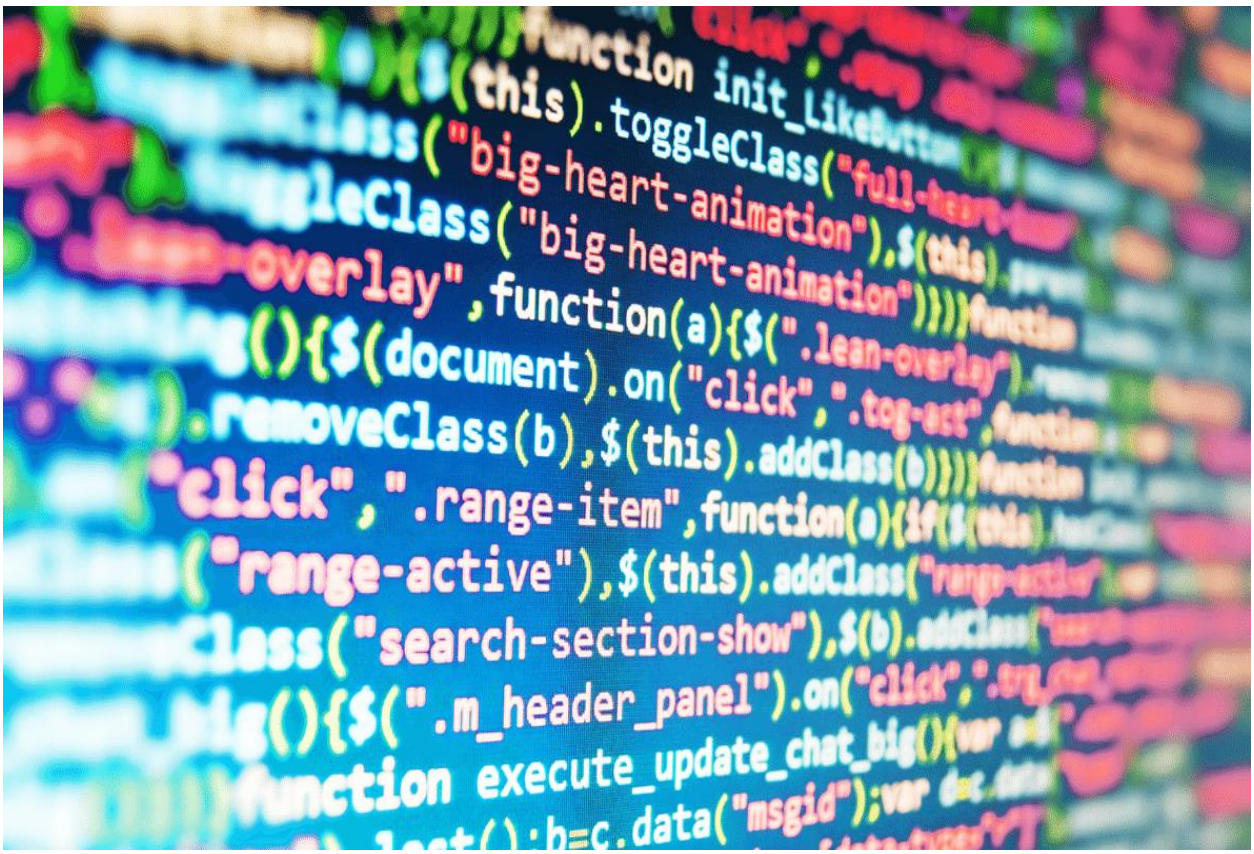



# Detailed Syllabus for Computer Science & Engineering with Specialization in Block Chain Technology

## DEPT. OF COMPUTER SCIENCE & ENGINEERING

## UNIVERSITY OF ENGINEERING & MANAGEMENT, JAIPUR

## PREAMBLE

Education plays an enormously significant role in the 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 marks or percentage-based evaluation 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.

## DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

It has been a necessity to align higher education with the emerging needs of the economy so as to ensure that the graduates of higher education system have adequate knowledge and skills for employment and entrepreneurship since last few years. The higher education system has to incorporate the requirements of various industries in its curriculum, in an innovative and flexible manner while developing a well-groomed graduate. CSE department aims to encourage research and innovation in the field of Machine Learning, Cyber security, Artificial Intelligence and other allied areas such as Computational Theory, Cloud Computing, Blockchain Technology, Data Science, Big Data Analytics and many more. The objective of the Computer Science & Engineering Programme with Specialization in Block Chain Technology is to prepare students to undertake careers involving innovative technologies, develop a problem solving capability, or to opt for advanced studies for research oriented careers.

In order to give due importance to practical applications as well as theoretical aspects of CSE, the curriculum for the Computer Science & Engineering Programme with Specialization in Block Chain Technology covers most of the foundational aspects as well as develops engineering skills for problem solving.

## JOB OPORTUNITIES

Booming IT sector in India has plenty of jobs for fresh computer science graduates. Candidates with a high percentage of mark and good communication skills as well as sound computer knowledge do not face problem in getting a job. Computer engineers can get jobs in non-IT companies like universities, research, private and public industries, government departments, business organizations, commercial organizations and the manufacturing sector, etc. Besides the Computer Engineers have plenty of options to work in IT companies in departments such as design, development, assembly, manufacture, and maintenance, etc. Software Developers: Software developers are professionals who are concerned with facets of the software development process which involves activities such as design and coding, computer programming, project management, etc. Blockchain is, of course, a new job sector with a known path to success. So, if you are thinking about whether it is good to choose Blockchain as a career or not, then the answer is certainly yes. The way to a career in Blockchain is, of course, new as well as innovative but it has a bright future for sure

## PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

**PEO 01:** High Quality Engineering Design and Development Work: Graduates of the program will engage in the effective practice of computer science and engineering to identify and solve important problems in a diverse range of application areas.

**PEO 02:** Real Life Problem Solving: To educate students with proficiency in core areas of Computer science & Engineering and related engineering so as to comprehend engineering trade-offs, analyse, design, and synthesize data and technical concepts to create novel products and solutions for the real life problems.

**PEO 03:** Leadership: Graduates of the program will engage in successful careers in industry, academia and attain positions of importance where they have impact on their business, profession and community.

**PEO 04:** Lifelong Learning: Graduates of the program will adapt to contemporary technologies, tools and methodologies to remain at the frontier of computer science and engineering practice with the ability to respond to the need of a challenging environment.

## PROGRAM OUTCOME (PO)

| PO | Summary | Description |
|---|---|---|
| **PO1** | **Engineering knowledge** | Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems. |
| **PO2** | **Problem analysis** | Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences. |
| **PO3** | **Design /development of solutions** | Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations. |
| **PO4** | **Conduct investigations of complex problems** | Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions. |
| **PO5** | **Modern tool usage** | Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations. |
| **PO6** | **The engineer and society** | Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities |

| | | |
|---|---|---|
| | | relevant to the professional engineering practice. |
| **PO7** | **Environment and sustainability** | Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development. |
| **PO8** | **Ethics** | Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice. |
| **PO9** | **Individual and team work** | Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. |
| **PO10** | **Communication** | Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions. |
| **PO11** | **Project management and finance** | Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments. |
| **PO12** | **Life-Long Learning** | Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change |

## TYPES OF COURSES

1. Courses are the subjects that comprise the Computer Science & Engineering Programme with Specialization in Block Chain Technology.
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 with Specialization in Block Chain Technology.

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

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

   c) **Specialization Elective Courses (SE):** 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 with Specialization in Block Chain Technology.

   iii. **Obligatory Courses:**

   a) **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.

   b) **Internship/Training/Project/Dissertation (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

   c) **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.

   d) **Basic Science Courses (BSC):** It is based upon content that leads to fundamental knowledge enhancement in sciences, and basic engineering principles.

   e) **Engineering Science Courses (ESC):** It is based upon content that leads to fundamental knowledge enhancement in basic Engineering Principles.

   f) **NPTEL (NPT):** "Essential Studies for Professionals Skill & Skill Development for Professionals" courses designed to encourage and enrich the students for the technical and professional exams.

g) **General Studies Courses (GSC):** "Essential Studies for Professionals Skill & Skill Development for Professionals" courses designed to encourage and enrich the students for the technical and professional exams.

**h) Mandatory Additional Requirements (MAR):** A student has to do the following things to achieve the MAR points: The student should engage herself / himself in activities outside the curriculum. Join different types of Clubs of NSCBIP, write something for the wall magazine, remain active in outer society, participate in Tech Fests activities, etc.

