Preamble

The National Education Policy (NEP) 2020 conceives a new vision for India's higher education system. It recognizes that higher education plays an extremely important role in promoting equity, human and societal well-being, and development of India as envisioned in its Constitution. Higher education should significantly contribute tor sustainable livelihoods and economic development of the nation as India moves towards becoming a knowledge economy and society.

Towards the attainment of holistic and multidisciplinary education, the flexible curricula of the University will include credit-based courses, projects in the areas of community engagement and service, environmental education, and value-based education. As part of holistic education, students will also be provided with opportunities for internships with local industries, businesses, artists, crafts persons, and so on, as well as research internships with faculty and researchers at the University, so that students may actively engage with the practical aspects of their learning and thereby improve their employability.

At The Assam RGU, we are committed that at the societal level, higher education will enable each student to develop themselves to be an enlightened, socially conscious, knowledgeable, and skilled citizen who can find and implement robust solutions to its own problems. For the students at the University, Higher education is expected to form the basis for knowledge creation and innovation, thereby contributing to a more vibrant, socially engaged, cooperative community leading towards a happier, cohesive, cultured, productive, innovative, progressive, and prosperous nation."

The Bachelor of Computer Applications (BCA) program, designed in alignment with the National Education Policy (NEP) 2020, aims to provide a comprehensive curriculum that emphasizes the development of both theoretical knowledge and practical skills in the field of computer applications. The program is structured to foster critical thinking, problem-solving capabilities, and an entrepreneurial mindset among students. Embracing the holistic and multidisciplinary approach of NEP 2020, the BCA curriculum integrates core computer science courses with interdisciplinary studies and soft skills training, ensuring students are well-prepared to adapt and innovate in the rapidly evolving digital landscape. Additionally, the program offers flexibility in course choices and durations, encouraging students to pursue internships and projects that align with their career goals and interests, ultimately molding them into skilled professionals ready to meet the challenges of the global IT industry.

Section 1:

Overview

1. 1. Introduction:

1.1.1 About NEP 2020

The National Education Policy (NEP) 2020 clearly indicates that higher education plays an extremely important role in promoting human as well as societal well-being in India. As envisioned in the 21st-century requirements, quality higher education must aim to develop good, thoughtful, well-rounded, and creative individuals. According to the new education policy, assessments of educational approaches in undergraduate education will integrate the humanities and arts with Science, Technology, Engineering and Mathematics (STEM) that will lead to positive learning outcomes. This will lead to develop creativity and innovation, critical thinking and higher-order thinking capacities, problem-solving abilities, teamwork, communication skills, more in-depth learning, and mastery of curricula across fields, increases in social and moral awareness, etc., besides general engagement and enjoyment of learning. and more in-depth learning.

The NEP highlights that the following fundamental principles that have a direct bearing on the curricula would guide the education system at large, viz.

i. Recognizing, identifying, and fostering the unique capabilities of each student to promote her/his holistic development.
ii. Flexibility, so that learners can select their learning trajectories and programmes, and thereby choose their own paths in life according to their talents and interests.
iii. Emphasis on conceptual understanding rather than rote learning, critical thinking to encourage logical decision-making and innovation; ethics and human & constitutional values, and life skills such as communication, teamwork, leadership, and resilience.
iv. Extensive use of technology in teaching and learning, removing language barriers, increasing access for Divyang students, and educational planning and management.
v. Respect for diversity and respect for the local context in all curricula, pedagogy, and policy.
vi. Equity and inclusion as the cornerstone of all educational decisions to ensure that all students can thrive in the education system and the institutional environment are responsive to differences to ensure that high-quality education is available for all.

1.1.2 About the BCA Course:

The Bachelor of Computer Applications (BCA) program, structured according to the National Education Policy (NEP) 2020, aims to equip students with a deep understanding of computer applications alongside a broad interdisciplinary educational foundation. This updated curriculum is designed to enhance analytical thinking, algorithmic skills, and software development capabilities while integrating insights from data science, artificial intelligence, and systems design. Embracing the NEP's flexible and student-centric approach, the BCA program allows learners to choose from a wide array of elective subjects, which not only expands their technical prowess but also hones their entrepreneurial and innovative thinking skills.

