# Examination Scheme and Syllabus

# for

# M.Sc. Computer Science

# (Semester: I to IV)

# w.e.f. Session-2021-22

# (Choice Based Credit System)

# CHAUDHARY BANSI LAL UNIVERSITY

# BHIWANI

# Chaudhary BansiLal University, Bhiwani

(Established under Govt of Haryana Act No 25 of 2014)

# Study & Evaluation Scheme
# of
# M.Sc. Computer Science

## Summary

- **Programme: M.Sc. Computer Science**
- **Duration: Two Years full time (Four Semesters)**
- **Medium: English**
- **Minimum Required Attendance: 75%**
- **Total Credits: 105**

**Assessment/ Evaluation**

| Internal Marks | External Marks | Total Marks |
|---|---|---|
| 20 | 80 | 100 |

**Internal Evaluation**

| Minor Test | Attendance | Assignment(s) |
|---|---|---|
| 10 | 05 | 05 |

**Duration of Examination**

| External | Minor Test (Internal) |
|---|---|
| 3 hrs | $1^{1}/_{2}$hr |

*Toqualifythe course, a student is required to secure a minimum of 40% marks in aggregate including the end semester examination and internal evaluation (i.e. both internal and external). A candidate who secures less than 40% of marks in a course shall be deemed to have failed in that course. The student should have at least 40% marks in aggregate to clear the semester.*

***Note: Students should be involved in extracurricular activities through Hobbies Club (Non-CGPA) such as Poetry, Science, Club, Drama etc. and will be awarded a letter grade at the competition of M.Sc.***

**Question Paper Structure**

1. *The paper shall consist of 9 questions. Out of which, first question shall be of short answer type and will be compulsory. Question No. 1 shall contain 8 parts representing all units of the syllabus and students shall have to answer all parts.*
2. *The remaining 8 questions shall have internal choice. The weightage for each question shall be 16 marks.*

# Program Outcomes for Post Graduate Program (CBCS) in the Faculty of Sciences

| | | |
|---|---|---|
| **PO1** | Knowledge | Capable of demonstrating comprehensive disciplinary knowledge gained during course of study |
| **PO2** | Communication | Ability to communicate effectively on general and scientific topics with the scientific community and with society at large |
| **PO3** | Problem Solving | Capability of applying knowledge to solve scientific and other problems |
| **PO4** | Individual and Team Work | Capable to learn and work effectively as an individual, and as a member or leader in diverse teams, in multidisciplinary settings. |
| **PO5** | Investigation of Problems | Ability of critical thinking, analytical reasoning and research based knowledge including design of experiments, analysis and interpretation of data to provide conclusions |
| **PO6** | Modern Tool usage | Ability to use and learn techniques, skills and modern tools for scientific practices |
| **PO7** | Science and Society | Ability to apply reasoning to assess the different issues related to society and the consequent responsibilities relevant to the professional scientific practices |
| **PO8** | Life-Long Learning | Aptitude to apply knowledge and skills that are necessary for participating in learning activities throughout the life |
| **PO9** | Environment and Sustainability | Ability to design and develop modern systems which are environmentally sensitive and to understand the importance of sustainable development. |
| **PO10** | Ethics | Apply ethical principles and professional responsibilities in scientific practices |
| **PO11** | Project Management | Ability to demonstrate knowledge and understanding of the scientific principles and apply these to manage projects |

# Program Specific Outcomes for Post Graduate Program (CBCS) in the subject of Computer Science

***After successful completion of the program, a student will be able to:***

| | |
|---|---|
| **PSO1** | Develop competency to administer knowledge and awareness in the computing discipline along with learning aptitude for lifelong endurance in professional realm. |
| **PSO2** | Develop proficiency to adapt to contemporary technologies, skills and models for computing practice. |
| **PSO3** | Acquire expertise to adopt skills realized during research, experimentation and trending technology cognizance to solve industrial problems. |
| **PSO4** | Promote professional competence to aspire careers in Commercial/ Government Sectors, Academics/ consultancy/ Research and Development for technological innovations, and collateral fields related to Computer Science and Information Technology. |
| **PSO5** | Foster analytical skills for programming and adept computer based designing of systems in the domains concordant to Algorithm Design, System Software, Web and Application Designing, Data Science & Analytics, Artificial Intelligence & Machine Intelligence, Graphics and Visualization, and Networking Services. |

## Outline of Type of courses

- **Core Course**: A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.
- **Discipline Specific Elective (DSE) Course**: Elective courses may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective. The University/Institute may also offer discipline related Elective courses of interdisciplinary nature (to be offered by main discipline/subject of study).
- **Skill Enhancement Courses (SEC):** courses are the courses based upon the content that leads to Knowledge enhancement. These courses are value-based and/or skill-based and are aimed at providing hands-on-training, competencies, skills. These courses may be chosen from a pool of courses designed to provide value-based and/or skill-based knowledge.
- **Open Elective Courses (OEC):** For Open Elective courses, students will have to choose a course from the list of open electives offered by other Departments of University.
- **Ability Enhancement Courses (AEC):** These courses enhance the ability of a student which includes Communication Skills course.

# Outline of Mode of Learning

- **Self-Learning (SL):** Self learning by students using prescribed open learning resource.
- **Guided Self Learning (GSL):** Guided Self learning-teachers to brief students about the open learning resources.
- **Blended Learning (BL):** Blended learning in the classroom-using traditional teaching combined with digital learning.
- **Classroom Learning (CL):** Only classroom, lab or field learning.

## Self-Learning Courses(SL)

# Guidelines:

**Objective:** These courses intend to create habits of reading books and to develop writing skills in a manner of creativity and originality. The students are to emphasis his/her own ideas/words which he/she has learnt from open learning resources, different books, journals and newspapers and deliberate the same by adopting different ways of communication techniques and adopting time scheduling techniques in their respective fields of research.

**Aims:**

- To motivate the students for innovative, research and analytical work
- To inculcate the habit of self-study and comprehension
- To infuse the sense of historical back ground of the problems
- To assess intensity of originality and creativity of the students

**Instructions for Students**

- Each student has to select a topic related to title of the course.
- Each student has to prepare a manuscript related to title of the course.
- Expected to be creative and original in approach.
- Submit handwritten manuscript of A4 size 8-10 pages.
- Organize manuscript in three broad steps:
    - Introduction
    - Main Body
    - Conclusions
- Use headings and sub-headings.
- Use graphics wherever necessary.
- Give a list of books/references cited/used.

## The examiner will assess the students as follows:

**Where MaximumMarks-25**

- Manuscript :10 Marks
- Viva-Voce :15 marks.

# Guided Self-Learning Courses (GSL)

# Guidelines:

Each student has to select a topic and prepare a presentation related to title of the course based on guided self-learning. Head of the department will create a mentor-mentee group (ten students per group). A mentor will guide mentees in choosing topic and preparing presentation. Each student will have to deliver a presentation of 15 minutes' duration before the students and teachers of the department. **A three-member committee (mentor of student and two teachers of the department of different branches) duly approved by the departmental council will be constituted to evaluate the presentation.** The following factors will be taken into consideration while evaluating the students.

**Where Maximum Marks-25**

Presentation: 10 marks
Depth of the subject matter: 10 marks
Viva-Voce: 05 marks

# Proposed Scheme of Examination and syllabus for M.Sc. – COMPUTER SCIENCE (Under Multiple Entry-Exit, Internship and CBCS in accordance to NEP-2020) w.e.f. 2023-2024 in Phased Manner

| Semester | Core-Course (C.C.) Subject-1 | Core-Course (C.C.) Subject-2 | Core-Course (C.C.) Subject-3 | Core-Course (C.C.) Subject-4 | Core-Course (C.C.) Subject-5 | Core-Course (C.C.) Subject-6 | Core-Course (C.C.) Subject-7 | Core-Course (C.C.) Subject-8 | Core-Course (C.C.) Subject-9 | Open Elective./MOOC S Courses | Total Credits | Exit option |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I | 21MCS101 Mathematical foundations of computing | 21MCS102 Data structure using C | 21MCS103 Database management system | 21MCS104 Fundamentals of web designing | 21MCS105 Computer architecture and organization | 21MCS106 Lab -I Based on 21MCS102 | 21MCS107 Lab -II Based on 21MCS103 | 21MCS108 Lab -III Based on 21MCS104 | 21MCS109 Seminar 1 | Select from Open elective pool | 29 | PG-Diploma in Computer Science |
| II | 21MCS201 Operating system and Unix | 21MCS202 Data communication and computer networks | 21MCS203 Data Mining | 21MCS204 Object oriented prog. using JAVA | 21MCS205 Artificial Intelligence | 21MCS206 Lab IV Based on 21MCS201 | 21MCS207 Lab V Based on 21MCS204 | 21MCS208 Programming in MATLAB | 21MCS209 Seminar 2 | 21CS100 Communication Skills | 28 | |
| Students existing the programme after second semester will be awarded PG-diploma in Computer Science | | | | | | | | | | | | |
| Semester | Core Course (C.C.) Subject-1 | Core Course (C.C.) Subject-2 | Core Course (C.C.) Subject-3 | Core Course (C.C.) Subject-4 | Core Course (C.C.) Subject-5 | Core Course (C.C.) Subject-6 | Core Course (C.C.) Subject-7 | | Open Elective./MOOC S Courses | | Total Credits | Exit Option |
| III | 21MCS301 Python Programming | 21MCS302 Computer Graphics | 21MCS303 Software Engineering | Elective 1 Group X/Y/Z | Elective 2 Group X/Y/Z | 21MCS306 LabVI Based o 21 MCS301 | 21MCS307 LabVII Based o 21 MCS302 | 21MCS308 Mini Project | Select from Open elective pool | | 28 | Post Graduate degree in Computer Science |
| IV | 21MCS401 Internship | 21MCS402 Dissertation | | | | | | | | | 20 | |

# Scheme of Examination for M.Sc.Computer Science

**Semester: 1st (w.e.f. Session 2021-22)** **Credits – 29** **Marks – 925**

| Sr. No. | Course/ Paper Code | Title of the Course | Mode of Learning | Course Type | Credit | | | Contact Hours per Week | | | Examination Scheme | | | Total Marks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Theory | Practical/ Seminar | Total | Theory | Practical /Seminar | Total | Major Test (End Semester Exam) | Internal Assessment | Practical (External) | |
| 1 | 21MCS101 | Mathematical Foundations of Computing | CL/BL | CC | 4 | -- | 4 | 4 | -- | 4 | 80 | 20 | -- | 100 |
| 2 | 21MCS102 | Data Structure using C | CL/BL | CC | 4 | -- | 4 | 4 | -- | 4 | 80 | 20 | -- | 100 |
| 3 | 21MCS103 | Database Management System | CL/BL | CC | 4 | -- | 4 | 4 | -- | 4 | 80 | 20 | -- | 100 |
| 4 | 21MCS104 | Fundamentals of web Designing | CL/BL | CC | 4 | -- | 4 | 4 | -- | 4 | 80 | 20 | -- | 100 |
| 5 | 21MCS105 | Computer Architecture and Organization | CL/BL | CC | 4 | -- | 4 | 4 | -- | 4 | 80 | 20 | -- | 100 |
| 6 | 21MCS106 | LAB - I ( Based on 21MCS102) | CL | SEC | -- | 2 | 2 | -- | 4 | 4 | -- | 20 | 80 | 100 |
| 7 | 21MCS107 | LAB - II (Based on 21MCS103) | CL | SEC | -- | 2 | 2 | -- | 4 | 4 | -- | 20 | 80 | 100 |
| 8 | 21MCS108 | LAB - III (Based on 21MCS104) | CL | SEC | -- | 2 | 2 | -- | 4 | 4 | -- | 20 | 80 | 100 |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9 | 21MCS109 | Seminar-I | GSL | SEC | 1 | -- | 1 | 1 | -- | 1 | -- | 25 | -- | 25 |
| 10 | | Open Elective-I/MOOCs Courses | BL | OEC | 2 | -- | 2 | 2 | -- | 2 | 80 | 20 | -- | 100 |
| | Total | | | | | | 29 | | | 35 | | | | 925 |

**Note: 1. For Open Elective-I, Students will have to choose a course from the list of open electives offered by other Departments of University.**

**CC - Core Course; SEC-Skill Enhancement Course; CMC-Complimentary Course; OEC-Open Elective Course;**

## Scheme of Examination for M.Sc. Computer Science

**Semester: 2nd (w.e.f. Session 2021-22) Credits – 28 Marks – 875**

| Sr. No. | Course/ Paper Code | Title of the Course | Mode of Learning | Course Type | Credit | | | Contact Hours per Week | | | Examination Scheme | | | Total Marks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Theory | Practical/ Seminar | Total | Theory | Practical /Seminar | Total | Major Test (End Semester Exam) | Internal Assessment | Practical (External) | |
| 1 | 21MCS201 | Operating System and UNIX | CL/BL | CC | 4 | -- | 4 | 4 | -- | 4 | 80 | 20 | -- | 100 |
| 2 | 21MCS202 | Data Communication and Computer Networks | CL/BL | CC | 4 | -- | 4 | 4 | -- | 4 | 80 | 20 | -- | 100 |
| 3 | 21MCS203 | Data Mining | CL/BL | CC | 4 | -- | 4 | 4 | -- | 4 | 80 | 20 | -- | 100 |
| 4 | 21MCS204 | Object Oriented Programming using JAVA | CL/BL | CC | 4 | -- | 4 | 4 | -- | 4 | 80 | 20 | -- | 100 |
| 5 | 21MCS205 | Artificial Intelligence | CL/BL | CC | 4 | -- | 4 | 4 | -- | 4 | 80 | 20 | -- | 100 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6 | 21MCS206 | LAB - IV (Based on 21MCS201) | CL | SEC | -- | 2 | 2 | -- | 4 | 4 | -- | 20 | 80 | 100 |
| 7 | 21MCS207 | LAB - V (Based on 21MCS204) | CL | SEC | -- | 2 | 2 | -- | 4 | 4 | -- | 20 | 80 | 100 |
| 8 | 21MCS208 | Programming in MATLAB | CL | SEC | -- | 2 | 2 | -- | 4 | 4 | -- | 20 | 80 | 100 |
| 9 | 21MCS209 | Seminar-II | SL | SEC | -- | 1 | 1 | -- | -- | -- | -- | -- | 25 | 25 |
| 10 | 21CS100 | Communication Skills | BL | AEC | -- | 1 | 1 | -- | 2 | 2 | -- | 50 | -- | 50 |
| | Total | | | | | | 28 | | | 34 | | | | 875 |

**CC - Core Course; SEC-Skill Enhancement Course; CMC-Complimentary Course; OEC-Open Elective Course;**
**AEC: Ability Enhancement Course;**

## Scheme of Examination for M.Sc. Computer Science

**Semester: 3rd (w.e.f. Session 2021-22) Credits – 28 Marks – 900**

| Sr. No. | Course/ Paper Code | Title of the Course | Mode of Learning | Course Type | Credits | | | Contact Hours per Week | | | Examination Scheme | | | Total Marks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Theory | Practical/ Seminar | Total | Theory | Practical/ Seminar | Total | Major Test (End Semester Exam) | Internal Assessment | Practical (External) | |
| 1 | 21MCS301 | Python Programming | CL/BL | CC | 4 | -- | 4 | 4 | -- | 4 | 80 | 20 | -- | 100 |
| 2 | 21MCS302 | Computer Graphics | CL/BL | CC | 4 | -- | 4 | 4 | -- | 4 | 80 | 20 | -- | 100 |
| 3 | 21MCS303 | Software Engineering | CL/BL | CC | 4 | -- | 4 | 4 | -- | 4 | 80 | 20 | -- | 100 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | Elective-I (Group X/Y/Z) | | CL/BL | CC | 4 | -- | 4 | 4 | -- | 4 | 80 | 20 | -- | 100 |
| 5 | Elective-II (Group X/Y/Z) | | CL/BL | CC | 4 | -- | 4 | 4 | -- | 4 | 80 | 20 | -- | 100 |
| 6 | 21MCS306 | LAB VI (Based on 21MCS301) | CL | SEC | -- | 2 | 2 | -- | 4 | 4 | -- | 20 | 80 | 100 |
| 7 | 21MCS307 | LAB VII (Based on 21MCS302) | CL | SEC | -- | 2 | 2 | -- | 4 | 4 | -- | 20 | 80 | 100 |
| 8 | 21MCS308 | Mini Project* | GSL | CC | -- | 2 | 2 | -- | 4 | 4 | -- | 20 | 80 | 100 |
| 9 | | Open Elective-II/MOOCs Courses | BL | OEC | 2 | -- | 2 | 2 | -- | 2 | 80 | 20 | -- | 100 |
| | Total | | | | | | 28 | | | 34 | | | | 900 |

**Note: For Open Elective-II, student have to choose a course from the list of open electives offered by other departments of University**

***After completition of 2nd Sem examinations, Student will undergo Summer Training of Six Weeks durationand report will be evaluated in the Mini Project in 3rd Semester by the External Examiner.**

**CC - Core Course; SEC-Skill Enhancement Course; OEC-Open Elective Course;**

# Scheme of Examination for M.Sc. Computer Science

**Semester: 4th (w.e.f. Session 2021-22) Credits – 20 Marks – 550**

| Sr. No. | Course/ Paper Code | Title of the Course | Mode of Learning | Course Type | Credits | | | Contact Hours per Week | | | Examination Scheme | | | Total Marks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Theory | Practical/ Seminar | Total | Theory | Practical/ Seminar | Total | Major Test (End Semester Exam) | Internal Assessment | Practical (External) | |
| 1 | 21MCS401 | Internship | SL | CC | -- | -- | 20 | -- | -- | -- | 450 | 100 | -- | 550 |
| 2 | 21MCS402 | Dissertation | GSL | | | | | | | | | | | |
| | | Total | | | | | 20 | | | -- | | | | 550 |

Note: Students will have to choose one option from Internship or Dissertation. Students will have to submit Internship Report after successful completition of Internship. For Dissertation, class will be divided into groups and each group will be assigned to a supervisor for guiding the dissertation work.

