

**Syllabus outline for Computer Science & Engineering (Hons.) with Specialization in Cloud Computing**

**DEPT. of COmputer Science & Engineering**

# PREAMBLE

Education plays enormously significant role in building of a nation. There are quite a large number of educational institutions, engaged in imparting education in our country. Majority of them have entered recently into semester system to match with international educational pattern. However, our present education system is churning out youth who have to compete locally, regionally, nationally as well as globally. The present alarming situation necessitates transformation and/or redesigning of system, not only by introducing innovations but developing “learner-centric approach.

Majority of Indian higher education institutions have been following the system, which obstructs the flexibility for the students to study the subjects/courses of their choice and their mobility to different institutions. There is need to allow the flexibility in education system, so that students depending upon their interests can choose inter-disciplinary, intra-disciplinary and skill-based courses. This can only be possible when choice based credit system (CBCS), an internationally acknowledged system, is adopted. The choice based credit system not only offers opportunities and avenues to learn core subjects but also explore additional avenues of learning beyond the core subjects for holistic development of an individual. The CBCS will undoubtedly facilitate benchmarking of our courses with best international academic practices.

Advantages of the choice based credit system:

• Shift in focus from the teacher-centric to student-centric education.

• Student may undertake as many credits as they can cope with (without repeating all courses in a given semester if they fail in one/more courses).

• CBCS allows students to choose inter-disciplinary, intra-disciplinary courses, skill oriented papers (even from other disciplines according to their learning needs, interests and aptitude) and more flexibility for students.

• CBCS makes education broad-based and at par with global standards. One can take credits by combining unique combinations.

• CBCS offers flexibility for students to study at different times and at different institutions to complete one course (ease mobility of students). Credits earned at one institution can be transferred to another institution.

# CHOICE BASED CREDIT SYSTEM

The Indian Higher Education Institutions have been moving from the conventional annual system to semester system. Currently many of the institutions have already introduced the Choice Based Credit System. The semester system accelerates the teaching-learning process and enables vertical and horizontal mobility in learning. The credit based semester system provides flexibility in designing curriculum and assigning credits based on the course content and hours of teaching. The Choice Based Credit System provides a ‘cafeteria’ type approach in which the students can take courses of their choice, learn at their own pace, undergo additional courses to acquire more than the required credits and adopt an interdisciplinary approach to learning.

## Programme Educational Objectives

This scheme and courses are related to four-year Computer Science & Engineering programme with following Programme Educational Objectives (PEO).

1. Graduates of the program will have successful technical and professional careers in industry, academia, govt. and entrepreneurship.

2. Graduates of the program will hold strong professional ethics with good team skills and communication

3. Graduates of the program will engage in lifelong learning to acquire new knowledge in an evolving technological landscape.

## Types of Courses

1. Courses are the subjects that comprise the Computer Engineering Programme.
2. A course may be designed to comprise lectures, tutorials, laboratory work, fieldwork, outreach activities, project work, vocational training, viva, seminars, term papers, assignments, presentations, self-study etc. or a combination of some of these components.
3. The learning outcomes of each course will be defined before the start of a semester.
4. Following are the course types:

i. **Core Course (CC):** This is a course, which is to be compulsorily studied by a student as a core requirement to complete the requirement of B.Tech in Computer Science &Engineering.

ii. **Elective Course:** An elective course is a course, which can be chosen from a pool of courses. It is intended to support the discipline of study by providing an expanded scope, enabling exposure to another discipline/domain and nurturing a student’s proficiency and skill. An elective may be of following types:

a) **Discipline Specific Elective (DE):** It is an elective course that adds proficiency to the students in the discipline.

b) **Generic Elective (GE):** It is an elective course taken from other engineering disciplines and enhances the generic proficiency and interdisciplinary perspective of students.

iii. **Obligatory Courses:**

1. **Mandatory Courses (MC)**: It can be taken from among a pool of foundation courses, which aim at value-based education. They may provide hands-on training to improve competencies and skills or provide education on human, societal, environmental and national values.
2. **Dissertation/Project/Training/Internship (PTI):**Course designed to acquire special/advanced knowledge, such as supplement study/support study to a project work, and a candidate studies such a course on his own with an advisory support by a teacher/faculty member is called dissertation/project
3. **Humanities, Social Sciences & Management (HSM):** It is an elective course taken from non-engineering disciplines (humanities, social sciences and management) that broadens the perspective of an engineering student.
4. **Basic Science Courses (BSC):** It is based upon content that leads to fundamental knowledge enhancement in sciences, and basic engineering principles.
5. **NPTEL (NPT):** Online MOOC courses are based on the respective year’s offered courses.
6. **General Studies Courses (GSC):** Course designed to encourage and enrich the students for the technical and professional exams
7. Each credit course contributes certain credits to the programme. A course can be offered either as a full course (4 credits) or as a half course (2 credits). A full course is conducted with 3 hours of lectures and either 1 hour of tutorial or 2 hours of practical work per week. A half course is conducted with 2 hours of lectures. There are also some exceptional electives with 3 credits and 1 credit.

Definition of Credit: -

|  |  |
| --- | --- |
| 1 Hr. Lecture (L) per week | 1 Credit |
| 1 Hr. Tutorial (T) per week | 1 Credit |
| 1 Hr. Practical (P) per week  Or  2 Hr. Practical (Lab)/week | 0.5 Credits  Or  1 Credit |

1. A project work/dissertation is considered as a special course involving application of the knowledge gained during the course of study in exploring, analyzing and solving complex problems in real life applications. A candidate completes such a course with an advisory support by a faculty member.
2. **Mandatory Courses** may be offered. They do not carry credits but aim at expanding knowledge or bridging deficiency in knowledge or skill.
3. A course may have pre-requisite course(s) that are given in the Semester-wise Course Allocation scheme.
4. A student can opt for a course only if he/she has successfully passed its pre- requisite(s).
5. A student has to register for all courses before the start of a semester.
6. **Program codes:** The codes for various undergraduate programmes are as follows:

i. Civil Engineering: CE

ii. Computer Science &Engineering: CS

iii. Electronics and Communication Engineering: EC

iv. Electrical Engineering: EE

v. Mechanical Engineering: ME

1. **Departmental Course Codes:** The codes for departmental core courses and discipline-specific electives are specific to each discipline. The first two characters are derived from departmental codes listed above. The third character is ‘C’ for core courses and ‘D’ for discipline-specific courses and ‘PT’ forDissertation/Project/Training/Internship. This is followed by a digit sequence number:

i. CSCyyy: Core Course

ii. CSDyyy: Discipline-Specific Elective Course

iii. CSPTyyy: Dissertation/Project/Training/Internship

1. **Common Elective Course Codes:** All disciplines will follow a common code as shown below. The 3-digit sequence number ‘yyy’ is taken from the respective tables of different types of courses.

