# Academic Programme Guide
# of
# Bachelor of Engineering
# (Computer Science and Engineering)

***Based on Choice Based Credit System (CBCS)/Elective Course System***

CHITKARA UNIVERSITY
HIMACHAL PRADESH
NAAC ACCREDITED

**w.e.f.**
**Academic Year: 2023-24**

Approved by the 31st Academic Council vide agenda item 31.13 dated 29th August 2023

# INDEX

## 1. General Information

The four-year B.E (CSE) Program at Chitkara University is designed to provide conceptual and practical knowledge of core courses in the field of Computer Science and Engineering and interdisciplinary courses. Various courses offered are in the areas of programming languages, database management, computational complexity theory, software engineering, algorithms, system architecture, operating system and many more. The program will emphasize on teaching fundamentals of basic courses along with the practical applications. Apart from core courses, students will be offered discipline electives and specialization elective courses in a view to provide in-depth knowledge and encourage research in integrated areas. In project courses, students will get opportunity to give practical shape to the knowledge gained through various courses.

The Programme Educational Objectives (PEO) are:

| | |
|---|---|
| PEO 1: | To provide the solution for the complex engineering problems by using the concepts of Computer Science and Engineering. |
| PEO 2: | To work independently and efficiently in multi-disciplinary teams by communicating effectively. |
| PEO 3: | To acquire the additional knowledge and skills through enduring edification. |
| PEO 4: | To contribute effectively towards sustainable solution for environment and society. |

### 1.1 Programme Outcomes (PO)

The department expects undergraduate students to be able to demonstrate the following outcomes. The students are expected to be able to:

**PO1**. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

**PO2**. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

**PO3**. 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**. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthes is of the information to pro- vide valid conclusions.

**PO5**. Create, select, and apply appropriate techniques, re-sources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

**PO6**. 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**. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

**PO8**. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

**PO9**. Function effectively as an individual, and as a member or leader in diverse teams, and multidisciplinary settings.

**PO10**. 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**. 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**. 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.

## 2. Eligibility for Admission

The student seeking admission in the B.E program should have a minimum aggregate of 60% marks or must have secured 60% in Physics, Chemistry and Mathematics in 12$^{th}$ grade. The admission is based purely on merit. Any other specific criteria by the State Government/UGC/ University will be notified before the admission process starts.

## 3. Programme Duration

The duration of the B.E program is four years divided into 8 semesters. Each semester will consist of 15-18 weeks of academic work equivalent to 90 actual teaching days. The odd semester will be scheduled from July to December and even semester from January to June. The maximum duration of completion of the degree is 6 years.

## 4. Pedagogical Aspects

The structural layout of the B.E program and its courses will consist of lecture sessions, tutorial, practical sessions and internship.

**Lecture Sessions:** Lectures are to be delivered by traditional Chalkboard method, supplemented by modern Information Communication Technology (ICT) methods. The students are encouraged to ask questions to make the lectures interactive and engaging. In some courses where case study-based methodology is adopted, the lectures are supplemented by discussions on case studies.

**Tutorial Sessions:** The tutorial sessions consist of small groups of students. During the tutorial sessions, the students interact with the teachers and clear their doubts and get more insight into the subjects.

**Lab/Practical Sessions:** During lab/practical sessions, the students work on a prescribed list of experiments and apply the concepts learnt during lecture/tutorial sessions. This helps the students to get in-depth understanding of the complex theoretical concepts.

**Internship:** Students are allowed to undergo industry internship to work on a real-life problem-solving environment helping them to become industry ready.

Besides the pedagogical aspects mentioned above, the curriculum is envisaged towards inclusion of practices that can lead to holistic development to students considering the varied parameters that are defined in the Charter of the University.

## 5. Programme Structure

The various courses prescribed for the B.E Program are categorized in terms of their functional objectives as follows:

(i) **Core Courses:** Core courses are the foundation courses that cater to develop the breadth of Computer Science stream and also include Humanities, Social Science, Management, Mathematics, Basic Science and Engineering Science courses. Core courses are compulsory and can be offered in any semester during the program tenure provided it meets the prerequisite requirement.

(ii) **Elective Courses:** The technical courses apart from core courses are offered as electives to the students. These are the professional courses that are offered to students to cover the depth in a specific area of computer science for their employment, research or higher education. It also includes courses from other departments and/or streams. The students may also choose a specialization track to enhance their skills in a particular area and to gain industry exposure. It includes:

a) Professional Electives (PE)
b) Open Electives (OE)
c) Department Electives (DE)

(iii) **Mandatory Courses:** These courses are intended for students to gain general knowledge, learn new skills or develop personal interests. Students have to pass these courses. However, no credits will be added for these courses. These courses may be offered in any semester of the program.

(iv) **Special Courses:** Besides the above three types of courses, all students are provided with opportunities to explore their potential through Special Courses (SC) such as industry internship, MOOC courses, courses delivered by professors from universities across the globe and international collaborations as detailed below.

**a) Projects and Hands-on Experience:** These are hands-on courses to apply the knowledge gained through core/elective courses. The students identify their team-mates and work on a unique project. The projects can be suggested by faculty or by students after getting due approval from faculty-in-charge. The projects are allotted to them at the start of the semester. The project statements are made in such a way that the students while working on these projects apply the concepts learned so far and the deliverables are multi-faceted.

**b) Engineering Exploration Courses:** Students are given a choice of technical and industry-oriented courses to get the knowledge of new technologies/skills. Students also have an option of choosing the MOOC courses from online platforms like NPTEL and SWAYAM.

**c) Courses for Global Exposure:** To provide global exposure to students, the short duration courses are offered by professors from universities across the globe. The students may choose or may be offered these courses. These courses are decided for each batch as per the expertise of the teaching faculty and is informed to the students before offering them in a semester.

**d) Courses for Skill Enhancement:** The courses of soft skills and logical reasoning are offered to students which help them in their overall professional development.

**e) Opportunity for Students to avail benefits of International Collaborations:**

The students of Chitkara University are given opportunity to enhance their knowledge and skill sets through the following programs under International Collaborations:

- Articulation Program
- Semester Exchange
- Semester Abroad

Apart from the courses being offered, the students are encouraged to participate in various technical events, competitions and hackathons organized by technical societies chapters and student branches.

## 6. Rules for Attendance

The University expects its students to be regular in attending the classes. Attendance of 75% is compulsory in a course to be eligible to appear for End Term Examination. The students are also encouraged to participate in co-curricular activities and can do so in 25% cushion provided in the attendance requirements. 10% concession in attendance requirements is possible only in case of extreme circumstances and at the sole discretion of the Vice-Chancellor or the competent authority appointed by the Vice-Chancellor.

## 7. Grading System

Grades are awarded to students based on the marks secured in the respective courses. The list of Letter Grades is given in table-1:

**Table 1:** Grade and grade points

| Marks Secured in % | Grade | Grade Point | Qualitative Meaning |
|---|---|---|---|

| | | | |
|---|---|---|---|
| 80-100 | O | 10 | Outstanding |
| 70-79 | A+ | 9 | Excellent |
| 60-69 | A | 8 | Very Good |
| 55-59 | B+ | 7 | Good |
| 50-54 | B | 6 | Above Average |
| 45-49 | C | 5 | Average |
| 40-44 | P | 4 | Pass |
| 0-39 | F | 0 | Fail |
| - | I | 0 | Incomplete / Absent |

### 7.1. Computation of SGPA and CGPA

The University follows the UGC recommended procedure to compute the **Semester Grade Point Average** (SGPA) and **Cumulative Grade Point Average** (CGPA):

(i) The SGPA is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e.

**SGPA** ($S_i$) = $\Sigma(C_i x\ G_i) / \Sigma C_i$

Where $C_i$ is the number of credits of the $i^{th}$ course and $G_i$ is the grade point scored by the student in the $i^{th}$ course.

(ii) The CGPA is also calculated in the same manner taking into account all the courses undergone by a student over all the semesters of a programme, i.e.

**CGPA** = $\Sigma(C_i x\ S_i) / \Sigma\ C_i$

where $S_i$ is the SGPA of the $i^{th}$ semester and $C_i$ is the total number of credits in that semester.

(iii) The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

### 7.2 Illustration of Computation of SGPA and CGPA

Computation of SGPA and CGPA are calculated as described in table-2 and table-3 respectively.