**CC - Core Course; SEC-Skill Enhancement Course; OEC-Open Elective Course;**

# LIST OF ELECTIVE PAPERS

## *Specialization - DATA ANALYTICS (GROUP X)*

| Course/ Paper Code | Name of Paper |
|---|---|
| 21MCS309 | R programming |
| 21MCS310 | Machine Learning |
| 21MCS311 | Social Network Analysis for Big Data |
| 21MCS312 | Soft Computing |

## *Specialization – CYBER SECURITY (GROUP Y)*

| Course/ Paper Code | Name of Paper |
|---|---|
| 21MCS313 | Introduction to Information Security & Cryptography |
| 21MCS314 | Cloud Computing Fundamentals & its Security |
| 21MCS315 | Mobile Wireless and VOIP Security |
| 21MCS316 | Intrusion Detection Systems and Analysis |

## *Specialization – NETWORKING (GROUP Z)*

| Course/ Paper Code | Name of Paper |
|---|---|
| 21MCS317 | Wireless and Mobile Networks |
| 21MCS318 | Wireless Internet and Pervasive Computing |
| 21MCS319 | Mobile Adhoc Network |
| 21MCS320 | Internet of Things |

**CO-PSO (Program Specific Outcomes) matrix for the course 21MCS101(Mathematical foundations of computing)**

| COs | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| 21MCS101.1 | 2 | 3 | 2.5 | 2 | 3 |
| 21MCS101.2 | 2 | 3 | 2.5 | 3 | 2 |
| 21MCS101.3 | 2 | 2.5 | 3 | 3 | 2.5 |
| 21MCS101.4 | 2 | 3 | 2.5 | 2 | 3 |
| Average | 2 | 2.8 | 2.6 | 2.5 | 2.6 |

**CO-PO (Program Outcomes) matrix for the course 21MCS101 (Mathematical foundations of computing**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 21MCS101.1 | 3 | 3 | 3 | - | 2 | 3 | - | 2 | 3 | - | 3 |
| 21MCS101.2 | 2 | 2 | 3 | - | 2 | 3 | - | 2 | 3 | - | 3 |
| 21MCS101.3 | 3 | 3 | 3 | - | 2 | 3 | - | 3 | 3 | -- | 2 |
| 21MCS101.4 | 2.5 | 2 | 2 | - | 2 | 3 | - | 2 | 3 | - | 3 |
| Average | 2.6 | 2.5 | 2.7 | | 2 | 3 | | 2.25 | 3 | | 2.75 |

**CO-PSO (Program Specific Outcomes) matrix for the course 21MCS102 (Data structure using C)**

| COs | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| 21MCS102.1 | 2 | 3 | 2 | 3 | 3 |
| 21MCS102.2 | 3 | 3 | 3 | 3 | 2 |
| 21MCS102.3 | 3 | 3 | 3 | 3 | 3 |
| 21MCS102.4 | 2 | 2 | 2 | 3 | 3 |
| Average | 2.5 | 2.75 | 2.5 | 3 | 2.75 |

**CO-PO (Program Outcomes) matrix for the course 21MCS102 (Data structure using C)**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 21MCS102.1 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 2 | 3 | - | 3 |
| 21MCS102.2 | 3 | 2 | 3 | 2 | 3 | 3 | 2.5 | 3 | 2 | - | 3 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **21MCS102.3** | **2** | **3** | **3** | **3** | **3** | **2.5** | **3** | **3** | **3** | **-** | **2** |
| **21MCS102.4** | **3** | **3** | **3** | **3** | **3** | **2** | **2** | **2** | **3** | **-** | **2** |
| **Average** | **2.75** | **2.75** | **3** | **2.5** | **2.75** | **2.6** | **2.6** | **2.5** | **2.75** | | **2.5** |

**CO-PSO (Program Specific Outcomes) matrix for the course 21MCS103(Database management system)**

| COs | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| **21MCS103.1** | **3** | **3** | **3** | **3** | **3** |
| **21MCS103.2** | **3** | **2** | **2** | **2** | **3** |
| **21MCS103.3** | **3** | **2** | **3** | **3** | **2** |
| **21MCS103.4** | **3** | **3** | **3** | **3** | **2.5** |
| **Average** | **3** | **2.5** | **2.75** | **2.75** | **2.6** |

**CO-PO (Program Outcomes) matrix for the course 21MCS103(Database management system)**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **21MCS103.1** | **3** | **3** | **2** | **3** | **3** | **3** | **3** | **3** | **3** | **-** | **2** |
| **21MCS103.2** | **3** | **2** | **2** | **2** | **3** | **3** | **2** | **3** | **3** | **-** | **3** |
| **21MCS103.3** | **3** | **3** | **2** | **3** | **3** | **2** | **2** | **3** | **3** | **--** | **2** |
| **21MCS103.4** | **3** | **2** | **3** | **3** | **3** | **2** | **3** | **3** | **2** | **-** | **3** |
| **Average** | **3** | **2.5** | **2.25** | **2.75** | **3** | **2.5** | **2.5** | **3** | **2.75** | | **2.5** |

**CO-PSO (Program Specific Outcomes) matrix for the course 21MCS104(Fundamental of Web Designing)**

| COs | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| **21MCS104.1** | **3** | **3** | **3** | **3** | **2** |
| **21MCS104.2** | **3** | **2** | **3** | **3** | **3** |
| **21MCS104.3** | **3** | **3** | **3** | **3** | **2** |
| **21MCS104.4** | **3** | **3** | **3** | **3** | **3** |
| **Average** | **3** | **2.75** | **3** | **3** | **2.5** |

**CO-PO (Program Outcomes) matrix for the course 21MCS104(Fundamental of Web Designing)**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 21MCS104.1 | 3 | 3 | 3 | 3 | 2.5 | 3 | 3 | 2 | 3 | - | 3 |
| 21MCS104.2 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | 2 |
| 21MCS104.3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | -- | 3 |
| 21MCS104.4 | 3 | 2 | 2 | 3 | 2.5 | 3 | 3 | 2 | 3 | - | 3 |
| Average | 3 | 2.5 | 2.75 | 2.75 | 2.7 | 3 | 3 | 2.5 | 3 | | 2.75 |

**CO-PSO (Program Specific Outcomes) matrix for the course 21MCS105 (Computer architecture and organisation)**

| COs | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| 21MCS105.1 | 3 | 3 | 3 | 3 | 3 |
| 21MCS105.2 | 3 | 3 | 3 | 3 | 3 |
| 21MCS105.3 | 3 | 2 | 3 | 3 | 3 |
| 21MCS105.4 | 3 | 3 | 3 | 3 | 2 |
| Average | 3 | 2.75 | 3 | 3 | 2.75 |

**CO-PO (Program Outcomes) matrix for the course 21MCS105 ((Computer architecture and organisation)**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 21MCS105.1 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | - | 2.5 |
| 21MCS105.2 | 3 | 3 | 3 | 3 | 3 | 2.5 | 2 | 3 | 2 | - | 2 |
| 21MCS105.3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | -- | 3 |
| 21MCS105.4 | 2 | 3 | 3 | 3 | 3 | 2.5 | 3 | 3 | 2 | - | 3 |
| Average | 2.5 | 3 | 2.75 | 3 | 3 | 2.75 | 2.75 | 3 | 2.5 | - | 2.6 |

**CO-PSO (Program Specific Outcomes) matrix for the course 21MCS106 (Lab-1 Based on 21MCS102)**

| Cos | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| 21MCS106.1 | 3 | 3 | 2 | 3 | 3 |
| 21MCS106.2 | 3 | 2 | 3 | 3 | 3 |
| 21MCS106.3 | 3 | 3 | 3 | 3 | 3 |
| 21MCS106.4 | 2.5 | 3 | 3 | 2 | 3 |
| Average | 2.8 | 2.75 | 3 | 2.75 | 3 |

**CO-PO (Program Outcomes) matrix for the course 21MCS106 (Lab-1 Based on 21MCS102)**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 21MCS106.1 | 3 | 2 | 2 | 3 | 2 | 2 | - | 2 | 3 | -- | 3 |
| 21MCS106.2 | 3 | 3 | 2 | 3 | 2 | 2 | - | 2.5 | 3 | -- | 2 |
| 21MCS106.3 | 3 | 2 | 2 | 3 | 2 | 2 | - | 2 | 2.5 | -- | 3 |
| 21MCS106.4 | 3 | 3 | 2 | 3 | 2 | 2 | - | 2.5 | 3 | -- | 3 |
| Average | 3 | 2.75 | 2 | 3 | 2 | 2 | - | 2.25 | 2.8 | -- | 2.75 |

**CO-PSO (Program Specific Outcomes) matrix for the course 21MCS107 (Lab-I1 Based on 21MCS103)**

| Cos | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| 21MCS107.1 | 3 | 3 | 2 | 3 | 3 |
| 21MCS107.2 | 3 | 2 | 3 | 2.5 | 3 |
| 21MCS107.3 | 3 | 2 | 3 | 3 | 2 |
| 21MCS107.4 | 2 | 3 | 3 | 3 | 2 |
| Average | 2.75 | 2.5 | 2.75 | 2.8 | 2.5 |

**CO-PO (Program Outcomes) matrix for the course 21MCS107 (Lab-II Based on 21MCS103**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 21MCS107.1 | 3 | 2.5 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | -- | 3 |
| 21MCS107.2 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | -- | 3 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **21MCS107.3** | **3** | **2.5** | **3** | **3** | **2.5** | **2** | **3** | **3** | **3** | **--** | **2** |
| **21MCS107.4** | **3** | **2** | **3** | **2** | **3** | **3** | **3** | **2** | **3** | **--** | **2** |
| **Average** | **3** | **2.25** | **3** | **2.75** | **2.8** | **2.75** | **3** | **2.25** | **3** | **--** | **2.75** |

**CO-PSO (Program Specific Outcomes) matrix for the course 21MCS108 (Lab-III Based on 21MCS104)**

| Cos | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| **21MCS108.1** | **3** | **3** | **3** | **3** | **3** |
| **21MCS108.2** | **3** | **3** | **3** | **2** | **3** |
| **21MCS108.3** | **2** | **3** | **3** | **3** | **3** |
| **21MCS108.4** | **3** | **2.5** | **3** | **2** | **3** |
| **Average** | **2.75** | **2.8** | **3** | **2.5** | **3** |

**CO-PO (Program Outcomes) matrix for the course 21MCS108 (Lab-III Based on 21MCS104)**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **21MCS108.1** | **3** | **2** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **--** | **3** |
| **21MCS108.2** | **3** | **2** | **3** | **2** | **3** | **2.5** | **3** | **3** | **3** | **--** | **3** |
| **21MCS108.3** | **2.5** | **2** | **3** | **3** | **3** | **3** | **3** | **3** | **2** | **--** | **3** |
| **21MCS108.4** | **2.5** | **2** | **2** | **2** | **3** | **3** | **3** | **3** | **3** | **--** | **3** |
| **Average** | **2.75** | **2** | **3** | **2.5** | **3** | **2.8** | **3** | **3** | **2.75** | **--** | **3** |

**CO-PSO (Program Specific Outcomes) matrix for the course 21MCS109 (Seminar )**

| Cos | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| **21MCS109.1** | **2.5** | **3** | **3** | **2.5** | **2** |
| | | | | | |
| | | | | | |
| | | | | | |
| **Average** | **2.5** | **3** | **3** | **2.5** | **2** |

**CO-PO (Program Outcomes) matrix for the course 21MCS109 (Seminar )**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 21MCS109.1 | 3 | 3 | 3 | 3 | 3 | 3 | 2.5 | 3 | 3 | 3 | 2 |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| Average | 3 | 3 | 3 | 3 | 3 | 3 | 2.5 | 3 | 3 | 3 | 2 |

**CO-PSO (Program Specific Outcomes) matrix for the course Open Elective**

| Cos | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| Open Elective | 2.5 | 2 | 3 | 3 | 3 |
| Open Elective | 3 | 2 | 3 | 2 | 3 |
| Open Elective | 2.5 | 2 | 3 | 3 | 3 |
| Open Elective | 3 | 2 | 3 | 3 | 3 |
| Average | 2.75 | 2 | 3 | 2.75 | 3 |

**CO-PO (Program Outcomes) matrix for the course Open Elective**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Open Elective | 3 | 3 | 2.5 | 3 | 3 | 2 | 3 | 3 | 2 | 3 | 2 |
| Open Elective | 2 | 3 | 3 | 2.5 | 3 | 2 | 3 | 2 | 3 | 2 | 2 |
| Open Elective | 3 | 3 | 3 | 2.5 | 3 | 2 | 3 | 3 | 3 | 2 | 2 |
| Open Elective | 3 | 3 | 2.5 | 2.5 | 3 | 2 | 3 | 2.5 | 2 | 2.5 | 2 |
| Average | 2.75 | 3 | 2.75 | 2.6 | 3 | 2 | 3 | 2.6 | 2.5 | 2.6 | 2 |

**CO-PSO (Program Specific Outcomes) matrix for the course 21MCS201 (Operating system and Unix)**

| Cos | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| 21MCS201.1 | 3 | 3 | 2 | 3 | 3 |
| 21MCS201.2 | 3 | 2 | 3 | 3 | 2 |
| 21MCS201.3 | 3 | 3 | 3 | 3 | 2 |

| | | | | | |
|---|---|---|---|---|---|
| **21MCS201.4** | **3** | **2** | **2** | **3** | **2.5** |
| **Average** | **3** | **2.75** | **2.5** | **3** | **2.3** |

**CO-PO (Program Outcomes) matrix for the course 21MCS201 (Operating system and Unix)**

| Cos | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **21MCS201.1** | **2** | **3** | **2** | **3** | **3** | **2** | **3** | **3** | **2** | **2** | **3** |
| **21MCS201.2** | **2** | **3** | **3** | **3** | **3** | **3** | **2.5** | **3** | **2** | **3** | **3** |
| **21MCS201.3** | **3** | **3** | **3** | **3** | **2** | **2** | **3** | **2** | **2** | **3** | **3** |
| **21MCS201.4** | **3** | **3** | **3** | **3** | **2** | **3** | **2** | **2** | **2** | **3** | **3** |
| **Average** | **2.5** | **3** | **2.75** | **3** | **2.75** | **2.5** | **2.6** | **2.75** | **2** | **2.75** | **3** |

**CO-PSO (Program Specific Outcomes) matrix for the course 21MCS202 (Data Communication and Computer Network)**

| Cos | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| **21MCS202.1** | **2** | **3** | **2** | **3** | **3** |
| **21MCS202.2** | **3** | **3** | **2.5** | **3** | **2** |
| **21MCS202.3** | **2.5** | **3** | **2** | **3** | **2** |
| **21MCS202.4** | **3** | **3** | **2.5** | **3** | **3** |
| **Average** | **2.6** | **3** | **2.25** | **3** | **2.5** |

**CO-PO (Program Outcomes) matrix for the course 21MCS202 (Data Communication and Computer Network)**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **21MCS202.1** | **3** | **3** | **2** | **2** | **3** | **3** | **2** | **3** | **2.5** | **2** | **2** |
| **21MCS202.2** | **3** | **3** | **3** | **2** | **3** | **3** | **2** | **3** | **2** | **2** | **3** |
| **21MCS202.3** | **3** | **2.5** | **3** | **3** | **3** | **2.5** | **2** | **3** | **2.5** | **3** | **3** |
| **21MCS202.4** | **3** | **3** | **3** | **2** | **3** | **2** | **2** | **3** | **2** | **3** | **3** |
| **Average** | **3** | **2.8** | **2.75** | **2.25** | **3** | **2.6** | **2** | **3** | **2.25** | **2.5** | **2.75** |

**CO-PSO (Program Specific Outcomes) matrix for the course 21MCS203(Data Mining)**

| Cos | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| 21MCS203.1 | 3 | 3 | 3 | 3 | 3 |
| 21MCS203.2 | 3 | 3 | 2 | 2 | 2.5 |
| 21MCS203.3 | 3 | 3 | 3 | 3 | 2.5 |
| 21MCS203.4 | 3 | 3 | 3 | 2 | 3 |
| Average | 3 | 3 | 2.75 | 2.5 | 2.75 |

**CO-PO (Program Outcomes) matrix for the course 21MCS203 (Data Mining)**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 21MCS203.1 | 3 | 2.5 | 2.5 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 2 |
| 21MCS203.2 | 3 | 3 | 3 | 2.5 | 3 | 2 | 3 | 3 | 2 | 3 | 2 |
| 21MCS203.3 | 3 | 2 | 3 | 2 | 3 | 2 | 3 | 3 | 3 | 2 | -2 |
| 21MCS203.4 | 3 | 2.5 | 2.5 | 2.5 | 3 | 2 | 2 | 3 | 3 | 2 | 2 |
| Average | 3 | 2.5 | 2.75 | 2.25 | 3 | 2 | 2.75 | 3 | 2.75 | 2.5 | 2 |

**CO-PSO (Program Specific Outcomes) matrix for the course 21MCS204 (Object Oriented Prog. using JAVA)**

| Cos | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| 21MCS204.1 | 3 | 3 | 3 | 3 | 3 |
| 21MCS204.2 | 3 | 3 | 3 | 2.5 | 2 |
| 21MCS204.3 | 2 | 3 | 3 | 3 | 2 |
| 21MCS204.4 | 3 | 3 | 3 | 3 | 2 |
| Average | 2.75 | 3 | 3 | 2.8 | 2.25 |

**CO-PO (Program Outcomes) matrix for the course 21MCS204 (Object Oriented Prog. using JAVA)**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 21MCS204.1 | 2 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 |
| 21MCS204.2 | 2 | 3 | 2.5 | 3 | 3 | 3 | 3 | 2.5 | 3 | 2 | 3 |
| 21MCS204.3 | 2 | 3 | 3 | 2 | 3 | 3 | 2.5 | 3 | 3 | 2 | 2 |
| 21MCS204.4 | 2 | 3 | 2.5 | 2 | 2 | 3 | 3 | 2.5 | 3 | 2 | 2 |
| Average | 2 | 3 | 2.75 | 2.5 | 2.75 | 3 | 2.6 | 2.75 | 3 | 2.25 | 2.5 |

**CO-PSO (Program Specific Outcomes) matrix for the course 21MCS205 (Artificial Intelligence)**

| Cos | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| 21MCS205.1 | 3 | 3 | 3 | 3 | 3 |
| 21MCS205.2 | 2.5 | 2.5 | 3 | 3 | 2 |
| 21MCS205.3 | 3 | 3 | 3 | 3 | 3 |
| 21MCS205.4 | 3 | 3 | 3 | 2 | 3 |
| Average | 2.8 | 2.8 | 3 | 2.75 | 2.75 |