i. HSMyyy: Humanities, Social Sciences& Management Course

ii. BSCyyy: Basic Science Course

iii. MCyyy: Mandatory Course

iv. GSCyyy: General Studies Courses

1. **General Electives:** A student may take a course under the category of General Elective (GE) offered by any other Department of the Institute under the categories of Core Course (CC) and Discipline Specific Electives (DE). However, such options shall be offered to a student as per prescribed guidelines of the Institute.
2. **General Electives:** A student may take a course under the category of General Elective (GE) offered by any other Department of the Institute under the categories of Core Course (CC) and Discipline Specific Electives (DE). However, such options shall be offered to a student as per prescribed guidelines of the Institute.
3. The opting of a course by the student will depend upon the requisites for that course and with the consent of the course advisor.

# PROGRAM OUTCOMES

1. At the completion of the B.Tech. Computer Science &Engineering Program, a student will achieve the following outcomes:
2. Gain an ability to apply the knowledge of mathematics, science, Engineering fundamentals and computer engineering in solving complex engineering problems.
3. Acquire the ability to survey the literature, conduct experiments, interpret data and analyze complex engineering problems.
4. Acquire the ability to design a system, its components and processes to meet requirements with due regard to social, economic and environmental considerations.
5. Acquire the ability to apply research based knowledge and methods to investigate complex engineering problems with focus on computer engineering.
6. Acquire the ability to select existing tools, techniques and resources and create new ones to model complex engineering problems and activities.
7. Understand the responsibilities of an engineering profession towards society, economy, health, safety and legal issues.
8. Understand a computer engineer’s role in enhancing sustainable development.
9. Demonstrate professional ethics and responsibilities with utmost integrity at all times
10. Acquire the ability to contribute effectively as members or leaders of diverse and multidisciplinary teams.
11. Communicate effectively among professional and with society through reports, presentations, documentations and instructions.
12. Engage in lifelong learning in ever evolving landscape of computer science and engineering.

# SCHEME – SEMESTER WISE COURSE ALLOCATION

**First Semester Syllabus**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Sl No. | Type | Subject Code | Topic | L | T | P | Credit Points |
| 1 | BSC | BSC--- | Physics | 3 | 1 | 3 | 5.5 |
| 2 | BSC | BSC--- | Mathematics-1 | 3 | 1 | 0 | 4 |
| 3 | GE | EEC101 | Basic Electrical Engineering | 3 | 0 | 2 | 4 |
| 4 | GE | MEC101 | Engineering Graphics & Design | 1 | 0 | 4 | 3 |
| 5 | GE | ECC101 | Basic Electronics Engineering | 2 | 0 | 0 | 2 |
| 6 | GSC | GSC101 | ESP & SDP-I | 0 | 1 | 0 | 1 |
|  |  |  | Total |  |  |  | 19.5 |

## Students will undergo a mandatory induction program

**Suggestive Choice Based Subjects**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Sl No. | Type | Subject Code | Topic | L | T | P | Credit Points |
| 1 | **BSC** | **BSC001** | **Physics - Semiconductor physics** | **3** | **1** | **3** | **5.5** |
| 2 | BSC | BSC002 | Physics - Introduction to Electromagnetic Theory | 3 | 1 | 3 | 5.5 |
| 3 | BSC | BSC003 | Physics - Introduction to Mechanics | 3 | 1 | 3 | 5.5 |
| 4 | BSC | BSC004 | Physics - Quantum Mechanics for Engineers | 3 | 1 | 3 | 5.5 |
| 5 | BSC | BSC005 | Physics - Oscillation, Waves and Optics | 3 | 1 | 3 | 5.5 |
| 6 | BSC | BSC006 | Chemistry | 3 | 1 | 3 | 5.5 |
| 7 | **BSC** | **BSC007** | **Mathematics - Calculus and Vector Calculus** | **3** | **1** | **0** | **4** |
| 8 | BSC | BSC008 | Mathematics –Calculus & Differential Equation | 3 | 1 | 0 | 4 |
| 9 | BSC | BSC009 | Mathematics – Statistics and Probability Theory | 3 | 0 | 0 | 3 |
| 10 | BSC | BSC010 | Mathematics - Discrete Mathematics | 3 | 0 | 0 | 3 |
| 11 | BSC | BSC011 | Mathematics - Numerical Methods & Probability Theory | 3 | 1 | 0 | 4 |
| 12 | BSC | BSC012 | Mathematics –Transform Calculus, Numerical Methods & Complex Analysis | 3 | 1 | 0 | 4 |
| 13 | BSC | BSC013 | Mathematics - Probability, Statistics & Stochastic Process | 3 | 1 | 0 | 4 |

**Second Semester Syllabus**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Sl No. | Type | Subject Code | Topic | L | T | P | Credit Points |
| 1 | BSC | BSC--- | Chemistry | 3 | 1 | 3 | 5.5 |
| 2 | BSC | BSC--- | Mathematics-2 | 3 | 1 | 0 | 4 |
| 3 | CC | CSC201 | Programming for Problem Solving | 3 | 0 | 2 | 4 |
| 4 | GE | MEC202 | Workshop/Manufacturing Practices | 1 | 0 | 4 | 3 |
| 5 | HSM | HSM001 | English | 2 | 0 | 2 | 3 |
| 6 | GSC | GSC202 | ESP & SDP - II | 0 | 2 | 0 | 2 |
| 7 | PTI | INT201 | Inter/Intra Institutional Activity | 0 | 0 | 6 | 3 |
| 8 | NPT | NPT## | (NPTEL) | - | - | - | 1 |
|  |  |  | Total |  |  |  | 25.5 |

