup> Edn., 1989, PHI
3. A.Milan and W.D. Kelton, "Simulation Modeling& Analysis", 1991, McGraw Hill
4. Narsingh Deo, "System Simulation with Digital Computers", 1993, PIII
5. Nancy Roberts et al, "Introduction to Computer Simulation - A System Dynamics Approach", 1983, Addison Wisely

## MCPE – 303: Principles of Programming Languages

### Unit – I

**Preliminary Concepts:** High Level Languages, Issues in Programming - Case studies, Programming paradigms, Language implementation. Syntactic Structure - Language representation, Abstract Syntax tree, -Lexical syntax, Context Free Grammars, Variants of CFG, Issues Involved and Normal Forms for CFG.

### Unit – II

**Imperative Languages:** Structured Programming - Need and Design issues. Block types arrays, records, sets, pointers, procedures, parameter passing, scope rules(in C),

### Unit – III

**Object Oriented Languages:** Grouping of data and Operations - Constructs for Programming Information Hiding, Program Design with Modules, Defined typos, TemplatoG programming - concept of Object, inheritance, Derived classes and Information hiding C++ as example language).

### Unit – IV

**Functional Programming:** Functional Programming - Features, Implementation, Types - values and operations, Product of types. Lists and Operations on Lists, Functions from a domain to a range, Function Application, Lexical Scope. Bindings of values and functions (Using Haskell as example language)

### Unit – V

**Logic Programming:** Formal Logic Systems, Working with relations and their implementation. (Using Prolog as example). Database query Languages, Exception handling (Using SQL as example)

### Reference Books

1. Pratt, Ze!kowitz, "Programming Languages: Design and Implementation Edition, 1998, PHI
2. Ravi Sethi, "Programming Language Concepts and Constructs", Addison Wesley, 1989
3. Doris Appleby, Julius J. Vandekopple, "Programming Languages: Paradigms and Practice", McGraw Hill, 1997
4. Damir Medak and Gerhard Navratil, "Haskell-Tutorial", Available on the Web, Feb 2003.
5. Paul Hudak, John Peterson and Joseph H. Fasel, "A gentle Introduction to Haskell-98", Available on the Web, Oct 1999.

## MCPE – 304: Soft Computing

### Unit – I

**Introduction to soft computing:** Concept of computing systems, soft computing versus Hard computing, characteristics of soft computing, some applications of soft computing techniques.

### Unit – II

**Fuzzy logic:** Introduction to Fuzzy logic, Fuzzy sets and membership functions, Operations on Fuzzy sets, Fuzzy relations, rules, propositions, implications and inferences, Defuzzification techniques, Fuzzy logic controller design, Some applications of Fuzzy logic.

### Unit – III

**Genetic Algorithms:** Concept of "Genetics" and "Evolution" and its application to probabilistic search techniques, Basic GA framework and different GA architectures, GA operators: Encoding, Crossover, Selection, Mutation, etc. Solving single-objective optimization problems using GAs.

### Unit – IV

**Multi-objective Optimization Problem Solving:** Concept of multi-objective optimization problems (MOOPs) and issues of solving them, Multi-Objective Evolutionary Algorithm (MOEA), Non-Pareto approaches to solve MOOPs, Pareto-based approaches to solve MOOPs, Some applications with MOEAs.

### Unit – V

**Artificial Neural Networks:** Biological neurons and its working, Simulation of biological neurons to problem solving, Different ANNs architectures, Training techniques for ANNs, Applications of ANNs to solve some real life problems.

#### Reference Book

1. Introduction to soft computing, Samir Roy, Udit Chakraborty, Pearson Publication
2. Principle of soft computing S.N Deepa Wiley International .



## MCPE – 305: Cloud and Grid Computing

### Unit – I

**Introduction:** Evolution of Distributed computing: Scalable computing over the Internet – Technologies for network-based systems – clusters of cooperative computers – Grid computing Infrastructures – cloud computing - service oriented architecture – Introduction to Grid Architecture and standards – Elements of Grid – Overview of Grid Architecture. Grid Services: Introduction to Open Grid Services Architecture (OGSA) – Motivation – Functionality Requirements – Practical & Detailed view of OGSA / OGSI – Data intensive grid service models – OGSA services.