**CO-PO (Program Outcomes) matrix for the course 21MCS205 (Artificial Intelligence)**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 21MCS205.1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | - | 3 |
| 21MCS205.2 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | - | 3 |
| 21MCS205.3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | -- | 3 |
| 21MCS205.4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | 2 |
| Average | 3 | 3 | 3 | 3 | 3 | 2.75 | 2.5 | 2.75 | 3 | - | 2.75 |

**CO-PSO (Program Specific Outcomes) matrix for the course 21MCS206(Lab IV Based on 21MCS201)**

| Cos | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| 21MCS206.1 | 3 | 3 | 2 | 3 | 3 |
| 21MCS206.2 | 3 | 3 | 3 | 2.5 | 3 |
| 21MCS206.3 | 3 | 3 | 3 | 3 | 3 |
| 21MCS206.4 | 3 | 3 | 2 | 3 | 3 |
| Average | 3 | 3 | 2.5 | 2.8 | 3 |

**CO-PO (Program Outcomes) matrix for the course 21MCS206(Lab IV Based on 21MCS201)**

| Cos | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 21MCS206.1 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2.5 |
| 21MCS206.2 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 2.5 | 2 |
| 21MCS206.3 | 2.5 | 2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **21MCS206.4** | **3** | **2** | **3** | **3** | **2** | **2** | **3** | **3** | **3** | **3** | **2** |
| **Average** | **2.6** | **2.25** | **3** | **3** | **2.5** | **2.5** | **3** | **3** | **3** | **2.8** | **2.3** |

**CO-PSO (Program Specific Outcomes) matrix for the course 21MCS 207 (Lab V Based on 21MCS204)**

| Cos | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| **21MCS 207.1** | **3** | **2** | **3** | **2.5** | **3** |
| **21MCS 207.2** | **3** | **3** | **2** | **2.5** | **3** |
| **21MCS 207.3** | **3** | **2** | **3** | **3** | **3** |
| **21MCS 207.4** | **3** | **2** | **2** | **3** | **3** |
| **Average** | **3** | **2.25** | **2.5** | **2.75** | **3** |

**CO-PO (Program Outcomes) matrix for the course 21MCS 207 (Lab V Based on 21MCS204)**

| Cos | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **21MCS 207.1** | **3** | **2.5** | **3** | **3** | **3** | **2.5** | **3** | **3** | **3** | **2** | **2** |
| **21MCS 207.2** | **3** | **2.5** | **3** | **2** | **3** | **3** | **3** | **3** | **3** | **3** | **2** |
| **21MCS 207.3** | **3** | **2.5** | **3** | **3** | **3** | **2.5** | **3** | **3** | **3** | **3** | **2** |
| **21MCS 207.4** | **3** | **3** | **3** | **2** | **3** | **3** | **3** | **3** | **3** | **3** | **2** |
| **Average** | **3** | **2.6** | **3** | **2.5** | **3** | **2.75** | **3** | **3** | **3** | **2.75** | **2** |

**CO-PSO (Program Specific Outcomes) matrix for the course 21MCS208 (Programming in MATLAB)**

| Cos | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| **21MCS208.1** | **3** | **2** | **3** | **2** | **3** |
| **21MCS208.2** | **2** | **3** | **3** | **2.5** | **2** |
| **21MCS208.3** | **2** | **2** | **2** | **2.5** | **3** |
| **21MCS208.4** | **3** | **2** | **3** | **3** | **3** |
| **Average** | **2.5** | **2.25** | **2.75** | **2.5** | **2.75** |

**CO-PO (Program Outcomes) matrix for the course 21MCS208 (Programming in MATLAB)**

| Cos | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **21MCS208.1** | **3** | **2.5** | **3** | **3** | **3** | **2.5** | **3** | **3** | **3** | **2** | **2** |
| **21MCS208.2** | **3** | **2.5** | **3** | **2** | **3** | **3** | **3** | **3** | **3** | **3** | **2** |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **21MCS208.3** | **3** | **2.5** | **3** | **3** | **3** | **2.5** | **3** | **3** | **3** | **3** | **2** |
| **21MCS208.4** | **3** | **3** | **3** | **2** | **3** | **3** | **3** | **3** | **3** | **3** | **2** |
| **Average** | **3** | **2.6** | **3** | **2.5** | **3** | **2.75** | **3** | **3** | **3** | **2.75** | **2** |

**CO-PSO (Program Specific Outcomes) matrix for the course 21MCS209 (Seminar-II)**

| Cos | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| **21MCS209.1** | **3** | **2** | **3** | **2** | **3** |
| | | | | | |
| | | | | | |
| | | | | | |
| **Average** | **3** | **2** | **3** | **2** | **3** |

**CO-PO (Program Outcomes) matrix for the course 21MCS209 (Seminar-II)**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **21MCS209** | **3** | **2** | **3** | **3** | **3** | **2** | **3** | **3** | **3** | **3** | **2** |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| **Average** | **3** | **2** | **3** | **3** | **3** | **2** | **3** | **3** | **3** | **3** | **2** |

**CO-PSO (Program Specific Outcomes) matrix for the course 21CS100 (Communication Skills)**

| Cos | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| **21CS100.1** | **3** | **3** | **3** | **3** | **3** |
| **21CS100.2** | **2** | **3** | **2.5** | **3** | **3** |
| **21CS100.3** | **2** | **3** | **3** | **3** | **3** |
| **21CS100.4** | **3** | **3** | **3** | **3** | **2** |
| **Average** | **2.5** | **3** | **2.8** | **3** | **2.75** |

**CO-PO (Program Outcomes) matrix for the course 21CS100(Communication Skills)**

| Cos | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 21CS100.1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 21CS100.2 | 3 | 2.5 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 3 |
| 21CS100.3 | 3 | 3 | 2 | 3 | 2 | 2 | 3 | 3 | 3 | 3 | 3 |
| 21CS100.4 | 3 | 2.5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Average | 3 | 2.75 | 2.75 | 3 | 2.75 | 2.5 | 3 | 3 | 3 | 2.75 | 3 |

**CO-PSO (Program Specific Outcomes) matrix for the course 21MCS301(Python Programming)**

| COs | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| 21MCS301.1 | 2 | 3 | 3 | 2 | 3 |
| 21MCS301.2 | 2 | 3 | 2 | 3 | 2 |
| 21MCS301.3 | 3 | 2 | 3 | 2 | 3 |
| 21MCS301.4 | 2 | 3 | 3 | 2 | 3 |
| Average | 2.25 | 2.75 | 2.75 | 2.25 | 2.75 |

**CO-PO (Program Outcomes) matrix for the course 21MCS301 (Python Programming)**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 21MCS301.1 | 3 | 2 | 3 | - | 2 | 3 | - | 3 | 3 | - | 3 |
| 21MCS301.2 | 2 | 2 | 3 | - | 3 | 3 | - | 3 | 2 | - | 3 |
| 21MCS301.3 | 3 | 3 | 3 | - | 3 | 2 | - | 3 | 3 | -- | 2 |
| 21MCS301.4 | 3 | 2 | 2 | - | 2 | 3 | - | 3 | 2 | - | 3 |
| Average | 2.75 | 2.25 | 2.7 | | 2.5 | 2.75 | | 3 | 2.5 | | 2.75 |

**CO-PSO (Program Specific Outcomes) matrix for the course 21MCS302 (Computer Graphics)**

| COs | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| 21MCS302.1 | 2 | 3 | 2 | 3 | 3 |
| 21MCS302.2 | 3 | 3 | 3 | 3 | 2 |
| 21MCS302.3 | 3 | 3 | 3 | 3 | 3 |
| 21MCS302.4 | 2 | 2 | 2 | 3 | 3 |

| | | | | | |
|---|---|---|---|---|---|
| **Average** | **2.5** | **2.75** | **2.5** | **3** | **2.75** |

**CO-PO (Program Outcomes) matrix for the course 21MCS302 (Computer Graphics)**

| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **21MCS302.1** | **3** | **3** | **3** | **2** | **2** | **3** | **3** | **2** | **3** | **-** | **3** |
| **21MCS302.2** | **3** | **2** | **3** | **2** | **3** | **3** | **2.5** | **3** | **3** | **-** | **3** |
| **21MCS302.3** | **2** | **3** | **3** | **3** | **3** | **2.5** | **3** | **3** | **3** | **-** | **2** |
| **21MCS302.4** | **3** | **3** | **3** | **2** | **3** | **2.5** | **2** | **2** | **3** | **-** | **2** |
| **Average** | **2.75** | **2.75** | **3** | **2.25** | **2.75** | **2.75** | **2.6** | **2.5** | **3** | | **2.5** |

**CO-PSO (Program Specific Outcomes) matrix for the course 21MCS303 (Software Engineering)**

| **COs** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** |
|---|---|---|---|---|---|
| **21MCS303.1** | **3** | **3** | **3** | **3** | **3** |
| **21MCS303.2** | **2** | **2** | **3** | **3** | **3** |
| **21MCS303.3** | **2** | **2** | **3** | **3** | **2** |
| **21MCS303.4** | **3** | **2** | **3** | **3** | **2.5** |
| **Average** | **2.5** | **2.25** | **3** | **3** | **2.6** |

**CO-PO (Program Outcomes) matrix for the course 21MCS303(Software Engineering)**

| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **21MCS303.1** | **3** | **3** | **2** | **3** | **3** | **3** | **3** | **3** | **3** | **-** | **2** |
| **21MCS303.2** | **2** | **2** | **2** | **3** | **2** | **3** | **2** | **3** | **3** | **-** | **3** |
| **21MCS303.3** | **3** | **3** | **2** | **3** | **3** | **2** | **2** | **3** | **3** | **--** | **2** |
| **21MCS303.4** | **3** | **2** | **3** | **3** | **3** | **2** | **3** | **3** | **2** | **-** | **3** |
| **Average** | **2.75** | **2.5** | **2.25** | **3** | **2.75** | **2.5** | **2.5** | **3** | **2.75** | | **2.5** |

**CO-PSO (Program Specific Outcomes) matrix for the course (Elective -I)**

| COs | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| (Elective -I) | 2 | 3 | 2 | 3 | 3 |
| (Elective -I) | 3 | 3 | 3 | 3 | 2 |
| (Elective -I) | 3 | 3 | 3 | 3 | 3 |
| (Elective -I) | 2 | 2 | 2 | 3 | 3 |
| Average | 2.5 | 2.75 | 2.5 | 3 | 2.75 |

**CO-PO (Program Outcomes) matrix for the course (Elective -I)**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| (Elective -I) | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 2 | 3 | 2 | 3 |
| (Elective -I) | 3 | 2 | 3 | 2 | 3 | 2 | 2.5 | 3 | 3 | 2 | 3 |
| (Elective -I) | 3 | 3 | 3 | 3 | 3 | 2.5 | 3 | 3 | 3 | 3 | 2 |
| (Elective -I) | 3 | 3 | 3 | 2 | 3 | 2.5 | 2 | 2 | 3 | 3 | 2 |
| Average | 3 | 2.75 | 3 | 2.25 | 2.75 | 2.5 | 2.6 | 2.5 | 3 | 2.5 | 2.5 |

**CO-PSO (Program Specific Outcomes) matrix for the course Elective II**

| COs | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| Elective II | 3 | 3 | 3 | 3 | 3 |
| Elective II | 2 | 2 | 3 | 3 | 3 |
| Elective II | 2 | 2 | 3 | 3 | 2 |
| Elective II | 3 | 2 | 3 | 3 | 2.5 |
| Average | 2.5 | 2.25 | 3 | 3 | 2.6 |

**CO-PO (Program Outcomes) matrix for the course Elective II**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Elective II | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 |
| Elective II | 2 | 2.5 | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 |
| Elective II | 3 | 3 | 2 | 2 | 3 | 2 | 2 | 3 | 3 | 3 | 2 |
| Elective II | 3 | 2.5 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 3 | 3 |
| Average | 2.75 | 2.5 | 2.25 | 2.75 | 3 | 2.5 | 2.5 | 3 | 2.75 | 3 | 2.5 |

**CO-PSO (Program Specific Outcomes) matrix for the course 21MCS306 (Lab (Based on 21MCS301))**

| COs | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| 21MCS306.1 | 3 | 3 | 3 | 3 | 2 |
| 21MCS306.2 | 3 | 2 | 3 | 3 | 3 |
| 21MCS306.3 | 3 | 3 | 3 | 3 | 3 |
| 21MCS306.4 | 3 | 3 | 3 | 3 | 3 |
| Average | 3 | 2.75 | 3 | 3 | 2.75 |

**CO-PO (Program Outcomes) matrix for the course 21MCS306(Lab (Based on 21MCS301))**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 21MCS306.1 | 3 | 3 | 3 | 3 | 2.5 | 3 | 2 | 2 | 3 | - | 3 |
| 21MCS306.2 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | 2 |
| 21MCS306.3 | 3 | 3 | 2 | 2 | 3 | 2 | 3 | 3 | 3 | -- | 3 |
| 21MCS306.4 | 3 | 2 | 3 | 3 | 2 | 3 | 2 | 3 | 3 | - | 3 |
| Average | 3 | 2.5 | 2.75 | 2.75 | 2.6 | 2.75 | 2.5 | 2.75 | 3 | | 2.75 |

**CO-PSO (Program Specific Outcomes) matrix for the course 21MCS307 (Lab (Based on 21MCS302))**

| COs | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| 21MCS307.1 | 3 | 3 | 3 | 3 | 3 |
| 21MCS307.2 | 2 | 3 | 2 | 3 | 3 |

| | | | | | |
|---|---|---|---|---|---|
| **21MCS307.3** | **2** | **2** | **2** | **3** | **2** |
| **21MCS307.4** | **3** | **3** | **2** | **3** | **3** |
| **Average** | **2.5** | **2.75** | **2.25** | **3** | **2.75** |

**CO-PO (Program Outcomes) matrix for the course 21MCS307Lab (Based on 21MCS302)**

| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **21MCS307.1** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **-** | **3** |
| **21MCS307.2** | **2** | **3** | **2** | **3** | **2** | **3** | **2** | **3** | **2.5** | **-** | **2.5** |
| **21MCS307.3** | **3** | **3** | **3** | **3** | **3** | **2** | **3** | **3** | **3** | **--** | **3** |
| **21MCS307.4** | **3** | **3** | **2** | **3** | **3** | **2** | **3** | **3** | **3** | **-** | **2.5** |
| **Average** | **2.75** | **3** | **2.5** | **3** | **2.75** | **2.5** | **2.75** | **3** | **2.8** | **-** | **2.75** |

**CO-PSO (Program Specific Outcomes) matrix for the course 21MCS308 (Mini Project)**

| **Cos** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** |
|---|---|---|---|---|---|
| **21MCS308** | **3** | **2** | **2** | **2** | **3** |
| | | | | | |
| | | | | | |
| | | | | | |
| **Average** | **3** | **2.3** | **2.25** | **2.25** | **2.6** |

**CO-PO (Program Outcomes) matrix for the course 21MCS308 (Mini Project)**

| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **21MCS308** | **3** | **2** | **2.5** | **2** | **2** | **2.5** | **2** | **2** | **3** | **2** | **2** |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| **Average** | **3** | **2** | **2.25** | **2** | **2** | **2.5** | **2** | **2** | **3** | **2** | **2** |

**CO-PSO (Program Specific Outcomes) matrix for the course Open Elective II**

| Cos | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| Open Elective II | 2.5 | 2 | 3 | 3 | 3 |
| Open Elective II | 3 | 2 | 3 | 2 | 3 |
| Open Elective II | 2.5 | 2 | 3 | 3 | 3 |
| Open Elective II | 3 | 2 | 3 | 3 | 3 |
| Average | 2.75 | 2 | 3 | 2.75 | 3 |

**CO-PO (Program Outcomes) matrix for the course Open Elective II**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Open Elective II | 3 | 3 | 2.5 | 3 | 3 | 2 | 3 | 3 | 2 | 3 | 2 |
| Open Elective II | 2 | 3 | 3 | 2.5 | 3 | 2 | 3 | 2 | 3 | 2 | 2 |
| Open Elective II | 3 | 3 | 3 | 2.5 | 3 | 2 | 3 | 3 | 3 | 2 | 2 |
| Open Elective II | 3 | 3 | 2.5 | 2.5 | 3 | 2 | 3 | 2.5 | 2 | 2.5 | 2 |
| Average | 2.75 | 3 | 2.75 | 2.6 | 3 | 2 | 3 | 2.6 | 2.5 | 2.6 | 2 |

**CO-PSO (Program Specific Outcomes) matrix for the course 21MCS401 (Internship)**

| Cos | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| 21MCS401 | 3 | 3 | 3 | 3 | 3 |
| | | | | | |
| | | | | | |
| | | | | | |
| Average | 3 | 3 | 3 | 3 | 3 |

**CO-PO (Program Outcomes) matrix for the course 21MCS401 (Internship)**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 21MCS401 | 3 | 2 | 3 | 3 | 2 | 2 | 3 | 2 | 3 | 3 | 3 |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| Average | 3 | 2 | 3 | 3 | 2 | 2 | 3 | 2 | 3 | 3 | 3 |

**CO-PSO (Program Specific Outcomes) matrix for the course 21MCS402(Dissertation)**

| Cos | PSO1 | PSO2 | PSO3 | PSO4 | PSO |
|---|---|---|---|---|---|
| 21MCS402 | 3 | 3 | 3 | 3 | 3 |
| | | | | | |
| | | | | | |
| | | | | | |
| Average | 3 | 3 | 3 | 3 | 3 |

**CO-PO (Program Outcomes) matrix for the course 21MCS402(Dissertation)**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 21MCS402 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| Average | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