**Table 2**: Illustration for SGPA

| **Course** | **Credit** | **Grade Letter** | **Grade Point** | **Credit Point (Credit X Grade)** |
|---|---|---|---|---|
| Course 1 | 3 | A | 8 | 3 X 8 = 24 |
| Course 2 | 4 | B+ | 7 | 4 X 7 = 28 |
| Course 3 | 3 | B | 6 | 3 X 6 = 18 |
| Course 4 | 3 | O | 10 | 3 X 10 = 30 |
| Course 5 | 3 | C | 5 | 3 X 5 = 15 |
| Course 6 | 4 | B | 6 | 4 X 6 = 24 |
| | **20** | | | **139** |

Thus, **SGPA =139/20 =6.95**

**Table 3:** Illustration for CGPA

| **Semester 1** | **Semester 2** | **Semester 3** | **Semester 4** |
|---|---|---|---|
| Credit:20<br>SGPA:6.9 | Credit:22<br>SGPA:7.8 | Credit:25<br>SGPA:5.6 | Credit:26<br>SGPA:6.0 |
| **Semester 5** | **Semester 6** | CGPA=6.73 | |
| Credit:26<br>SGPA:6.3 | Credit:25<br>SGPA:8.0 | | |

$$Thus, CGPA = \frac{20X6.9 + 22X7.8 + 25X5.6 + 26X6.0 + 26X6.3 + 25X8.0}{144} = 6.73$$

**Transcript:** Based on the above criteria, the University may issue the transcript to the desiring students as per the University policy.

**Evaluation for Engineering Exploration Courses:** The evaluation of the courses under Engineering Exploration will consist of internal component and external component and will be conducted as per the details mentioned in the respective CHO.

**Evaluation for MOOC Courses:** The evaluation of the MOOC courses will be conducted as per the details mentioned in the respective CHO.

**Evaluation for Global Exposure Courses:** There will be only one evaluation at the end of the course. The type of evaluation may vary depending on the course type on the discretion of the concerned authority.

**Evaluation for Mandatory Courses:** There will be only one evaluation at the end of the course. The type of evaluation may vary depending on the course type on the discretion of the concerned authority.

## 8. Promotion and Registration

Any bonafide student, who appears for the examination conducted by the University, shall be promoted to the next higher semester and shall carry forward all course(s) in which he/ she is declared Fail. The student shall have to pass all papers within the stipulated maximum duration as prescribed by the University to qualify for the award of the degree.

All students are eligible to register for next semester irrespective of the number of backlogs. A student is not permitted to register in a term if:

- He/She has dues outstanding to the University, hostel, or any recognized authority or body of the University, or
- His/Her grade sheet in his/her immediately preceding term is withheld, or
- He/ She has been specifically debarred or asked to stay away from that term

Late registration may be granted in case a student fails to register on the stipulated date. Students failing to register on the specified day of registration will be allowed to register only after permission from the Head of the Department and after paying the stipulated late fee. Any students who have not registered will not be allowed to attend classes.

(a) If the registration of a student in a course is not found to be as per the regulations, his / her registration in that course will be canceled and the grade obtained, if any, will be rejected.

(b) The registration of a student in a course or complete set of courses in a term can be canceled by the

concerned authority when he is found guilty in case of unfair means, breach of discipline, etc. or when he/she persistently and deliberately does not pay his dues.

(c) Absence for a period of four or more weeks at a stretch without any information to the concerned authority during a term shall result in automatic cancellation of the registration of a student from all the courses in that term.

A student who is duly registered in a term is considered to be on the rolls of the University. After registration, if he/she withdraws from the term, or has been given prior permission to temporarily withdraw from the University for the term, or has been asked to stay away by an appropriate authority of the University will be considered to be on the rolls of the University for that term. While such a student retains the nominal advantage of being on the rolls of the University, the loss of time from studies and its consequences cannot be helped by the University.

If for any valid reason a student is unable to register in a term, he/she must seek prior permission of Head/Dean of Department to drop the term. If such permission has not been requested or after a request, the permission has been denied, his/her name would be struck off the rolls of the University and he/she would no longer be a student of the University. His/her case will be automatically processed and the file will be closed. However, if such a student, after his/her name has been struck off the rolls of the University, is permitted to come back, his/her case can be considered at the sole discretion of the competent authority of the University with the provision that all his/ her previous records as a former student are revived under the current academic and administrative structure, regulations and schedule offers.

## 9. Migration/Credit Transfer/Lateral Entry

The following procedures will be followed for credit transfer for a student under migration, studied in other Universities in India and Abroad:

The credits earned by the student from the other universities in India or abroad shall be transferred as per the mapping of the courses. The Degree shall only be awarded to the candidate subject to the condition that student has earned the minimum number of credits defined by the Academic Regulation/APG of the Programme run by the Chitkara University.

In case a student undergoes international exchange programme or internship for 1 semester/ 1 year/ 2 years, then the courses, credits and grades earned by the student during that period will be reflected on the grade card issued by the Chitkara University after successful mapping of the courses/credits. The courses will be marked as (*) on the grade card/transcript.

## 10. Eligibility for the Award of the Degree

A student will be declared as “Pass” in a course if he/she obtains the minimum passing marks (40%) in the course enrolled and has appeared in the end term examination of that course. A student must complete (Pass) all the required courses (in all years) in which he/she has registered.

OR

Any specific criteria followed by the University for any Particular Course.

To be eligible for award of B.E degree in Computer Science and Engineering, a student must earn a minimum of 155 credits and a minimum CGPA of 4.5 in the B.E program.

## 11. Program Overview

The B.E CSE Program consists of courses under the following categories:

HSM: Humanity and Social Science

BSC: Basic Science Courses

ESC: Environmental Science Courses

PC: Professional Courses

EC: Engineering Courses

PE: Professional Electives

OE: Open Electives

DE: Department Electives

SC: Special Courses

AC: Additional Credits through Global Week.

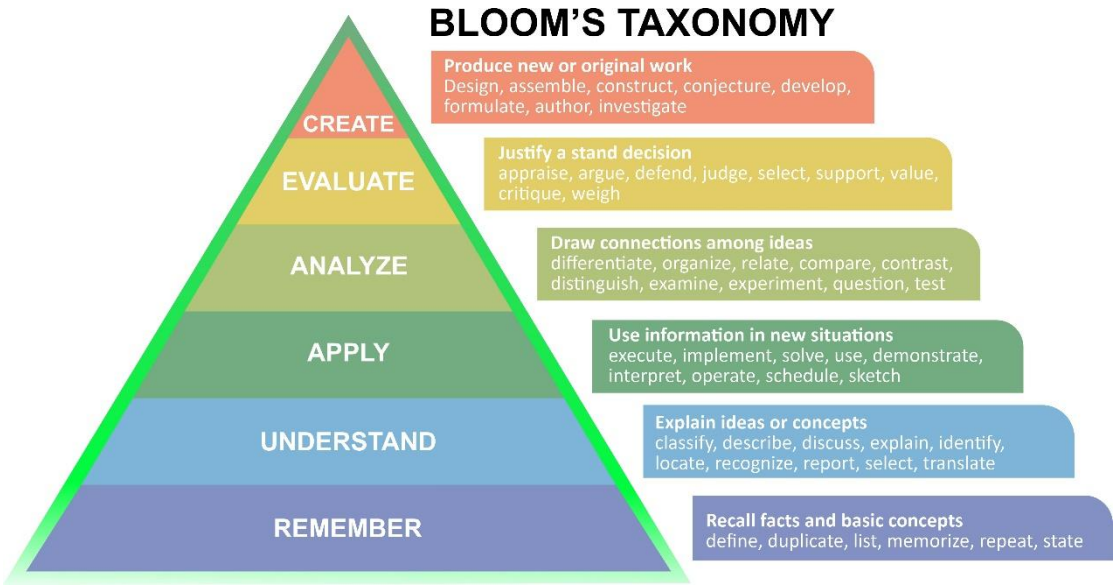
NCC: National Cadet Corps

NSS: National Service Scheme

- In addition to these courses, a student must take UGC mandatory courses.
- The number of courses and total credits may vary based on the choice of electives/specialization/additional courses by the student.
- Student may earn credits in final year by taking Co-Op training.
- Student may also choose additional electives instead of Co-Op training in the final year.

**12. Assessments**

A lot of emphasis is laid on quality of assignment, so as to make sure that all assessment components are incorporated while following different levels of Bloom's Taxonomy as mentioned in figure below.




Further, a focused effort will be made to align every single test item in assessment components with one or the other course learning outcome.

**13. Examples of questions as per different levels of Blooms Taxonomy**

**a. Remember**

Retrieving, recognizing, and recalling relevant knowledge from long-term memory.

Sample Questions:

1. Define schema and instances.

2. List the advantages of database over file system.

**b. Understand**

Constructing meaning from oral, written and graphic messages through interpreting, exemplifying, classifying, summarizing, inferring, comparing and explaining.