5. 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 |

6. 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.
7. **Mandatory Courses** may be offered. They do not carry credits but aim at expanding knowledge or bridging deficiency in knowledge or skill.
8. A course may have pre-requisite course(s) that are given in the Semester-wise Course Allocation scheme.
9. A student can opt for a course only if he/she has successfully passed its pre- requisite(s).
10. A student has to register for all courses before the start of a semester.
11. **Program codes:** The codes for various undergraduate programmes are as follows:
    i. Civil Engineering: CE
    ii. Computer Science & Engineering: CS
    (Specialization in Block Chain Technology (CSBCT))
    iii. Electronics and Communication Engineering: EC
    iv. Electrical Engineering: EE
    v. Mechanical Engineering: ME
12. **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 'INT' for Dissertation/Project/Training/Internship. This is followed by a digit sequence number:
    i. CSCyyy: Core Course
    ii. CSDyyy: Discipline-Specific Elective Courses

iii. BCyyy: Specialization Elective Courses

iv. XXXyyy: Open Elective Courses (Depends on the respective Dept.)

v. INTyyy: Project/Training/Internship/ Dissertation

13. **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

v. MARyyy: Mandatory Additional Requirements

Here, yyy will be follow by a sequence of digit.

14. **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.

15. The opting of a course by the student will depend upon the requisites for that course and with the consent of the course advisor.

## PROCESS FOR DESIGNING THE PROGRAM CURRICULUM

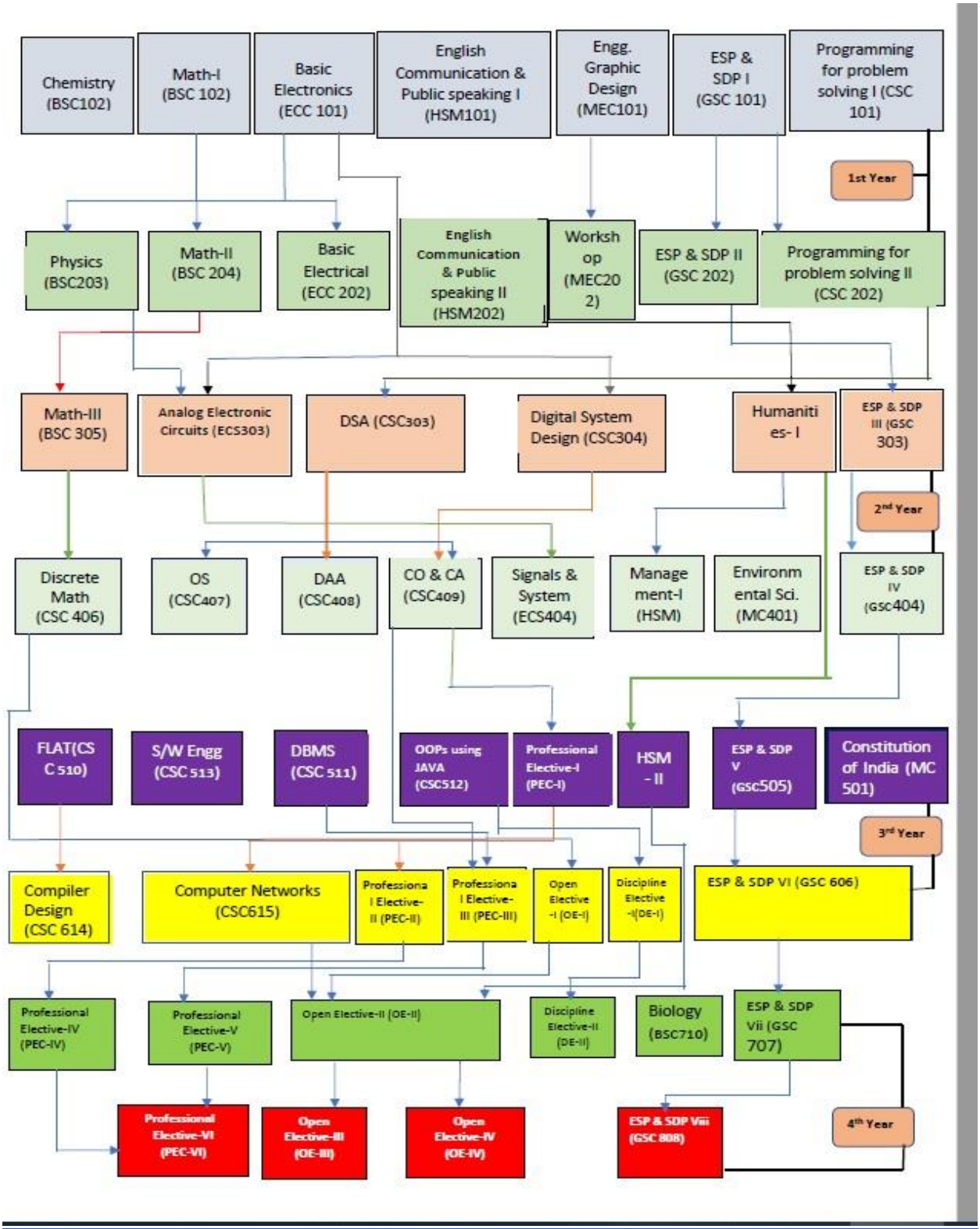
The process for designing the program curriculum involves consideration of the following aspects:

i) Feedback from stakeholders

ii) Institutional and Departmental Vision, Mission and PEOs

iii) Recent trends in industry and research

## PREREQUISITE TREE



## SCHEME – SEMESTER WISE COURSE ALLOCATION

### First Semester Syllabus

| Sl No. | Type | Subject Code | Topic | L | T | P | S | Credit Points |
|---|---|---|---|---|---|---|---|---|
| **1.** | BSC | BSC101 | Chemistry | 3 | 1 | 3 | 0 | 5.5 |
| **2.** | BSC | BSC102 | Mathematics-I (Calculus & Linear Algebra) | 3 | 1 | 0 | 0 | 4 |
| **3.** | ESC | ECC101 | Basic Electronics Engineering | 2 | 0 | 2 | 0 | 3 |
| **4.** | ESC | MEC101 | Engineering Graphics & Design | 1 | 0 | 2 | 0 | 2 |
| **5.** | ESC | CSC101 | Programming for Problem Solving-I (C) | 2 | 0 | 0 | 2 | 2 |
| **6.** | HSM | HSM101 | English Communication & Public Speaking Skills-I | 0 | 0 | 2 | 0 | 1 |
| **7.** | GSC | GSC101 | ESP & SDP-I | 2 | 0 | 0 | 2 | 2 |
| | | | Total | 13 | 2 | 9 | 4 | 19.5/28 |

#Students will undergo a mandatory Induction Program

### Second Semester Syllabus

| Sl No. | Type | Subject Code | Topic | L | T | P | S | Credit Points |
|---|---|---|---|---|---|---|---|---|
| **1.** | BSC | BSC203 | Physics (Semi-Conductor Physics) | 3 | 1 | 3 | 0 | 5.5 |
| **2.** | BSC | BSC204 | Mathematics-II(Probability & Statistics) | 3 | 1 | 0 | 0 | 4 |
| **3.** | ESC | EEC202 | Basic Electrical Engineering | 2 | 0 | 2 | 0 | 3 |
| **4.** | ESC | MEC202 | Workshop & Manufacturing Practices | 1 | 0 | 2 | 0 | 2 |
| **5.** | ESC | CSC202 | Programming for Problem Solving-II (Python) | 2 | 0 | 0 | 2 | 2 |
| **6.** | HSM | HSM202 | English Communication & Public Speaking Skills-II | 1 | 0 | 3 | 0 | 2 |
| **7.** | GSC | GSC202 | ESP & SDP-II | 2 | 0 | 0 | 2 | 2 |
| **8.** | NPT | NPT201 | (NPTEL/MOOCs) | - | - | - | - | 2 |
| | | | Total | 15 | 0 | 9 | 4 | 22.5/28 |

#(NPT201)NPTEL/MOOCs are based on the respective year's offered courses.