**Table-1: CO-PO-PSO mapping matrix for all the courses of M.Sc. Computer Science Programme**

| Course Code | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 21MCS101 | 2.6 | 2.5 | 2.7 | | 2 | 3 | | 2.25 | 3 | | 2.75 | 2 | 2.8 | 2.6 | 2.5 | 2.6 |
| 21MCS102 | 2.75 | 2.75 | 3 | 2.5 | 2.75 | 2.6 | 2.6 | 2.5 | 2.75 | | 2.5 | 2.5 | 2.75 | 2.5 | 3 | 2.75 |
| 21MCS103 | 3 | 2.5 | 2.25 | 2.75 | 3 | 2.5 | 2.5 | 3 | 2.75 | | 2.5 | 3 | 2.5 | 2.75 | 2.75 | 2.6 |
| 21MCS104 | 3 | 2.5 | 2.75 | 2.75 | 2.7 | 3 | 3 | 2.5 | 3 | | 2.75 | 3 | 2.75 | 3 | 3 | 2.5 |
| 21MCS105 | 2.5 | 3 | 2.75 | 3 | 3 | 2.75 | 2.75 | 3 | 2.5 | - | 2.6 | 3 | 2.75 | 3 | 3 | 2.75 |
| 21MCS106 | 3 | 2.75 | 2 | 3 | 2 | 2 | - | 2.25 | 2.8 | -- | 2.75 | 2.8 | 2.75 | 3 | 2.75 | 3 |
| 21MCS107 | 3 | 2.25 | 3 | 2.75 | 2.8 | 2.75 | 3 | 2.25 | 3 | -- | 2.75 | 2.75 | 2.5 | 2.75 | 2.8 | 2.5 |
| 21MCS108 | 2.75 | 2 | 3 | 2.5 | 3 | 2.8 | 3 | 3 | 2.75 | -- | 3 | 2.75 | 2.8 | 3 | 2.5 | 3 |
| 21MCS109 | 3 | 3 | 3 | 3 | 3 | 3 | 2.5 | 3 | 3 | 3 | 2 | 2.5 | 3 | 3 | 2.5 | 2 |
| Open Elective | 2.75 | 3 | 2.75 | 2.6 | 3 | 2 | 3 | 2.6 | 2.5 | 2.6 | 2 | 2.75 | 2 | 3 | 2.75 | 3 |
| 21MCS201 | 2.5 | 3 | 2.75 | 3 | 2.75 | 2.5 | 2.6 | 2.75 | 2 | 2.75 | 3 | 3 | 2.75 | 2.5 | 3 | 2.3 |
| 21MCS202 | 3 | 2.8 | 2.75 | 2.25 | 3 | 2.6 | 2 | 3 | 2.25 | 2.5 | 2.75 | 2.6 | 3 | 2.25 | 3 | 2.5 |
| 21MCS203 | 3 | 2.5 | 2.75 | 2.25 | 3 | 2 | 2.75 | 3 | 2.75 | 2.5 | 2 | 3 | 3 | 2.75 | 2.5 | 2.75 |
| 21MCS204 | 2 | 3 | 2.75 | 2.5 | 2.75 | 3 | 2.6 | 2.75 | 3 | 2.25 | 2.5 | 2.75 | 3 | 3 | 2.8 | 2.25 |
| 21MCS205 | 3 | 3 | 3 | 3 | 3 | 2.75 | 2.5 | 2.75 | 3 | - | 2.75 | 2.8 | 2.8 | 3 | 2.75 | 2.75 |
| 21MCS206 | 2.6 | 2.25 | 3 | 3 | 2.5 | 2.5 | 3 | 3 | 3 | 2.8 | 2.3 | 3 | 3 | 2.5 | 2.8 | 3 |
| 21MCS 207 | 3 | 2.6 | 3 | 2.5 | 3 | 2.75 | 3 | 3 | 3 | 2.75 | 2 | 3 | 2.25 | 2.5 | 2.75 | 3 |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **21MCS208** | **3** | **2.6** | **3** | **2.5** | **3** | **2.75** | **3** | **3** | **3** | **2.75** | **2** | **2.5** | **2.25** | **2.75** | **2.5** | **2.75** |
| **21MCS209** | **3** | **2** | **3** | **3** | **3** | **2** | **3** | **3** | **3** | **3** | **2** | **3** | **2** | **3** | **2** | **3** |
| **21CS100** | **3** | **2.75** | **2.75** | **3** | **2.75** | **2.5** | **3** | **3** | **3** | **2.75** | **3** | **2.5** | **3** | **2.8** | **3** | **2.75** |
| **21MCS301** | **2.75** | **2.25** | **2.7** | | **2.5** | **2.75** | | **3** | **2.5** | | **2.75** | **2.25** | **2.75** | **2.75** | **2.25** | **2.75** |
| **21MCS302** | **2.75** | **2.75** | **3** | **2.25** | **2.75** | **2.75** | **2.6** | **2.5** | **3** | | **2.5** | **2.5** | **2.75** | **2.5** | **3** | **2.75** |
| **21MCS303** | **2.75** | **2.5** | **2.25** | **3** | **2.75** | **2.5** | **2.5** | **3** | **2.75** | | **2.5** | **2.5** | **2.25** | **3** | **3** | **2.6** |
| **(Elective-I)** | **3** | **2.75** | **3** | **2.25** | **2.75** | **2.5** | **2.6** | **2.5** | **3** | **2.5** | **2.5** | **2.5** | **2.75** | **2.5** | **3** | **2.75** |
| **Elective II** | **2.75** | **2.5** | **2.25** | **2.75** | **3** | **2.5** | **2.5** | **3** | **2.75** | **3** | **2.5** | **2.5** | **2.25** | **3** | **3** | **2.6** |
| **21MCS306** | **3** | **2.5** | **2.75** | **2.75** | **2.6** | **2.75** | **2.5** | **2.75** | **3** | | **2.75** | **3** | **2.75** | **3** | **3** | **2.75** |
| **21MCS307** | **2.75** | **3** | **2.5** | **3** | **2.75** | **2.5** | **2.75** | **3** | **2.8** | **-** | **2.75** | **2.5** | **2.75** | **2.25** | **3** | **2.75** |
| **21MCS308** | **3** | **2** | **2.25** | **2** | **2** | **2.5** | **2** | **2** | **3** | **2** | **2** | **3** | **2.3** | **2.25** | **2.25** | **2.6** |
| **Open Elective II** | **2.75** | **3** | **2.75** | **2.6** | **3** | **2** | **3** | **2.6** | **2.5** | **2.6** | **2** | **2.75** | **2** | **3** | **2.75** | **3** |
| **21MCS401** | **3** | **2** | **3** | **3** | **2** | **2** | **3** | **2** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **3** |
| **21MCS402** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **3** |

**21MCS101 MATHEMATICAL FOUNDATIONS OF COMPUTING 4L:0T:0P 4 Credits**

Maximum Marks: 100
External Examination: 80
Internal Assessment: 20
Max. Time: 3 Hrs

**Objectives of the course**

- To develop and understand the mathematical and logical basis to many modern techniques in computing like machine learning, programming language design, and concurrency.

***Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Students will have to attempt one question from each unit. Each question shall carry equal marks.***

**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 F**unctions:** Properties of Relations, Equivalence Relation, Partial Order Relation, Function: Domain and Range, Onto, Into and One to One Functions, Composite and Inverse Functions.

**UNIT – II**

**Propositional Logic:** Proposition logic, basic logic, Logical Connectives, truth tables, tautologies, contradiction, Logical implication, Logical equivalence, Normal forms, Theory of Inference and deduction. **Predicate Calculus:** Predicates and quantifiers. Mathematical Induction.

**Matrices:** Definition, Types of Matrices, Addition, Subtraction, Scalar Multiplication and Multiplication of Matrices, Adjoint and Inverse of a matrix. Determinants: Definition, Minors, Cofactors, Properties of Determinants, Applications of determinants in finding area of triangle, solving a system of linear equations.

**UNIT – III**

**Graph:** Definition, walks, paths, trails, connected graph, regular and bipartite graph, cycles and circuits. Tree and rooted tree, Spanning tree, Eccentricity of a vertex radius and diameter of a graph, Central graphs. Centre(s) of a tree. Hamiltonian and Eulerian graph, planar graphs

**UNIT – IV**

**Probability and Distribution:** Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality.

**Course Outcome**

After completion of course, students would be able to understand:

- The basic notions of discrete and continuous probability.
- The methods of statistical inference and the role that sampling distributions play in those methods.
- Correct and meaningful statistical analyses of simple to moderate complexity.

**Suggested Readings:**


1. C.L.Liu: *Elements of Discrete Mathematics, McGraw Hill.*
2. Lipschutz, Seymour: *Discrete Mathematics, Schaum's Series.*
3. John Vince: Foundation Mathematics for Computer Science, Springer.
4. Trembley, J.P & R. Manohar: *Discrete Mathematical Structure with Application to Computer Science, TMH*.
5. Kenneth H. Rosen: *Discrete Mathematics and its applications, TMH.*
6. M. Mitzenmacher and E. Upfal. Probability and Computing: Randomized Algorithms and Probabilistic Analysis
7. Doerr Alan &Levasseur Kenneth: *Applied Discrete Structures for Computer Science, Galgotia Pub. Pvt. Ltd.*
8. Babu Ram: *Discrete Mathematics, Vinayek Publishers, New Delhi.*


**21MCS102 DATA STRUCTURE USING C 4L:0T:0P 4 Credits**

Maximum Marks: 100
External Examination: 80
Internal Assessment: 20
Max. Time: 3 Hrs

**Objectives of the course**

- To impart the basic concepts of data structures and algorithms.
- To understand concepts about searching and sorting techniques.
- To understand basic concepts about stacks, queues, lists, trees and graphs.
- To enable them to write algorithms for solving problems with the help of fundamental data structures.

***Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Students will have to attempt one question from each unit. Each question shall carry equal marks.***

**UNIT-I**

**Programming in C:** Introduction to C, Data type, constants and variable; Structure of a C program, Operators and Expressions, Control statements: Sequencing, Alteration and Iteration; Arrays: Representation of single and multidimensional arrays; String and pointers, Functions, Recursion.

**UNIT-II**

**Data Structures:** Definition and its types, Abstract Data Types, Review of strings: String representation and manipulation, Static and dynamic memory storage, Arrays, matrices, sparse matrices, multi-dimensional arrays, operations on arrays. Linked Lists, List Types (singly, doubly, singly circular, header, doubly circular), Operations on Lists – create, insert, delete, search, Applications of linked list

**UNIT-III**

**Stacks:** Definition, Array implementation of stacks, Linked implementation of stacks, Applications of Stacks: Infix, Postfix and prefix expression, conversions and evaluation of expressions.

**Queues:** Definition, Array implementation of queues, Linked implementation of queues, Circular queues, Priority queues, Double-ended queues

**Searching and Sorting:** Linear search, Binary search, Insertion sort, selection sort, Bubble sort, Merge sort, Quick Sort, Heap Sort; Hashing, Hash table, Hash functions.

**UNIT-IV**

**Trees:** Binary Trees and their properties, Linked and static Representation of binary trees, Complete Binary Tree, Threaded Binary tree, Different tree traversal algorithms, Binary Search Tree (create, delete, search, insert, display) and its complexity analysis, AVL Trees, Balanced multi-way search trees. **Graphs**: Definition, Array and linked representation of graphs, Graph Traversal (BFS and DFS), Adjacency matrix and adjacency lists, path matrix, Finding Shortest Path - Warshall's Algorithm.

**Course Outcomes**

After completion of course, students would be able to understand:

- For a given algorithm student will able to analyze the algorithms to determine the time and computation complexity and justify the correctness.
- For a given Search problem (Linear Search and Binary Search) student will able to implement it.
- For a given problem of Stacks, Queues and linked list student will able to implement it and analyze the same to determine the time and computation complexity.
- Student will able to write an algorithm Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort and compare their performance in term of Space and Time complexity.
- Student will able to implement Graph search and traversal algorithms and determine the time and computation complexity.

**Suggested Reading:**

1. Fundamentals of Data Structures: *Illustrated Edition by Ellis Horowitz, SartajSahni, Computer Science Press.*
2. Schaum's outline series:*Data Structure, TMH.*
3. Tenenbaum, Langsam, Augenstein: *Data Structures using C, Pearson Education.*
4. E. Horowitz and S. Sahani:*Fundamentals of Data Structures, GalgotiaBooksourcePvt. Ltd.*
5. BalaGuruswamy: *Data Structures Using C, TMH.*

**21MCS103 DATABASE MANAGEMENT SYSTEM 4L:0T:0P 4 Credits**

Maximum Marks: 100
External Examination: 80
Internal Assessment: 20
Max. Time: 3 Hrs

**Objectives of the course**

- To develop an understanding of essential DBMS concepts such as: database security, integrity, concurrency, distributed database, and intelligent database, Client/Server (Database Server), Data Warehousing.
- To design and build a simple database system and demonstrate competence with the fundamental tasks involved with modelling, designing, and implementing a DBMS.

***Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Students will have to attempt one question from each unit. Each question shall carry equal marks.***

**UNIT I**

**Database system architecture:** Data Abstraction, Data Independence, Data Definition Language (DDL), Data Manipulation Language (DML).
**Data models:** Entity-relationship model, network model, relational and object oriented data models, integrity constraints, data manipulation operations.

**UNIT II**

**Relational query languages:** Relational algebra, Tuple and domain relational calculus, SQL3, DDL and DML constructs, Open source and Commercial DBMS - MYSQL, ORACLE, DB2, SQL server.
**Relational database design:** Domain and data dependency, Armstrong's axioms, Normal forms, Dependency preservation, Lossless design.
**Query processing and optimization:** Evaluation of relational algebra expressions, Query equivalence, Join strategies, Query optimization algorithms.

**UNIT III**

**Transaction processing:** Concurrency control, ACID property, Serializability of scheduling, Locking and timestamp based schedulers, Multi-version and optimistic Concurrency Control schemes, Database recovery.

**UNIT IV**

**Database Security:** Authentication, Authorization and access control, DAC, MAC and RBAC models, Intrusion detection, SQL injection.
**Advanced topics:** Object oriented and object relational databases, Logical databases, Web databases, Distributed databases, Data warehousing and data mining.

**Course Outcomes**

After completion of course, students would be able to understand:

- For a given query write relational algebra expressions for that query and optimize the developed expressions.
- For a given specification of the requirement design the databases using E-R method and normalization.
- For a given transaction-processing system, determine the transaction atomicity, consistency, isolation, and durability.
- Implement the isolation property, including locking, time stamping based on concurrency control and serializability of scheduling.

**Suggested Readings:**

1. Database System Concepts: *6th Edition by Abraham Silberschatz, Henry F. Korth, S. Sudarshan, McGraw-Hill.*
2. Principles of Database and Knowledge – Base Systems: Vol 1 by J. D. Ullman, Computer Science Press.
3. Fundamentals of Database Systems: 5th Edition by R. Elmasri and S. Navathe, Pearson Education.
4. Foundations of Databases: Reprint by Serge Abiteboul, Richard Hull, Victor Vianu, Addison-Wesley.

**21MCS104 FUNDAMENTALS OF WEB DESIGNING 4L:0T:0P 4 Credits**

Maximum Marks: 100
External Examination: 80
Internal Assessment: 20
Max. Time: 3 Hrs

**Objectives of the course:**

- To impart the basic concepts of Web designing and web programming.
- To understand concepts about client side and server side programming.

***Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Students will have to attempt one question from each unit. Each question shall carry equal marks.***

## UNIT-I

**Introduction to Web programming** – Introduction to SGML features – HTML, XHTML, DHTML, XML – HTML Vs XML – Creating XML documents – Parsing an XML document – Writing well-formed documents – Organizing elements with namespaces – Defining elements in a DTD – Declaring elements and attributes in a DTD. Overview of HTML - basic formatting tags - heading, paragraph, underline break, bold, italic, underline, superscript, subscript, font and image. Attributes - align, color, bgcolor, font face, border, size. Navigation Links using anchor tag - internal, external, mail and image links. Lists - ordered, unordered and definition, Table tag, HTML Form controls - form, text, password, text area, button, checkbox, radio button, select box, hidden controls.

## Unit II

**Cascading Style Sheets:** Introduction, Inline, Internal, External CSS, Linking CSS to Web Page. Client–Side Programming: Introduction to JavaScript, Basic Syntax, Variables and Data types, Statements, Operators, Literals, Functions, Objects, Arrays. XML: Relation between XML and HTML, Goals of XML, Structure and Syntax of XML, Well Formed XML, DTD and its Structure, tree structures in data organization, Searching with XPath.

## Unit III

**Web Application and Information Gathering:** HTTP Request, Response, Header Fields and HTTPS, Understanding Same Origin, Sessions, Web Application Proxies. **Web server** – role - Apache Web Server – Introduction – Architecture – Features - Apache's Role in the Internet – LAMP – WAMP - Installation and Configuration - Build and Install Apache Web Server - Verify Initial Configuration Start, Stop, and Status the Apache Server Process.

## UNIT-IV

**Server side programming** – server side scripts – PHP – Designing dynamic web pages using PHP - Defining PHP variables – variable types – operators – control flow constructs in PHP – passing form data between pages - Establishing connection with MySQL database – managing database

**Course Outcomes**

After completion of course, students would be able to understand:

- The client side and server side scripts used in programming
- The basic concept of designing websites
- Database connectivity with the web pages

**SuggestedReadings:**

1. Dick Oliver: Tech Yourself HTML 4 in 24 Hours, Techmedia.
2. Satish Jain: "O" – Level Information Technology.

3. AchyutGodbole, “Web Technologies”, Tata McGraw Hill, India.
4. Craig Zacker: 10 minutes Guide to HTML Style Sheets, PHI.
5. V.K. Jain: "O" – Level Information Technology, BPB Publications.
6. Gill Nasib Singh: Essentials of Computer and Network Technology, Khanna Books Publishing Co., New Delhi.
7. Margaret Levine Young: Internet – The Complete Reference
8. Harley Hahn: The Internet – Complete Reference, TMH.
9. Rajender Singh Chhillar: Application of IT to Business, Ramesh Publishers, Jaipur.

**21MCS105 COMPUTER ARCHITECTURE AND ORGANIZATION 4L:0T:0P 4 Credits**

Maximum Marks: 100
External Examination: 80
Internal Assessment: 20
Max. Time: 3 Hrs

**Objectives of the course**

- To have a thorough understanding of the basic structure and operation of a digital computer
- To study the different ways of communicating with I/O devices and standard I/O interfaces
- To learn the architecture and assembly language programming of 8085 microprocessor
- To study peripherals and their interfacing with 8085 microprocessor

***Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Students will have to attempt one question from each unit. Each question shall carry equal marks.***

**UNIT-I**

**Boolean Algebra and Logic Gates**: Basic definition, Axiomatic Definition, Basic theorem and Properties of Boolean algebra, Minterms and Maxterms, Logic Operations, Digital logic gates, IC digital logic families

**Simplification of Boolean functions:** Different types map method, product of sum simplification, NAND or NOR implementation, Don't care condition, Tabulation method, Adder, subtractor, Decoder, Encoder, Code Conversion, Universal Gate.