Furthermore, the BCA under NEP 2020 emphasizes the development of key soft skills such as communication, teamwork, and problem-solving, which are vital in today's collaborative and dynamic work environments. The inclusion of mandatory internship opportunities and project work in the curriculum ensures that students can apply their theoretical knowledge in real-world settings, bridging the gap between academic learning and professional requirements. This hands-on experience is critical in preparing graduates for the technological challenges of the future, making them valuable assets in a global and highly competitive job market.

1.1.3 Vision

To cultivate globally competent information technology professionals through integrated educational experiences and diverse cultural exposure, preparing graduates to excel in a dynamic international environment.

1.1.4 Mission

- To foster academic excellence in the field of information technology through cutting-edge, research-driven, and industry-relevant education
- To instil ethical conduct and compassion through active community engagement.
- To develop responsible leaders who are poised to drive positive change and shape the future of technology and society.

1.2. Credits in Indian Context:

1.2.1. Choice Based Credit System (CBCS)

Under the CBCS system, the requirement for awarding a degree or diploma or certificate is prescribed in terms of the number of credits to be earned by the students. This framework is being implemented in several universities across States in India. The main highlights of CBCS are as below:

- The CBCS provides flexibility in designing curriculum and assigning credits based on the course content and learning hours.
- The CBCS provides for a system wherein students can take courses of their choice, learn at their own pace, undergo additional courses and acquire more than the required credits, and adopt an interdisciplinary approach to learning.
- CBCS also provides opportunity for vertical mobility to students from a bachelor's degree programme to masters and research degree programmes.

1.3. Definitions

1.3.1. Academic Credit:

An academic credit is a unit by which a course is weighted. It is fixed by the number of hours of instructions offered per week. As per the National Credit Framework:

1 Credit = 30 NOTIONAL CREDIT HOURS (NCH)

Yearly Learning Hours = 1200 Notional Hours (@40 Credits x 30 NCH)

30 Notional Credit Hours		
Lecture/Tutorial	**Practicum**	**Experiential Learning**
1 Credit = 15 -22 Lecture Hours	10-15 Practicum Hours	0-8 Experiential Learning Hours

1 Hr. Lecture (L) per week 1 credit	1 credit
1 Hr. Tutorial (T) per week	1 credit
1 Hr. Practical (P) per week	0.5 credits
2 Hours Practical (Lab) per week	1 credit

1.3.2. Course of Study:

Course of study indicate pursuance of study in a particular discipline/programme. Discipline/Programmes shall offer Major Courses (Core), Minor Courses, Skill Enhancement Courses (SEC), Value Added Courses (VAC), Ability Enhancement Compulsory Courses (AECCs) and Interdisciplinary courses.

1.3.3. Disciplinary Major:

The major would provide the opportunity for a student to pursue in-depth study of a particular subject or discipline. Students may be allowed to change major within the broad discipline at the end of the second semester by giving her/him sufficient time to explore interdisciplinary courses during the first year. Advanced-level disciplinary/interdisciplinary courses, a course in research methodology, and a project/dissertation will be conducted in the seventh semester. The final semester will be devoted to seminar presentation, preparation, and submission of project report/dissertation. The project work/dissertation will be on a topic in the disciplinary programme of study or an interdisciplinary topic.

1.3.4. Disciplinary/interdisciplinary minors:

Students will have the option to choose courses from disciplinary/interdisciplinary minors and skill-based courses. Students who take a sufficient number of courses in a discipline or an interdisciplinary area of study other than the chosen major will qualify for a minor in that discipline or in the chosen interdisciplinary area of study. A student may declare the choice of the minor at the end of the second semester, after exploring various courses.

1.3.5. Courses from Other Disciplines (Interdisciplinary):

All UG students are required to undergo 3 introductory-level courses relating to any of the broad disciplines given below. These courses are intended to broaden the intellectual experience and form part of liberal arts and science education. Students are not allowed to choose or repeat courses already undergone at the higher secondary level (12^{th} class) in the proposed major and minor stream under this category.

i. Natural and Physical Sciences: Students can choose basic courses from disciplines such as Natural Science, for example, Biology, Botany, Zoology, Biotechnology, Biochemistry, Chemistry, Physics, Biophysics, Astronomy and Astrophysics, Earth and Environmental Sciences, etc.