## Third Semester Syllabus

| Sl No. | Type | Subject Code | Topic | L | T | P | S | Credit Points |
|---|---|---|---|---|---|---|---|---|
| **1.** | BSC | BSC305 | Mathematics-III (Differential Calculus) | 2 | 0 | 0 | 0 | 2 |
| **2.** | PCC | CSC303 | Data Structure & Algorithms | 3 | 0 | 3 | 0 | 4.5 |
| **3.** | ESC | ECS303 | Analog Electronic Circuits | 2 | 0 | 3 | 0 | 3.5 |
| **4.** | PCC | CSC304 | Digital Electronics | 3 | 0 | 3 | 0 | 4.5 |
| 5. | PCC | CSC305 | IT Workshop (Sci Lab/MATLAB) | 1 | 0 | 4 | 0 | 3 |
| 6. | HSM | HSM--- | Humanities-I | 3 | 0 | 0 | 0 | 3 |
| **7.** | GSC | GSC303 | ESP & SDP-III | 2 | 0 | 0 | 2 | 2 |
| **8.** | MAR | MAR381 | Mandatory Additional Requirements (MAR) | 0 | 0 | 0 | 1 | 0.5 |
| **9.** | NPT | NPT302 | (NPTEL/MOOCs) | - | - | - | - | 2 |
| | | | Total | 17 | 0 | 13 | 3 | 25/33 |

#(NPT302): NPTEL/MOOCs 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.** | HSM | **HSM303** | Organizational Behavior | 3 | 0 | 0 | 3 |
| **2.** | **HSM** | **HSM304** | **Values and Ethics in Profession** | 3 | 0 | 0 | 3 |
| **3** | HSM | HSM305 | Industrial Psychology | 3 | 0 | 0 | 3 |

## Fourth Semester Syllabus

| Sl No. | Type | Subject Code | Topic | L | T | P | S | Credit Points |
|---|---|---|---|---|---|---|---|---|
| **1.** | PCC | CSC406 | Discrete Mathematics | 3 | 0 | 0 | 0 | 3 |
| **2.** | PCC | CSC407 | Operating System | 3 | 0 | 3 | 0 | 4.5 |
| **3.** | PCC | CSC408 | Design & Analysis of Algorithms | 3 | 0 | 3 | 0 | 4.5 |
| **4.** | PCC | CSC409 | Computer Organization & Architecture | 3 | 0 | 3 | 0 | 4.5 |
| **5.** | ESC | ECS404 | Signals & System | 3 | 0 | 0 | 0 | 3 |
| **6.** | HSM | HSM--- | Management-I | 3 | 0 | 0 | 0 | 3 |
| **7.** | GSC | GSC404 | ESP & SDP-IV | 2 | 0 | 0 | 2 | 2 |
| **8.** | MC | MC401/402 | Environmental Sciences/Disaster Management | 0 | 0 | 0 | 2 | 0 |
| **9.** | MAR | MAR484 | Mandatory Additional Requirements (MAR) | 0 | 0 | 0 | 1 | 0.5 |
| **10.** | NPT | NPT403 | (NPTEL/MOOCs) | - | - | - | - | 2 |
| | | | Total | 20 | 0 | 9 | 5 | 27/34 |

#(NPT403): NPTEL/MOOCs 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.** | HSM | HSM406 | Human Resource Development and Organizational Behavior | 3 | 0 | 0 | 3 |
| **2.** | HSM | **HSM407** | **Economics & Financial Accounting** | 3 | 0 | 0 | 3 |
| 3. | HSM | HSM408 | Economics for Engineers | 3 | 0 | 0 | 3 |

## Fifth Semester Syllabus

| Sl No. | Type | Subject Code | Topic | L | T | P | S | Credit Points |
|---|---|---|---|---|---|---|---|---|
| **1.** | PCC | CSC510 | Formal Language & Automata Theory | 3 | 0 | 0 | 0 | 3 |
| **2.** | PCC | CSC511 | Data Base Management System | 3 | 0 | 3 | 0 | 4.5 |
| **3.** | PCC | CSC512 | Object Oriented Programming Using Java | 2 | 0 | 3 | 0 | 3.5 |
| **4.** | PCC | CSC513 | Software Engineering | 2 | 0 | 2 | 0 | 3 |
| **5.** | PEC/SEC | --- | Professional/Specialization Elective -I | 3 | 0 | 0 | 0 | 3 |
| **6.** | HSM | HSM--- | Humanities-II | 3 | 0 | 0 | 0 | 3 |
| **7.** | MC | MC503 | Constitution of India/Essence of Indian Knowledge Tradition | 0 | 0 | 0 | 0 | 0 |
| **8.** | GSC | GSC505 | ESP & SDP-V | 2 | 0 | 0 | 2 | 2 |
| **9.** | PTI | INT501 | Internship/Project-I | 0 | 0 | 0 | 1 | 1 |
| **10.** | NPT | NPT504 | (NPTEL/MOOCs) | - | - | - | - | 2 |
| | | | Total | 19 | 0 | 6 | 3 | 25/28 |

#(NPT504): NPTEL/MOOCs 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. | PEC* | CSP501 | Embedded Systems | 2 | 0 | 2 | 3 |
| 2. | PEC** | CSP502 | AI & Machine Learning | 2 | 0 | 2 | 3 |
| 3. | HSM | HSM509 | Industrial Psychology | 2 | 0 | 0 | 2 |
| 4. | HSM | **HSM510** | **Principle of Management** | 2 | 0 | 0 | 2 |
| 5. | HSM | HSM511 | Total Quality Management | 2 | 0 | 0 | 2 |

**Note: Students can opt any Professional Track from 5th Sem Onwards/Block Chain Technology Specialization**

***Track:** IOT, Cybersecurity & Blockchain Track

****Track:** AI & Machine Learning Track

## Sixth Semester Syllabus

| Sl No. | Type | Subject Code | Topic | L | T | P | S | Credit Points |
|---|---|---|---|---|---|---|---|---|
| 1 | PCC | CSC614 | Compiler Design | 3 | 0 | 3 | 0 | 4.5 |
| 2 | PCC | CSC615 | Computer Networks | 3 | 0 | 3 | 0 | 4.5 |
| 3 | PEC/SEC | --- | Professional/Specialization Elective -II | 2 | 0 | 2 | 0 | 3 |
| 4 | PEC/SEC | --- | Professional/Specialization Elective -III | 3 | 0 | 0 | 0 | 3 |
| 5 | OE | --- | Open Elective-I | 2 | 0 | 0 | 0 | 3 |
| 6 | DE | CSD--- | Discipline Elective-I | 2 | 0 | 2 | 0 | 3 |
| 7. | GSC | GSC606 | ESP & SDP-VI | 2 | 0 | 0 | 2 | 2 |
| 8. | PTI | INT604 | Internship/Industrial Training/Project-II | 0 | 0 | 0 | 1 | 1 |
| 9. | NPT | NPT605 | (NPTEL/MOOCs) | - | - | - | - | 2 |
| | | | Total | 17 | 0 | 10 | 3 | 26/30 |

#(NPT605): NPTEL/MOOCs 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. | PEC* | CSP5603 | Blockchain Technology | 3 | 0 | 0 | 3 |
| 2. | PEC** | CSP604 | Soft Computing | 3 | 0 | 0 | 3 |
| 3. | PEC* | CSP605 | AI & Machine Learning | 3 | 0 | 2 | 4 |
| 4. | PEC** | CSP606 | Big Data Analytics | 3 | 0 | 2 | 4 |
| 5. | OE | BSC607 | Numerical Methods & Operation Research | 2 | 0 | 2 | 3 |
| 6. | OE | BSC608 | Operations Research | 2 | 0 | 2 | 3 |
| 7. | OE | BSC609 | Statistics for Data Analysis | 2 | 0 | 2 | 3 |
| 8. | OE* | CSD601 | Blockchain Technology | 3 | 0 | 0 | 3 |
| 9. | OE** | CSD602 | Big Data Analytics | 3 | 0 | 2 | 4 |
| 10. | DE | CSD603 | Web Technology | 2 | 0 | 2 | 3 |
| 11. | DE | CSD604 | Computer Graphics | 2 | 0 | 2 | 3 |
| 13. | DE | **CSD605** | **Software Project Management** | 2 | 0 | 2 | 3 |
| 14. | DE | CSD606 | E-Commerce | 2 | 0 | 2 | 3 |

## Seventh Semester Syllabus

| Sl No. | Type | Subject Code | Topic | L | T | P | Credit Points |
|---|---|---|---|---|---|---|---|
| 1 | PEC/SEC | --- | Professional/Specialization Elective -IV | 3 | 0 | 0 | 3 |
| 2 | PEC/SEC | --- | Professional/Specialization Elective -V | 3 | 0 | 0 | 3 |
| 3. | OE | --- | Open Elective-II | 3 | 0 | 0 | 3 |
| 4. | BSC | BSC710 | Biology | 2 | 1 | 0 | 3 |
| 5. | GSC | GSC707 | ESP & SDP-VII | 2 | 0 | 2 | 2 |
| 6. | PTI | INT705 | Internship/Industrial Training/Project-III | 0 | 0 | 8 | 4 |
| | | | Total | 13 | 1 | 8 | 18/21 |