**UNIT-II**

**Sequential Logic:** Flip-flops, Triggering of Flip-flops, Analysis of clocked sequential circuits, State reduction and Assignment, Flip-flop excitation, Design of counters, Design with state equations

**Overview Of Register Transfer And Microoperations**: Register Transfer Language, Register transfer, Bus and Memory transfer, Arithmetic Micro-operations, Logic Micro-operations, Shift Micro-operations, Arithmetic Logic Shift Unit

**UNIT-III**

**Basic Computer Organization and Design**: Instruction codes, Computer registers, Computer instructions, Timing and Control, Instruction cycle, Memory-Reference Instructions, Input-output and interrupt,Design Basic computer, Design of Accumulator Unit

**Programming The Basic Computer**: Introduction, Machine Language, Assembly Language, the Assembler, Program loops, Programming Arithmetic and logic operations, Subroutines, I-O Programming

**UNIT-IV**

**Central Processing Unit**: Introduction, General Register Organization, Stack Organization, Instruction format, Addressing Modes, Data transfer and manipulation, Program Control, Reduced Instruction Set Computer (RISC).

**Pipeline Processing**: Pipeline and Vector Processing, Parallel processing, Pipelining, Arithmetic Pipeline, Instruction pipeline and Arrays Processors.

**Course Outcomes**

- Understanding Logic gates, flip flops and counter
- Clear Understanding of Computer Architecture
- Pipeline processing
- RISC and CISC architectures
- Develop a base for advance micro-processors

**Suggested Readings:**

1. Computer System Architecture: By M. Morris Mano.
2. Structured Computer Organization: By Tanenbaum.
3. Computer Organization: By Stallings.
4. Computer Architecture and Organization: By Hayes.
5. Microprocessor Architecture, Programming, and Applications with the 8085 - Ramesh S. Gaonkar Pub: Penram International.

**21MCS106 LAB-I (BASED ON 21MCS102) 0L:0T:4P 2 Credits**

**Course Outcomes: By the end of the course the students will be able to:**

CO1: Able to develop basic programs of in C language and Use various problem solving techniques.
CO2: Programming in C by using functions, structures and union.
CO3: Able to use various searching and sorting algorithms using arrays in C
CO4: Able to implement Stack, Queue, Linked List, Trees, Graphs
CO5: Able to solve various problems using C language on small scale.

**List of Practical:**

1. Write a C program to implement recursive and non-recursive Linear search and Binary search
2. Write a C program to implement Searching and Sorting
3. Write a C program to implementLinked List.
4. Write a C program to implement list ADT to perform following operations a) Insert an element into a list. b) Delete an element from list c) Search for a key element in list d) count number of nodes in list
5. Write C program to implement the following using a singly linked list. a) Stack ADT b) Queue ADT
6. Write C programs to implement the deque (double ended queue) ADT using a doubly linked list and an array.
7. Write a C program to perform the following operations: a) Insert an element into a binary search tree. b) Delete an element from a binary search tree. c) Search for a key element in a binary search tree.
8. Write C programs for implementing the following sorting methods: Merge sort b) Heap sort
9. Write C programs that use recursive functions to traverse the given binary tree in a) Preorder b) inorder and c) postorder.
10. Write a C program to perform the following operations a) Insertion into a B-tree b) Deletion from a B-tree
11. Write a C program to perform the following operations a) Insertion into an AVL-tree b) Deletion from an AVL-tree
12. Program for Queue and Circular Queue Task
14. Program for Single Link List to insert a node at any point and display all nodes Task
15. Program for Single Link List to delete a node at any point and display all nodes

**21MCS107 LAB-II (BASED ON 21MCS103) 0L:0T:4P 2 Credits**

**Course Outcomes: By the end of the course the students will be able to:**

CO1: Knowledge of Basic fundamentals of database management and implementation of MYSQL Queries.
CO2: Basic understanding of DDL, DML statements
CO3: Basic operations and queries on data

**List of Practical:**

1. To study DBMS, RDBMS.
2. To study Data Definition language Statements.
3. To study Data Manipulation Statements.
4. Study of SELECT command with different clauses.
5. Study of SINGLE ROW functions (character, numeric, Data functions).\
6. Study of GROUP functions (avg, count, max, min, Sum).
7. Study of various type of SETOPERATORS (Union, Intersect, Minus).
8. Study of various types of Integrity Constraints.
9. Study of Various types of JOINS.
10. To study Views and Indices.

**Course Outcomes: By the end of the course the students will be able to:**

CO1: Designing the web page using HTML, DHTML, JavaScript, CSS, PHP

**21MCS108 LAB-III (BASED ON 21MCS104) 0L:0T:4P 2 Credits**

CO2: Writing the client side and server side scripts

**List of Practical:**

1. Create a simple HTML page with title, heading, and paragraph, formatting tags, hyperlinks, list items and image elements.
2. Create a simple HTML page having image elements with the use of map.
3. Create a simple HTML page having a complex table.
4. Create a simple HTML page having multiple Frames.
5. Embed Video in a HTML page.
6. Create a simple HTML page that uses Inline CSS
7. Create a simple HTML page that uses Document level CSS
8. Create a simple HTML page that uses External level CSS
9. Create a HTML page that uses all CSS properties Contents Tasks List Description
10. Write a simple JavaScript to print text on to the HTML document.
11. Write a simple script in head portion of HTML document.
12. Write a simple script in body portion of the HTML document.
13. Write an external script and link it to the HTML document.
14. Write a PHP script to get the PHP version and configuration information
15. Write a PHP script to display any multi-line string
16. Write a PHP script to place a variable to a title and as hyperlink of the Web page
17. Create a simple HTML form and accept the user name and display the name through PHP echo statement.
18. Use MySQL console to use database

**21MCS201 OPERATING SYSTEM AND UNIX 4L:0T:0P 4 Credits**

Maximum Marks: 100
External Examination: 80
Internal Assessment: 20
Max. Time: 3 Hrs

**Objectives of the course**

- Basic Concepts of Operating Systems
- Explain basic Unix concepts related to concurrency and control of programs
- Identify and define key terms related to operating system
- Capability to name and state the function of Unix commands

***Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Students will have to attempt one question from each unit. Each question shall carry equal marks.***

**UNIT-I**

**Operating systems overview:** Operating systems as an extended machine & resource manager, Operating systems classification; Operating systems and system calls; Operating systems architecture.

**Process Management functions:** Process model, hierarchies, and implementation; process states and transitions; multi-programming, multi-tasking, multi-threading; level of schedulers and scheduling algorithms.

**UNIT-II**

**Memory Management and Virtual Memory :** Logical versus Physical Address Space, Swapping, Contiguous Allocation, Paging, Segmentation, Segmentation with Paging, Demand Paging, Performance of Demanding Paging, Page Replacement, Page Replacement Algorithm, Allocation of Frames, Thrashing.

**UNIT-III**

**Device Management function:** I/O devices and controllers interrupt handlers, device independent I/O software, user-space I/O software; disk scheduling; clock hardware software; terminal input/output software.

**File management functions:** file naming, structure, types, access mechanisms, attributes and operations; directory structures and directory operations; file space allocations; file sharing, file locking; symbolic links; file protection and security: distributed file systems.

**UNIT-IV**

**Concurrent programming:** sequential and concurrent process; precedence graph, Bernsterins condition; time dependency and critical code section, mutual exclusion problem; classical process coordination problems; deadlock handling, inter-process communication.

**UNIX Operating System:** Overview of UNIX OS in general and implementation of all above functions in Unix Operating System.

**Course Outcomes**

- Be able to understanding basic operating system fundamentals
- Know how an operating system can be used as a service
- Familiarity with Linux programming concepts
- Have a foundation stone to understand operating systems working

**Suggested Readings:**

1. M.J. Bach "Design of UNIX O.S. ", Prentice Hall of India.
2. Y.Kanetkar "Unix shell programming", BPB Pub.Tenenbaum: Modern Operating Systems, Prentice-Hall.
3. Silberschatz, Galvin, Gagne, "Operating System Concepts", 8th Edition, John Wiley & Sons Inc.
4. Peterson, James L: Operating System Concepts, Addison Wesley Publ. &Silberschatz Comp.
5. Deitel, H.M.: An Introduction to Operating System, Addison Wesley Publ. Comp.
6. Brain Kernighen& Rob Pike: The UNIX Programming Environment, Prentice Hall.

**21MCS202 DATA COMMUNICATION AND COMPUTER NETWORKS 4L:0T:0P 4 Credits**

Maximum Marks: 100
External Examination: 80
Internal Assessment: 20
Max. Time: 3 Hrs

**Objectives of the course**

- Explain basic concepts related to Data Communication
- To explore the issues and challenges of protocols design while delving into TCP/IP protocol suite.
- To study the types of modes and channels for communications
- To explore the inter-working of various layers of OSI.

***Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Students will have to attempt one question from each unit. Each question shall carry equal marks.***

**UNIT-I**

Introduction to Computer Network: Types of Networks, Network Topologies, OSI and TCP/IP Reference Models; Comparison of Models. Data Communications Concepts: Digital Vs. Analog communication; Parallel and Serial Communication; Synchronous, Asynchronous and Isochronous Communication; Communication modes: simplex, half duplex, full duplex; Multiplexing; Transmission media: Wired-Twisted pair, Coaxial cable, Optical Fiber, Wireless transmission: Terrestrial, Microwave, Satellite, Infra red.

**UNIT-II**

Communication Switching Techniques: Circuit Switching, Message Switching, Packet Switching. Data Link Layer Fundamentals: Framing, Basics of Error Detection, Forward Error Correction, Cyclic Redundancy Check codes for Error Detection , Flow Control. Media Access Protocols: ALOHA, Carrier Sense Multiple Access (CSMA), CSMA with Collision Detection (CSMA/CD), Token Ring, Token Bus.

**UNIT-III**

High-Speed LAN: Standard Ethernet, Fast Ethernet, Gigabit Ethernet, 10G; Wireless LANs: IEEE 802.11, Bluetooth. Network Layer: IP Addressing and Routing, Network Layer Protocols: IPv4 (Header Format and Services), ARP, ICMP (Error Reporting and Query message); IPv6 (Header Format and Addressing).

**UNIT-IV**

Transport Layer: Process-to-Process Delivery: UDP, TCP; Connection Management by TCP; Basics of Congestion Control. Application Layer: Domain Name System (DNS); SMTP; HTTP; WWW. Network Security: Security Requirements and attacks; Cryptography: Symmetric Key (DES, AES), Public Key Cryptography (RSA); Firewall

**Course Outcomes**

- Familiar with the basic Networking Protocols
- Be able to understand some of the Communication Techniques
- Detailed understanding of Various Layers in OSI and TCP/IP reference models

**Suggested Readings:**

1. B. Muthukumaran, “Introduction to High Performance Networks”, Vijay Nicole Imprints.
2. Wayne Tomasi, “Introduction to Data Communications and Networking”, Pearson Education.

3. James F. Kurose, Keith W. Ross, “Computer Networking, A Top-Down Approach Featuring the Internet”, Pearson Education.
4. Andrew S. Tanenbaum, “Computer Networks”, Pearson Education.
5. Mahbub Hassan, Raj Jain, “High Performance TCP/IP Networking, Concepts, Issues, and Solutions”, Pearson Education.
6. Andrew S. Tanenbaum, Marten Van Steen, “Distributed Systems-Principles & Paradigms”, Pearson Education.

**21MCS203 DATA MINING 4L:0T:0P 4 Credits**

Maximum Marks: 100
External Examination: 80
Internal Assessment: 20
Max. Time: 3 Hrs

**Objectives of the course**

- Basic Concepts of Mining the relevant information
- Basic understanding about the processing of data
- To study the different types of techniques for Data Mining
- To analyze data, choose relevant models and algorithms for respective applications

***Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Students will have to attempt one question from each unit. Each question shall carry equal marks.***

**Unit I**

**Introduction to Data Mining:** Scope of Data Mining, How does Data Mining Works, Predictive Modelling on Data Mining, and Architecture for Data Mining, Profitable Applications of Data Mining, Data Mining Tools

**Business Intelligence:** Introduction, Business Intelligence, Business Intelligence tools, Business Intelligence Infrastructure, Business Intelligence Applications, BI versus Data Warehouse, BI versus Data Mining, Future of BI.

**Unit II**

**Data Pre-processing:**Data Pre-processing Overview, Data Cleaning, Data Integration and Transformation, Data Reduction, Discretization and Concept Hierarchy Generation.

**Data Mining Techniques- An Overview:** Introduction of Data MiningTechniques, Data Mining Versus Database Management System, Data Mining Techniques- Association rules, Classification, Regression, Clustering, Neural networks.

**Unit III**

**Clustering:** Introduction of Clustering, Cluster Analysis, Clustering Methods- K means, Hierarchical clustering, Agglomerative clustering, Divisive clustering, clustering and segmentation software, evaluating clusters.

**Web Mining:** Terminologies, Categories of Web Mining – Web Content Mining, Web Structure Mining, Web Usage Mining, Applications of Web Mining, and Agent based and Data base approaches, Web mining Software

**Unit IV**

**Applications of Data mining:** Business Applications Using Data Mining- Risk management and targeted marketing, Customer profiles and feature construction, Medical applications (diabetic screening), Scientific Applications using Data Mining, Other Applications.

**Course Outcomes**

- Implement different data mining techniques on the pre-processed data set for extracting hidden patterns from data.
- Identify appropriate data mining algorithms to solve real world problems

- Compare and evaluate different data mining techniques like classification, prediction, clustering and association rule mining

**Suggested Readings:**

1. Jiawei Han &MichelineKamber: Data Mining - Concepts & Techniques, Harcourt India PVT Ltd. (Morgan Kaufmann Publishers).
2. I.H. Whiffen: Data Mining, Practical Machine Cearing tools & techniques with Java (Morgan Kanffmen)
3. A.K. Pujari: Data Mining Techniques, University Press.
4. Pieter AdriaansDolfZantinge: Data Mining, Addition Wesley.
5. David Hand, HeikkiMannila, and Padhraic Smyth: Principles of Data Mining, PHI Publication.

**21MCS204 OBJECT ORIENTED PROGRAMMING USING JAVA 4L:0T:0P 4 Credits**

Maximum Marks: 100
External Examination: 80
Internal Assessment: 20
Max. Time: 3 Hrs

**Objectives of the course**

- Basic Concepts of Object Oriented Programming
- Basic understanding ofJAVA language
- To study the use of Java for GUI programming

***Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Students will have to attempt one question from each unit. Each question shall carry equal marks.***

**Unit I**

**Introduction to Java:** Basics of Java programming, Data types, Variables, Operators, Control structures including selection, Looping, Java methods, Overloading, Math class, Arrays in java.

**Objects and Classes:** Basics of objects and classes in java, Constructors, Finalizer, Visibility modifiers, Methods and objects, Inbuilt classes like String, Character, StringBuffer, File, this reference

**Unit II**

**Inheritance and Polymorphism:** Inheritance in java, Super and sub class, Overriding, Object class, Polymorphism, Dynamic binding, Generic programming, Casting objects, Instance of operator, Abstract class, Interface in java, Package in java, UTIL package.

**Unit III**

**Event and GUI programming:** Event handling in java, Event types, Mouse and key events, GUI Basics, Panels, Frames, Layout Managers: Flow Layout, Border Layout, Grid Layout, GUI components like Buttons, Check Boxes, Radio Buttons, Labels, Text Fields, Text Areas, Combo Boxes, Lists, Scroll Bars, Sliders, Windows, Menus, Dialog Box, Applet and its life cycle, Introduction to swing.

**Unit IV**

**I/O programming:** Text and Binary I/O, Binary I/O classes, Object I/O, Random Access Files.

**Multithreading in java:** Thread life cycle and methods, Runnable interface, Thread synchronization, Exception handling with try-catch-finally, Collections in java, Introduction to JavaBeans and Network Programming.

**Course Outcomes**

- Familiar with the basic concepts of OOPS
- Implementing Java programs using Inheritance and Polymorphism
- Understanding the concept of Threading

**Suggested Readings:**

1. Patrick Naughton& Herbert Schildt.: Java 2.0: The Complete Reference, TMH.

2. HolznerSteven: Java 2, Swing, Servlets, JDBC & Java Beans Programming (Black Book), IDG Books India (P) Ltd.
3. Hatman& Eden: ASP with VBScript, SQL and HTML Programming Reference, IDG Books India(P), Ltd.
4. Jackson, J. : Java by Example, Sunsoft Press.
5. Wiber, J. : Using Java 2 Platform, PHI.
6. Harold, E. : Java Secrets, Comdex.

**21MCS205 ARTIFICIAL INTELLIGENCE 4L:0T:0P 4 Credits**

Maximum Marks: 100
External Examination: 80
Internal Assessment: 20
Max. Time: 3 Hrs

**Objectives of the course**

- To conceptualize the basic ideas and techniques underlying the design of intelligent systems
- To make students understand advanced representation formalism and search techniques
- To make students understand and Explore the mechanism of mind that enable intelligent thought and action.

***Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Students will have to attempt one question from each unit. Each question shall carry equal marks.***

**Unit-I**

Introduction: Introduction to Artificial Intelligence, various definitions of AI, AI Applications and Techniques, Turing Test and Reasoning - forward & backward chaining.Introduction to Intelligent Agents, Rational Agent, their structure, reflex, model-based, goal-based, and utility-based agents, behaviour and environment in which a particular agent operates.

**Unit-II**

Problem Solving and Search Techniques: State space search, Problem Characteristics, Production Systems, Control Strategies, Breadth First Search, Depth First Search, iterative deepening, uniform cost search, Hill climbing and its Variations, simulated annealing, genetic algorithm search; Heuristics Search Techniques: Best First Search, A* algorithm, AO* algorithm, Minmax& game trees, refining minmax, Alpha – Beta pruning, Constraint Satisfaction Problem, Means-End Analysis.

**Unit-III**

Reasoning with Uncertain Knowledge: Different types of uncertainty - degree of belief and degree of truth, various probability constructs - prior probability, conditional probability, probability axioms, probability distributions, Bayes' rule, other approaches to modelling uncertainty such as Dempster-Shafer theory.