## (NPT201)NPTEL courses are based on the respective year’s offered courses

**Suggestive Choice Based Subjects**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Sl No. | Type | Subject Code | Topic | L | T | P | Credit Points |
| 1 | BSC | BSC001 | Physics - Semiconductor Physics | 3 | 1 | 3 | 5.5 |
| 2 | BSC | BSC002 | Physics - Introduction to Electromagnetic Theory | 3 | 1 | 3 | 5.5 |
| 3 | BSC | BSC003 | Physics - Introduction to Mechanics | 3 | 1 | 3 | 5.5 |
| 4 | BSC | BSC004 | Physics - Quantum Mechanics for Engineers | 3 | 1 | 3 | 5.5 |
| 5 | BSC | BSC005 | Physics - Oscillation, Waves and Optics | 3 | 1 | 3 | 5.5 |
| 6 | BSC | BSC006 | Chemistry | **3** | **1** | **3** | **5.5** |
| 7 | BSC | BSC007 | Mathematics - Calculus and Vector Calculus | 3 | **1** | **0** | **4** |
| 8 | **BSC** | **BSC008** | **Mathematics – Advanced Calculus & Differential Equation** | 3 | 1 | 0 | 4 |
| 9 | BSC | BSC009 | Mathematics – Statistics and Probability Theory | 3 | 0 | 0 | 3 |
| 11 | BSC | BSC012 | Mathematics –Transform Calculus, Numerical Methods & Complex Analysis | 3 | 1 | 0 | 4 |
| 12 | BSC | BSC013 | Mathematics - Probability, Statistics & Stochastic Process | 3 | 1 | 0 | 4 |

**Third Semester Syllabus**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Sl No. | Type | Subject Code | Topic | L | T | P | Credit Points |
| 1 | BSC | BSC--- | Mathematics-3 | 3 | 0 | 0 | 3 |
| 2 | CC | CSC302 | Object Oriented Programming using C++ | 3 | 0 | 2 | 4 |
| 3 | CC | CSC303 | Data Structure & Algorithms | 3 | 0 | 2 | 4 |
| 4 | DE | --- | Discipline Specific Elective | 1 | 0 | 3 | 2.5 |
| 5 | GE | ------ | Generic Elective | - | - | - | 4 |
| 6 | NPT | NPT## | (NPTEL) | - | - | - | 1 |
| 7 | GSC | GSC303 | ESP & SDP - III | 0 | 2 | 0 | 2 |
| 8 | HSM | HSM--- | Humanities | 3 | 0 | 0 | 3 |
|  |  |  | Total |  | | | 23.5 |

##(NPT301) NPTEL courses are based on the respective year’s offered courses

**Suggestive Choice Based Subjects**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Sl No | Type | Subject Code | Topic | L | T | P | Credit Points |
| 3 | **BSC** | **BSC009** | **Mathematics –Applied Statistics and Probability Theory** | 3 | 0 | 0 | 3 |
| 4 | BSC | BSC010 | Mathematics - Discrete Mathematics | 3 | 0 | 0 | 3 |
| 5 | BSC | BSC011 | Mathematics - Numerical Methods & Probability Theory | 3 | 1 | 0 | 4 |
| 6 | BSC | BSC012 | Mathematics –Transform Calculus, Numerical Methods & Complex Analysis | 3 | 1 | 0 | 4 |
| 7 | BSC | BSC013 | Mathematics - Probability, Statistics & Stochastic Process | 3 | 1 | 0 | 4 |
| 8 | GE | ECC407 | Analog Circuits | 3 | 0 | 2 | 4 |
| 9 | GE | ECC306 | Digital System Design& Computer Organization | 3 | 0 | 2 | 4 |
| 10 | HSM | HSM004 | Industrial Psychology | 3 | 0 | 0 | 3 |
| 11 | HSM | HSM013 | Values and Ethics in Profession | 3 | 0 | 0 | 3 |
| 12 | HSM | HSM014 | E Commerce | 3 | 0 | 0 | 3 |
| 13 | DE | CSD301 | Introduction to Python Programming | 1 | 0 | 2 | 2 |
| 14 | DE | CSD302 | Introduction to Android Programming | 1 | 0 | 2 | 2 |

**Fourth Semester Syllabus**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Sl No. | Type | Subject Code | Topic | L | T | P | Credit Points |
| 1 | BSC | BSC--- | Mathematics-4 | 3 | 0 | 0 | 3 |
| 2 | CC | CSC404 | Formal Language & Automata Theory | 3 | 0 | 0 | 3 |
| 3 | CC | CSC405 | Object Oriented Methodology using Java | 3 | 0 | 2 | 4 |
| 4 | CC | CSC406 | Design & Analysis of Algorithms | 3 | 0 | 2 | 4 |
| 5 | CC | CSC407 | Software Engineering | 3 | 0 | 2 | 4 |
| 6 | HSM | HSM--- | Humanities | 3 | 0 | 0 | 3 |
| 7 | GSC | GSC404 | ESP & SDP – IV | 0 | 2 | 0 | 2 |
| 8 | NPT | NPT## | (NPTEL) | - | - | - | 1 |
| 9 | PTI | INT502 | Internship Industrial Training | 0 | 0 | 6 | 3 |
|  |  |  | Total |  | | | 27 |

## (NPT401)NPTEL courses are based on the respective year’s offered course

**Suggestive Choice Based Subjects**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Sl No. | Type | Subject Code | Topic | L | T | P | Credit Points |
| 1 | **BSC** | **BSC016** | **Mathematics - Numerical Methods & Operation Research** | 3 | 0 | 0 | 3 |
| 2 | BSC | BSC016 | Operation Research | 3 | 0 | 0 | 3 |
| 3 | BSC | BSC018 | Statistics for Data Analysis | 3 | 0 | 0 | 3 |
| 4 | **BSC** | **BSC019** | **Graph Theory** | 3 | 0 | 0 | 3 |
| 5 | BSC | BSC020 | Statistical Inference | 3 | 0 | 0 | 3 |
| 6 | **HSM** | **HSM006** | **Economics for Engineers** | 3 | 0 | 0 | 3 |
| 7 | HSM | HSM008 | Principle of Management | 3 | 0 | 0 | 3 |
| 8 | HSM | HSM009 | Total Quality Management | 3 | 0 | 0 | 3 |