#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. | PE* | CSP707 | Blockchain Technology | 3 | 0 | 0 | 3 |
| 2. | PE** | CSP708 | Natural Language Processing | 3 | 0 | 0 | 3 |
| 3. | PEC* | CSP709 | Digital Forensics | 3 | 0 | 0 | 3 |
| 4. | PEC** | CSP710 | Computer Vision | 3 | 0 | 0 | 3 |
| 5. | CSD* | CSD707 | Cyber Law, IPR & Ethics | 3 | 0 | 0 | 3 |
| 6. | CSD** | CSD708 | Natural Language Processing | 3 | 0 | 0 | 3 |
| 7. | OE | CSD709 | Wireless Sensor Network & Network Security | 3 | 0 | 0 | 3 |
| 8. | OE | CSD710 | Neural Network and Application | 3 | 0 | 0 | 3 |
| 9. | OE | CSD711 | Real Time Operating System | 3 | 0 | 0 | 3 |
| 10. | OE | CSD712 | Distributed System | 3 | 0 | 0 | 3 |
| 11. | BSC | BSC711 | Statistics For Data Analytics | 3 | 0 | 0 | 3 |
| 12. | BSC | BSC712 | Statistical Methods For Decision Making | 3 | 0 | 0 | 3 |
| 13. | BSC | BSC713 | Exploratory Data Analysis | 3 | 0 | 0 | 3 |
| 14. | BSC | BSC714 | Graph Theory | 3 | 0 | 0 | 3 |

## Eighth Semester Syllabus

| Sl No. | Type | Subject Code | Topic | L | T | P | Credit Points |
|---|---|---|---|---|---|---|---|
| **1.** | PEC/SEC | --- | Professional/Specialization Elective-VI | 3 | 0 | 0 | 3 |
| **2.** | OE | --- | Open Elective-III | 3 | 0 | 0 | 3 |
| **3.** | OE | --- | Open Elective-IV | 3 | 0 | 0 | 3 |
| **4.** | GSC | GSC808 | ESP & SDP - VIII | 2 | 0 | 2 | 2 |
| **5.** | PTI | INT806 | Internship Industrial Training/Project-IV | 0 | 0 | 12 | 6 |
| **6.** | CC | CSC881 | Grand Viva | 0 | 0 | 0 | 2 |
| | | | Total | 11 | 0 | 14 | 19/25 |

#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. | PEC* | CSP811 | Digital Forensics | 3 | 0 | 0 | 3 |
| 2. | PEC** | CSP812 | Deep Learning | 3 | 0 | 0 | 3 |
| 3. | OE | CSD813 | Data Mining & Data Ware Housing | 3 | 0 | 0 | 3 |
| 4. | OE | CSD814 | Information Theory & Coding | 3 | 0 | 0 | 3 |
| 5. | OE | CSD815 | Advanced Algorithms | 3 | 0 | 0 | 3 |
| 6. | OE | CSD816 | Digital Image Processing | 3 | 0 | 0 | 3 |

## Professional Elective Courses:

| Subject Code | IOT, Cybersecurity & Blockchain Track | Subject Code | AI & Machine Learning Track |
|---|---|---|---|
| CSP501 | Embedded Systems | CSP502 | AI & Machine Learning |
| CSP603 | Blockchain Technology | CSP504 | Soft Computing |
| CSP605 | AI & Machine Learning | CSP606 | Big Data Analytics |
| CSP707 | Cyber Security | CSP608 | Natural Language Processing |
| CSP709 | Cyber Law, IPR & Ethics | CSP710 | Computer Vision |
| CSP811 | Digital Forensics | CSP712 | Deep Learning |

## Specialization Course:

| Subject Code | Block Chain |
|---|---|
| **BC501** | Fundamentals of Blockchain |
| **BC602** | Smart Contracts and Solidity |
| **BC603** | Blockchain Platforms and Use cases |
| **BC704** | Blockchain Security and Performance |
| **BC705** | Blockchain and FinTech |
| **BC806** | Block Chain Business Application & Implication |
| **BC807** | Emerging Areas, The Merkle Tree and Cryptocurrencies |

**Note: Refer to Computer Science & Engineering Syllabus for "syllabus of other subject".**

**TITLE OF COURSE: Fundamentals of Blockchain**
**COURSE CODE: BC501**
**L-T-P: 3-0-0**
**CREDITS: 3**

**Pre-requisite:** Basic concepts in networking.

**Introduction:**

• The students should be able to understand a broad overview of the essential concepts of blockchain technology.
• To familiarize students with Bitcoin protocol followed by the Ethereum protocol – to lay the foundation necessary for developing applications and programming.
• Students should be able to learn about different types of blockchain and consensus algorithms.

**Course Outcomes (CO):**

After completion of this course, students would be able:
**CO1:** To explain the basic notion of distributed systems.
**CO2:** To use the working of an immutable distributed ledger and trust model that defines blockchain.
**CO3:** To illustrate the essential components of a blockchain platform.

**Mapping of Course Outcomes (CO) and Program Outcomes (PO):**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | ✓ | ✓ | ✓ | | ✓ | | | | | | | ✓ |
| CO2 | ✓ | | | ✓ | | | | ✓ | | | | ✓ |
| CO3 | ✓ | ✓ | ✓ | | | | | | | | | ✓ |

**Course Contents:**

**Module 1**
**Basics:** The Double-Spend Problem, Byzantine Generals' Computing Problems, Public-Key Cryptography, Hashing, Distributed Systems, Distributed Consensus.
**Module 2**
**Technology Stack:** Blockchain, Protocol, Currency.
**Bitcoin Blockchain:** Structure, Operations, Features, Consensus Model, Incentive Model.
**Module 3**
**Ethereum Blockchain:** Smart Contracts, Ethereum Structure, Operations, Consensus Model, Incentive Model.
**Module 4**
**Tiers of Blockchain Technology**: Blockchain 1.0, Blockchain 2.0, Blockchain 3.0, Types

of Blockchain: Public Blockchain, Private Blockchain, Semi-Private Blockchain, Sidechains.

**Module 5**

**Types of Consensus Algorithms:** Proof of Stake, Proof of Work, Delegated Proof of Stake, Proof Elapsed Time, Deposite-Based Consensus, Proof of Importance, Federated Consensus or Federated Byzantine Consensus, Practical Byzantine Fault Tolerance. Blockchain Use Case: Supply Chain Management.

**Text Books**

1. Kirankalyan Kulkarni, Essentials of Bitcoin and Blockchain, Packt Publishing.
2. Anshul Kaushik, Block Chain & Crypto Currencies, Khanna Publishing House.
3. Tiana Laurence, Blockchain for Dummies, 2nd Edition 2019, John Wiley & Sons.
4. Mastering Blockchain: Deeper insights into decentralization, cryptography, Bitcoin, and popular Blockchain frameworks by Imran Bashir, Packt Publishing (2017).

**References**

1. Blockchain: Blueprint for a New Economy by Melanie Swan, Shroff Publisher O'Reilly Publisher Media; 1st edition (2015).
2. Mastering Bitcoin: Programming the Open Blockchain by Andreas Antonopoulos.

**Corresponding Online Resources:**

1. https://www.coursera.org/specializations/blockchain.
2. https://nptel.ac.in/courses/106105184/
3. Introduction to Blockchain Technology and Applications, https://swayam.gov.in/nd1_noc20_cs01/preview

**TITLE OF COURSE: Smart Contracts and Solidity**
**COURSE CODE: BC602**
**L-T-P: 3-0-2**
**CREDITS: 4**

**Pre-requisite:** Basic concepts in networking.

**Introduction:**

1. Students should be able to understand the concept of smart contracts related to blockchain.
2. Students should be able to understand the smart contract higher-level language Solidity and apply it to create smart contracts.
3. Students should be able to learn Truffle IDE for creating and deploying a DApp.

**Course Outcomes (CO):**

After completion of course, students would be able to:

**CO1:** To understand the working and importance of smart contracts.
**CO2:** To learn the solidity language required for coding Ethereum smart contracts.