### Unit – II

**Virtualization:** Cloud deployment models: public, private, hybrid, community – Categories of cloud computing: Everything as a service: Infrastructure, platform, software - Pros and Cons of cloud computing – Implementation levels of virtualization – virtualization structure – virtualization of CPU, Memory and I/O devices – virtual clusters and Resource Management – Virtualization for data center automation.

### Unit – III

Programming Model 9 Open source grid middleware packages – Globus Toolkit (GT4) Architecture, Configuration – Usage of Globus – Main components and Programming model - Introduction to Hadoop Framework - MapReduce, Input splitting, map and reduce functions, specifying input and output parameters, configuring and running a job – Design of Hadoop file system, HDFS concepts, command line and java interface, dataflow of File read & File write.

### Unit – IV

Security 9 Trust models for Grid security environment – Authentication and Authorization methods – Grid security infrastructure – Cloud Infrastructure security: network, host and application level – aspects of data security, provider data and its security, Identity and access management architecture, IAM practices in the cloud, SaaS, PaaS, IaaS availability in the cloud, Key privacy issues in the cloud.

### Reference Books

1. Kai Hwang, Geoffery C. Fox and Jack J. Dongarra, “Distributed and Cloud Computing: Clusters, Grids, Clouds and the Future of Internet”, First Edition, Morgan Kaufman Publisher, an Imprint of Elsevier, 2012.
2. Jason Venner, “Pro Hadoop- Build Scalable, Distributed Applications in the Cloud”, A Press, 2009.
3. Tom White, “Hadoop The Definitive Guide”, First Edition. O’Reilly, 2009.
4. Bart Jacob (Editor), “Introduction to Grid Computing”, IBM Red Books, Vervante, 2005.
5. Ian Foster, Carl Kesselman, “The Grid: Blueprint for a New Computing Infrastructure”, Morgan Kaufmann, 2nd Edition.
6. Frederic Magoules and Jie Pan, “Introduction to Grid Computing” CRC Press, 2009.
7. Daniel Minoli, “A Networking Approach to Grid Computing”, John Wiley Publication, 2005

## MCPE – 306: Android Application

### Unit – I

**Introduction to Android Operating System:** Android OS design and Features – Android development framework, SDK features, Installing and running applications on Eclipse platform, Creating AVDs, Types of Android applications, Best practices in Android programming, Android tools Android application components – Android Manifest file, Externalizing resources like values, themes, layouts, Menus etc, Resources for different devices and languages, Runtime Configuration Changes Android Application Lifecycle – Activities, Activity lifecycle, activity states, monitoring state changes.

### Unit – II

**Android User Interface:** Measurements – Device and pixel density independent measuring units Layouts – Linear, Relative, Grid and Table Layouts User Interface (UI) Components – Editable and non editable Text Views, Buttons, Radio and Toggle Buttons, Checkboxes, Spinners, Dialog and pickers Event Handling – Handling clicks or changes of various UI components Fragments – Creating fragments, Lifecycle of fragments, Fragment states, Adding fragments to Activity, adding, removing and replacing fragments with fragment transactions, interfacing between fragments and Activities, Multi-screen Activities

### Unit – III

**Intents and Broadcasts:** Intent – Using intents to launch Activities, Explicitly starting new Activity, Implicit Intents, Passing data to Intents, Getting results from Activities, Native Actions, using Intent to dial a number or to send SMS Broadcast Receivers – Using Intent filters to service implicit Intents, Resolving Intent filters, finding and using Intents received within an Activity Notifications – Creating and Displaying notifications, Displaying Toasts.

### Unit – IV

**Persistent Storage:** Files – Using application specific folders and files, creating files, reading data from files, listing contents of a directory Shared Preferences – Creating shared preferences, saving and retrieving data using Shared Preference Database – Introduction to SQLite database, creating and opening a database, creating tables, inserting retrieving and deleting data, Registering Content Providers, Using content Providers (insert, delete, retrieve and update). Advanced Topics: Alarms– Creating and using alarms Using Internet Resources – Connecting to internet resource, using download manager Location Based Services – Finding Current Location and showing location on the Map, updating location.