Fuzzy logic: Definition, Difference between Boolean and Fuzzy logic, fuzzy subset, fuzzy membership function, fuzzy expert system, Inference process for fuzzy expert system, fuzzy controller

**Unit-IV**

Expert system development life cycle: Problem selection, Prototype construction, Formalization, Implementation, Evaluation, Knowledge acquisition: Knowledge engineer, Cognitive behavior, Acquisition techniques. Knowledge representation: Level of representation, Knowledge representation schemes, Formal logic, Inference Engine, Semantic net, Frame, Scripts.

**Course Outcome**

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

**Suggested Readings:**

1. Rich Elaine and Knight Kevin: Artificial Intelligence, Tata McGraw Hill .
2. TaniMoto : Introduction to AI using LISP.
3. Patterson: Artificial Intelligence and Expert Systems.
4. SangalRajeev: LISP Programming, Tata McGraw Hill.
5. Balagurusamy : Artificial Intelligence & Technology.
6. Mishkoff, Henry C: Understanding Artificial Intelligence, BPB Publ.
7. Bharti&Chaitenya: Natural Language Processing, PHI

**21MCS206 LAB-IV (BASED ON 21MCS201) 0L:0T:4P 2 Credits**

**Course Outcomes: By the end of the course the students will be able to:**

CO1: Knowledge of Basic fundamentals of operating system and UNIX Commands
CO2: Able to write scripts and working with shell programming in UNIX Type Operating system.

**List of Practical:**

1. Getting started with UNIX / Linux: a) Basic Commands for login and logout, b) Change password, c) Shutdown or rebooting system
2. Commands for Basic Utilities: a)Calender, Help, command manual, b)date & time, current user status, knowing present working directory
3. Commands for Directories & File listing
4. Commands for identifying UNIX shell - Listing the shell variables - Changing the shell - Path setting - Setting Prompt variable Contents Tasks List Description
5. Commands for File Management
6. Commands for Directory Management
7. Commands to change file and directory access permissions
8. Using Pipes & filters & meta characters
9. Command to deal with processes - Listing of processes - Running foreground & background processes - Stopping processes
10. Commands for communication - Pinging another computer in the network
11. Commands for vi editor - Open and closing, Operation modes, editing, navigation, copying text, searching

**21MCS207 LAB-V (BASED ON 21MCS204) 0L:0T:4P 2 Credits**

**Course Outcomes: By the end of the course the students will be able to:**

CO1: Programming by using the Concept of OOPS like Inheritance and Polymorphism
CO2: Able to use various Loops and conditions in dealing with a real world problem
CO3: Able to implement types of Inheritance and concepts like Function Overloading and Overriding
CO4: Demonstrate in detailed on multilevel inheritance with suitable example.
CO5: Demonstrate on multiple Thread class and use set Priority method with suitable example.
CO6: Elaborate on runtime polymorphism with suitable example.
CO7: Demonstrate on applet with differentiate between main () method using suitable example

**List of Practical:**

1. A Simple Program in Class & Object.
2. A Program for Simple Inheritance.
3. A Program for Multilevel Inheritance.
4. A Program for Multiple Inheritance.
5. A Program of Polymorphism with Overloading.
6. Program of Polymorphism with Overriding.
7. A Program to Use Interface.
8. A Program to Use Abstract Class.
9. Write a program for Multiple Inheritance using Interface.
10. Write a program for using multidimensional array in java.

**21MCS208 PROGRAMMING IN MATLAB 0L:0T:4P 2 Credits**

Maximum Marks: 100
External Practical Examination: 80
Internal Assessment: 20
Max. Time: 3 Hrs

**Objectives of the course**

- To familiarize the student in introducing and exploring MATLAB & LABVIEW softwares.
- To enable the student on how to approach for solving Engineering problems using simulation tools.
- To prepare the students to use MATLAB/LABVIEW in their project works.
- To provide a foundation in use of this softwares for real time applications.

***Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Students will have to attempt one question from each unit. Each question shall carry equal marks.***

**UNIT-I**

Introduction to MATLAB programming, Basic of MATLAB programming, Variables and assignments, data types, operators, working with numbers, mathematical operations, functions, good programming style, commands, M-files.

**Unit-II**

Introduction to Vectors in MATLAB: Vector types, referencing the elements of vector, Matrix generations, Array operations and Linear Equations; Introduction to programming in Matlab: M-File scripts, M-File functions, Colon notations; Introduction to Matrices in Matlab:defining Matrix, Matrix functions, Vector operations, Matrix operations.

**Unit-III**

Looping and Decision Making: for loops, while loop, branching and nesting, if statement, if-else statement, else-if statement, subroutine, built in function and user defined functions, handling functions in m-files.

**Unit-IV**

Data Files: Data import and data output, read/write, Plotting and Graphics in MATLAB: Polar plot, 2D and 3D plots, mesh, contour, Algebra, Optimization, Numerical Integration, Numerical Differentiation, solving polynomial equations, Introduction to SIMULINK.

**Course Outcomes:**

- Ability to find importance of this software for Lab Experimentation.
- In-depth knowledge of providing virtual instruments on MATLAB Environment.
- Articulate importance of software's in research by simulation work.

**Suggested Readings:**

1. Amos Gilat, *MATLAB An Introduction With Applications 5ed,*Wiley, ISBM13: 978-1118629864
2. Krister Ahlersten*, An Introduction to Matlab,* Bookboon.com, ISBN:978-87-403-0283-7
3. Stephen J. Chapman,*MATLAB Programming for Engineers*, Cengage Learning, 2015

**21CS100 COMMUNICATION SKILLS 0L:0T:2P 2 Credits**

Maximum Marks: 50

**Objective of the course:**

- To introduce the theory and practice of communicative skills so as to enable the students to communicate effectively and conduct themselves graciously in the business of life.

***Note: One hour of classroom teaching will be devoted to the teaching of theory. In another hour, the students will be engaged in practical activities and the evaluation of their communication skills will be done by the internal examiner on the basis of classroom presentations, discussions and assignments.***

**Unit-I**

Human Communication, Verbal and Non Verbal Communication, Barriers to communication; the seven C's of effective communication.Preparing for interviews, CV/ Bio-data, Group Discussion, Public Speaking, Mass Communication.

**Unit -II**

Common Courtesies, Introducing Oneself Formally and Informally; Introducing Oneself on Social Media; Speaking Strategies: Making Enquiries, Clarifications, Recommendations, Explanations, Rejections, etc.; Being Diplomatic; Telephonic Communication.

**Unit-III**

Conversational Practice in Various Situations:

(meeting, parting, asking/talking about daily activities, at railway station, seeking information, buying at shops, asking about buses, travelling by bus, using expressions of time, talking about money, identifying people, at the post office, at the bank, at the grocery store, immediate family and relatives, hiring a taxi, talking about weather/weather conditions, breakfast or lunch at a restaurant, ordering food, dinner conversations, at the doctors clinic, quitting and finding jobs, office conversations, conversations about school/ college/ university, the English class, driving a car).

Students shall develop dialogue-based conversations on the above-mentioned situations.

**Unit-IV**

Personality Development Skills: Personal Grooming; Assertiveness; Improving Self-Esteem; Significance of Critical Thinking; Confidence Building; SWOC analysis.

Emotional intelligence: Recognizing and Managing Emotions and Situations; Stress and Anger Management; Positive Thinking; Developing Sense of Humour.

**Course Outcomes**

After completion of course, students would be able to understand:

- Modes of Communication including Verbal and Non-verbal communication
- To express effectively & with maximum efficiency.
- To develop Interpersonal skills

**21MCS301 PYTHON PROGRAMMING 4L:0T:0P 4 Credits**

Maximum Marks: 100
External Examination: 80
Internal Assessment: 20
Max. Time: 3 Hrs

**Objectives of the course**

- To learn how to design and program Python applications
- To learn how to build and package Python modules for reusability.
- To learn how to read and write files in Python.
- To learn how to design object-oriented programs with Python classes.
- To learn how to use class inheritance in Python for reusability.
- To learn how to use exception handling in Python applications for error handling.

***Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Students will have to attempt one question from each unit. Each question shall carry equal marks.***

**UNIT I**

**Introduction:** History of Python, Need of Python Programming, Applications Basics of Python Programming Using the REPL(Shell), Running Python Scripts, Variables, Assignment, Keywords, Input-Output, Indentation.

**UNIT II**

**Types, Operators and Expressions:** Types – Integers, Strings, Booleans; Operators- Arithmetic Operators, Comparison (Relational) Operators, Assignment Operators, Logical Operators, Bitwise Operators, Membership Operators, Identity Operators, Expressions and order of evaluations Control Flow- if, if-elif-else, for, while break, continue, pass

**Data Structures Lists:** Operations, Slicing, Methods; Tuples, Sets, Dictionaries, Sequences. Comprehensions

**UNIT III**

**Functions:** Defining Functions, Calling Functions, Passing Arguments, Keyword Arguments, Default Arguments, Variable-length arguments, Anonymous Functions, Fruitful Functions (Function Returning Values), Scope of the Variables in a Function- Global and Local Variables. Modules: Creating modules, import statement, from. Import statement, name spacing, Python packages, Introduction to PIP, Installing Packages via PIP, Using Python Packages

**UNIT IV**

**Object-Oriented Programming OOP in Python:** Classes, 'self-variable', Methods, Constructor Method, Inheritance, Overriding Methods, Data hiding, Error, and Exceptions: Difference between an error and Exception, Handling Exception, try except for block, Raising Exceptions, User Defined Exceptions, Data Compression, Multithreading, GUI Programming, **Turtle Graphics Testing:** Basic concepts of testing, Unit testing in Python, Writing Test cases, Running Tests.

**Course Outcomes:**

- Making Software easily right out of the box.
- Experience with an interpreted Language.
- To build software for real needs.
- Prior Introduction to testing software

**Suggested Readings:**


- Python Programming: A Modern Approach, VamsiKurama, Pearson
- Learning Python, Mark Lutz, Orielly
- Think Python, Allen Downey, Green Tea Press
- Core Python Programming, W.Chun, Pearson.
- Introduction to Python, Kenneth A. Lambert, Cengage

**21MCS302 COMPUTER GRAPHICS 4L:0T:0P 4 Credits**

Maximum Marks: 100
External Examination: 80
Internal Assessment: 20
Max. Time: 3 Hrs

**Objectives of the course**

- To equip students with the fundamental knowledge and basic technical competence in the field of computer graphics.
- To emphasize on implementation aspect of Computer Graphics Algorithms.
- To prepare the student for advance areas like Image Processing or Computer Vision or Virtual Reality and professional avenues in the field of Computer Graphics.

***Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Students will have to attempt one question from each unit. Each question shall carry equal marks.***

**UNIT-I**

Introduction to Computer Graphics: Computer Graphics and Its Types, Applications of Computer Graphics; Graphics Display Devices.

Scan conversion: Scan converting a point, line (Bresenham's, DDA), 2-D transformations (Rotation, Rotation about an arbitrary line, Scaling, Translation, Shearing, Reflection, and Reflection about an arbitrary line), circle and ellipse. Transformation:Basic Transformation, Various 2D and 3D Transformation matrices (Translation, Rotation, Scaling, Shearing and Reflection), Composite transformations: Reflection, Shearing and Transformation between coordinate Systems.

**UNIT-II**

Curves and Surfaces Bezier Curves, 4 point and 5 point Bezier curves using Bernstein Polynomials, Conditions for smoothly joining curve segments, Bezier bi-cubic surface patch, BSpline Curves, Cubic B-Spline curves using uniform knot vectors, first and second order continuities, Effect of multiple control points at same location, Geometrical Construction, Computing control points given end slopes for a specified curve segment.

**UNIT-III**

Transformations: 3-D Transformation, Computing location of V.P, 2-D viewing, Window-toview port transformation Clipping: Line Clipping; Sutherland Cohen clipping algorithms, Sutherland-Hodgeman. Projection: Parallel and Perspective Projections Solid Modeling: Sweeping a polygon or a surface patch along a path to form solids, Boundary Representation (B-Rep), octrees, CSG – Constructive Solid Geometry.

**UNIT-IV**

Shading: Shading, Illumination Model for diffused Reflection, Effect of ambient lighting & distances, Specular Reflection Model, Computing Reflection Vector, Curved Surfaces, Polygonal Approximations, Gourard Shading, Phong Model. Hidden Surface Removal: Floating Horizon Method, Depth Buffer (Z-Buffer, A-Buffer) Method, Scan Line Method, Depth Sorting Method, BSP- tree Method, Area Subdivision Method.

**Course Outcomes:**

- Understand the concepts used in various computer graphic devices.
- Drawing different drawing objects and apply different types of transformations.
- Apply clipping on points, lines and closed objects with respect to given rectangular window.
- Explain the concepts of interactive computer graphics.
- Implement the algorithms learnt in some programming language.

**Suggested Readings:**

1. Hearn, D.,Baker, : Computer Graphics, Prentice Hall.
2. Plastock : Theory & Problem of Computer Graphics, Schaum Series.
3. Foley & Van Dam: Fundamentals of Interactive Computer Graphics, Addison-Wesley.
4. Newman : Principles of Interactive Computer Graphics, McGraw Hill.
5. Foley James D, "Computer Graphics", AW 2nd Ed.
6. Rogers, "Procedural Element of Computer Graphics", McGraw Hill.
7. Donnald Hearn and M. Pauline Baker, "Computer Graphics", PHI.
8. Ven Harrington, "Computer Graphics: A programming Approach", TMH.
9. Newman and Sproul, "Principal of to Interactive Computer Graphics", McGraw Hill.
10. Roge and Adams, "Mathematics Element of Computer Graphics", McGraw Hill.
11. R. Plastock and G Kalley, "Theory and Problems of Computer Graphics", Schaum's Series, Mc Graw Hill, 1986.
12. F. S. Hill, Jr. Stephen M. Kelley, "Computer Graphics using Open GL", PHI, 3rd Ed., 2009.
13. Malay K. Pakhira, "Computer Graphics Multimedia Animation", PHI, 2008.

**21MCS303 SOFTWARE ENGINEERING 4L:0T:0P 4 Credits**

Maximum Marks: 100
External Examination: 80
Internal Assessment: 20
Max. Time: 3 Hrs

**Objectives of the course**

- To assist the student in understanding the basic theory of software engineering, and to apply these basic theoretical principles to a group software development project.
- To study fundamental concepts in software testing, including software testing objectives, process, criteria, strategies, and methods.
- To expose the advanced software testing topics, such as object-oriented software testing methods, and component-based software testing issues, challenges, and solutions.

***Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Students will have to attempt one question from each unit. Each question shall carry equal marks.***

**UNIT-I**

**Software Engineering:** Introduction - Software characteristics - Classification of Software - Phases in Software Engineering - Key challenges in Software Engineering. SDLC-Software Process, Project and Product - Components of Software Process- Process Framework - Process Assessment. Software Re-engineering, Software Reverse Engineering.
**Software Life Cycle Models**: Waterfall, Prototype, Time boxing and Spiral Models, RAD Model and Automation through software environments

**UNIT-II**

**Requirements Engineering**: Feasibility study - Types of Feasibility - Requirement Elicitation - Elicitation techniques. Requirement analysis - Structured Analysis – DFD - Object Oriented Modeling. Activity Diagram - Data Diagram- ER diagram - Use case Diagram, Software Requirements Specification: Purpose of SRS, Structure of SRS, IEEE template of SRS.
**Software Design:** Principles of Software Design- Software Design Concepts.
**Software Coding:** Features of Software Code - Coding Guidelines- Coding Methodology. Code verification techniques.

**UNIT-III**

**Software Testing:** Basics of software testing, Testing objectives, Principles of testing, Testing and debugging, Test metrics and measurements, STLC, Verification, Validation, Software Quality and Reliability.
**Types of testing:** Functional and non – functional Testing; system testing, recovery testing, security testing, stress testing, performance testing, usability testing, White box testing, static testing, static analysis tools, Structural testing: Unit/Code functional testing, Code coverage testing, Code complexity testing, Black Box testing, Requirements based testing, Boundary value analysis, Equivalence partitioning, state/graph based testing, Scenario Testing, Alpha, Beta and Acceptance Testing: Acceptance criteria; test cases selection and execution.

**UNIT-IV**

**Software Maintenance Activities:** Need for Maintenance, Categories of Maintenance: Preventive, Corrective and Perfective Maintenance, Cost of Maintenance, Software Re Engineering, Reverse Engineering. Software Configuration Management Activities, Change Control Process, Software Version Control, Software Reuse, Software Evolution, Software Quality Attributes, Software Quality

Assurance – plans & activities, Software Documentation. ISO Quality models: ISO 9000 and SEICMM and their relevance.

**Course Outcomes**

After completion of course, students would be able to understand:

- The software engineering practice over the entire system lifecycle.
- Requirement engineering, analysis, prototyping, design, implementation, testing, maintenance activities and management of risks involved in software and embedded systems.