Sample Questions:

1. Explain the three-level architecture with data independence.
2. What is Deadlock and how it can be avoided?

**c. Applying**

Carrying out or using a procedure through executing or implementing.

Sample Question:

Chitkara University aims to create a database to manage information related to students, courses, and faculty members. The university has provided you with the following requirements:

- Students should be uniquely identified by their student ID, and their information should include their name, date of birth, and contact information (address, email, phone).
- Courses offered by the university should have a unique course code, a title, and the maximum number of students allowed to enroll in each course.
- Faculty members should be identified by their employee ID, and their information should include their name, department, and contact information.
- Students can enroll in multiple courses, and each course can have multiple students. A student can enroll in a course only once.
- Each course is taught by one faculty member, but a faculty member can teach multiple courses.
- Faculty members may also serve as academic advisors to students. A student can have one academic advisor.

Draw an Entity-Relationship (ER) diagram that includes entities, attributes, relationships, and cardinality constraints to represent the university database in accordance with these requirements.

**d. Analyzing**

Breaking material into constituent parts, determining how the parts relate to one another and to an overall structure or purpose through differentiating, organizing and attributing

Sample Questions:

1. A class of 10 students consists of 5 males and 5 females. We intend to train a model based on their past scores to predict the future score. The average score of females is 60 whereas that of male is 80. The overall average of the class is 70. Give two ways of predicting the score and analyse them for fitting model.

2. Return statement can only be used to return a single value. Can multiple values be returned from a function? Justify your answer.

**e. Creating & Evaluating**

Produce new or original work

Sample Questions:

Alpha Inc. company is preparing its production plan for 2021. The quarterly demands for 2020 are given as follows:

| Quarter | Demand |
|---|---|

| | |
|---|---|
| 1 | 200 |
| 2 | 190 |
| 3 | 250 |
| 4 | 290 |

Seasonality indexes for each quarter are 0.92, 0.90, 0.97, and 1.10, which are estimated based on actual demands from 2000 to 2020 and believe to apply to 2021. Use appropriate forecasting model to obtain the demands of all 4 quarters in 2021.

**14. Course Handout**

An elaborate document named as 'Course Handout' providing details of a particular course is shared with students at the beginning of every semester. This document typically has various components like-

1. Title of the course
2. Course code
3. Name of the faculty members teaching that course in a typical semester
4. Scope and objective of the course
5. Course learning outcomes
6. Alignment of every single CLO with Program out comes (CLO-PO mapping)
7. Detailed delivery plan
8. Information about reliable and authenticated web resources
9. Assessment methodologies etc.

Faculty members are expected to religiously follow the Contents of the course handout in complete letter and spirit.

**15. Flexibilities**

Students are given a choice to make a selection on how they want to pursue their final leg of degree program. Various choices available with student are-

**(a) Co-Op project at Industry:** Under this category, students are allowed to undergo industry internship during their final year. This is divided into two modules:

i. Co-Op Project at Industry (Module-I): During seventh semester

ii. Co-Op Project at Industry (Module-II): During eighth semester

Through these modules, students get more exposure to apply their learning skills in real life applications. The evaluation is a combination of University examination and industry feedback.

**(b) Industry Oriented Hands-on Experience (IOHE):**
This is the mandatory internship module for all students of B.E CSE. The students who are not in the Co-Op module have to complete this mandatory internship during the eighth semester. The evaluation is a combination of University examination and industry feedback.

Students may also be given opportunity to complete this module through in-house training provided by the University.

**16. Opportunities for international exposure**

Chitkara University boasts of having very strong collaboration with more than 200 international University partners. Students are encouraged to draw the maximum benefit from the same by being in regular touch with office of international affairs at University and participating in various opportunities like short term mobility, internships modules etc. Credits earned by student through these opportunities at international University partners are suitably mapped to eventually get those reflected in the student's grade card.

To keep pace with the industry requirements, the curriculum needs regular revision. The courses mentioned in the APG are subject to changes as recommended and approved by the competent authority for curriculum revision from time to time. Any changes in the curriculum during the tenure of the degree program will be informed to the students during respective academic year/semester.

## Course Scheme B.E (CSE)-2023

**On the basis of Choice Based Credits System as per UGC notification dated 10th, August, 2016.**

| | BE CSE Batch 2023 | | | |
|---|---|---|---|---|
| | **Semester - 1** | | | |
| **S.No** | **Course Code** | **Course Name** | **L-T-P** | **Credits** |
| 1 | 23CS001 | Computer Programming-I | 3-0-4 | 5 |
| 2 | 23CS002 | Introduction to Web Technologies | 3-0-2 | 4 |
| 3 | 23AM001 | Calculus and Statistical Analysis | 4-1-0 | 5 |
| 4 | 23PH001 / 23EC001 | Modern and Computational Physics / Basics of Electronics Engineering | 3-0-0 | 3 |
| 5 | 23PH002 / 23EC002 | Modern and Computational Physics Lab / Basics of Electronics Engineering Lab | 0-0-2 | 1 |
| 6 | 23ES001 | Environmental Sciences | 2-0-0 | 2 |
| 7 | 23CL001 | English-I | 2-0-0 | 2 |
| | | **Total** | **26** | **22** |

| | **Semester - 2** | | | |
|---|---|---|---|---|
| **S.No** | **Course Code** | **Course Name** | **L-T-P** | **Credits** |
| 1 | 23CS003 | Computer Programming-II | 3-0-4 | 5 |
| 2 | 23CS004 | Introduction to Linux | 3-0-2 | 4 |
| 3 | 23CS005 | Operating System | 3-0-0 | 3 |
| 4 | 23AM002 | Differential Equations and Transformations | 4-1-0 | 5 |
| 5 | 23PH001 / 23EC001 | Modern and Computational Physics / Basics of Electronics Engineering | 3-0-0 | 3 |
| 6 | 23PH002 / 23EC002 | Modern and Computational Physics Lab / Basics of Electronics Engineering Lab | 0-0-2 | 1 |
| 7 | 23IP001 | Integrated Project-I | 0-0-4 | 2 |
| 8 | 23HV001 | Human Values and Professional Ethics | 1-0-0 | 0 |
| | | **Total** | **30** | **23** |

| | **Semester - 3** | | | |
|---|---|---|---|---|
| **S.No** | **Course Code** | **Course Name** | **L-T-P** | **Credits** |
| 1 | 24CS008 | Object Oriented Programming Using C++ | 3-0-4 | 5 |
| 2 | 24CS009 | Front-end Engineering | 2-0-2 | 3 |
| 3 | 24CS010 | Database Management System | 3-0-2 | 4 |
| 4 | 24CS011 | Computer Networks | 3-0-2 | 4 |
| 5 | 24AM003 | Discrete Structures | 4-0-0 | 4 |
| 6 | 23/24EEXXX | Engineering Exploration | 2-0-0 | 2 |
| 7 | 24CS012 | Cyber Security | | Non-Credit |
| 8 | 24CL002 | Professional Communication Skills | 0-0-4 | 2 |
| | | **Total** | **31** | **24** |
| | **Engineering Exploration** | | | |
| **S.No** | **Course Code** | **Course Name** | **L-T-P** | **Credits** |

| | | | | |
|---|---|---|---|---|
| 1 | 23EE001 | Introduction to Internet of Things | 2-0-0 | 2 |
| 2 | 23EE003 | Introduction to Augmented Reality/Virtual Reality (AR/VR) | 2-0-0 | 2 |
| 3 | 23EE004 | Publishing Research | 2-0-0 | 2 |
| 4 | 24EE024 | Python Programming | 2-0-0 | 2 |
| 5 | 23EE005 | Artificial Intelligence : Search Methods For Problem solving | 2-0-0 | 2 |
| 6 | 23EE006 | Ethical Hacking | 2-0-0 | 2 |
| 7 | 23EE010 | The Joy of Computing using Python | 2-0-0 | 2 |
| 8 | 23EE011 | Introduction To Game Theory And Mechanism Design | 2-0-0 | 2 |
| 9 | 23EE012 | Introduction to Industry 4.0 and Industrial Internet of Things | 2-0-0 | 2 |
| 10 | 23EE013 | Cloud Computing | 2-0-0 | 2 |
| 11 | 23EE014 | Introduction to Machine Learning | 2-0-0 | 2 |
| 12 | 24EE025 | Microsoft Certified: Azure AI Fundamentals | 2-0-0 | 2 |
| 13 | 24EE026 | Microsoft Certified: Azure Data Fundamentals | 2-0-0 | 2 |
| 14 | 24EE027 | Microsoft Certified: Security, Compliance, and Identity Fundamentals | 2-0-0 | 2 |