ii. Mathematics, Statistics, and Computer Applications: Courses under this category will facilitate the students to use and apply tools and techniques in their major and minor disciplines. The course may include training in programming software like Python among others and applications software like STATA, SPSS, Tally, etc. Basic courses under this category will be helpful for science and social science in data analysis and the application

of quantitative tools.

iii. Library, Information, and Media Sciences: Courses from this category will help the students to understand the recent developments in information and media science (journalism, mass media, and communication)

iv. Commerce and Management: Courses include business management, accountancy, finance, financial institutions, fintech, etc.,

v. Humanities and Social Sciences: The courses relating to Social Sciences, for example, Anthropology, Communication and Media, Economics, History, Linguistics, Political Science, Psychology, Social Work, Sociology, etc. will enable students to understand the individuals and their social behaviour, society, and nation. Students be introduced to survey methodology and available large-scale databases for India. The courses under humanities include, for example, Archaeology, History, Comparative Literature, Arts & Creative expressions, Creative Writing and Literature, language(s), Philosophy, etc., and interdisciplinary courses relating to humanities. The list of Courses can include interdisciplinary subjects such as Cognitive Science, Environmental Science, Gender Studies, Global Environment & Health, International Relations, Political Economy and Development, Sustainable Development, Women's, and Gender Studies, etc. will be useful to understand society.

1.3.6. Ability Enhancement Courses (AEC):

Modern Indian Language (MIL) & English language focused on language and communication skills. Students are required to achieve competency in a Modern Indian Language (MIL) and in the English language with special emphasis on language and communication skills. The courses aim at enabling the students to acquire and demonstrate the core linguistic skills, including critical reading and expository and academic writing skills, that help students articulate their arguments and present their thinking clearly and coherently and recognize the importance of language as a mediator of knowledge and identity. They would also enable students to acquaint themselves with the cultural and intellectual heritage of the chosen MIL and English language, as well as to provide a reflective understanding of the structure and complexity of the language/literature related to both the MIL and English language. The courses will also emphasize the development and enhancement of skills such as communication, and the ability to participate/conduct discussion and debate.

1.3.7. Skill Enhancement Course (SEC):

These courses are aimed at imparting practical skills, hands-on training, soft skills, etc., to enhance the employability of students and should be related to Major Discipline. They will aim

at providing hands- on training, competencies, proficiency, and skill to students. SEC course will be a basket course to provide skill-based instruction. For example, SEC of English Discipline may include Public Speaking, Translation & Editing and Content writing. A student shall have the choice to choose from a list, a defined track of courses offered from 1st to 3rd semester.

1.3.8. Value-Added Courses (VAC):

i. Understanding India: The course aims at enabling the students to acquire and demonstrate the knowledge and understanding of contemporary India with its historical perspective, the basic framework of the goals and policies of national development, and the constitutional obligations with special emphasis on constitutional values and fundamental rights and duties. The course would also focus on developing an understanding among student-teachers of the Indian knowledge systems, the Indian education system, and the roles and obligations of teachers to the nation in general and to the school/community/society. The course will attempt to deepen knowledge about and understanding of India's freedom struggle and of the values and ideals that it represented to develop an appreciation of the contributions made by people of all sections and regions of the

country, and help learners understand and cherish the values enshrined in the Indian Constitution and to prepare them for their roles and responsibilities as effective citizens of a democratic society.

ii. Environmental science/education: The course seeks to equip students with the ability to apply the acquired knowledge, skills, attitudes, and values required to take appropriate actions for mitigating the effects of environmental degradation, climate change, and pollution, effective waste management, conservation of biological diversity, management of biological resources, forest and wildlife conservation, and sustainable development and living. The course willalso deepen the knowledge and understanding of India's environment in its totality, its interactive processes, and its effects on the future quality of people's lives.

iii. Digital and technological solutions: Courses in cutting-edge areas that are fast gaining prominences, such as Artificial Intelligence (AI), 3-D machining, big data analysis, machine learning, drone technologies, and Deep learning with important applications to health, environment, and sustainable living that will be woven into undergraduate education for enhancing the employability of the youth.

iv. Health & Wellness, Yoga education, sports, and fitness: Course components relating to health and wellness seek to promote an optimal state of physical, emotional, intellectual, social, spiritual, and environmental well-being of a person. Sports and fitness

activities will be organized outside the regular institutional working hours. Yoga education would focus on preparing the students physically and mentally for the integration of their physical, mental, and spiritual faculties, and equipping them with basic knowledge about one's personality, maintaining self-discipline and self-control, to learn to handle oneself well in all life situations. The focus of sports and fitness components of the courses will be on the improvement of physical fitness including the improvement of various components of physical and skills-related fitness like strength, speed, coordination, endurance, and flexibility; acquisition of sports skills including motor skills as well as basic movement skills relevant to a particular sport; improvement of tactical abilities; and improvement of mental abilities.