**CO3:** To create and deploy a DApp on a Ethereum test network.

**Mapping of Course Outcomes (CO) and Program Outcomes (PO):**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | ✓ | ✓ | ✓ | | ✓ | | | | | | | ✓ |
| CO2 | ✓ | | | ✓ | | | | ✓ | | | | ✓ |
| CO3 | ✓ | ✓ | ✓ | | | | | | | | | ✓ |

**Course Contents:**

**Module 1**

**Smart Contracts**: Definition and Need, Features of Smart Contracts, Life Cycle of a Smart Contract, Introduction to Ethereum Higher-Level Languages.

**Module 2**

**Development Environment:** Building A Simple Smart Contract with Solidity, Solc-Compiler, Ethereum Contract ABI, Remix-IDE for Smart Contract Development.

**Module 3**

**Introduction to Solidity**: Contracts, Constructors & Functions, Variables, Getters & Setters, Arrays, Memory vs Storage, Mappings in Solidity

**Advanced Solidity**: Structs, Error Handling & Restrictions, Libraries, Global Variables in Solidity, Abstract Contracts, Inheritance, And Interfaces, Events

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**Module 4**

**Truffle Framework & Ganache**: Environment Setup for Truffle & Ganache, Truffle Project Creation, Truffle Compile, Migrate and Create Commands.

**Module 5**

**Decentralized App Creation**: Smart Contract Creation, Front-End Creation, Connecting Smart Contract with Front-End Application, Deploying Dapp, Validation, And Testing of Dapp.

**Text Books**

1. Tiana Laurence, Blockchain for Dummies, 2nd Edition 2019, John Wiley & Sons.
2. Anshul Kaushik, Block Chain & Crypto Currencies, Khanna Publishing House.

**References**

1. Building Blockchain Projects, Narayan Prusty, Packt Publishing.
2. Mastering Ethereum: Building Smart Contracts and Dapps Book by Andreas Antonopoulos and Gavin Wood, Shroff Publisher/O′Reilly Publisher.

**Corresponding Online Resources:**

1. https://www.coursera.org/learn/smarter-contracts
2. https://www.udemy.com/course/solidity-smart-contracts-build-dapps-inethereum-blockchain/
3. Introduction to Blockchain Technology and Applications,

https://swayam.gov.in/nd1_noc20_cs01/preview

**TITLE OF COURSE: Blockchain Platforms and Use cases**
**COURSE CODE: BC603**
**L-T-P: 3-0-0**
**CREDITS: 3**

**Pre-requisite:** Basic concepts in networking.

**Introduction:**

• Students should be able to learn different types of blockchain platforms.

• Students should be able to understand different types of Decentralized applications developed using blockchain technology.

• Students should be able to understand several types of blockchain use cases.

**Course Outcomes (CO):**

After completion of course, students would be able to:
**CO1:** To distinguish between different types of blockchain platforms.
**CO2:** To understand different types of uses of blockchain and apply it to some real-life scenarios accordingly.
**CO3:** To learn about the shortcomings of blockchain technology and their corresponding solutions.

**Mapping of Course Outcomes (CO) and Program Outcomes (PO):**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | ✓ | ✓ | ✓ | | ✓ | | | | | | | ✓ |
| CO2 | ✓ | ✓ | | ✓ | | ✓ | | ✓ | | | | ✓ |
| CO3 | ✓ | ✓ | ✓ | | | | | | | ✓ | | ✓ |

**Course Contents:**

**Module 1**

**Permissioned Blockchains**: Hyperledger Fabric Services, Model and Functions, Hyperledger Composer, Microsoft Azure Blockchain Platform and Services, Other Platforms: IOTA, TRON, Ziliqa, Cosmos, Ripple.

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**Module 2**

**Decentralized Application Platforms**: Augur-Decentralised Prediction Market Platform, Grid+-Energy Ecosystem Platform.

**Module 3**

**Challenges and Solutions Related to Blockchain:** Consensus, Scalability, Privacy and Confidentiality, Escrow, and Multi signature.

**Module 4**

**Alternative Decentralized Solutions:** Interplanetary File System (IPFS) Working and Uses, Hashgrapgh- Working, Benefits, And Use-Cases.

**Module 5**

**Blockchain Use Cases:** Financial Services Related Use Cases, Revolutionization of Global Trade, Digital Identity, Auditing Services, Supply Chain Management, Healthcare Related Services, Blockchain and IOT, Blockchain and AI.

**Text Books**

1. Tiana Laurence, Blockchain for Dummies, 2nd Edition 2019, John Wiley & Sons.
2. Anshul Kaushik, Block Chain & Crypto Currencies, Khanna Publishing House.
3. Building Blockchain Projects, Narayan Prusty, Packt Publishing.

**References**

1. Mastering Blockchain: Deeper insights into decentralization, cryptography, Bitcoin, and popular Blockchain frameworks by Imran Bashir, Packt Publishing (March 17, 2017).
2. Blockchain: Blueprint for a New Economy by Melanie Swan, Shroff Publisher publisher/O'Reilly Publisher Media; 1st edition (2015).

**Corresponding Online Resources:**

1. https://nptel.ac.in/courses/106105184/
2. https://www.coursera.org/learn/blockchain-platforms.
3. Introduction to Blockchain Technology and Applications, https://swayam.gov.in/nd1_noc20_cs01/preview.

## TITLE OF COURSE: Blockchain Security and Performance

**COURSE CODE: BC704**
**L-T-P: 3-0-2**
**CREDITS: 4**

**Pre-requisite:** Basic concepts in networking.

**Introduction:**

Students should be able to understand the security and performance-related issues of blockchain.

- Students should be able to learn techniques and tools to tackle the security related issues of blockchain.
- Students should be able to learn new approaches required for enhancing blockchain performance.

**Course Outcomes (CO):**

After completion of course, students would be able to:
**CO1:** To understand the security and performance perspective of blockchain technology.
**CO1:** To learn and apply security analysis and performance-enhancing techniques related to blockchain.
**CO1:** To understand the real-life applications of blockchain technology and apply it to provide solutions to some real-life problems.

**Mapping of Course Outcomes (CO) and Program Outcomes (PO):**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | ✓ | ✓ | ✓ | | ✓ | | | | | | | ✓ |
| CO2 | ✓ | ✓ | | ✓ | | ✓ | | ✓ | | | | ✓ |
| CO3 | ✓ | ✓ | ✓ | | | | | | | ✓ | | ✓ |

**Course Contents:**

**Module 1**

**Security Issues**: Blockchain Related Issues, Higher-Level Language (Solidity) Related Issues, EVM Bytecode Related Issues, Real-Life Attacks on Blockchain Applications/ Smart Contracts, Trusted Execution Environments.

**Module 2**

**Security Tools for Smart Contracts**: Working, Advantages, And Disadvantages of Tools- Oyente, Securify, Maian, Manticore, Mythril, SmartCheck, Verx. Secure Key Management, Quantum Resilience Keys.

**Module 3**

**Performance Related Issues**: Transaction Speed, Transaction Fees, Network Size, Complexity, Interoperability Problems, Lack of Standardization. Lack of Supportive Regulations Related to Blockchain Applications.

**Module 4**

**Performance Improvements**: Off-Chain State Channels, Sidechains, Parallels Chains, Concurrent Smart Contract Transactions, Sharding Technique and Its Benefits, Atomic Swaps Between Smart Contracts.

**Module 5**

**Blockchain Applications**: Decentralized Cryptocurrency, Distributed Cloud Storage, EVoting, Insurance Claims, Cross-Border Payments, Asset Management, Smart Appliances.

**Text Books**

1. Mastering Ethereum: Building Smart Contracts and Dapps Book by Andreas Antonopoulos and Gavin Wood, Shroff Publisher/O′Reilly Publisher.

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**Corresponding Online Resources:**

1.https://www.edx.org/course/blockchain-and-fintech-basics-applications-and-limitations

**TITLE OF COURSE: Blockchain and FinTech**
**COURSE CODE: BC705**
**L-T-P: 3-0-2**
**CREDITS: 4**

**Pre-requisite:** Basic concepts in networking.

**Introduction:**

• Students should be able to understand the benefits of using blockchain in financial sector.

• Students should understand how decentralized nature of blockchain is impacting banking and financial sector.

• Students should learn blockchain regulations and future trends related to blockchain to be used in financial sector.