| **Semester-4** | | | | |
|---|---|---|---|---|
| 1 | 24CS013 | Data Structures | 3-0-4 | 5 |
| 2 | 24CS014 | Front-end Frameworks and Libraries | 2-0-2 | 3 |
| 3 | 23CS006 | Machine Learning Systems for Real World | 2-0-2 | 3 |
| 4 | 24CS015 | Object Oriented Software Engineering | 3-0-2 | 4 |
| 5 | 24CS016 | Computer System Architecture | 3-0-0 | 3 |
| 6 | 24IP002 | Integrated Project-II | 0-0-4 | 2 |
| 7 | 24UH003 | Disaster Management | 2-0-0 | Non-Credit |
| 8 | 24CL003 | Corporate Communications and Professional Skills | 2-0-0 | 2 |
| Total | | | 31 | 22 |
| **Semester-5** | | | | |
| S.No | Course Code | Course Title | L-T-P | Credits |
| 1 | CS126 | Algorithm Design & Implementation | 2-0-4 | 4 |
| 2 | CS161 | Java Programming | 3-0-4 | 5 |
| 3 | CS254G | Professional Practice-System Design | 2-0-0 | 2 |
| 4 | CS269 | Full Stack Web Development | 3-0-4 | 5 |
| 5 | GE101 | Numerical Ability and Logical Reasoning | 0-0-8 | 4 |
| 6 | PD080 | Vital Employability Skills | 0-0-6 | 3 |
| **Total** | | | 36 | 23 |
| **Semester-6** | | | | |
| **S.No** | **Course Code** | **Course Title** | **L-T-P** | **Credits** |
| 1 | CS268 | Advanced Algorithm Design & Implementation | 3-0-4 | 5 |

| | | | | |
|---|---|---|---|---|
| 2 | CS269 | Full Stack Web Development | 3-0-4 | 5 |
| 3 | CS270 | Cloud Computing Essentials | 3-0-4 | 5 |
| 4 | CS205 | Integrated Project-III | 0-0-4 | 2 |
| 5 | DM101 | Disaster Management | | Non Credit |
| Total | | | 25 | 17 |

| **Semester-7** | | | | |
|---|---|---|---|---|
| **S.No** | **Course Code** | **Course Title** | **L-T-P** | **Credits** |
| 1 | ** | Open Elective – I | ** | 6 |
| 2 | ** | Open Elective – II | ** | |
| 3 | CS183 | Lab Oriented Project | 0-0-6 | 3 |
| 4 | CS244 | Professional Practices-Coding | 0-0-6 | 3 |
| **OR** | | | | |
| 1 | CS251 | Co-op Project at Industry Module-I | ** | 12 |
| | | | **18#** | **12** |

| **Semester-8** | | | | |
|---|---|---|---|---|
| **S.No** | **Course Code** | **Course Title** | **L-T-P** | **Credits** |
| 1 | CS253 | Industry Oriented Hands-on Experience | - - - | 12 |
| **OR** | | | | |
| 1 | CS252 | Co-op Project at Industry Module-II | - - - | 12 |
| | | | **-** | **12** |

| S.No | **Course Code** | **Semester 7 (Open Electives)** |
|---|---|---|
| 1 | ER104 | Foundational Course in Entrepreneurship |
| 2 | ER103 | Advanced Course in Entrepreneurship |
| 3 | CS4003 | Network Security |
| 4 | CS251 | Co-op project at Industry Module-I |
| 5 | CS245 | Big Data Analytics |
| 6 | CS244 | Professional Practices – Coding |
| 7 | CS183 | Lab Oriented Project |
| 8 | CS243 | Artificial Intelligence and Machine Learning |
| 9 | CS181 | Software Quality Assurance and Testing |

The course structure for the students under articulation program, semester exchange program or semester abroad program will be followed as per the academic/credit transfer policy defined by the office of international affairs.

| | Courses offered under CBCS | | | |
|---|---|---|---|---|
| | Semester - I | | | |
| S.No | Course Code | Course Name | L-T-P | Credits |
| 1 | 23PS001 | Front-end web development-I | 4-0-0 | 4 |
| 2 | 23PF001 | Critical thinking 101 | 4-0-0 | 4 |
| 3 | 23PD004 | Discrete Mathematics | 4-0-0 | 4 |
| 4 | 23PF002 | Professional skills for the workplace | 3-0-0 | 3 |
| 5 | 23PD001 | The breadth of computer science-I | 4-0-0 | 4 |
| 6 | 23PS002 | Problem solving using programming | 4-0-0 | 4 |
| 7 | 23PD013 | Design for developers | 3-0-0 | 3 |
| **Total** | | | **26** | **26** |

| | Semester - II | | | |
|---|---|---|---|---|
| S.No | Course Code | Course Name | L-T-P | Credits |
| 1 | 23PF003 | Learning how to learn | 3-0-2 | 4 |
| 2 | 23PS004 | Front-end web development-II | 4-0-2 | 5 |
| 3 | 23PS003 | Database Management System-I | 2-0-0 | 2 |
| 4 | 23PS005 | Backend Development | 4-0-2 | 5 |
| 5 | 23PD002 | The breadth of computer science-II | 3-0-2 | 4 |
| 6 | 23HV001 | Human Values and Professional Ethics | 1-0-0 | 0 |
| **Total** | | | **24** | **20** |

**COURSE OUTLINE**

The course outline for the core courses is given here. The detailed course structure, examination pattern, evaluation components, pedagogy, mode of lecture delivery, question paper format as per Bloom's taxonomy, CO-PO mapping and other details for all courses are given in the Course Handout of the respective courses.

**CS111-Introduction to Web Technologies**

Getting Started with Basics, Introduction to HTML, More on HTML, Forms, Introduction to CSS, Styling with CSS, Resume Project, Flex, Completing Resume, Responsive Design, Animations and 3d Space, Bootstrap, Web Design Process, CSS Variables, CSS Variables Scope , Project Demo Video, Starting with JavaScript, JavaScript functions and Arrays, Object and Timing Events, Understanding Dom, Calculator Project, Closures, Constructors and Prototypes, Introduction to JQuery, Writing Code Using J query, Modifying CSS Using Query , Event Handling Using J Query, Explore J Query.

**CS140-Problem Solving using Python Programming**

Introduction to python programming, Applications in All Engineering Domains, Origin and intentions, Differences to other programming languages, Introduction to logic building and flowcharts. Anaconda Installation, Running Python Programs, Writing Python Scripts with Jupyter Notebook. Logic building, Algorithm and Flowchart. Fundamentals: Data Types, Variables and literals, Blocks and Syntax Rules, Operators and Expressions, Assignment Statements, Expression Statements, Multiway Branching. Looping, Decisions, Control Flow- Conditionals and loops, pattern designing. Defining Functions, Scope Rules, Global Statements, Closures, Argument Matching, Passing Arguments, Recursive Functions, Lambda Expressions. Lists, Indexing and Slicing, References and Copies, List Comprehension, map, filter & reduce functions. Searching & Sorting: Imports and Attributes, Creating

Modules, Searching & Sorting, Namespaces, Reloading, Generating Random values. Two Dimensional Lists, Strings and its relative methods and properties, Tuples, Set and Dictionaries- introduction, methods and its relative properties. Files and Directories, File I/O, File positioning, File operators. Introducing Widgets, Adding and Working with Widget, Displaying Text and Images With Label Widgets, Getting User Input With Entry Widgets, Displaying Clickable Buttons With Button Widgets, Controlling Layout With Geometry Managers, Using Events and Event Handlers.

**CS255- Design Thinking**

Introduction to design thinking, history of design thinking, case studies, design thinking in social innovations, tools of design thinking, customer journey map, product lock down workshops, implementing design thinking for making the process of a user better, case studies in retail, case studies in banking, case studies in management decisions, design thinking process and implementing it for a digital product.

**CS501 –Cyber Security**

Introduction to Security, Security principles, threats and attack techniques, Basics of Cryptography, Cryptographic mechanisms, Classical Encryption Techniques, Symmetric and Asymmetric cryptography, Introduction to cybercrime, cybercrime and information security, Classifications of cybercrimes, Cybercrime and the Indian ITA 2000, Cyber offenses, Botnets- The fuel for cybercrime, Phishing, Password cracking, key loggers and SQL injection, attacks on wireless networks, Cost of cybercrimes and IPR issues, lessons for organization, web threats for organization, security and privacy implications from cloud computing, social media marketing, security risks and perils for organizations, social computing and the associated challenges for organizations, protecting people's privacy in the organization, organizational guidelines for internet usage, safe computing guidelines and computer usage policy, incident handling, Cyber Forensics, Best practices for organizations, Media and Asset Protection, Importance of endpoint security in organizations, cybercrime and cyber terrorism, Intellectual property in the cyberspace, the ethical dimensions of cybercrimes, the Psychology, mindset and skills of hackers and other cybercriminals, Cybercrime, Illustrations of financial frauds in cyber domain, digital signature related crime scenarios.