These are a common pool of courses offered by different disciplines and aimed towards embedding ethical, cultural and constitutional values; promote critical thinking. Indian knowledge systems; scientific temperament of students.

1.3.9. Summer Internship /Apprenticeship:

The intention of inducting Internship or Apprenticeship into curriculum to familiarize student into actual work situations**.** All students must undergo internships / Apprenticeships in a firm, industry, or organization or Training in labs with faculty and researchers in their own or other HEIs/research institutions during the***summer term***. Students should take up opportunities for internships with local industry, business organizations, health and allied areas, local governments (such as panchayats, municipalities), Parliament or elected representatives, media organizations,artists, crafts persons, and a wide variety of organizations so that students may actively engage with the practical side of their learning and, as a by-product, further improve their employability. Students who wish to exit after the first two semesters will undergo a 4-credit work-based learning/internship during the summer term to get a UG Certificate.

1.3.9.1. Community engagement and service: The curricular component of 'community engagement and service' seeks to expose students to the socio- economic issues in society so that the theoretical learnings can be supplemented by actual life experiences to generate solutions to real-life problems. This can be part of summer term activity or part of a major or minor course depending upon the major discipline.

Field-based learning/minor project: The field-based learning/minor project will attempt to provide opportunities for students to understand the different socio-economic contexts. It will aim at giving students exposure to development-related issues in rural and urban settings. It will provide opportunities for students to observe situations in rural and urban contexts, and to observe and study actual field situations regarding issues related to socioeconomic development. Students will be given opportunities to gain

a first- hand understanding of the policies, regulations, organizational structures, processes, and programmes that guide the development process. They would have the opportunity to gain an understanding of the complex socio-economic problems in the community, and innovative practices required to generate solutions to the identified problems. This may be a summer term project or part of a major or minor course depending on study.

1.3.10.Indian Knowledge System:

In view of the importance accorded in the NEP 2020 to rooting our curricula and pedagogy in the Indian context all the students who are enrolled in the four-year UG programmes should be encouraged to take an adequate number of courses in IKS so that the ***total credits of the courses taken in IKS amount to at least five per cent of the total mandated credits*** *(i.e. min. 8 credits for a 4 yr. UGP & 6 credits for a 3 yr. UGP).* The students may be encouraged to take these courses, preferably *during the first four semesters of the UG programme*. At least half of these mandated credits should be in courses in disciplines which are part of IKS and are related to the major field of specialization that the student is pursuing in the UG programme. They will be included as a part of the total mandated credits that the student is expected to take in the major field of specialization. The rest of the mandated credits in IKS can be included as a part of the mandated Multidisciplinary courses that are to be taken by every student. All the students should take a Foundational Course in Indian Knowledge System, which is designed to present an overall introduction to all the streams of IKS relevant to the UG programme. The foundational IKS course should be broad-based and cover introductory material on all aspects.

Wherever possible, the students may be encouraged to choose a suitable topic related to IKS for their project work in the 7/8th semesters of the UG programme.

(Note: Refer "Guidelines for Incorporating Indian Knowledge in Higher Education Curricula", University Grants Commission, March 2023 for further details)

1.3.11. Experiential Learning:

One of the most unique, practical & beneficial features of the National Credit Framework is assignment of credits/credit points/ weightage to the experiential learning including relevant experience and professional levels acquired/ proficiency/ professional levels of a learner/student. Experiential learning is of two types:

a. ***Experiential learning as part of the curricular structure*** of academic or vocational program. E.g., projects/OJT/internship/industrial attachments etc. This could be either within the Program- internship/ summer project undertaken relevant to the program

being studied or as a part time employment (not relevant to the program being studied-up to certain NSQF level only). In the case where experiential learning is a part of the curricular structure the credits would be calculated and assigned as per basic principles of NCrF i.e., 40 credits for 1200 hours of notional learning.

b. Experiential learning as active employment (both wage and self) post completion of an academic or vocational program. This means that the experience attained by a person after undergoing a particular educational program shall be considered for assignment of credits. This could be either Full or Part time employment after undertaking an academic/ Vocation program.