**Fifth Semester Syllabus**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Sl No. | Type | Subject Code | Topic | L | T | P | Credit Points |
| 1 | CC | CSC508 | Data Base Management System | 3 | 0 | 2 | 4 |
| 2 | CC | CC501 | Introduction to Cloud Computing | 3 | 0 | 0 | 3 |
| 3 | CC | CSC510 | Operating System | 3 | 0 | 2 | 4 |
| 4 | GE | --- | Generic Elective | - | - | - | 4 |
| 5 | DE\* | --- | Discipline Specific Elective | - | - | - | 3 |
| 6 | GSC | GSC505 | ESP & SDP – V | 0 | 2 | 0 | 2 |
| 7 | NPT | NPT## | (NPTEL) | - | - | - | 1 |
| 8 | BSC | BSC | Mathematics-5 | 3 | 0 | 0 | 3 |
| 9 | MC | MC001 | Environmental Science | 0 | 0 | 0 | 0 |
|  |  |  | Total |  | | | 24 |

##(NPT501) NPTEL courses are based on the respective year’s offered course

**Suggestive Choice Based Subjects**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Sl No. | Type | Subject Code | Topic | L | T | P | Credit Points |
| 1 | DE\* | CSD503 | Programming with Ruby on Rails | 2 | 0 | 2 | 3 |
| 2 | **DE\*** | **CSC407** | **Software Engineering** | 2 | 0 | 2 | 3 |
| 3 | DE\* | CSD504 | Advanced Programming with Python | 2 | 0 | 2 | 3 |
| 4 | GE | ECC510 | Digital Signal Processing | 3 | 0 | 2 | 4 |
| 5 | GE | ECC406 | Analog &Digital Communication | 3 | 0 | 2 | 4 |
| 5 | **BSC** | **BSC010** | **Mathematics - Discrete Mathematics** | 3 | 0 | 0 | 3 |
| 6 | BSC | BSC017 | Operations Research | 3 | 0 | 0 | 3 |
| 7 | BSC | BSC018 | Statistics for Data Analysis | 3 | 0 | 0 | 3 |

**Sixth Semester Syllabus**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Sl No. | Type | Subject Code | Topic | L | T | P | Credit Points |
| 1 | CC | **CC602** | Cloud Adaptation and Migration | 3 | 0 | 0 | 3 |
| 2 | CC | CC603 | Introduction to Virtualization &Networks in Cloud Computing | 3 | 0 | 2 | 4 |
| 3 | DE | … | Discipline Specific Elective | 3 | 0 | 2 | 4 |
| 4 | GE/DE | ----- | Discipline Specific Elective/Generic Elective | 3 | 0 | 2 | 4 |
| 5 | DE | ----- | Discipline Specific Elective | - | - | - | 3 |
| 6 | GE/DE | ------ | Discipline Specific Elective/Generic Elective | - | - | - | 3 |
| 7 | GSC | GSC606 | ESP & SDP – VI | 0 | 1 | 0 | 1 |
| 8 | NPT | NPT## | (NPTEL) | - | - | - | 1 |
| 9 | MC | MC002 | Disaster Management | 0 | 0 | 0 | 0 |
|  |  |  | Total |  | | | 23 |

##(NPT601)NPTEL courses are based on the respective year’s offered course

#Students will undergo project/training/internship in the industry / research organization / reputed Institute during the vacation

**Suggestive Choice Based Subjects**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Sl No. | Type | Subject Code | Topic | L | T | P | Credit Points |
| 1 | DE\* | CSC612 | Data Communication & Networking | 3 | 0 | 2 | 4 |
| 2 | DE\* | CSD606 | Big Data &Data Analytics | 3 | 0 | 2 | 4 |
| 3. | DE\* | CSD607 | Web Technology | 3 | 0 | 2 | 4 |
| 5. | DE\*\* | CSD713 | Internet of Things using Raspberry Pi | 1 | 0 | 4 | 3 |
| 6. | DE\*\* | CSD503 | Programming with Ruby on Rails | 1 | 0 | 4 | 3 |
| 7. | GE | ECC408 | Microprocessor & Microcontrollers | 2 | 0 | 2 | 3 |
| 8. | CSD | CSC509 | Computer Organization & Architecture | 2 | 0 | 2 | 3 |

**Seventh Semester Syllabus**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Sl No. | Type | Subject Code | Topic | L | T | P | Credit Points |
| 1 | HSM | HSM | Humanities | - | - | - | 3 |
| 2 | DE\* | …… | Discipline Specific Elective | 3 | 0 | 2 | 4 |
| 3 | DE\*\* | …… | Discipline Specific Elective | 3 | 0 | 0 | 3 |
| 4 | DE/BSC |  |  | - | - | - | 3 |
| 5 | GSC | GSC707 | ESP & SDP – VII | 0 | 1 | 0 | 1 |
| 7 | PTI | INT502 | Internship Industrial Training | 0 | 0 | 6 | 3 |
|  |  |  | Total |  | | | 17 |

## NPTEL courses are based on the respective year’s offered course

#Students will undergo project/training/internship in the industry / research organization / reputed Institute during the vacation

**Suggestive Choice Based Subjects**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Sl No. | Type | Subject Code | Topic | L | T | P | Credit Points |
| 1. | DE\* | CC704 | Introduction to Cloud Security | 3 | 0 | 0 | 3 |
| 2. | DE\* | CSD710 | Internet Technology | 3 | 0 | 0 | 3 |
| 3. | DE\*\* | CSD711 | E-Commerce | 3 | 0 | 0 | 3 |
| 4. | DE\*\* | CSD609 | Artificial Intelligence | 3 | 0 | 2 | 4 |
| 6. | DE\*\* | CSD606 | Big Data &Data Analytics | 3 | 0 | 2 | 4 |
| 7. | BSC | BSC013 | Mathematics - Graph Theory | 3 | 0 | 0 | 3 |
| 8. | HSM | HSM010 | Professional Practice, Law & Ethics | 3 | 0 | 0 | 3 |  |
| 9. | HSM | HSM011 | Human Resource Development and Organizational Behavior | 3 | 0 | 0 | 3 |  |
| 10. | HSM | HSM003 | Organizational Behavior | 3 | 0 | 0 | 3 |
| 11. | HSM | HSM006 | Economics for Engineers | 3 | 0 | 0 | 3 |