**GE102**- Introduction to Emerging Technologies

Skillsets and traits for the future, 5G a revolution for communication services providers and consumers, social engineering in cyber security, machine learning and artificial intelligence, leading through crisis, future of technology, building scalable Android apps, impact vs actions, future trends of databases, impact of Covid – evolving skills, career and life, technical and HR skills for future readiness, demystifying AI/ML, data 4.0 journey, self awareness for professional success, agile workforce.

**AM121 - Calculus and Statistical Analysis**

Differentiation, matrices, normal form, Eigen values and vectors, partial differentiation & its applications, Euler's theorem, Taylor's series expansion, Maclaurin's series, Lagrange's method of undetermined multipliers, multiple integration & its applications, change of order, change of variables, Beta and Gamma functions, introduction to scalar & vector, Green's theorem, Stokes' theorem, Gauss divergence theorem. Statistical Inference: Estimation, Interval estimation, Testing of Hypothesis

**AM122 - Differential Equations and Transformations**

Problems related to Fourier series on arbitrary intervals, Fourier transform, differential equations of first order & first degree, complementary function, Laplace transform, formation of partial differential equations, second order linear partial differential equations, separation of variables, limits, continuity, Cauchy's theorem, Taylor's & Laurent's expansion.

**CS106- Object-Oriented Programming**

Introduction to java, control statement, working with Array, Object Oriented Programming, Objects and classes, Access Control Modifier, Inheritance, Abstract Method & Classes, String, Exception Handling, Multithreading, Generic, Collections framework, IO Streams, JDBC, Practice Problems.

**CS163- Advanced Web Development**

jQuery, jQuery effects, jQuery callback, jQuery chaining, jQuery HTML, jQuery AJAX, bootstrap, BS tables, images, jumbotron, glyphicons, BS forms, BS media objects, BS carousel, bootstrap grids.

**EC101 - Basics of Electronics Engineering**
Semiconductor Diodes and applications, V-I characteristics of P-N Junction Diode, Photodiode, Zener diodes as voltage, use of diode in Rectifiers, Transistors and Applications, Characteristics of BJT in CB and CE Configuration, Introduction to junction filed Effect Transistor, digital circuits, binary arithmetic, Review of logic gates, introduction to combinational and sequential logic, integrated Circuits, modes of operations of IC555, Introduction to IOT, Application using case studies.

**ES101- Environmental Sciences**
Definition, scope, importance, need for public awareness, natural resources, renewable and non-renewable resources, water resources, ecosystems, biodiversity & its conservation, threats to biodiversity, environmental pollution, disaster management, environment protection acts, welfare program.

**PH121 - Modern and Computational Physics**
Electrodynamics, Vector and scalar fields, Gradient, divergence, curl, Gauss's theorem and Stoke's theorem, Laser, Laser characteristics such as coherence, monochromaticity, collimated and angular divergence, laser action, stimulated absorption, spontaneous emission, stimulated emission, Population inversion and pumping. Derivation of Einstein's coefficient relation, Various level lasers, two level, three level, four level, Ruby laser, Helium-Neon laser, Semiconductor laser, concepts of Holography, LASER Applications in engineering. Fiber Optics, Basic principle of optical fibre, Parameters of optical fibers, acceptance angle, acceptance cone, numerical aperture, normalized frequency, Attenuation in optical fibers, Magnetic Materials: Terminology and classification, Derivation of Magnetic moments of an atom, Ferromagnetism and related phenomena, Ferrites, The domain structure, The hysteresis loop, Types of magnetic materials, soft magnetic materials, hard magnetic materials, comparison between ferromagnetic and superparamagnetic materials, applications of magnetic materials in engineering. Superconductivity, Introduction, Meissner effect, critical field, critical current, Isotope effect, Types of superconductors: type I superconductors, type II superconductors, London equations, Penetration depth, Cooper pair and BCS theory (Qualitative only), high temperature superconductors. Applications of superconductivity e.g Lavitation Effect, SQUID, Quantum Mechanics, Introduction to Quantum Mechanics, Group velocity and phase velocity, de-Broglie waves, Uncertainty principle, Wave function and its significance, Normalised wave function, Time Independent Schrodinger wave equations, Time dependent Schrodinger wave equation.

**AM103- Discrete Structures**
Introducing sets, Introduction to relations, Introduction to functions, Permutations &Combinations, Pigeonhole principle, Recurrence relation, Characteristic polynomial & Introduction to generating functions, Logic, Lattices, Boolean Algebra, Graph Theory, Multi graph, Sub graphs, Euler's formula & its applications, Tree, Shortest path algorithm, Warshall's Algorithm, Prim's Algorithm

**CS110- Introduction to Linux**
Introduction, history of Linux, installation, mounting, introduction to GCC compiler, Linux commands, system configuration from the graphical interface, command-line operations, working with files, directory-oriented commands, searching, GCC, file system, communication-oriented commands, managing users, local security principles, network operations, regular expressions, redirections & filters in Linux, advanced Bash shell scripting, process scheduling, process priority, bash shell scripting.

**CS114- Data Structures**
C++ Fundamental, Decision control and looping statement, user defined functions, Dynamic Memory management & pointers, object and classes, basic terminology, Arrays, link list, stacks, queues, sorting techniques, trees, tree traversal. Balanced binary trees, Graphs, Link list representation, graph traversals, hashing

**CS115 - Operating System**
Introduction to Operating systems, OS structure, OS operations, Operating System Services, User and OS interface, Process Scheduling, Operations On Processes, Inter-process Communication, Threads, CPU Scheduling, Shortest Job First Scheduling Algorithms (SJF), Scheduling Algorithms, Process Synchronization, Semaphores, Classic problems of Synchronization, Critical regions, Monitors, System Model Deadlock Characterization, Memory Management, Introduction to Virtual Memory, Demand Paging, Process creation: Copy- on write, Page Replacement Algorithms, Allocation of frames, Thrashing, File System, Implementing File System, Mass Storage structure, Disk Scheduling, Security

**CS201H01- Engineering Exploration (Programming in C++)**
C++ Fundamentals, arrays, pointers, strings, dynamic memory management, recursion, classes and objects, constructors and destructors, operator overloading, inheritance, virtual base class, overriding, virtual functions, polymorphism, exception handeling, templates and generic programming, containers, iterators, vectors, lists, maps, project.

**EC105 - Digital Electronics and Logic Design**
Introduction to Digital Concepts, Logic Gates, Number systems, Binary codes, Boolean algebra, Boolean Functions and their representation, Karnaugh map (upto 5 variable), Q-M method of minimization, Combinational circuit, Magnitude Comparator, Encoder, Priority encoder, Decoder, Code Converters, Parity bit generators and checkers, Sequential circuits, Shift Registers, Counters, Digital IC families (DTL, TTL, ECL, MOS and CMOS), A/D Converter, Semiconductor Memories, Programmable Logic Devices

**EC106 - Digital Electronics and Logic Design Lab**
Logic gates, design circuit using universal gates, 1-bit half-adder, 1-bit full-adder, 4-bit full-adder, comparator, convertor, combinational circuit, registers, data transfer, SISO, SIPO, PISO, PIPO, LED 7-segment, sequencer. Design, and verify the 4-bit synchronous counter. Design, and verify the 4-bit asynchronous counter.

**CSP101-** Database Management Concepts Lab
Introduction to SQL and architecture of database (tool to be used), Using DDL, DML, DCL commands, Exploring select clause and its single row functions, group functions, Implement nested and co-related queries, Table Creation and alteration, Insert, Update and delete, Views

**CSP102- Principles of Computer Network Lab**
Introduction to computer network devices, Cabling and Connecting Computers through Cross cables, Introduction to Wire-shark, How to capture packets in Wire-shark, Subnetting –Class C, B and A, VLSM, Connecting Computers through Switches

**CSP104- Design and Analysis of Algorithms Lab**

Practical Implementation of Theoretical Concepts: divide & conquer, greedy method, Knapsack problem, dynamic programming, backtracking, branch & bound, B-trees, NP hard & NP complete problems, polynomial time approximation.