**Suggested Readings:**

1. Sommerville Ian: *Software Engineering, Addison Wesley.*
2. Hoffer, George:*Valacich, Modern System Analysis and Design, Pearson Education.*
3. Pressman S. Roger: *Software Engineering, Tata McGraw-Hill.*
4. Software Testing techniques:*BarisBeizer, Dreamtech.*
5. Tom Gilb: *Principles of Software Engineering Management, Addison-Wesley.*
6. Michael Dyer: *The Cleanroom approach to Quality Software Engineering, Wiley & Sons.*
7. Jalote, Pankaj: *An Integrated Approach to Software Engineering, Narosa Publications.*

# ELECTIVE GROUP-X

**21MCS309 R PROGRAMMING 4L:0T:0P 4 Credits**

Maximum Marks: 100
External Examination: 80
Internal Assessment: 20
Max. Time: 3 Hrs

**Objectives of the course**

- Master the use of the R interactive environment
- Understand the different data types, data structures in R
- Use R for mathematical operations
- Understand the concepts of objects and assignment
- Understand the concepts of vector and data types

***Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Students will have to attempt one question from each unit. Each question shall carry equal marks.***

**Unit - I**

**Introduction to R:** R Sessions and Functions, Basic Math, Variables, Data Types, Vectors, Conclusion, Advanced Data Structures, Data Frames, Lists, Matrices, Arrays, Classes, R Programming Structures, Control Statements, Loops, Looping Over NonvectorSets, - If-Else, Arithmetic and Boolean Operators and values, Default Values for Argument, Return Values, Deciding Whether to explicitly call return-Returning Complex Objects, Functions are Objective, No Pointers in R, Recursion,

**Unit - II**

**Doing Math and Simulation in R:** Math Function, Extended Example Calculating Probability-Cumulative Sums and Products-Minima and Maxima-Calculus, Functions Fir Statistical Distribution, Sorting, Linear Algebra Operation on Vectors and Matrices, Extended Example: Vector cross Product-Extended Example: Finding Stationary Distribution of Markov Chains, Set Operation, Input /output, Accessing the Keyboard and Monitor, Reading and writer Files,

**Unit - III**

**Graphics:** Creating Graphs, The Workhorse of R Base Graphics, the plot() Function Customizing Graphs, Saving Graphs to Files,Probability Distributions, Normal Distribution, Binomial Distribution, Poisson Distributions Other Distribution, Basic Statistics, Correlation and Covariance, T-Tests, ANOVA Test

**Unit - VI**

**Linear Models**: Simple Linear Regression, -Multiple Regression Generalized Linear Models, Logistic Regression, - Poisson Regression- other Generalized Linear Models-Survival Analysis, Nonlinear Models, Splines- Decision- Random Forests

**Course Outcomes:**

- List motivation for learning a programming language
- Access online resources for R and import new function packages into the R workspace
- Import, review, manipulate and summarize data-sets in R
- Explore data-sets to create testable hypotheses and identify appropriate statistical tests
- Perform appropriate statistical tests using R Create and edit visualizations with

**Suggested Readings**

1. R Cookbook, PaulTeetor, Oreilly.
2. R in Action,RobKabacoff, Manning
3. The Art of R Programming, Norman Matloff, Cengage Learning
4. R for Everyone, Lander, Pearson
5. Siegel, S. (1956), Nonparametric Statistics for the Behavioral Sciences, McGraw-Hill International, Auckland.
6. Venables, W. N. and Ripley, B. D. (2000), S Programming, Springer-Verlag, New York.
7. Venables, W. N. and Ripley, B. D. (2002), Modern Applied Statistics with S, 4th ed., Springer-Verlag, New York.
8. Weisberg, S. (1985), Applied Linear Regression, 2nd ed., John Wiley & Sons, New York.
9. Zar, J. H. (1999), Biostatistical Analysis, Prentice Hall, Englewood Cliffs, NJ

**21MCS310 MACHINE LEARNING 4L:0T:0P 4 Credits**

Maximum Marks: 100
External Examination: 80
Internal Assessment: 20
Max. Time: 3 Hrs

**Objectives of the course**

- discovering patterns in data and then make predictions based on those patterns
- dealing with complex patterns to answer business questions and solving problems.
- helps to analyse data and identify trends.

***Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Students will have to attempt one question from each unit. Each question shall carry equal marks.***

**Unit I**

**Introduction**: Definition of learning systems. Goals and applications of machine learning, Aspects of developing a learning system: training data, concept representation, function approximation

**Inductive Classification**: The concept learning task, Concept learning as search through a hypothesis space, General-to-specific ordering of hypotheses, Finding maximally specific hypotheses, Version spaces and the candidate elimination algorithm, learning conjunctive concepts, the importance of inductive bias

**Unit II**

**Decision Tree Learning:** Representing concepts as decision trees, Recursive induction of decision trees,Picking the best splitting attribute: entropy and information gain, Searching for simple trees and computational complexity, Occam's razor,Over fitting, noisy data, and pruning

**Ensemble Learning:**Using committees of multiple hypotheses, Bagging, boosting, and DECORATE Active learning with ensembles

**Unit III**

**Experimental Evaluation of Learning Algorithms**: Measuring the accuracy of learned hypotheses, Comparing learning algorithms: cross-validation, learning curves, and statistical hypothesis testing

**Computational Learning Theory**: Models of learnability, learning in the limit, probably approximately correct (PAC) learning, Sample complexity: quantifying the number of examples needed to PAC learn, Computational complexity of training, Sample complexity for finite hypothesis spaces, PAC results for learning conjunctions,

**Unit IV**

**Rule Learning:** Translating decision trees into rules, Heuristic rule induction using separate and conquer and information gain. First-order Horn-clause induction (Inductive Logic Programming) and Foil, Learning recursive rules, Inverse resolution

**Classification problems in language:** word-sense disambiguation, sequence labeling. Hidden Markov models (HMM's),Veterbi algorithm for determining most-probable state sequences, Forward-backward EM algorithm for training the parameters of HMM's, Use of HMM's for speech recognition, part-of-speech tagging, and information extraction. Conditional random fields (CRF's), Probabilistic context-free grammars (PCFG)

**Course Outcomes**:

- Become aware of variety of Machine Learning Algorithms
- Understanding the types of problems that machine learning algorithms can solve
- Articulate how these algorithms are fundamentally different from the traditional programming algorithms

**Suggested Readings:**

1. Miroslav Kubat, *An Introduction to Machine Learning*, 2nd Edition, Springer.
2. John Slavio, *Machine Learning for Beginners: An Introduction to Artificial Intelligence and Machine Learning.*
3. Tom M. Mitchell, *Machine Learning*, Tata McGraw Hill, 2017
4. Christopher M. Bishop, *Pattern Recognition and Machine Learning.*

**21MCS311** **SOCIAL NETWORK ANALYSIS FOR BIG DATA** **4L:0T:0P** **4 Credits**

Maximum Marks: 100
External Examination: 80
Internal Assessment: 20
Max. Time: 3 Hrs

**Objectives of the course**

- To provide an overview of an exciting growing field of big data analytics.
- To introduce the tools required to manage and analyse big data like Hadoop.
- To teach the fundamental techniques and principles in achieving big data analytics with scalability and streaming capability.
- To enable students to have skills that will help them to solve complex real-world problems in for decision support

***Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Students will have to attempt one question from each unit. Each question shall carry equal marks.***

**UNIT I**

**Introduction to Social Network Analysis for 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.

**UNIT III**

**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 IV**

**Hive And Hiveql , H base :** Hive Architecture and Installation, Comparison with Traditional Database, Hive QL - Querying Data - Sorting And Aggregating, Map Reduce Scripts, Joins & Subqueries, HB as concepts Advanced Usage, Schema Design, Advance Indexing - PIG, Zookeeper - how it helps in monitoring a cluster, H Base uses Zookeeper and how to Build Applications with Zookeeper.

**Course Outcomes:**

- Understand the key issues in big data management and its associated applications in intelligent business and scientific computing.
- Acquire fundamental enabling techniques and scalable algorithms like Hadoop in big data analytics.
- Interpret business models and scientific computing paradigms, and apply software tools for big data analytics.
- Achieve adequate perspectives of big data analytics in various applications like recommender systems, social media applications, etc.

**Suggested Readings:**

1. Boris lublinsky, Kevin t. Smith, Alexey Yakubovich, “Professional Hadoop Solutions”, Wiley, ISBN: 9788126551071, 2015.
2. Chris Eaton, Dirk derooset al. , “Understanding Big data ”, McGraw Hill, 2012.
3. Tom White, “HADOOP: The definitive Guide”, O Reilly 2012. 6 IT2015SRM(E&T)
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.

**21MCS312 SOFT COMPUTING 4L:0T:0P 4 Credits**

Maximum Marks: 100
External Examination: 80
Internal Assessment: 20
Max. Time: 3 Hrs

**Objectives of the course**

- To learn the basic concepts of Soft Computing
- To become familiar with various techniques like neural networks, genetic algorithms and fuzzy systems.
- To apply soft computing techniques to solve problems.

***Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Students will have to attempt one question from each unit. Each question shall carry equal marks.***

**Unit-I**

**Introduction to Soft Computing:** Introduction, Evolution of Computing, Difference between Hard and Soft computing, From Conventional AI to Computational Intelligence, Machine Learning, Basics Requirement of Soft computing, Major Areas of Soft Computing, Applications of Soft Computing.

**Unit II**

**Fuzzy Logic**: Fuzzy Sets, Operations on Fuzzy Sets, Fuzzy Relations, Membership Functions: Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy Expert Systems, Fuzzy Decision Making, Implementation using Python/Matlab

**Unit III**

**Neural Networks**: Machine Learning Using Neural Network, Adaptive Networks, Feed forward Networks, Back Propagation networks, Supervised Learning Neural Networks, Radial Basis Function Networks: Reinforcement Learning, Unsupervised Learning Neural Networks, Introduction to Associative Memory, Self-Organizing Map, Adaptive Resonance architectures, Advances in Neural networks, Implementation using Python/ Matlab

**Unit IV**

**Genetic Algorithms**: Introduction to Genetic Algorithms (GA), Applications of GA in Machine Learning, Machine Learning Approach to Knowledge Acquisition,GA based Back Propagation Networks, Implementation using Python/ Matlab, LR type Fuzzy numbers, Fuzzy Neuron, Fuzzy BP Architecture, Learning in Fuzzy BP, Application of Fuzzy BP Networks, Hybrid Systems and their types.

**Course Outcomes:**

- Apply suitable soft computing techniques for various applications.
- Integrate various soft computing techniques for complex problems.

**Suggested Readings:**

1. Jyh-Shing Roger Jang, Chuen-Tsai Sun, EijiMizutani, —Neuro-Fuzzy and Soft Computing, Prentice-Hall of India, 2002.
2. KwangH.Lee, —First course on Fuzzy Theory and Applications, Springer, 2005.
3. George J. Klir and Bo Yuan, —Fuzzy Sets and Fuzzy Logic-Theory and Applications, Prentice Hall, 1996.
4. James A. Freeman and David M. Skapura, —Neural Networks Algorithms, Applications, and Programming Techniques, Addison Wesley, 2003.

# ELECTIVE GROUP-Y

**21MCS313** **INTRODUCTION TO INFORMATION SECURITY & CRYPTOGRAPHY** **4L:0T:0P** **4 Credits**

Maximum Marks: 100
External Examination: 80
Internal Assessment: 20
Max. Time: 3 Hrs

**Objectives of the course**

- Understand OSI security architecture and classical encryption techniques.
- Acquire fundamental knowledge on the concepts of finite fields and number theory.
- Understand various block cipher and stream cipher models.
- Describe the principles of public key cryptosystems, hash functions and digital signature.

***Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Students will have to attempt one question from each unit. Each question shall carry equal marks.***

**UNIT I**

**Introduction & Number Theory**: Services, Mechanisms and attacks-the OSI security architecture-Network security model-Classical Encryption techniques (Symmetric cipher model, substitution techniques, transposition techniques, steganography).FINITE FIELDS AND NUMBER THEORY: Groups, Rings, Fields-Modular arithmetic-Euclid‟s algorithm-Finite fields- Polynomial Arithmetic –Prime numbers-Fermat‟s and Euler‟s theorem-Testing for primality -The Chinese remainder theorem-Discrete logarithms.

**UNIT II**

**Block Ciphers & Public Key Cryptography:**Data Encryption Standard-Block cipher principles-block cipher modes of operation-Advanced Encryption Standard (AES)-Triple DES-Blowfish-RC5 algorithm. Public key cryptography: Principles of public key cryptosystems-The RSA algorithm-Key management – Diffie Hellman Key exchange-Elliptic curve arithmetic-Elliptic curve cryptography.

**UNIT III**

**Security Practice & System Security**: Authentication applications – Kerberos – X.509 Authentication services – Internet Firewalls for Trusted System: Roles of Firewalls – Firewall related terminology-Types of Firewalls – Firewall designs – SET for E-Commerce Transactions. Intruder – Intrusion detection system – Virus and related threats – Countermeasures – Firewalls design principles – Trusted systems – Practical implementation of cryptography and security.

**UNIT IV**

**E-Mail, IP& Web Security**: E-mail Security: Security Services for E-mail-attacks possible through E-mail – establishing keys privacy-authentication of the source-Message Integrity-Non-repudiation-Pretty Good Privacy-S/MIME. IPSecurity: Overview of IPSec – IP and IPv6-Authentication Header-Encapsulation Security Payload (ESP)-Internet Key Exchange (Phases of IKE, ISAKMP/IKE Encoding). Web Security: SSL/TLS Basic Protocol-computing the keys- client authentication-PKI as deployed by SSLAttacks fixed in v3- Exportability-Encoding-Secure Electronic Transaction (SET).

**Course Outcomes:**

- Compare various Cryptographic Techniques
- Design Secure applications
- Inject secure coding in the developed applications

**Suggested Readings:**

1. Behrouz A. Ferouzan, “Cryptography & Network Security”, Tata McGraw Hill, 2007.
2. Man Young Rhee, “Internet Security: Cryptographic Principles”, “Algorithms and Protocols”, Wiley Publications, 2003.
3. Charles Pfleeger, “Security in Computing”, 4th Edition, Prentice Hall of India, 2006.
4. Ulysess Black, “Internet Security Protocols”, Pearson Education Asia, 2000.
5. Charlie Kaufman and Radia Perlman, Mike Speciner, “Network Security, Second Edition, Private Communication in Public World”, PHI 2002.
6. Bruce Schneier and Neils Ferguson, “Practical Cryptography”, First Edition, Wiley Dreamtech India Pvt Ltd, 2003.
7. Douglas R Simson “Cryptography – Theory and practice”, First Edition, CRC Press, 1995.

**21MCS314** **CLOUD COMPUTING FUNDAMENTALS & ITS SECURITY** **4L:0T:0P** **4 Credits**

Maximum Marks: 100
External Examination: 80
Internal Assessment: 20
Max. Time: 3 Hrs

**Objectives of the course**

- Discuss with confidence, what is cloud computing and what are key security and control considerations within cloud computing environments.
- Identify various cloud services.
- Assess cloud characteristics and service attributes, for compliance with enterprise objectives.
- Explain the four primary cloud category "types".
- Evaluate various cloud delivery models.
- Contrast the risks and benefits of implementing cloud computing.
- Specify security threat exposure within a cloud computing infrastructure.

***Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Students will have to attempt one question from each unit. Each question shall carry equal marks.***

**Unit I**

**Cloud Computing Fundamentals:** Cloud Computing definition, Types of cloud, Cloud services: Benefits and challenges of cloud computing, Evolution of Cloud Computing , usage scenarios and Applications , Business models around Cloud – Major Players in Cloud Computing - Issues in Cloud - Eucalyptus - Nimbus - Open Nebula, CloudSim.

**Unit II**

**Types of Cloud services:** Software as a Service - Platform as a Service – Infrastructure as a Service - Database as a Service - Monitoring as a Service - Communication as services - Service providers- Google App Engine, Amazon EC2 - Service providers- Google App Engine, Amazon EC2 - Introduction to MapReduce - GFS - HDFS - Hadoop Framework

**Unit III**

**Cloud architecture:** Cloud delivery model - SPI framework, SPI evolution, SPI vs. tradition al IT Model, Collaborating on Calendars, Schedules and Task Management – Collaborating on Event Management, Contact Management, Project Management – Collaborating on Word Processing , Databases – Storing and Sharing Files- Collaborating via Web-Based Communication Tools – Evaluating Web Mail Services – Collaborating via Social Networks – Collaborating via Blogs and Wikis.

**Unit IV**

**Virtualization:** Need for Virtualization – Pros and cons of Virtualization – Types of Virtualization – System Vm, Process VM, Virtual Machine monitor – Virtual machine properties - Interpretation and binary translation, HLLVM - Hypervisors – Xen, KVM , VMWare, Virtual Box, Hyper-V.

**Security in Clouds:** Cloud security challenges – Software as a Service Security, Common Standards: The Open Cloud Consortium – The Distributed Management Task Force – Standards for application Developers – Standards for Messaging – Standards for Security, End user access to cloud computing, Mobile Internet devices and the cloud

**Course Outcome:**

- Explain the core concepts of the cloud computing paradigm: how and why this paradigm shin came about, the characteristics, advantages and challenges brought about by the various models and services in cloud computing
- Discuss system virtualization and outline its role in enabling the cloud computing system model
- Illustrate the fundamental concepts of cloud storage and demonstrate their use in storage systems such as Amazon S3 and HDFS
- Analyse various cloud programming models and apply them to solve problems on the cloud

**Suggested Readings:**

1. Cloud computing a practical approach - Anthony T.Velte, Toby J. Velte Robert Elsenperer TATA McGraw- Hill, New Delhi - 2010
2. Cloud Computing: Web-Based Application s That Change the Way You Work and Collaborate Online - Michael Miller - Que 2008
3. Cloud Computing Bible, Barrie Sosinsky, Wiley-India, 2010
4. Cloud Computing: Principles and Paradigms, Editors: RajkumarBuyya, James Broberg, Andrzej M. Goscinski, Wile, 2011
5. Cloud Computing: Principles, Systems and Applications, Editors: Nikos Antonopoulos, Lee Gillam, Springer, 2012
6. Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Ronald L. Krutz, Russell Dean Vines, Wiley-India, 2010

**21MCS315 MOBILE WIRELESS AND VOIP SECURITY 4L:0T:0P 4 Credits**

Maximum Marks: 100
External Examination: 80
Internal Assessment: 20
Max. Time: 3 Hrs

**Objectives of the course**

- To understand the concept of mobile wireless technology
- Brief understanding of Voice over IP concept
- To aware about the various security measures for wireless medium including VOIP

***Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Students will have to attempt one question from each unit. Each question shall carry equal marks.***

**Unit I**

**Introduction to Mobile Communication and Computing:** Basic history of Mobile Computing, Architecture for mobile computing, Design considerations for mobile computing, Mobile computing through internet, Wireless network architecture, Application and significance of mobile communications, Mobile and wireless devices along with the history of wireless communication

**Unit II**

**Wireless Transmission:** Various frequencies used for communication, Types of signals and the antennas used for communication, Signals are propagated using various modulation techniques, Analog modulation and digital modulation, Spectrum technology: Direct Sequence Spread Spectrum (DSSS) and Frequency Hopping Spread Spectrum (FHSS), Cellular systems used for mobile communications along with the way frequency and planned

**Unit III**

**Wireless Medium Access Control:** Specialized MAC in wireless domain, Medium accessing technique, Space Division Multiple Access (SDMA), Frequency Division Multiple Access (FDMA), Time Division Multiple Access (TDMA) and Code Division Multiple Access (CDMA), Architecture of a GSM system and GSM –TDMA/ FDMA frame, Universal Mobile Telecommunication System (UMTS)

**Unit IV**

**Overview of Voice over IP (VoIP):** Traditional Telephony Systems, VoIP network architecture, VoIP protocols, VoIP signalling, media and supporting protocols: RTP, RTCP, SIP, H.323, MGCP, MEGACO/H.248, VoIP support protocols: DNS, DHCP, NTP, HTTP, SNMP, and TFTP, VoIP Security Threat Overview, Voice Network Designs, VPN (Virtual Private Networks) and VoIP, Types of attacks, Denial of Service (DOS), TCP/IP insecurity, Eavesdropping, Sniffing/Snooping/Wiretapping

**VoIP security issues:** VOIP Risks, Threats, and Vulnerabilities, Confidentiality and Privacy, Integrity Issues, Availability and Denial of Service, VoIP Issues with Firewalls & NAT, Proxy Servers, Encryption Issues and Performance, Existing Security Features within the SIP Protocol, Authentication of Signalling Data using HTTP Digest Authentication, Security Considerations, Overcoming NAT Issues, NAT/Firewall traversal.