**Eighth Semester Syllabus**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Sl No. | Type | Subject Code | Topic | L | T | P | Credit Points |
| 1 | DE | … | Discipline Specific Elective | 3 | 0 | 0 | 3 |
| 2 | DE | … | Discipline Specific Elective | 3 | 0 | 0 | 3 |
| 3 | DE/GE | … | Generic Elective | 3 | 0 | 0 | 4 |
| 4 | GSC | GSC808 | ESP & SDP – VIII | 0 | 1 | 0 | 1 |
| 5 | PTI | INT801 | Internship Industrial Training/Project | 0 | 0 | 8 | 4 |
|  |  |  | Total |  | | | 14 |

**Suggestive Choice Based Subjects**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Sl No. | Type | Subject Code | Topic | L | T | P | Credit Points |
| 1 | DE\* | CC805 | Google Cloud - Organization & IAM | 3 | 0 | 0 | 3 |
| 2. | DE\* | CSD815 | Natural Language Processing | 3 | 0 | 0 | 3 |
| 3. | DE\* | CC806 | Cloud Architecture & Development Model | 3 | 0 | 0 | 3 |
| 5. | DE\*\* | CSD818 | Neural Network and Application | 3 | 0 | 0 | 3 |
| 6 | DE\*\* | CC808 | Introduction to Microsoft Azure and Its Services | 3 | 0 | 0 | 3 |
| 9. | GE | ECC510 | Digital Signal Processing | 3 | 0 | 0 | 3 |
| 10. | GE | ECD019 | Speech & Audio Processing | 3 | 0 | 0 | 3 |

**Detailed Syllabus of Specialization Course**

**CLOUD COMPUTING**

**Title of Course: INTRODUCTION TO Cloud Computing**

**Course Code: CC501**

**L-T Scheme: 3-0-0**

**Course Credits: 3**

**Objectives:**The course covers the fundamental concepts and practical aspects of Service Oriented Architecture. The current software development and delivery model is service oriented in nature. The applications are inherently getting distributed and shared by multiple clients. Thus, there is a need to get an insight into service oriented architectures.

**Learning Outcome:**After having undergone the course, the student shall be able to understand the issues related with detailed design aspects and standards of SOA.

**Course Contents:**

**Unit-1:**SOA Fundamentals, Technologies, Benefits, Challenges and basic mechanisms associated with other computing service (Delivery models - SAS, IAS & PAS, Common Cloud deployment models and cloud characters), Security threats and mechanisms.

**Unit-2:**Introduction and fundamental of SOA, Benefits and Goals, SOA Manifesto, SOA and network management architecture, Service as web services, Discovery and publishing of web services, Service roles, Service models, Description of services with WSDL, Messaging with SOAP.

**Unit-3:**Exchange patterns of message, Service activity, Coordination, Composition, Types, Activation and registration process, Business activities, Orchestration, Composition of heterogeneous web services Choreography, Addressing, Reliable messaging, Correlation, Policies, Notification and eventing.

**Unit-4:**Security threats and mechanisms, Essential techniques, Patterns, Security architecture for service oriented solutions, Infrastructure, Middleware, Multitenancy concepts.

**Text Books**

1. Service Oriented Architecture, Concepts Technology and Design, Thomas Erl, Pearson Education, 2008

2. SOA in Practice: The Art of Distributed System Design, Nicolai M. Josuttis, O'Reilly, 2007

# Title of Course: Cloud Adaptation and migration

# Course Code: CC602

# L-T-P Scheme: 3-0-0

# Course Credits: 3

**Objectives:**

In this course we will study the important terminology and familiar with cloud adaptation, cloud migrations, some of the constraints that cloud avoid cloud migration, legacy hardware and software architecture.

**Learning Outcomes:**

From this course students will be able to learn about intra cloud data adaptation and inter cloud data migration. Students will also get some sense to implement data migration techniques from this course.

**Course Contents:**

**Unit-1 (Cloud computing definition and use cases):** Introduction – Component of CC – Comparing CC with Virtualization, Grids, Utility Computing, client- server model, P-to-P Computing - Key Drivers for Cloud Computing - Cloud computing Service delivery model, Cloud Types – Private, Public and Hybrid. Introduction to cloud computing &it’s application. Goal of cloud adaptation and migration. Various use cases of cloud computing.

**Unit- 2 (Adopting the cloud)**

Instantaneous provisioning of computing resources, tapping into an infinite storage capacity, cost-effective pay-as-you-use billing models. Handling sensitive data, aspects of cloud security, assessing governance solutions. Adoption of Public cloud by SMBs- Public Cloud Adoption phase for SMBs- Vendor liability and Management Adoption process of Public clouds by Enterprises – Managed Private clouds Migrating Application to the cloud – Impact of Shared Resources and Multi-Tenancy on cloud Applications – Phases during Migration an Application to An IaaS Cloud

**Unit- 3 (Cloud Adaptation)**

Introduction, definition, cloud adaptation architecture, adaptation techniques, decision engine architecture, adaptation in cloud resource configuration, VM- adaptation

**Unit-4 (Migration Framework)**

Re-architecting applications for the cloud, integrating the cloud with existing applications, avoiding vendor lock-in, planning the migration and selecting a vendor.

**Unit-5 (Migration Planning & Discovery)**

Identifying and mitigating risk, The 6 R’s of cloud migration, asset and application discovery, licensing , data sovereignty , and governance.

**Unit-6 (Mobile Cloud computing)**

Introduction, Definition, Architecture, Benefits, challenges in mobile and at cloud shield.