**Course Outcomes (CO):** After completion of course, students would be able to:

**CO1:** To understand difference between different types of coins and tokens related to blockchain technology.

**CO2:** To understand the benefits of blockchain in banking sector.

**CO3:** To understand the concept of decentralized markets.

**Mapping of Course Outcomes (CO) and Program Outcomes (PO):**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | ✓ | ✓ | ✓ | | ✓ | | | | | | | ✓ |
| CO2 | ✓ | ✓ | | ✓ | | ✓ | | ✓ | | | | ✓ |
| CO3 | ✓ | ✓ | ✓ | | | | | | | ✓ | | ✓ |

**Course Contents:**

**Module 1**

**Cryptocurrencies:** Concept**,** Cryptocurrency Mining**,** Uses of Cryptocurrencies**,** Tokens, Token vs Crypto Coin, Concept of ICOs (Initial Coin Offerings), Benefits of Using ICOs, STOs (Security token offerings), ICO vs STO, Cryptocurrency wallets.

**Module 2**

**Decentralized Finance (DeFi):** Concept, Benefits and Risks Associated with DeFi, Centralized vs Decentralized finance, DeFi Projects, DeFi future trends.

**Module 3**

**Decentralized Markets:** Concept of Decentralized markets**,** impact of decentralization on financial market**,** Decentralized Exchanges (DEX)**,** Security, control and privacy concerns related to DEX, Liquidity and Usability of DEX, best DEXs for trading, Fund Management and Trading logic of DEX, Concept of Decentralized Web.

**Module 4**

**Blockchain & Cryptocurrency Regulations:** Introduction, History Stance of the Government, Judicial Approach to Cryptocurrency, Possible Reasons for Ban, Virtual Currency Regulations, Global Perspective of Regulations on Blockchain, Future needs for Regulations.

**Module 5**

**Blockchain in Banking Sector**: Cross-Border Payments Using Blockchain and Its Benefits, Study of blockchain platforms used for cross-border payments, Impact of Blockchain on Banking Services.

**Stable Coin:** Concept, Uses and Types of Stable Coins

**Case-Study**: Tether and Libra Coins

**Text Books**

1. Melanie Swan, Blockchain: Blueprint for a new economy, Shroff Publisher/O'Reilly Publisher.
2. Ron Quaranta, Blockchain in Financial Markets and Beyond: Challenges and Applications, Risk Books Publisher.

**References**

1. Richard Hayen, Blockchain & FinTech: A Comprehensive Blueprint to Understanding Blockchain & Financial Technology. - Bitcoin, FinTech, Smart Contracts, Cryptocurrency, Risk Books Publisher.

**Corresponding Online Resources:**

1. https://www.accenture.com/in-en/insight-blockchain-technology-how-banksbuilding-real-time
2. https://medium.com/search?q=decentralized%20exchange
3. Emerging Technology Projection: The Total Economic Impact™ Of IBM Blockchain https://www.ibm.com/downloads/cas/QJ4XA0MD
4. https://www.globallegalinsights.com/practice-areas/blockchain-laws-andregulations/india#chaptercontent1
5. https://www.eduonix.com/blockchain-and-cryptocurrencies-for-beginners
6. https://www.coursera.org/learn/cryptocurrency

## TITLE OF COURSE: BLOCKCHAIN BUSINESS APPLICATION & IMPLICATION

**COURSE CODE: BC806**
**L-T-P: 3-0-0**
**CREDITS: 3**

**Pre-requisite:** Basic concepts in block chain.

**Introduction:**
This course examines different type of business application through block chain. The Topics to be covered (tentatively) include: opportunities for blockchain, blockchain changes the deep structures and architecture of the firm, application of block chain in civil society, private sector, Trust and Vulnerability in block chain.

**Course Outcomes (CO):**
In this course we will study the block chain in business application. Students are expected to be capable of understanding the implementation of block chain, their advantages and drawbacks, how to implement them in industry, how their drawbacks can be overcome and what the applications are and where they can be used. To reach this goal, the following objectives need to be met:

**CO1:** Students would be able to analyses opportunity in blockchain properly.
**CO2:** Students would be able to implement any problem by writing their own business idea.
**CO3:** By analyzing the core idea of efficient business proposal in blockchain.
**CO4:** To become an efficient blockchain business administrator.

**Mapping of Course Outcomes (CO) and Program Outcomes (PO):**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | ✓ | ✓ | ✓ | | ✓ | | | | | | | ✓ |
| CO2 | ✓ | | | ✓ | | | | | | | | ✓ |
| CO3 | ✓ | ✓ | ✓ | | | | | | | | | ✓ |
| CO4 | ✓ | ✓ | ✓ | | ✓ | | | | | | | ✓ |

**Course Contents:**
**Module-1:** New Business Models, opportunities for blockchain to disrupt or displace traditional centralized business models. blockchain technology can support "open networked enterprise" business models through the inclusion of native payment systems, reputation systems, uncensorable content, trustless transactions, smart contracts, and autonomous agents.
**Module-2:** Blockchain and the C-Suite, blockchain changes the deep structures and architecture of the firm, it will consequently transform our models of management and the roles of the C-Suite. Navigating the balance between blockchain's hype and its true potential is a key responsibility of an organization's management team, decisions and changes that business leaders can anticipate when considering how the future of blockchain will unfold within their business.
**Module-3:** Leadership for the Next Era, Blockchain alone is just a tool, fulfill its long-term promise, humans must lead. Rather than relying on state-based institutions, blockchain must be primarily self-governed through collaborations of civil society, private sector, government, and stakeholders in non-state networks, the idea of blockchain governance networks and explain how they can support blockchain stewardship at three levels: The platform level, the application level, and the ecosystem level. As well, you will learn about the conditions that are necessary for a blockchain-based hub of innovation to succeed.
**Module-4:** Blueprint for a New Social Contract, digital revolution unfolds, global economy, labor markets, old institutions, and society as a whole. To realize the potential of the blockchain revolution, we need business leaders to come to the table as responsible and active participants in a new social

contract for both their own long-term interests as well as in the interest of a healthy society and economy, possible directions for a new social contract—i.e. the agreements, laws, and behaviors that people, companies, civil society, and their governments adhere, catalyze investigation, debate, and action, Trust and Vulnerability Short history of the scaling out of human trust. High and Low trust societies, Types of Trust model: Peer-to-Peer, Leviathan, and Intermediary

**Text Books**
1 Blockchain Basics: A Non-Technical Introduction in 25 Steps Kindle Edition, by Daniel Drescher

**References**
1. Bitcoin and Cryptocurrency Technologies, by Arvind Narayanan, Joseph Bonneau, Edward Felten.

## TITLE OF COURSE: EMERGING AREAS, THE MERKLE TREE AND CRYPTOCURRENCIES
## COURSE CODE: BC807
## L-T-P: 3-0-0
## CREDITS: 3

**Pre-requisite:** Basic concepts in mathematics and programming languages.

**Introduction:**
This course examines Merkle Tree. The Topics to be covered (tentatively) include: an introduction to Merkle Tree and Immutability, hash values and hash sequences, hash functions and hash puzzles, basic principal of proof-of-work and proof-of-stake.

**Course Outcomes (CO):**
In this course we will study the Merkle Tree and Immutability. Students are expected to be capable of understanding the Merkle Tree, their advantages and drawbacks, how to implement them in block chain as crypto currency, how their drawbacks can be overcome and what the applications are and where they can be used. To reach this goal, the following objectives need to be met:

**CO1:** Students would be able to implement Markel Tree properly.
**CO2:** Students would be able to implement hash function and solve hash puzzles.
**CO3:** By analyzing the logic, students would be able to write proper algorithm.
**CO4:** To become an efficient developer.

**Mapping of Course Outcomes (CO) and Program Outcomes (PO):**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | ✓ | ✓ | ✓ | | ✓ | | | | | | | ✓ |
| CO2 | ✓ | | | ✓ | | | | | | | | ✓ |
| CO3 | ✓ | ✓ | ✓ | | | | | | | | | ✓ |
| CO4 | ✓ | ✓ | ✓ | | ✓ | | | | | | | ✓ |

**Course Contents:**

**Module-1:** Data blocks are assembled as well as how hash values and encryption are used to ensure the proper sequencing and integrity of data blocks that are added to a blockchain. Round Table Discussion - The Merkle Tree and Immutability

**Module-2:** Hashing and an Introduction to Cryptocurrencies, hash values and hash sequences. Assembling block header hash values for a specified hash puzzle difficulty level. Blockchain Basics, Round Table Discussion - Proof of Work and Proof of Stake

**Module-3:** Investigated hash functions and hash puzzles, we will focus on proof-of-work, which is an approach to modifying the blockchain that can be difficult and time-consuming to compute. We will also focus on proof-of-stake, an alternative to updating the blockchain in which larger nodes are modified that already represent a large portion of the blockchain.