**Course Outcomes:**

- Explain the basic concepts of mobile communication and computing
- Discusses about vulnerability of wireless medium
- VOIP security issues and measures to overcome these.

**Suggested Readings:**

1. Brijendra Singh, *Network Security and Management*, 3rd Edition, PHI publication.
2. Doherty, *Wireless and Mobile Device Security*, Publisher: Jones & Bartlett Learning, *2015,* ISBN: 9781284059274
3. Alotaibi Mutlaq, *Security Aspects for Voip Systems.*
4. James F. Ransome, John W. Rittinghouse,*Voice over Internet Protocol Security.*

**21MCS316** **INTRUSION DETECTION SYSTEMS AND ANALYSIS** **4L:0T:0P** **4 Credits**

Maximum Marks: 100
External Examination: 80
Internal Assessment: 20
Max. Time: 3 Hrs

**Objectives of the course**

- To understand about the intruders.
- To know the intrusion detection and prevention policies
- Analyze intrusion detection alerts and logs to distinguish attack types from false alarms

***Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Students will have to attempt one question from each unit. Each question shall carry equal marks.***

**UNIT I**

History of Intrusion detection, Audit, Concept and definition , Internal and external threats to data, attacks, Need and types of IDS, Information sources Host based information sources, Network based information sources.

**UNIT II**

Intrusion Prevention Systems, Network IDs protocol based IDs, Hybrid IDs, Analysis schemes, thinking about intrusion. A model for intrusion analysis, techniques Responses requirement of responses, types of responses mapping responses to policy Vulnerability analysis

**UNIT III**

Introduction to Snort, Snort Installation Scenarios, Installing Snort, Running Snort on Multiple Network Interfaces, Snort Command Line Options, Step-By-Step Procedure to Compile and Install Snort Location of Snort Files, Snort Modes Snort Alert Modes

**UNIT IV**

Working with Snort Rules, Rule Headers, Rule Options, The Snort Configuration File etc. Plugins, Pre-processors and Output Modules, Using Snort with MySQL UNIT-V Using ACID and Snort Snarf with Snort, Agent development for intrusion detection, Architecture models of IDs and IPs.

**Course Outcomes:**

1. Explain the fundamental concepts of Network Protocol Analysis and demonstrate the skill to capture and analyze network packets.
2. Use various protocol analyzers and Network Intrusion Detection Systems as security tools to detect network attacks and troubleshoot network problems. UNIT-I History of Intrusion detection, Audit,

**Suggested Readings:**

1. Ali A. Ghorbani, Wei Lu, “Network Intrusion Detection and Prevention: Concepts and Techniques”, Springer, 2010.

2. Carl Enrolf, Eugene Schultz, Jim Mellander, “Intrusion detection and Prevention”, McGraw Hill, 2004
3. Paul E. Proctor, “The Practical Intrusion Detection Handbook “,Prentice Hall , 2001.
4. AnkitFadia and MnuZacharia, “Intrusiion Alert”, Vikas Publishing house Pvt., Ltd, 2007.
5. Earl Carter, Jonathan Hogue, “Intrusion Prevention Fundamentals”, Pearson Education, 2006.

# ELECTIVE GROUP-Z

**21MCS317 WIRELESS AND MOBILE NETWORKS 4L:0T:0P 4 Credits**

Maximum Marks: 100
External Examination: 80
Internal Assessment: 20
Max. Time: 3 Hrs

**Objectives of the course**

- Understand the fundamentals of wireless and mobile networks.
- Learn and analyze the different wireless technologies.
- Evaluate Ad-hoc networks and wireless sensor networks.
- Understand and evaluate emerging wireless technologies and standards
- Understand design considerations for wireless and mobile networks

***Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Students will have to attempt one question from each unit. Each question shall carry equal marks.***

**Unit I**

**Introduction to Wireless Telecommunication Systems and Networks**: Concepts of Wireless Communication, History and Evolution of Wireless Communication, Different Generations of Wireless Networks.

**Common Cellular System Components:** Cellular networks architecture, Signal strength and cell area, Common cellular networks components, Components Identification and call establishment.

**Unit II**

**Wireless Network Architecture and Operation:** Fundamentals of Cellular Architecture, Mobility Management in Wireless Network, Power Management in Wireless Network, Security in Wireless Network.

**GSM Interface and Protocol Stack:** GSM PLMN Interfaces, GSM Radio Interface, GSM Abis Interface, GSM A Interface , GSM Interface for Connecting Other Components, Mapping of GSM Layers onto OSI Layers, Protocols Used Across Other Interfaces of GSM.

**Unit III**

**GSM TDMA Techniques:** GSM and TDMA Techniques, GSM Channels, GSM Identifiers.

**CDMA Technology:** CDMA overview, CDMA channels Concept, CDMA system operations.

**Speech Coding in GSM**: Speech coding in GSM, Speech coding methods, Speech codec attributes, LPAS, ITU-T Standards.

**Wireless Modulation Techniques:** Concept of Modulation, Wireless Modulation Techniques, Air Interface, Path Loss Models, Multiple Access Techniques.

**Unit IV**

**Wireless Modulation Techniques:** Orthogonal Frequency Division Multiplexing (OFDM), Ultra Wide Band Radio Techniques, Diversity Techniques, GSM Hardware.

**Wireless Local Area Networks:** Evolution of Wireless LANs, Wireless LAN Topologies, Wireless LAN Requirements, IEEE 802.11 Standards, IEEE 802.15 Standards, IEEE 802.16 Standards, Wireless LAN Applications.

**Wi-Fi and Wimax Technology:** Wi-Fi (802.11), WiMAX(802.16).

**Course Outcomes:**

- Explain the basic concepts of wireless network and wireless generations.
- Demonstrate the different wireless technologies such as CDMA, GSM, GPRS etc.

- Describe and judge the emerging wireless technologies standards such as WLL, WLAN, WPAN, WMAN.
- Explain the design considerations for deploying the wireless network infrastructure.

**Suggested Readings:**

1. Rappaport. T.S., "Wireless communications", Pearson Education, 2003.
2. Gordon L. Stuber, "Principles of Mobile Communication", Springer International Ltd., 2001.
3. Andrea Goldsmith, Wireless Communications, Cambridge University Press, 2007.

**21MCS318** **WIRELESS INTERNET AND PERVASIVE COMPUTING** **4L:0T:0P** **4 Credits**

Maximum Marks: 100
External Examination: 80
Internal Assessment: 20
Max. Time: 3 Hrs

**Objectives of the course**

- This course covers design principles and applications of wireless Internet access technologies, pervasive mobile device architecture, and information appliances in Internet and cloud applications.

***Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Students will have to attempt one question from each unit. Each question shall carry equal marks.***

**Unit I**

**WIRELESS NETWORKS:** Wireless LANs and PANs –IEEE 802.11 Standard –Architecture –Services –Network –HiperLAN –BlueTooth-Wi-Fi –WiMAX
**Pervasive Computing and web based Applications (continued):** Wireless Application Protocol (WAP) Architecture and Security - Wireless Mark-Up language (WML) – Introduction.

**Unit II**

**ROUTING:** Mobile IP –DHCP –AdHoc–Proactive and Reactive Routing Protocols –Multicast Routing.

**Unit III**

**TRANSPORT AND APPLICATION LAYERS:** Mobile TCP–WAP –Architecture –WWW Programming Model–WDP –WTLS –WTP –WSP –WAE –WTA Architecture –WML –WMLScripts
**User Interface Issues in Pervasive Computing, Architecture:**
Smart Card- based Authentication Mechanisms - Wearable computing Architecture.

**Unit IV**

**PERVASIVE COMPUTING:** Pervasive computing infrastructure-applications-Device Technology - Hardware,Human-machine Interfaces, Biometrics, and Operating systems–Device Connectivity – Protocols, Security, and Device Management-Pervasive Web Application architecture-Access from PCs and PDAs -Access via WAP

**Course Outcomes:**

- This course covers various wireless networks like WiFi, WiMAX, etc.
- Understanding of Routing Algorithms
- Design principles and applications of Pervasive Computing.

**Suggested Readings:**

1. Rahul Banerjee: Internetworking Technologies: An Engineering Perspective, Prentice –Hall of India, New Delhi, 2003. (ISBN 81-203- 2185-5)
2. Rahul Banerjee: Lecture Notes in Pervasive Computing, Outline Notes, BITS-Pilani, 2003.
3. Ivan Stojmenovic , “Handbook of Wireless Networks and Mobile Computing”, John Wiley & sons Inc, Canada, 2002.

4. Asoke K Taukder,Roopa R Yavagal,"Mobile Computing", Tata McGraw Hill Pub Co. , New Delhi, 2005.
5. SengLoke," Context-Aware Computing Pervasive Systems" Auerbach Pub., New York, 2007.
6. Hansmannet al , "Pervasive Computing", Springer, New York

**21MCS319 MOBILE ADHOC NETWORK 4L:0T:0P 4 Credits**

Maximum Marks: 100
External Examination: 80
Internal Assessment: 20
Max. Time: 3 Hrs

**Objectives of the course**

- To study the Mobile Adhoc networks and its applications
- To study the routing algorithm in mobile adhoc network
- To study the transport protocols used in mobile adhoc network
- To understand the security mechanism used in mobile adhoc network
- To understand the quality of service for mobile adhoc network.

***Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Students will have to attempt one question from each unit. Each question shall carry equal marks.***

**UNIT I**

**Introduction:** Introduction to ad-hoc networks – definition, characteristics features, applications. Characteristics of wireless channel, ad-hoc mobility models: indoor and outdoor models.

**Medium Access Protocols:** MAC Protocols: Design issues, goals and classification. Contention based protocols – with reservation, scheduling algorithms, protocols using directional antennas. IEEE standards: 802.11a, 802.11b, 802.11g, 802.15. HIPERLAN.

**UNIT II**

**Network Protocols**: Routing Protocols: Design issues, goals and classification. Proactive Vs reactive routing, unicast routing algorithms, Multicast routing algorithms, hybrid routing algorithm, energy aware routing algorithm, hierarchical routing, QoS aware routing.

**UNIT III**

**END – END Delivery and Security:** Transport Layer: Issues in designing – Transport layer classification, adhoc transport protocols. Security issues in adhoc networks: issues and challenges, network security attacks, secure routing protocols.

**UNIT IV**

**Cross Layer Design:** Cross layer Design: Need for cross layer design, cross layer optimization, parameter optimization techniques, cross layer cautionary perspective. Integration ofadhoc with Mobile IP networks

**Course Outcomes:**

- To understand the routing algorithm used mobile adhoc network
- To understand the Transport protocol of mobile adhoc network
- To understand the security mechanism used in mobile adhoc network
- To understand the quality of service
- An Ability to understand the security mechanism for mobile adhoc network
- An ability to understand the solutions to improve the quality of service in mobile adhoc network

**Suggested Readings:**


5. Stefano Basagni, Marco Conti, Silvia Giordano and Ivan stojmenovic, Mobile ad-hoc networking, Wiley-IEEE press, 2004.
6. Mohammad Ilyas, The handbook of ad-hoc wireless networks, CRC press, 2002.
7. T. Camp, J. Boleng, and V. Davies " A Survey of Mobility Models for Ad-hoc Network"
8. Research, "Wireless Communication, and Mobile Computing.. Special Issue on Mobile Ad-hoc Networking Research, Trends and Applications, Vol. 2, no. 5, 2002, pp. 483 – 502.
9. A survey of integrating IP mobility protocols and Mobile Ad-hoc networks, Fekri M. bduljalil and Shrikant K. Bodhe, IEEE communication Survey and tutorials, no: 12007.

**21MCS320 INTERNET OF THINGS 4L:0T:0P 4 Credits**

Maximum Marks: 100
External Examination: 80
Internal Assessment: 20
Max. Time: 3 Hrs

**Objectives of the course**

- Students will understand the concepts of Internet of Things and can able to build IoT applications
- To learn different applications in IOT.
- To learn different protocols used in IOT.
- To learn the concepts of smart city development in IOT.
- To learn how to analysis the data in IOT

***Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Students will have to attempt one question from each unit. Each question shall carry equal marks.***

**Unit I**

**Introduction to IoT:** Defining IoT, Characteristics of IoT, Physical design of IoT, Logical design of IoT, Functional blocks of IoT, Communication models & APIs

**IoT&M2M**: Machine to Machine, Difference between IoT and M2M, Software define Network

**Unit II**

Board, IoT system management, SNMP,NETCONF, YANG, IoT Design methodology, Basic building blocks of IoT, Overview of IoT supported Hardware platforms such as: Raspberry pi

**Unit III**

**Challenges in IoT**: Design challenges, Development challenges, Security challenges, Other challenges

**Domain specific applications of IoT:** Home automation, Industry applications, Surveillance applications, Other IoT applications

**Unit IV**

**Developing IoTs** : Introduction to Python, Introduction to different IoT tools, Developing applications through IoT tools, Developing sensor based application through embedded system platform, Implementing IoT concepts with python

**Course Outcomes:**

- Apply the concepts of IOT.
- Identify the different technology.
- Apply IOT to different applications.
- Analysis and evaluate protocols used in IOT.
- Design and develop smart city in IOT.
- Analysis and evaluate the data received through sensors in IOT.

**Suggested Readings:**


1. Vijay Madisetti, ArshdeepBahga, “Internet of Things: A Hands-On Approach”
2. WaltenegusDargie,ChristianPoellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice
3. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, StamatisKarnouskos, David Boyle, “From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence”, 1 st Edition, Academic Press, 2014.
4. Peter Waher, “Learning Internet of Things”, PACKT publishing, BIRMINGHAM – MUMBAI
5. Bernd Scholz-Reiter, Florian Michahelles, “Architecting the Internet of Things”, ISBN 978-3-642-19156-5 e-ISBN 978-3-642-19157-2, Springer
6. Daniel Minoli, “Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications”, ISBN: 978-1-118- 47347-4, Willy Publications
7. Vijay Madisetti and ArshdeepBahga, “Internet of Things (A Hands-onApproach)”, 1 st Edition, VPT, 2014

**21MCS306 LAB-VI (BASED ON 21MCS301) 0L:0T:4P 2 Credits**

**Course Outcomes: By the end of the course the students will be able to:**

CO1 Explain the concepts used in various computer graphic devices.
CO2 Draw different primitive drawing objects and apply transformations.
CO3 Apply clipping on points, lines and closed objects with respect to given rectangular window.
CO4 Explain the concepts of interactive computer graphics.
CO5 Implement the algorithms learnt in some programming language.
CO6 Implementing Functions in Python Programming
CO7 Explaining the concept of OOPS in Python Programming

**List of Practical:**

1. Write a Python program to sum all the items in a list.
2. Write a Python program to multiply all the items in a list.
3. Write a Python program to get the largest number from a list.
4. Write a Python program to get the smallest number from a list.
5. Write a Python program to count the number of strings where the string length is 2 or more and the first and last character are same from a given list of strings. Sample List : ['abc', 'xyz', 'aba', '1221']
6. Write a Python program to get a list, sorted in increasing order by the last element in each tuple from a given list of non-empty tuples. Sample List : [(2, 5), (1, 2), (4, 4), (2, 3), (2, 1)] Expected Result : [(2, 1), (1, 2), (2, 3), (4, 4), (2, 5)]
7. Write a Python program to remove duplicates from a list.
8. Write a Python program to check a list is empty or not.
9. Write a Python program to clone or copy a list.
10. Write a Python program to find the list of words that are longer than n from a given list of words.
11. Write a Python function that takes two lists and returns True if they have at least one common member.
12. Write a Python program to print a specified list after removing the 0th, 4th and 5th elements. Sample List : ['Red', 'Green', 'White', 'Black', 'Pink', 'Yellow'] Expected Output : ['Green', 'White', 'Black']
13. Write a Python program to generate a 3*4*6 3D array whose each element is *.
14. Write a Python program to print the numbers of a specified list after removing even numbers from it.
15. Write a Python program to shuffle and print a specified list.
16. Write a Python program to generate and print a list of first and last 5 elements where the values are square of numbers between 1 and 30 (both included).
17. Write a Python program to generate and print a list except for the first 5 elements, where the values are square of numbers between 1 and 30 (both included).
18. Write a Python program to generate all permutations of a list in Python.
19. Write a Python program to get the difference between the two lists.
20. Write a Python program access the index of a list

**21MCS307 LAB-VII (BASED ON 21MCS302) 0L:0T:4P 2 Credits**

**Course Outcomes: By the end of the course the students will be able to:**

CO1 Explain the concepts used in various computer graphic devices.
CO2 Draw different primitive drawing objects and apply transformations.
CO3 Apply clipping on points, lines and closed objects with respect to given rectangular window.
CO4 Explain the concepts of interactive computer graphics.

**List of Practical:**

1. A program to draw curve using function
2. A Program to draw line and circle using function
3. A program to draw a line using Digital Differential Analyzer (DDA) Algorithm
4. A program to draw a line using Bresenham's Line Algorithm (BLA) for lines with slopes negative and less than 1.
5. A program to draw a line using Bresenham's Line Algorithm (BLA) for lines with slopes positive and less than 1.
6. A program to draw a line using Bresenham's Line Algorithm (BLA) for lines with slopes positive and greater than 1.
7. A program to draw a line using Contents Tasks List Description Bresenham's Line Algorithm (BLA) for lines with slopes negative and greater than 1.
8. A program to draw a circle using Bresenham's Circle Algorithm.
9. A program to fill different types of geometric shapes using Flood Fill.Algo.
10. A program to fill different types of geometric shapes using Boundary Fill Algo.
11. A program to draw a smiley
12. A Program to draw moving ball
13. A Program to draw kettle shape
14. A Program to draw small game
15. A Program to draw floating boat