**Text Books**

1. Cloud Migration from on-premise data center to AWS by Charista Keiko

2. Cloud Computing: Concepts, Technology & Architecture by RichardoPuttini, Thomas Erl, and Zaigham Mahmood

# Title of Course: Introduction to Virtualization & Network in Cloud Computing

# Course Code: CC603

# L-T-P: 3-0-2

# Credits: 4

**Introduction:**

The course enables students to understand the virtualization technology, Applications along with cloud computing concepts and services.

**Pre-requisite:** Knowledge is also assumed of basic concepts of Virtualization utilization in big data handling.

**Course Outcomes (CO):**

The students will be able to know the basics of virtualization technology, hypervisors and cloud computing concepts

**Course Contents:**

**UNIT-I:** Overview: introduction to cloud computing, OS and Virtualization, VM, advantage of Virtualization, Virtualization and cloud and its overlapping, service driven model, advantage of cloud computing: marketing point of view, types of services, business value, business impact of cloud, technological value of cloud, end user benefits, change for provider and administrator, pros and cons of cloud model, anatomy of cloud, solution component, service catalog, user self-service portal, service request management, provisioning, optimized infrastructure, chargeback, benefit of cloud, delivery and deployment model, different cloud architecture: public, private and hybrid and its pros and cons, delivery models. Cloud transformation roadmap, history of cloud, Clint-server, cluster, grid models, cloud vs grid and their relationship, cluster and cloud, utility computing and evolution of cloud computing, cloud computing.

**UNIT-II:**Introduction to Virtualization. Overview of Virtualization: Need of Virtualization, traditional IT Infrastructure, shortcoming of physical infrastructure, benefit of Virtualization, comparison of traditional IT infrastructure with virtualized infrastructure.

**UNIT-III:**Virtualization: Implementing Virtualization, typical hardware / software server stack and its logical equivalence, pre/post virtualization server stack ,types of virtualization, area and technology based classification, history of virtualization, time sharing system, IBM mainframe and Power virtualization, Extending Virtualization to x86 and its hardware support, impact of Virtualization: cost and manageability impact.

**UNIT-IV:** Server and Storage Virtualization. Types of Server Virtualization, simulation, Hardware Assisted Virtualization, Hypervisors, Ring levels on x86 processors, types of Hypervisors, IBM PowerVM Hypervisors, common consideration in server Virtualization, Desktop Virtualization: Benefits Constraints and Types. Anatomy of server Virtualization, three major layers in Xen server, storage Virtualization overview: benefit and types, features of logical layers, Host level storage Virtualization, host based mirroring, storage level Virtualization, network based storage Virtualization.

**UNIT-V:** Network and Application Virtualization. Network Virtualization overview: VPN, VLAN, challenges in using application in traditional install, use and update model, solution for challenges, Architecture, benefits of Application Virtualization.

**UNIT-VI:** Cloud Implementation, Deployment and Delivery Models. Cloud Deployment models: Public, Private, Hybrid, pros and cons of each architecture, cloud deployment decision factors, Business IT Control, Business critical application, data and transaction security, compliance and audit, balance of CAPEX and OPEX, workload characteristics, workload lifespan preferences, Industry segment- SME and Large enterprises, Data Freedom, software characteristics, time to deploy, Public Cloud: factor matrix, advantage, disadvantage, Public Cloud: Factor Matrix, advantage and disadvantage, Hybrid Cloud: factor matrix, advantage, disadvantage, Overview of Cloud delivery models, infrastructure, IT Layers, IaaS Overview, features, cloud bursting, multi tenancy, resource pooling, PaaS: overview, component, example, SaaS: advantage, example.

**UNIT-VII:** Case Study on Virtualization and Cloud workloads. Case study overview, customer IT landscape, function of data center, trigger for virtualization, preparation for virtualization, server selection, server sizing, server criticality, provisioning, proximity and locality, transition tool for virtualization, cost savings, cloud workload overview, workload characterization, factor s, suitable workload for cloud, private cloud solution, types of workload, advantage, mission. critical workload, mixed workload, production only workload for hybrid cloud, industry specific workload, non suitable workload: public, private cloud, possible workload by cloud.

**Text Books:**

1. Introduction to Virtualization and Cloud Computing (IBM ICE Publication)

**Reference Books:**

1. “ Distributed and Cloud Computing “ By Kai Hawang , GeofreyC.Fox, Jack J. Dongarra Pub: Elservier

2. Cloud Computing, Principal and Paradigms, Edited By RajkumarBuyya, JemesBroberg, A. Goscinski, Pub.- Wiley

3. Kumar Saurabh, “Cloud Computing”, Wiley Pub

4. Krutz , Vines, “Cloud Security “ , Wiley Pub

5. Velte, “Cloud Computing- A Practical Approach”, TMH Pub

# Title of Course: Introduction to Virtualization & Network in Cloud Computing

# Course Code: CC693

# L-T-P: 0-0-2

# Credits: 4

# Title of Course: introduction to cloud security

# Course Code: CC704

# L-T-P: 3-0-0

# Credits: 3

**Introduction:**

Information is an important strategic and operational corporate asset. These days computers and computer networks, are increasingly being used for storing and retrieving information. Some of these information may be of a sensitive nature. Consequently they need to have adequate security measures that can safeguard sensitive information. In this course, we will begin by investigating some of the security measures that can be employed to safeguard information. For the most part we will look into the theory that goes into designing these measures rather than studying security tools and techniques. This is because there are too many of those tools out there and they are changing frequently. The course examines how system designs, network protocols, and software engineering practices can result in vulnerabilities. The course explores how to better design and implement future systems in order to mitigate vulnerabilities. In addition, the course explores how to detect and mitigate vulnerabilities in existing systems

**Pre requisites:**

1. Knowledge of a programming language such as Python, Java or C/C++

2. Students are expected to have broad understanding of different aspects of how computer systems work.

3. It is strongly recommended that the student have a working knowledge of computer networks.

4. The students should also feel comfortable with algorithmic concepts and modular arithmetic.

**Objective:**

• Understand the fundamental principles of access control models and techniques, authentication and secure system design

• Have a strong understanding of different cryptographic protocols and techniques and be able to use them

• Apply methods for authentication, access control, intrusion detection and prevention

• Indentify and mitigate software security vulnerabilities in existing systems.