**CST101- Database Management Concepts**
Introduction to database and Characteristics of Data Base approach. Advantages and Disadvantages of DBMS approach. Introduction to Data Models: Hierarchical Model, Network Model, ER Model, Relational Model. Schemas, Instances, Schema architecture and Data Independence, three tier Architecture for DBMS, ER Model: Data base design process, Entity Types, Entity sets, Attributes, keys and their types, Weak entity types, ER diagrams, naming convention and design issues. Relational Algebra: Unary operation Relation, Relational Algebra Operations from Set Theory. Introduction to Normalization, their practical uses. Functional Dependencies (Full, Partial, Transitive, Multi-valued & Join Dependencies), SQL queries programming: The Forms of a Basic SQL Query, Null Values, Introduction to Concurrency Control Techniques. Two Phase Locking Techniques for Concurrency Control. Dealing with Deadlocks, Introduction to Database Recovery Techniques, Distributed Databases: Introduction to distributed databases, Advantages and Functions of distributed databases.

**CST102- Principles of Computer Networks**
Uses of computer networks, network hardware, network software, ISO-OSI architecture, TCP/IP reference model, physical layer, data link layer, network layer, transport layer, application layer, wireless WAN, routing protocols, network security.

**CST103- Introduction to Artificial Intelligence**

Problem Solving & Search, Problem Solving, Knowledge, Reasoning & Planning Expert Systems,

Reasoning with Uncertainty, Artificial Neural Networks.

**CST104- Design and Analysis of Algorithms**

Introduction, divide & conquer, greedy method, Knapsack problem, dynamic programming, backtracking, branch & bound, B-trees, NP hard & NP complete problems, polynomial time approximation.

**CST105- Computer System Organization and Architecture**

Evolution of computers, Von Neumann machine, Flynn's classification, basic computer organization, instruction codes, introduction to 8085 microprocessors, add, subtract, multiply algorithms, micro programmed control, central processing unit, input-output organization, DMA, IO interface, IOP, memory organization, virtual memory.

**CL501- Business Communication**

Personal Introduction, Give your strengths and weaknesses, Grooming session, Interview Skills, Personal Interview, Behavioral Interview, Panel Interview, Body Language, Formal dressing, Verbal Communication, Nonverbal communication, Social Etiquette (LinkedIn), Social Etiquette (Facebook), Office Etiquette (Virtual) Group Discussion on General Topic Group Discussion on Politics Listening Skills Email Writing Report Writing Preparing MOM Resume Writing cover letter and CV writing Preparing presentation. English in your country, job hunting, world of sport, discussing experiences, planning a trip, wedding bells, telephoning, catching up, around town, Dos and Don'ts, customer care, people are different, facts and figures, the workplace, Medicare.

**CS126 - Algorithm Design and Implementation**

Mathematical coding problems (Prime Factorization, GCD of two numbers, Distribute in circle), Basic Sorting Algorithms – Bubble sort, Insertion sort, Selection sort, Divide and Conquer algorithms - Quick Sort and Merge Sort, Searching (Linear and Binary), String Algorithms - String Algorithms (KMP, Manacher, Z-value Algorithm), Hash Table: Introduction to Hash Table, Collision, Open Addressing, Linear Probing, Separate Chaining, Heap and Priority Queues : Heap Sort, Priority Queues, Implement Priority Queue using Linked List, Find max/min in the continuous stream of data, Greedy Algorithms: Greedy Algorithms, Fractional Knapsack problem, Interval scheduling , Job Scheduling with deadlines, Dynamic Programming: Why Dynamic Programming, Memorization, Tabulation, Count number of ways to cover a distance, Minimum Cost Path to last element of matrix, Longest Common Subsequence (LCS), Binary Trees, Binary Search Trees: Introduction to Binary Search Trees, Traversals ( recursive& non recursive), Delete a Node.

**CS179 - Programming Abstractions**

C++ Fundamentals: Data types, Conditional Statements, Loops, Arrays, Pointers, Strings & 2-D Arrays in C++, Functions in C++: Inline functions, Default arguments, Function prototyping, Function Overloading, Pointers & Dynamic Memory Management, Asymptotic Notation (Big O), Recursion, Bitwise Operators, Classes and Objects, Constructors and Destructors, Operator Overloading and Type Conversion, Inheritance, Virtual base class, Overriding member functions, Virtual Functions and Polymorphism: Concept of Binding - Early binding and late binding, Virtual functions, Pure virtual functions, Abstract classes, Exception Handling, Templates and Generic Programming, Standard Template Library - Containers, Iterators and Algorithms. Vectors, Lists, Map, Single, Double and Circular linked list, Slow and Fast pointer technique, Dividing and Merging Linked Lists, Stacks implementation using Arrays, Linked Stacks, 2 stacks in a Array, k stacks in an array, tower of hanoi, Queues implementation using Arrays, Linked Queues, Circular Queues, Implement Queue using Stacks.

**CS192- Front-end Engineering**

Introduction to Web, Static and dynamic Pages, fast revision to html tags and their usages. Writing first javascript program and and intro to difference development tools, Loops, Arrays, Functions and its types. Objects, JSON, nested JSON, Local storage, DOM, Event Handling, Asynchronous programming, ES6, Classes and objects, React and its components, NPM, Hooks and its functions, Lifecycle.

**CS193- Back-end Engineering**

Introduction and setup of NodeJS, Express JS and middle wares, session handling, templating using

EJS, SQL and No SQL databases, introduction to AWS and IAM, AWS-EC2, RDS, Route 53, AWS S3, docker, elastic bean talk.

**CS254G- Professional Practices-System Design**

Process Management, Process Control Blocks, Process States. Process Control Block (PCB), Process Scheduling Queues. Schedulers, Threading, Memory management (types, fragmentation, paging, segmentation). Scheduling Algorithms pre-emptive and non-pre-emptive. Virtual memory, Demand Paging, page replacement algorithms. Swapping, Thrashing. File System (Types of file system, File system structure). Allocation methods, directory implementation file system vs DBMS. HLD (Decision Tables, Decision Trees, Flow Diagrams, Flow Charts, Data Dictionary), LLD. Case Studies, Scaling (Vertical and Horizontal Scaling) OSI Layers (physical layer). Data link layer, network layer. Transport layer, session layer, presentation layer, application layer. IP addressing. Types of IP address, Classes. SQL Commands, NoSQL (graph, Document, Column family) Practice Queries. Normalization, Indexing Tabular vs Columnar Data.

**GE101 - Numerical Ability and Logical Reasoning**

Vedic math and calculation tricks, Chain rule part 1, Chain rule part 2, Time and work part 1, Time and work part 2, Pipes and cisterns, Set Theory-definition and types of sets, Set theory problems., Venn diagram-operation on sets, clocks (part1), Clocks (part 2), Number series, Letter series, Factorials, Remainders, Unit digits, Simplification, Surds and indices, Formula based problems, Square and square roots, Ratio & Proportion, Mixtures & Allegation, Partnership, Ranking sequence, Time sequence, Averages, Weighted averages, Direction sense, Percentages - basics problems, Percentages –product consistency, Percentages – miscellaneous problems, Inserting missing character, Profit and loss- basic problems, Profit and loss- cheating problems and discount problems, Comparison of ranks, Classification Puzzles, Data tables, Pie chart, Bar graphs, Line graphs; HCF – LCM – definition and uses, Problems on HCF and LCM, number sequences, alpha numeric sequence, Quantitative Analysis, Sitting Arrangement, Sequence and series, Problems on logarithms, Time speed distance – problems on linear distances, Theorems on triangles, Circles and its theorems, Quadrilaterals, Problems on geometrical figures, Mensuration – area and perimeter, Mensuration.

**CS107- Object Oriented Software Engineering**

Software engineering concepts, software development life cycle, software process models, modeling with UML, project organization & communication, requirements elicitation, analysis & system design, object design & code, mapping models to code, testing, project management strategies, project estimation, project scheduling, risk management, quality management.

**CS258- Advanced Data Structures and Algorithms**

Two Pointers Introduction and Sliding Window, Two Pointers Introduction and Sliding Window, String Matching, Naive String-matching Algorithm, Rabin Karp Algorithm, KMP Algorithm, Recursion Advance Problems, OOPS Concepts, Advance hashing Techniques, Dynamic Programming: Matrix Chain Multiplication, Greedy Programming, Bitmasking, Number Theory, Chinese Remainder Theorem Implementation, Graphs, Tries.

**CS259- Advanced Front-end Engineering**

Javascript Basics, Arrays iterators, Objects, Dom Manipulation and dynamic nodes, Ajax, API, Functions, tuples, union, Enum, Union Intersection, Optional Chaining, Interfaces, Classes, Inheritance, Namespaces & Modules, React, Functional Components, Events, Class components, Smart vs Dumb components, List and keys, NPM and Router, Introduction to Hooks, Node lifecycle, Project based approach.