**Module-4: T**he pros and cons of each approach and prepare to apply the principles of proof-of-work and proof-of-stake Comparing proof-of-work and proof-of-stake, alternative approaches that combine the best features of proof-of-work and proof-of-stake.

**Text Books**

1. Understanding Bitcoin: Cryptography, Engineering and Economics, By Pedro Franco, Wiley.
2. Cryptocurrency Investing For Dummies 1st Edition, by Kiana Danial, ISBN-13: 978-1119533030, ISBN-10: 1119533031

**References**

1. The Crypto Book: How to Invest Safely in Bitcoin and Other Cryptocurrencies by Siam Kidd

# Other Important Subjects in BLOCK CHAIN

**TITLE OF COURSE: BLOCKCHAIN BASICS**
**COURSE CODE:**
**L-T-P: 3-0-0**
**CREDITS: 3**

**Pre-requisite:** Basic concepts in networking.

**Introduction:**
This course describe basic blockchain technology in networking system. The Topics to be covered (tentatively) include: an introduction to blockchain, Crypto asset or Digital asset, Ethereum Blockchain, Bitcoin & Blockchain, Decentralized Systems and Ethereum Blockchain.

**Course Outcomes (CO):**
In this course we will study the basic components of blockchain. Students are expected to be capable of understanding the crypto currency, their advantages and drawbacks, how to implement them in blockchain, how their drawbacks can be overcome and what the applications are and where they can be used. To reach this goal, the following objectives need to be met:

**CO1:** Students would be able to design & implement any blockchain properly.

**CO2:** Students would be able to implement any problem by writing their own algorithm in blockchain.

**CO3:** By analyzing, students would be able to implement public private key combination in security.

**CO4:** To become an efficient blockchain developer.

**Mapping of Course Outcomes (CO) and Program Outcomes (PO):**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | ✓ | ✓ | ✓ | | ✓ | | | | | | | ✓ |
| CO2 | ✓ | | | ✓ | | | | ✓ | | | | ✓ |
| CO3 | ✓ | ✓ | ✓ | | | | | | | | | ✓ |
| CO4 | ✓ | ✓ | ✓ | | ✓ | | | | | | | ✓ |

**Course Contents:**
**Module-1:** Basic introduction about blockchain in digital world, Crypto asset or Digital asset, Self Sovereign Identity, Smart Contract, Decentralized Business Model, Device to device communication

in blockchain

**Module-2:** Network Security, Different type of network attack, Warm hole attack, byzantine attack, network based attack etc, Trust based Secure routing schemes.

**Module-3:** Bitcoin & Blockchain: Blockchain Structure, Basic Operations, Beyond Bitcoin, Gas, minor's role in blockchain.

**Module-4:** Ethereum Blockchain : Smart Contracts, Ethereum Structure, Ethereum Operations, Incentive Model in blockchain.

**Module-5:** Cryptography and cryptocurrency: Algorithms & Techniques Public-Key Cryptography, Public key and private key combinations in Blockchain security, Hashing, Transaction Integrity, Securing Blockchain.

**Module-6:** Decentralized Systems : Consensus Protocol, Practitioner's Perspective Decentralized Governance, Robustness, Forks.

**Text Books**

1. The Blockchain Developer: A Practical Guide for Designing, Implementing, Publishing, Testing, and Securing Distributed Blockchain-based Projects, by Elad Elrom, ISBN-13: 978-1484248461, ISBN-10: 1484248465

**References**

1. Blockchain Technology Explained: The Ultimate Beginner's Guide about Blockchain Wallet, Mining, Bitcoin, Ethereum, Litecoin, Zcash, Monero, Ripple, Dash, IOTA and Smart Contracts, by Alan T. Norman

## TITLE OF COURSE: BLOCKCHAIN COMPONENTS & ARCHITECTURE

**COURSE CODE:**
**L-T-P: 3-0-0**
**CREDITS: 3**

**Pre-requisite:** Basic concepts in blockchain and networking.

**Introduction:**

This course described implementation and architecture of blockchain. The Topics to be covered (tentatively) include: an introduction to Blockchain history, Digital Money, Hash, Signature, Blockchains design goals, Blockchain for Government: Digital identity and records.

**Course Outcomes (CO):**

In this course we will study the basic components of blockchain in digital asset. Students are expected to be capable of understanding the blockchain architecture, their advantages and drawbacks, how to implement them in network, how their drawbacks can be overcome and what the applications are and where they can be used. To reach this goal, the following objectives need to be met:

**CO1:** Students would be able to design & implement blockchain as a digital asset properly.
**CO2:** Students would be able to implement different security algorithm in blockchain.
**CO3:** By analyzing the logic of any algorithm, students would be able to implement Blockchain in Financial Software and Systems.
**CO4:** To become an efficient blockchain developer.

**Mapping of Course Outcomes (CO) and Program Outcomes (PO):**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | ✓ | ✓ | ✓ | | ✓ | | | | | | | ✓ |
| CO2 | ✓ | | | ✓ | | | | | | | | ✓ |
| CO3 | ✓ | ✓ | ✓ | | | | | | | | ✓ | ✓ |
| CO4 | ✓ | ✓ | ✓ | | ✓ | | | | | | | ✓ |

**Course Contents:**

**Module-1:** Introduction to Blockchain history: Digital Money to Distributed Ledgers Design Primitives: Protocols, Security, Consensus, Permissions, Privacy

**Module-2:** Blockchain Architecture and Design. Basic crypto primitives: Hash, Signature, Hashchain to Blockchain, Basic consensus mechanisms

**Module-3:** Consensus, Requirements for the consensus protocols, Proof of Work (PoW) Scalability aspects of Blockchain consensus protocols

**Module-4:** Permissioned Blockchains, Design goals, Consensus protocols for Permissioned Blockchains Hyperledger, Decomposing the consensus process Hyperledger fabric components Chaincode Design and Implementation Hyperledger Fabric beyond Chain code fabric SDK and Front End, Hyperledger composer tool

**Module-5:** Blockchain in Financial Software and Systems (FSS):Settlements, KYC, Capital markets, Insurance

Use case II: Blockchain in trade supply chain: Provenance of goods, visibility, tradesupply chain finance, invoice management discounting, etc

**Module-6:** Blockchain for Government: Digital identity, and records and other kinds of record keeping between government entities, public distribution system social
welfare systems

**Module-7:** Blockchain Cryptography Privacy and Security on Blockchain, Blockchain consensus protocols, Various recent works on scalability

**Module-8:** Secure cryptographic protocols on Blockchain Secured, Multi-party Computation, Blockchain, for science: making better use of the data-mining network, Case Studies:
Comparing Ecosystems - Bitcoin, Hyperledger, Ethereum and more

**Text Books**

1. Blockchain Technology Explained, by Alan T. Norman

**References**

1. Blockchain: Ultimate guide to understanding blockchain, bitcoin, cryptocurrencies, smart contracts and the future of money.
2. The Bitcoin Standard: The Decentralized Alternative to Central Banking by Saifedean Ammous

**TITLE OF COURSE: TRANSACTION ON BLOCKCHAIN**
**COURSE CODE:**
**L-T-P: 3-0-2**
**CREDITS: 4**

**Pre-requisite:** Basic concepts in blockchain technology.

**Introduction:**
This course examines basic block chain. The Topics to be covered (tentatively) include: an introduction to Cryptoassets, Smart Contracts, Digital Signatures, Financial Services etc.

**Course Outcomes (CO):**
In this course we will study the basic components of cryptoasset and transaction of blockchain. Students are expected to be capable of understanding the smart contract, their advantages and drawbacks, how to implement them in blockchain, how their drawbacks can be overcome and what the applications are and where they can be used. To reach this goal, the following objectives need to be met:

**CO1:** Students would be able to design & implement any transaction at blockchain properly.
**CO2:** Students would be able to implement any problem by writing their own business idea.
**CO3:** By analyzing the logic of transaction, students would be able to write efficient business proposal in blockchain.
**CO4:** To become an efficient blockchain developer.