**Unit-I:** Introduction to Cloud Security. Introduction- Architectural and Technological Influences of Cloud Computing -the Cloud deployment models security concepts- Cloud Computing Roles- threats- risk modeling and security services-Proactive activity monitoring, Incident Response -Monitoring for unauthorized access, malicious traffic, abuse of system privileges, intrusion detection, events and alerts - Auditing – Record generation, Reporting and Management- Tamper-proofing audit logs - Quality of Services - Secure Management -Identity management - Security Information and Event Management.

**Unit-II:** Access control models: Policy, Compliance and Risk Management in Cloud Computing-Discretionary and mandatory access control- Covert channels and Chinese Wall-Clark-Wilson, RBAC, ABAC.

**Unit-III:** Introduction to cryptography, Secret key cryptosystems- Key escrow-Modular Arithmetic and Public key cryptosystems-Public key cryptosystems- Diffie-Hellman, RSA, El-Gammal- Pairing based cryptosystems, IBE and attribute-based encryption.

**Unit-IV:** Message digests, Merkle hashes, digital signatures-Identification and authentication, Passwords, Biometrics- One-time passwords and challenge response schemes, Kerberos- SSL, SSH

**Unit-V:** Wireless Security. Wireless Security- Privacy- Cloud Compliance Assessment and Reporting - Case Study- PCI DSS 3.0 Compliant Cloud Tenant- Protecting PHI in Cloud.

**Text Books:**

1. Charles P. Pfleeger, "Security in Computing", Prentice Hall.

2. William Stallings, "Cryptography and Network Security: Principles and Practice.", Prentice-Hall.

**Reference Books:**

1. William R. Cheswick and Steven M. Bellovin, "Firewalls and Internet Security: Repelling the Wily Hacker", Addison-Wesley.

2. Charlie Kaufman, Radia Perlman and Mike Spencer, "Network Security: Private Communication in a Public World", Prentice Hall.

3. Marshall D. Adams, Sushil Jajodia and Harold J. Podell, eds., "Information Security: An Integrated Collection of Essays". IEEE Computer Society Press.

4. Edward Amoroso, "Fundamentals of Computer Security Technology", Prentice-Hall.

# Title of Course: google cloud-organization & Identity access management (IAM)

# Course Code: CC805

# L-T-P: 3-0-0

# Credits: 3

**Unit-1:** Introducing Google Cloud Platform. Advantages of Google Cloud Platform.Components of Google's network infrastructure, including: Points of presence, data centers, regions, and zones.

Understand the difference between Infrastructure-as-a- Service (IaaS) and Platform-as-a-Service (PaaS).

**Unit-2:** Getting Started with Google Cloud Platform. Identify the purpose of projects on Google Cloud Platform.Understand the purpose of and use cases for Identity and Access Management.List the methods of interacting with Google Cloud Platform.Getting Started with Google Cloud Platform.

**Unit-3:** Virtual Machines and Networks in the Cloud. Identify the purpose of and use cases for Google Compute Engine.Understand the various Google Cloud Platform networking and operational tools and services.

**Unit-4:** Storage in the Cloud. Understand the purpose of and use cases for: Google Cloud Storage, Google Cloud SQL, Google Cloud Bigtable, and Google Cloud Datastore. Learn how to choose between. Various storage options on Google Cloud Platform.Cloud Storage and Cloud SQL.

**Unit-5:** Containers in the Cloud. Concept of a container and identify uses for containers.Identify the purpose of and use cases for Google Kubernetes Engine and Kubernetes.Kubernetes Engine

**Unit-6:** Applications in the Cloud. Understand the purpose of and use cases for Google App Engine.Contrast the App Engine Standard environment with the App Engine Flexible environment.Understand the purpose of and use cases for Google Cloud Endpoints.App Engine.

**Unit-7:** Developing, Deploying, and Monitoring in the Cloud. Understand options for software developers to host their source code.Understand the purpose of template-based creation and management of resources.Understand the purpose of integrated monitoring, alerting, and debugging.Deployment Manager and Stackdriver.

**Unit-8:** Big Data and Machine Learning in the Cloud, Understand the purpose of and use cases for the products and services in the Google Cloud big data and machine learning platforms.

**Text Books:**

1. Google Cloud Platform for Developers by Steven Porter
2. Google Cloud Platform in Action 1st Edition by JJ Geewax
3. Google Professional Cloud Architect Study Guide 1st Edition by Dan Sullivan
4. Professional Cloud Architect- Google Cloud Certification Guide : A complete GCP Cloud Architect certification guide filled with exam objectives and mock tests Kindle Edition by Konrad Clapa (Author), Brian Gerrard
5. Google Cloud Platform Cookbook: Implement, deploy, maintain, and migrate applications on Google Cloud Platform Kindle Edition by LegorieRajan PS
6. Introducing Google Cloud Platform: Enabling a whole new possibilities Kindle Edition by Soumen Chatterjee

**Title of Course: CLOUD COMPUTING ARCHITECTURE &DEVELOPMENT MODEL**

**Course Code: CC806**

**L-T-P: 3-0-0**

**Credits: 3**

**Introduction:**

The objective is to study the architecture and deployment models to develop a private cloud using the open standards tools such as open stack. Cloud is the future of computing. It is about outsourcing of IT services and infrastructure to make them accessible remotely via the Internet. Utilizing cloud-computing models boosts not only productivity but also provide a competitive edge to organizations. The growing popularity of cloud computing has given rise to different types of cloud service deployment models and strategies. Therefore, today there exists a variety of enterprise cloud solutions depending on the degree of desired outsourcing needs.

**Pre-requisite:**Knowledge is also assumed of basic concepts of grid computing and cloud computing introduction.

**Course Outcomes (CO):**

After successful completion of this course, the students will be able to:

1. Understand the architecture and deployment model of cloud computing
2. Understand the architecture and components related to open stack. Understand other open standards tools for deploying a private cloud such as Eucalyptus.

**Course Contents:**

**UNIT-I:** Definition of cloud computing, Delivery Models, Conceptual reference model, Cloud Computing solution components.

**UNIT-II:** Cloud computing Architecture:The conceptual reference model, Service Deployment, Cloud service management, cloud taxonomy, IBM CC RA, Common cloud management platform.