In case where experiential learning is as a part of employment the learner would earn credits as weightage. The maximum credit points earned in this case shall be double of the credit points earned with respect to the qualification/ course completed. The credit earned and assigned by virtue of relevant experience would enable learners to progress in their career through the work hours put in during a job/employment

1.3.12. MOOCS

In accordance with the academic guidelines of the university and UGC recommendations, students are required to **enroll in one MOOC (Massive Open Online Course)** offered through **SWAYAM** or other recognized platforms **in each semester**.

- This course is assigned **2 credits per semester**.
- The course must be **approved by the departmental coordinator** prior to enrollment.
- On successful completion, the student must **submit the course completion certificate** to the department for credit transfer and grade entry

Section 2

Award of Degree

The structure and duration of undergraduate programmes of study offered by the University as per NEP 2020 include:

2.1.1. Undergraduate programmes of either 3 or 4-year duration with Single Major, with multiple entry and exit options, with appropriate certifications:

2.1.2. UG Certificate: Students who opt to exit after completion of the first year and have secured 40 credits will be awarded a UG certificate if, in addition, they complete one vocational course of 4 credits during the summer vacation of the first year. These students are allowed to re-enter the degree programme within three years and complete the degree programme within the stipulated maximum period of seven years.

2.1.3. UG Diploma: Students who opt to exit after completion of the second year and have secured 80 credits will be awarded the UG diploma if, in addition, they complete one vocational course of 4 credits during the summer vacation of the second year. These students are allowed to re-enter within a period of three years and complete the degree programme within the maximum period of seven years.

2.1.4. 3-year UG Degree: Students who will undergo a 3-year UG programme will be awarded UG Degree in the Major discipline after successful completion of three years, securing 120 credits and satisfying the minimum credit requirement.

2.1.5. 4-year UG Degree (Honours): A four-year UG Honours degree in the major discipline will be awarded to those who complete a four-year degree programme with 160 credits and have satisfied the credit requirements as given in Table 6 in Section 5.

2.1.6. 4-year UG Degree (Honours with Research): Students who secure 75% marks and above in the first six semesters and wish to undertake research at the undergraduate level can choose a research stream in the fourth year. They should do a research project or dissertation under the guidance of a Faculty Member of the University. The research project/dissertation will be in the major discipline. The students who secure 160 credits, including 12 credits from a research project/dissertation, will be awarded UG Degree (Honours with Research).

2.1.7. (Note: ***UG Degree Programmes with Single Major:*** A student must secure a minimum of 50% credits from the major discipline for the 3-year/4-year UG degree to be awarded a single major. For example, in a 3-year UG programme, if the total number of credits to be earned is 120, a student of Mathematics with a minimum of 60 credits will be awarded a B.Sc. in Mathematics with a single major. Similarly, in a 4-year UG programme, if the total number of credits to be earned is 160, a student of Chemistry with a minimum of 80

credits will be awarded a B.Sc. (Hons./Hon. With Research) in Chemistry in a 4-year UG programme with single major. Also the **4-year Bachelor's degree programme with Single Major** is considered as the preferred option since it would allow the opportunity to experience the full range of holistic and multidisciplinary education in addition to a focus on the chosen major and minors as per the choices of the student.)

Table: 1: Award of Degree and Credit Structure with ME-ME

Award	**Year**	**Credits to earn**	**Additional Credits**	**Re-entry allowed within (yrs)**	**Years to Complete**
UG Certificate	1	40	4	3	7
UG Diploma	2	80	4	3	7
3-year UG Degree (Major)	3	120	x	X	x
4-year UG Degree (Honours)	4	160	x	X	x
4-year UG Degree (Honors with Research):	4	160	Students who secure cumulative 75% marks and above in the first sixsemesters		

Section 3

Credit, Credit Points & Credit hours for different types of courses

3.1. Introduction:

'Credit' is recognition that a learner has completed a prior course of learning, corresponding to a qualification at a given level. For each such prior qualification, the student would have put in a certain volume of institutional or workplace learning, and the more complex a qualification, the greater the volume of learning that would have gone into it. Credits quantify learning outcomes that are subject achieving the prescribed learning outcomes to valid, reliable methods of assessment.