**Mapping of Course Outcomes (CO) and Program Outcomes (PO):**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | ✓ | ✓ | ✓ | | ✓ | | | | | | | ✓ |
| CO2 | ✓ | | | ✓ | | | | | | | | ✓ |
| CO3 | ✓ | ✓ | ✓ | | | | | | | | | ✓ |
| CO4 | ✓ | ✓ | ✓ | | ✓ | | | | | | | ✓ |

**Course Contents:**
**Module-1:** Cryptoassets, Cryptocurrencies, Protocol Tokens, Utility Tokens (App Coins),Security Tokens, Natural Asset & Commodity Tokens, Crypto-collectibles, Crypto-fiat Currencies and Stable coins, Practitioner Perspective – Tokenomics, Practitioner Perspective - Cristina Dolan: Cryptoassets, Initial Coin Offerings: A New Breed of Meta-Asset, Practitioner Perspective - Rolf Hoefer: ICOs, Recap of Cryptoassets Protocol Tokens, Utility Tokens (App Coins), Security Tokens, Natural Asset & Commodity Tokens.
**Module-2:** Smart Contracts, Practitioner Perspective - Rolf Hoefer: Smart Contracts, Smart Contract Phases, Smart vs. Traditional Contracts, Smart Contracts and Law, Practitioner Perspective - Smart Contracts, Smart Contract Application Areas, Practitioner Perspective - Rob Carter: Smart Contracts, Smart Contract Strategies & Best Practices for the Organization, Smart vs. Traditional Contracts, Smart Contract Application Areas
**Module-3:** Identity, Introduction to Identity and Identifiers, Five Problems With Identifiers, Distributed, Self-sovereign Identity Systems, Practitioner Perspective - Carlos Augier: Identity, Blockchain Identity Applications, Practitioner Perspective - Stephen Tse & Li Jiang: Personal Data, Managing Health Data on a Blockchain, Polyalphabetic Ciphers, Symmetric Digital Signatures, RSA, ECC, ECDS
**Module-4:** Rethinking Finance, Six Inefficiencies in Financial Services, The Golden Eight Part, The

Golden Eight Part, Problems With Modern Accounting, The World Wide Ledger, Rethinking Financial Services, The Golden Eight, New Frameworks for Accounting, The Golden Eight

**Text Books**

1. A Practical Guide to Blockchain and its applications by Parikshit Jain, Publisher: Bloomsbury India

**References**

1. Blockchain Enabled Applications: Understand the Blockchain Ecosystem and How to Make it Work for You, by Vikram Dhillon & David Metcalf & Max Hooper

**TITLE OF COURSE: BLOCKCHAIN OPPORTUNITY ANALYSIS**
**COURSE CODE:**
**L-T-P: 3-0-0**
**CREDITS: 3**

**Pre-requisite:** Basic concepts in blockchain.

**Introduction:**

This course examines Blockchain Transformations for Every Industry. The Topics to be covered (tentatively) include: Industry Transformations, Introduction to the Blockchain Case Commons, Problem Solving with Blockchain, Decision Matrix, Statement of Benefit.

**Course Outcomes (CO):**

In this course we will study the business are of blockchain. Students are expected to be capable of understanding the implementation blockchain in industry, their advantages and drawbacks, how to implement them in network, how their drawbacks can be overcome and what the applications are and where they can be used. To reach this goal, the following objectives need to be met:

**CO1:** Students would be able to analyses opportunity in blockchain properly.
**CO2:** Students would be able to implement any problem by writing their own business idea.
**CO3:** By analyzing the logic of transaction, students would be able to write efficient business proposal in blockchain.
**CO4:** To become an efficient blockchain administrator.

**Mapping of Course Outcomes (CO) and Program Outcomes (PO):**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | ✓ | ✓ | ✓ | | ✓ | | | | | | | ✓ |
| CO2 | ✓ | | | ✓ | | | | | | | | ✓ |
| CO3 | ✓ | ✓ | ✓ | | | | | | | | | ✓ |
| CO4 | ✓ | ✓ | ✓ | | ✓ | | | | | | | ✓ |

**Course Contents:**

**Module-1:** Blockchain Transformations for Every Industry, Practitioner Perspective: Rob Carter, CIO at FedEx, How to Use the Blockchain Case Commons, Decentralizing the Enterprise, Blockchain & ConsenSys, Transaction Costs and the Structure of the Firm, Opportunity Search, Opportunity Contracting, Opportunity Coordination, Opportunity, Building Trust, Determining Corporate Boundaries, Hacking Your Future: Boundary Decisions, Decentralizing the Enterprise, Transaction Costs and the Structure of the Firm

**Module-2:** Industry Transformations, Introduction to the Blockchain Case Commons, Exploratory Market Research, Conducting Preliminary Market Research, How to Perform a Competitive Analysis, Intellectual Property, Payments, Attribution, and Licensing, Distributed Ownership

**Module-3:** APAC Business Development & Strategic Relations, Use a Decision Matrix, Problems That Blockchain Can and Cannot Solve, Blockchain Opportunity Brainstorm, Problem Solving With Blockchain, Decision Matrix, Statement of Benefit,

**Module-4:** Keyless Technologies, Strategic Positioning of Your Organization, Regulatory Principles, Regulation, Regulation vs. Governance, Regulation & Governance, The Blockchain Stack, Multiple Layers of Blockchain Governance, A New Framework for Blockchain Governance, Practitioner Perspective - Rob Carter: Governance, Profile of a Blockchain Hotbed

**Text Books**

1. Blockchain: Blueprint for a New Economy Kindle Edition, by Melanie Swan

**References**

1. The Internet of Money Kindle Edition, by Andreas M. Antonopoulos
2. Bitcoin Billionaires: A True Story of Genius, Betrayal, and Redemption, by Ben Mezrich

## TITLE OF COURSE: BITCOIN AND CRYPTO CURRENCY

**COURSE CODE:**
**L-T-P: 3-0-0**
**CREDITS: 3**

**Pre-requisite:** Basic concepts in blockchain architecture.

**Introduction:**

This course examines bit coin as a crypto currency. The Topics to be covered (tentatively) include: an introduction to crypto currency, Hash Functions, Hash Pointers, Bitcoin Transactions, Bitcoin Scripts, Applications, payment service in bit coin.

**Course Outcomes (CO):**

In this course we will study the bit coin as a crypto currency. Students are expected to be capable of understanding the crypto currency, their advantages and drawbacks, how to implement them in python, how their drawbacks can be overcome and what the applications are and where they can be used. To reach this goal, the following objectives need to be met:

**CO1:** Students would be able to design & implement bit coin as a crypto currency properly.
**CO2:** Students would be able to implement Ethereum under the hood.
**CO3:** By analyzing the logic of any hash function, students would be able to implement crypto asset.
**CO4:** To become an efficient blockchain developer.

**Mapping of Course Outcomes (CO) and Program Outcomes (PO):**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | ✓ | ✓ | ✓ | | ✓ | | | | | | | ✓ |
| CO2 | ✓ | | | ✓ | | | | | | | | ✓ |
| CO3 | ✓ | ✓ | ✓ | | | | | | | | | ✓ |
| CO4 | ✓ | ✓ | ✓ | | ✓ | | | | | | | ✓ |

**Course Contents:**

**Module-1:** Cryptographic Hash Functions, Hash Pointers and Data Structures, Digital Signatures, Public Keys as Identities, A Simple Cryptocurrency, Transacting in Bitcoin, Why Cryptocurrency.

**Module-2:** Centralization vs. Decentralization, Distributed Consensus, Consensus without Identity, the Block Chain, Incentives and Proof of Work, Putting It All Together, The Digital Signature, A Tamper Proof Ledger, Examples, Distributed Consensus, Proof of Work, Mining and Currency Supply.

**Module-3:** Bitcoin Transactions, Bitcoin Scripts, Applications of Bitcoin Scripts, Bitcoin Blocks, The Bitcoin Network, Limitations & Improvements, Cryptocurrency as an Asset Class, Risk and Return to Cryptocurrency, Review of Portfolio Theory, Asset Allocation with Cryptocurrency, Mining, Crypto Classifications, The Crypto Vision, Ethereum Overview, Ethereum Under the Hood, The DAO, Private Blockchains.

**Module-4:** How to Store and Use Bitcoins, Hot and Cold Storage, Splitting and Sharing Keys, Online Wallets and Exchanges, Payment Services, Transaction Fees, Currency Exchange Markets, Building the Blockchain, Crypto Finance, Business Use Cases, Blockchain in Gaming, Investing in Blockchain, Government and Regulation, Media and Advocacy1m, Creating the New Frontier of FinTech.

**Text Books**

1. Bitcoin and Cryptocurrency Technologies, by Arvind Narayanan, Joseph Bonneau, Edward Felten
2. Understanding Bitcoin: Cryptography, Engineering and Economics, By Pedro Franco, Wiley

**References**

1. The Blockchain Developer: A Practical Guide for Designing, Implementing, Publishing, Testing, and Securing Distributed Blockchain-based Projects, by Elad Elrom, ISBN-13: 978-1484248461, ISBN-10: 1484248465