Case Study:IBM Smart Cloud Entry, VMware vClouddirector.

**UNIT-III:**

Cloud vendor selection:SLA, Security and privacy, periodic update and maintenance, data location and Jurisdiction, Measurability, Pricing, Interoperability and lock in, Exit process, track record.

**UNIT-IV:**

Open Stack:Definition, Advantages, Releases, Architectural overview, Different components of Open Stack, Open stack- Hypervisors, Network Services, Storage- Block Storage, Object Storage, Choosing Storage Backends , Commodity Storage Backend Technologies: swift, Ceph, Gluster, LVM, ZFS.

**UNIT-V:**

Advance concepts in Openstack: MultiserverOpenstack, Tenant model architecture, Cloud orchestration using OpenStack using OpenStack Heat and Ubuntu Juju.

Eucalyptus: Introduction, Features and Functionality, Architecture, Basic and Advanced Components. Eucalyptus vs Openstack

OpenNebula: Introduction, Features and Functionality, Architecture, Basic and Advanced Components. OpenNebula vs Openstack

**Text Books:**

1. Raj Kumar Buyya, James Broberg, Andrezei M. Goscinski (2011), Cloud Computing: Principles and paradigms.

#### **Reference Book:**

1. Rittinghouse, John, W, Cloud computing: Implementation, management and security.
2. Barrie Sosinsky (2011), Cloud Computing Bible, Wiley.
3. Bumgardner, V. C. (2016). OpenStack in action. Manning Publications Company.

**Title of Course: Introduction to Microsoft Azure and Its Services**

**Course Code: CC807**

**L-T-P: 3-0-0**

**Credits: 3**

**Pre-requisite:**Knowledge is also assumed of basic concepts of grid computing and cloud computing introduction.

**Introduction:**

The objective is to study the architecture and deployment models to develop a private cloud using the open standards tools such as open stack. Cloud is the future of computing. It is about outsourcing of IT services and infrastructure to make them accessible remotely via the Internet. Utilizing cloud-computing models boosts not only productivity but also provide a competitive edge to organizations. The growing popularity of cloud computing has given rise to different types of cloud service deployment models and strategies. Therefore, today there exists a variety of enterprise cloud solutions depending on the degree of desired outsourcing needs.

**Course Outcomes (CO):**

After successful completion of this course, the students will be able to:

1. Understand the architecture and deployment model of cloud computing
2. Understand the architecture and components related to open stack. Understand other open standards tools for deploying a private cloud such as Eucalyptus.

**Unit-1:** Introduction to Microsoft Azure and Its Services-Azure Subscriptions, Azure Resources, Azure Free Tier Account, Azure Resource Manager, Azure Resource Manager Template, Azure Storage, Types of Azure Storage

**Unit-2:** Azure Virtual Machines and Networking-Azure Resource Manager Virtual Machine, Virtual Machines in ARM Template, Overview of Azure Virtual Machine, Azure Managed Disks, Azure Blob Storage, Networking in Azure, Subnets, NIC, NSG, IP Addresses, DNS

**Unit-3:** Azure VMSS and Availability Zones-Resiliency, Azure Availability Sets, Azure Availability Zone, Autoscaling, Virtual Machine Scale Set, Fault Domain, Update Domain, Load Balancer, Application Gateway, Azure Disk Encryption

**Unit-4:** Azure App Services and Its Features-Azure App Service Web Apps, App Service Security, Serverless Computing Concepts, Function Apps, Azure Event Grid, Azure Service Bus, Azure App Service Logic App, Using Shell Commands to create Web App, Background Tasks, Swagger tool-

**Unit-5:** Advanced Azure Hybrid Connectivity and Site Recovery-Hybrid Connectivity, VNet S2S VPN, VNet Peering, Service Chaining, Azure VPN Gateway, Policy Based Gateway, Route Based Gateway, Swagger tool, Gateway Connections, Express Route, VNet Routing, User Defined Route, Border Gateway Protocol

**Unit-6:** Azure Storage Solution and Design Patterns-Azure Architecture Center, Cloud design patterns, Cache-aside pattern, Sharding Pattern, Azure SQL DB, Azure Elastic Pool, Azure Data Lakes, Azure Data Factory, Azure Cosmos DB

**Unit-7:** Azure Kubernetes Service-Application Environment Components, Docker, DockerFile, Docker Image, Azure Container Registry, Azure Container Instance, Orchestration, Azure Kubernetes Service, Diagnostics Logs

**Unit-8:** Azure Active Directory and Role Based Access Control-Access Control, Role Based Access Control, Authentication in applications (certificates, Azure AD, Azure AD Connect, token-based), Multi-factor authentication (MFA), Claims-based authorization, Role-based access control (RBAC) authorization, End-to-end encryption, Azure confidential computing, SSL and TLS communications, Azure Key Vault, Configure Fraud alerts, Bypass option, trusted IPs, Managed Service Identity, Service Principal authentication

**Unit-9:** Azure Messaging Service (Events, Hubs, Queue and Bus)-Azure Messaging Service,Azure Service Bus,Azure Events Hub,Azure Events Grid,Azure Notifications Hub,Auto Scale Ruling in Azure,Transient Fault Handling

**Unit-10:** Azure Monitoring and Insights Service-Azure Monitoring, Azure Analytics, Azure Alerts, Azure Resource Metrics, Azure Activity Log, Service Health, Azure Log Analytics, Azure App Insights

**Text Books:**

1. Azure for Architects: Implementing Cloud Design, DevOps, IoT, and Serverless Solutions on Your Public Cloud, by Ritesh Modi

2. Microsoft Azure Tutorial the Ultimate Beginners Guide, by Dennis Hutten

3. Introducing Windows Azure for IT Professionals, by Mitch Tulloch

4. Azure: Microsoft Azure Tutorial for Beginners, by Kennan Bismar

5. Implementing Microsoft Azure Infrastructure, by Michael Washam and Rick Rainey

6. Mastering Microsoft Azure Infrastructure Services, by John Savill

7. Azure for Architects: Implementing Cloud Design, DevOps, Containers, IoT, and Serverless Solutions on Your Public Cloud, 2nd Edition, by Ritesh Modi