### Reference Books

1. RetoMeier,,Professional Android 4 Application Development, Wiley India, (Wrox) , 2012.
2. James C Sheusi,,Android Application Development for Java Programmers, Cengage Learning, 2013
3. Wei-MengLee,,Beginning Android 4 Application Development, Wiley India (Wrox), 2013

## MCPE – 307: Mobile Computing

### Unit – I

**Introduction:** Mobile Computing – Mobile Computing Vs wireless Networking – Mobile Computing Applications – Characteristics of Mobile computing – Structure of Mobile Computing Application. MAC Protocols – Wireless MAC Issues – Fixed Assignment Schemes – Random Assignment Schemes – Reservation Based Schemes

### Unit – II

**Mobile Internet Protocol and Transport Layer:** Overview of Mobile IP – Features of Mobile IP – Key Mechanism in Mobile IP – route Optimization. Overview of TCP/IP – Architecture of TCP/IP- Adaptation of TCP Window – Improvement in TCP Performance. Mobile Telecommunication System: Global System for Mobile Communication (GSM) – General Packet Radio Service (GPRS) – Universal Mobile Telecommunication System (UMTS)

### Unit – III

**Mobile Ad-Hoc Networks:** Ad-Hoc Basic Concepts – Characteristics – Applications – Design Issues – Routing – Essential of Traditional Routing Protocols – Popular Routing Protocols – Vehicular Ad Hoc networks (VANET) – MANET vs VANET – Security.

### Unit – IV

**Mobile Platforms and Applications:** Mobile Device Operating Systems – Special Constrains & Requirements – Commercial Mobile Operating Systems – Software Development Kit: iOS, Android, BlackBerry, Windows Phone – M Commerce – Structure – Pros & Cons – Mobile Payment System – Security Issues.

**Mobile Platforms and Applications:** Mobile Device Operating Systems – Special Constrains & Requirements – Commercial Mobile Operating Systems – Software Development Kit: iOS, Android, BlackBerry, Windows Phone – M Commerce – Structure – Pros & Cons – Mobile Payment System – Security Issues.

### Reference Books

1. Prasant Kumar Pattnaik, Rajib Mall, “Fundamentals of Mobile Computing”, PHI Learning Pvt. Ltd, New Delhi – 2012.
2. Jochen H. Schller, “Mobile Communications”, Second Edition, Pearson Education, New Delhi, 2007.
3. Dharma Prakash Agarval, Qing and An Zeng, "Introduction to Wireless and Mobile systems", Thomson Asia Pvt Ltd, 2005.
4. UweHansmann, LotharMerk, Martin S. Nicklons and Thomas Stober, “Principles of Mobile Computing”, Springer, 2003
5. William.C.Y.Lee,“Mobile Cellular Telecommunications-Analog and Digital Systems”, Second Edition, Tata McGraw Hill Edition,2006.
6. C.K.Toth, “AdHoc Mobile Wireless Networks”, First Edition, Pearson Education, 2002.

## **MCPE – 308: E – Commerce**

### **Unit – I**

IT and business, various applications of IT in business field. History of e-commerce, definition, classification- B2B, B2C, C2C, G2C, B2G sites, e-commerce in education, financial, auction, news, entertainment sectors, Doing e-commerce., EDI and its components

### **Unit – II**

Electronic payment systems – credit cards, debit cards, smart cards, e-credit accounts, e-money, EFT, security concerns in e-commerce, authenticity, privacy, S-HTTP, Secure e-mail protocols, integrity, non-repudiation, encryption, secret key cryptography, public key cryptography, SET, SSL, digital signatures, firewalls.

### **Unit – III**

Internet Marketing Phase, Marketing on the web, marketing strategies, creating web presence, advertising, customer service and support, web branding strategies, web selling models.

### **Unit – IV**

E-commerce; case study of two internationally successful e-commerce web sites and two Kerala-based e-commerce web sites; IT act (India) and e-commerce.

### **Reference Books**

1. C. S. V. Murthy, E-Commerce, Himalaya Publishing House.
2. NIIT, Basics of E-Commerce, PHI.
3. Erfan Turban et. al., Electronic Commerce–A Managerial Perspective, Pearson Education.
4. R Kalokota, Andrew V. Winston, Electronic Commerce – A Manager’s Guide, Pearson Education.