**CS260- Advanced Back-end Engineering**

Client server architecture, Nodejs, Request Handling, Modules, Exception handling, Express, Routing, Serve static files - Request lifecycle, Client state management, managing session, Node style async error handling , Authentication, Authorization, EJS to template, Live application with EJS, Login/Signup and dashboard, Databases, SQL, NoSQL, MongoDB, Connectivity, CRUD, Threads,

Loops, Socket Programming, JSON web token, Enhancing Node Performance, PM2 Installation and Configuration, Redis Introduction, Hashes, Cache key, Advance Mongo db- Query plan and execution and profiling, Indexes, Compound indexes and complex data handling, Ecommerce application backend in detail, Project.

### CS261- Introduction to Cloud Technology

Cloud Computing Basics – History of Cloud Computing, Characteristics, Need, Deployment, Services, Amazon Web Services, EC2, Amazon Machine Images (AMI's), Converting An Instance Store AMI To An EBS AMI, Cloud data lifecycle phases, cloud data storage types, Buckets and Objects, Glacier Storage Service, Describe Amazon Dynamo, Access Control Lists (ACLs), Setting Up VPC And Internet Gateway, Amazon Identity and Access Management (IAM), Dockers and Kubernetes, Introduction to Elastic Beanstalk, Backup technologies, Inter-country legal frameworks, Resource planning etc.

### CS262- SF Administrator

Navigate the Salesforce platform and its different building blocks, Understand the Security Model and Controls, Manage the data and workflow rules, Enable and configure the Chatter feeds on groups, Build an automated Business Process and models.

### CS263- SF Developer

Understanding Salesforce Architecture, Declarative vs. Programmatic Changes and Customizations, Application Development Tools in Salesforce, AppExchange as Application Development Strategy, Finding and Navigating Salesforce Documentation.

**CS183- Lab Oriented Project**

This course is aimed to describe hands-on instruction provided to students in an industrial setting in order to help them develop the necessary skills to become future professionals. It is an important component of the curriculum and is typically completed near the end of the course. Students practice on the different language and platform to prepare the project during this time to gain practical experience. It may involve imparting classroom instructions, hands-on training or a combination of both. The evaluation is based on the project, working abilities, report and presentation.

**CS253-Industry Oriented Hands-on Experience**

The course provides a wide scope of learning & understanding to give the student supervised opportunities to experience the essential practical tasks emphasized in their professional study and also to provide opportunities to apply their acquired skills and knowledge in working life. Students prepare a project to showcase their technical ability. Evaluation is done on the basis of their project report, presentation and viva. The students may also go abroad to complete this course in foreign Universities.

**CS251-Co-op project at Industry (Module-I)**

Among the objectives of the course is to expose students to the real world of work; expose students to the latest technologies as well the latest knowledge in the market; expose students to specific practices in their respective field of specialties; enhancing knowledge, skills. This course refers to the placement of students in an organization to conduct supervised practical training in the industry sector within the stipulated time before they are awarded a bachelor's degree. Evaluation is based on the Project and presentation in the viva.

**CS252-Co-Op Project at Industry (Module-II)**

This course of Industrial Training is to expose students to real work of environment experience and at the same time, to gain the knowledge through hands on observation and job execution. From the industrial training, the students will also develop skills in work ethics, communication, management and others. Student needs to prepare a report about their learning during the internship period. Evaluation is based on the assessment by the employer, Project and presentation in the viva.

### 23SM001-Business Modular Integrated Development Environment

Teamcenter User Level, Integration for NX Users, Teamcenter PLM Overview, NX data structure and management, Rich Client Interface, Teamcenter capabilities in NX, Data Objects and Views, Active Workspace overview and functionality, Access Management, NX data creation, storage, access, and

revising, Product Structure Create, View, Configure, Exporting and importing data, Classification Overview, sharing data and working in a shared environment. Workflow Viewer Monitoring Process, creating part families, Working with JT data.

**23SM002-Fundamentals of Teamcenter**
Teamcenter Architecture Overview, Teamcenter Directories, Organization, Business Modular IDE Overview, List Of Values and Types, Business Modeling, Queries and Reports, Access Manager, Project Creation and Administration, Workflow Process Modeling, Classification Administration, Utilities and their Purpose.

**23SM003-Active Workspace in Project Management**
Visual Studio environment setup, Eclipse environment setup, ITK framework, BMIDE data model customization, Teamcenter Services, Rich Client customization, Active workspace Overview, Understanding User Interface, Active Workspace and four tier Architecture, Active Workspace Installation, Active Workspace Configuration.

**23SN001-ServiceNow Administrative Fundamentals**
Introduction to ServiceNow, The Modern Work Experience, Explore the Power of the ServiceNow Platform, Configure Applications for Business, Configure Self Service, Enable Productvity, Manage and Instance, Manage Data, Package Enhancements for Testing, Capstone Project, Introduction to Scripting in ServiceNow, UI Policies.

**23SN002-Application Developer Fundamentals**
Application Developer Overview, Create Application Modules, Work with Application Forms, Control Access, Automate Work, Import and Integrate External Data, Flow Designer Introduction, Flow Designer: Create a Flow, Flow Designer Create Subslows and Actions, Flow Designer Micro-Certification Assessment, UI Builder Fundamentals, Application Developer User Interface.

**23ST001-JAVA for Software Testing**
Software Development Life Cycle (SDLC), Introduction to Software Testing, White Box Testing, Black Box Testing, Functionality Testing, Integration Testing, Introduction to Test case, Test case Design Techniques, Introduction to defects, Software Test Life Cycle (STLC), Introduction to Applications, JDBC and Servlet, XML.

**23ST002-Software Development Engineering in Testing**
Programming Language, Platform and its types, JDK installation, Structure of Java program, Objects, non-static and non-static members, Exception and Exception Handling, Selenium Introduction, Selenium architecture, Web driver hierarchy, Introduction to writing scripts, Selenium Framework, AI Based Scriptless Automation tool.

**23SF001-Database and Schema Applications**
Basics Of Programming, Introduction to Visualforce, Routing to a different page (PageReference), Different RealTime VisualForce Page Scenarios, Controllers - Standard/Custom/Extensions, Introduction to Apex Class, SOQL - Salesforce Object Query Language, Email Services, Triggers, Salesforce Annotations, Apex Sharing Rules, Test Classes, Schema Programming.

**23SF002-Automate Business Processes**
Basics of Cloud Computing, Introduction to CRM and SalesForce, Production vs Sandbox, Types of Sandboxes Brief about Appexchange, Architecture, Salesforce User Account Creation, Queues vs Public Groups, Objects & Fields - Standard & Custom, Relationships - Lookup, Master-Detail, Workflow Rules - Email templates, Single-Sign-On, Deployment Activities - change sets, external (visual studio code, workbench).

**23SF003-Designing Advanced User Interface Components**

An overview of the user interface, User interface design principles, Characteristics of Graphical User Interface, Graphical User Interface (GUI), Web User Interface (WUI) Voice User Interfaces (VUI), Tangible User Interfaces (TUI), Ubiquitous User Interfaces (UUI), Prototyping user interfaces, Introduction to Lightning Experience, How to enable lightning, Explain Lightning Pages, Set up the development environment, Installing VS code, Installing Salesforce CLI, Understanding LWC Architecture, LWC Fundamentals - HTML Template, JS, Overview of J2S and Super Badges for LWC.

**23AI001-Business problems with AI and Machine Learning**

Identify Data-Driven Emerging Technologies Module Introduction, The Data Hierarchy, Big Data, Data Mining, Applied AI and ML in Business, Appropriate Business Problems, Challenges of AI/ML, Machine Learning Model, Machine Learning Workflow Useful Skillsets, Concept Drift and Transfer Learning, Problem Formulation, Differences Between Traditional Programming and Machine Learning.

**23AI002-Applied Artificial Intelligence**

Decision Tree, Classification and Regression Tree (CART), Gini Index Example, CART Hyperparameters, Pruning, C4, Bin Determination, One-Hot Encoding, Decision Trees Compared to Other Algorithms, Ensemble Learning, Random Forest, Random Forest Hyperparameters, Decision Tree Algorithm Comparison, Guidelines for Building a Decision Tree Model, Guidelines for Building a Random Forest Model, Building Decision Trees and Random Forests, Support-Vector Machines (SVM), Artificial Neural Network (ANN).

**23AI003-Build Regression, Classification, and Clustering Models**

Linear Regression, Linear Equation, Straight Line Fit to Data Example, Linear Regression in Machine Learning, Matrices in Linear Regression, Normal Equation, Advanced Linear Models, Cost Function, MSE and MAE, Coefficient of Determination, Normal Equation Shortcomings, Building Linear Regression Models Using Linear Algebra, Regularization Techniques, Ridge Regression, Lasso Regression, Elastic Net Regression.

**23AI004-Build Decision Trees, SVMs, and ANN**

Decision Tree, Classification and Regression Tree (CART), Gini Index Example, CART Hyperparameters, Pruning, C4, Bin Determination, One-Hot Encoding, Decision Trees Compared to Other Algorithms, Ensemble Learning, Random Forest, Random Forest Hyperparameters, Decision Tree Algorithm Comparison, Guidelines for Building a Decision Tree Model, Guidelines for Building a Random Forest Model, Building Decision Trees and Random Forests, Support-Vector Machines (SVM), Artificial Neural Network (ANN).

**23ML001-Fundamentals of Machine Learning**

Introduction to Machine Learning, Data Preprocessing, Introduction to Python, Control Structures, Functions, Data Structures, Introduction to Libraries and Modules, Introduction to Libraries and Modules, Supervised Learning, Unsupervised Learning, Model Selection and Evaluation, Deep Learning. Introduction to Regression Analysis, Simple Linear Regression, Multiple Linear Regression, Polynomial Regression, Logistic Regression, Multiple Regression, Ridge Regression, 1-N Regression, Real-World Applications.

**23ML002- Advanced Machine Learning**

Introduction to Regression Analysis, Simple Linear Regression, Multiple Linear Regression, Polynomial Regression, Logistic Regression, Multiple Regression, Ridge Regression, 1-N Regression, Real-World Applications.

**23ML003-Machine Learning: Classification**

Introduction to Machine Learning Classification, Data Preprocessing, Imbalanced Data and Sampling

Techniques, Anomaly Detection and Outlier Handling, Logistic Regression, Decision Trees and Random Forests, Support Vector Machines (SVM), K-Nearest Neighbors (K-NN), Naive Bayes Classification, Ensemble Methods, Neural Networks for Classification, Model Evaluation Metrics, Decision Boundary and Margin, Text Classification, Image Classification, Time Series Classification, Image and Video Classification, Customer Churn Prediction.

**23ML004-Machine Learning: Clustering & Retrieval**

Introduction to Machine Learning Clustering and retrieval, Types of Data in Clustering and retrieval, Evaluation Metrics in Clustering & Retrieval, Dimensionality Reduction Techniques, -Means Clustering, Hierarchical Clustering, Density-Based Clustering (DBSCAN), Gaussian Mixture Models (GMM), Clustering for Text Data, Introduction to Information Retrieval, Retrieval Models and Ranking, Query Expansion and Relevance Feedback, Web Search and PageRank, Spectral Clustering, Latent Dirichlet Allocation (LDA), Neural Network Embeddings, Graph-Based Retrieval, Image Clustering and Object Detection, Text Classification and Clustering in NLP.

**23DS001-Python for Data Science**

Intro to Excel, Introduction to SQL, Introduction to Python, Python Collection Objects, Introduction to Numpy, Introduction to Pandas, Arithmetic Operations, Series Ranking and Sorting, Pandas Dataframe, Reading Data from Various Files, Understanding Data, Dataframe Operations, Visualization using Matplotlib, Summary Statistics, Advanced Data Explorations.

**23DS002-Statistics & Probability for Data Science**

Introduction to Statistics, Random Variables, Descriptive Statistics, Probability, Probability Basics using Python, Probability Distributions, Probability Distributions using python, Introduction to Hypothesis Testing, ANOVA Hypothesis, Post Hoc Test, Chi-Square Test, Chi-Square Test Steps, Chi-Square Example.

**23DS003-Machine Learning**

Introduction to Machine Learning, Machine Learning Modelling Flow, Parametric and Non-parametric Algorithms, Types of Machine Learning, Introduction of Linear Regression, Types of Linear Regression, Intro to Logistic Regression, Maximum Likelihood Estimation, Introduction to Decision Tree, Greedy Algorithm, Decision Tree: Regression, Introduction to Random Forests, Random Forest, Clustering, Hierarchical Clustering, Introduction to PCA, Introduction to Tableau, Visual Data Analytics, Ensemble Techniques, Neural Network, Intro to OpenCV, Introduction to the NLTK Library, Recurrent Neural Network.

**23BK001-Fundamentals of Blockchain**

Introduction to Blockchain, Blockchain Architecture, Consensus Mechanisms, Cryptography in Blockchain, Smart Contracts, Ethereum and Solidity, Security in Blockchain, Privacy in Blockchain, Scalability and Performance, Interoperability, Blockchain and IoT, Legal and Regulatory Aspects, Blockchain and Cryptocurrency.

**23BK002-Blockchain: Tools and Technologies**

Introduction to Blockchain, Setting Up Blockchain Development Environment, Smart Contract Development, Ethereum Development Stack, Interacting with Smart Contracts, Decentralized Finance (DeFi) Tools, Non-Fungible Tokens (NFTs), Decentralized Identity and Self-Sovereign Identity (SSI), Blockchain Oracles and Real-World Data, Blockchain Security Tools, Privacy and Confidentiality Solutions, Scaling Solutions and Layer 2, Hyperledger Frameworks, Corda for Business Use Cases, Integrating Blockchain with Legacy Systems, Cryptocurrency Wallets and Management, Cross-Chain Compatibility, Blockchain Governance Models, Blockchain in Supply Chain Management.

**23BK003-Ethereum and Solidity**

Introduction to Blockchain Technology, Understanding Ethereum, Ethereum Development Environment Setup, Ethereum Transactions and Gas, Ethereum Transactions and Gas, Introduction to Solidity, Ethereum Smart Contracts, Building Decentralized Applications (DApps) , Solidity Advanced Concepts, Testing and Debugging Smart Contracts, Security Best Practices for Smart Contracts, Ethereum Development Frameworks, Introduction to Decentralized Finance (DeFi), Non-Fungible Tokens (NFTs), Ethereum 2.0 and Proof of Stake (PoS), Scaling Solutions for Ethereum, Governance and Upgrades in Ethereum, Emerging Trends in Ethereum, Decentralized Identity and Self-Sovereign Identity (SSI).

**23CY001-Information Security**

Information Security, Goals of Information Security, Security is not just Vulnerability Assessment and Penetration Testing (VAPT), Security Models, Data Base Security, Physical and Environmental Security, Career in information Security, Information Security Jargons, Internet of Things Hacking: Technologies and Protocols, Cloud Security: Basics, Challenges and Application, Network Security, Network Security Overview, IPsec, Virtual private network (VPN), Domain Name System Security Extensions (DNSSEC), Wireless Security, wired equivalent privacy (WEP), Secure Development and Deployment, Blockchain Security, Cryptography Concepts & Techniques:, Symmetric and Asymmetric Key Cryptography, Steganography, Data Integrity Algorithms.

**23CY002-Threat and Risk Analysis for Cyber Security**

Cyber Security Risk Analysis: Conduct a risk assessment survey, Types of Risk Analysis, Identify and analyse the risk, Developing and implementing a risk management plan, Classification of Cybercrimes: Common cybercrimes, Computer as a Weapon and target, Cybercrime against individual or organization: Cybercrime against women, children, organisation, Financial Frauds, Building a Cyber Security Lab: Identifying and downloading appropriate open-source operating systems, extensions, virtual machines, and stimulators, Network Setting, VPAT: Process, Assessment Tools, NMAP, Nessus, Exploitation: Tools and Techniques; Reporting: Technique and Importance.

**23CY003-IT Governance**

Intellectual Property Rights, Secrets, Intellectual Property and Digital Age, Intellectual Property Management and Ethical considerations, National Cyber Security Policy; ISO 27001, Other Audit Standards: CoBit , PCI DSS; Business Continuity Planning: Project management, Business impact analysis, Recovery strategies, E commerce, Digital Payments and related frauds; Social Networks, Social media activity and privacy, Access Control: Security/Emerging issues in Access Control, DAC, MAC, RBAC, Defining Cyber space: Computer and web technology, Communication and Web technology, Internet, Regulation of cyber space.

**CS267-Quantitative Aptitude and Reasoning**

Revision of concepts of number system, average, HCG and LCM. Understanding of blood relation, simplification, remainder theorem, Analogy, ratio and proportion, problem based on ages, Allegation, Syllogism, Percentage, Coding-Decoding. Practice problems on simple interest, compound interest, profit and loss, series, time, and work. Problems on mixed proportion, time sequence, time, speed and distance, permutation and combination, probability, area calculation, volume, triangle, critical thinking.

**PD040-Life Skills and Business Communication**

Ice breaking session, SWOT analysis, Communication skills, verbal and non-verbal, Presentation skills, speeches, personality development skills, work etiquettes, ethics, time management, Team building, Group discussion, presenting on self, cracking interviews, case studies, interview preparation.