The ***credit points*** will give the learners, employers, and institutions a mechanism for describing and comparing the learning outcomes achieved. The credit points can be calculated as credits attained multiplied with the credit level.

The workload relating to a course is measured in terms of credit hours. A credit is a unit by which the coursework is measured. It determines the number of hours of instruction required per week over the duration of a semester (minimum 15 weeks). Each course may have only a lecture component or a lecture and tutorial component or a lecture and practicum component or a lecture, tutorial, and practicum component, or only practicum component.

A course can have a combination of ***lecture credits, tutorial credits, practicum credits and experiential learning credits.*** The following types of courses/activities constitute the programmes of study. Each of them will require a specific number of hours of teaching/guidance and laboratory/studio/workshop activities, field-based learning/projects, internships, and community engagement and service.

- **Lecture courses:** Courses involving lectures relating to a field or discipline by an expert or qualified personnel in a field of learning, work/vocation, or professional practice.
- **Tutorial courses:** Courses involving problem-solving and discussions relating to a field or discipline under the guidance of qualified personnel in a field of learning, work/vocation, or professional practice. Should also refer to the Remedial Classes, flip classrooms and focus on both Slow and Fast Learners of the class according to their merit.

- **Practicum or Laboratory work:** A course requiring students to participate in a project or practical or lab activity that applies previously learned/studied principles/theory related to the chosen field of learning, work/vocation, or professional practice under the supervision of an expert or qualified individual in the field of learning, work/vocation or professional practice.
- **Seminar:** A course requiring students to participate in structured discussion/conversation or debate focused on assigned tasks/readings, current or historical events, or shared experiences guided or led by an expert or qualified personnel in a field of learning, work/vocation, or professional practice.
- **Internship:** A course requiring students to participate in a professional activity or work experience, or cooperative education activity with an entity external to the education institution, normally under the supervision of an expert of the given external entity. A key aspect of the internship is induction into actual work situations. Internships involve working with local industry, government or private organizations, business organizations, artists, crafts persons, and similar entities to provide opportunities for students to actively engage in on-site experiential learning.
- **Field practice/projects:** Courses requiring students to participate in field-based learning/projects generally under the supervision of an expert of the given external entity.
- **Community engagement and service:** Courses requiring students to participate in field-based learning/projects generally under the supervision of an expert of the given external entity. The curricular component of 'community engagement and service' will involve activities that would expose students to the socio-economic issues in society so that the theoretical learnings can be supplemented by actual life experiences to generate solutions to real-life problems.

Table:2: Course wise Distribution of Credits

Broad Category ofCourse	**Minimum Credit Requirement**	
	3-year UG	**4-Year UG**
Major (Core)	60	80
Minor Stream	24	32
Interdisciplinary	9	9
Ability Enhancement Courses (AEC)	8	8
Skill Enhancement Courses (SEC)	9	9
Value Added Coursescommon for all UG	6	6
Summer Internship	4	4
Research Project /Dissertation	NA	12
MOOCS	12	16
Total	**132**	**176**

Table 3: Credit Distribution for 3-year Course

Semester		**Course Credits**							
	Major	**Minor**	**ID**	**AEC**	**SEC**	**VAC**	**SI**	**MOOCS**	**Total**
I	6	3	3	2	3	3	0	**2**	**22**
II	6	3	3	2	3	3	0	**2**	**22**
III	8	4	3	2	3	0	0	**2**	**22**
IV	12	6	0	2	0	0	0	**2**	**22**
V	12	4	0	0	0	0	4	**2**	**22**
VI	16	4	0	0	0	0	0	**2**	**22**
	60	**24**	**9**	**8**	**9**	**6**	**4**	**12**	**132**

Table 4: Credit Distribution for 4-year Course

Semester	Course Credits									Total
	Major	Minor	ID	AEC	SEC	VAC	SI	RP	MOOC	
I	6	3	3	2	3	3	0	0	2	**22**
II	6	3	3	2	3	3	0	0	2	**22**
III	8	4	3	2	3	0	0	0	2	**22**
IV	12	6	0	2	0	0	0	0	2	**22**
V	12	4	0	0	0	0	4	0	2	**22**
VI	16	4	0	0	0	0	0	0	2	**22**
VII	16	4	0	0	0	0	0	0	2	**22**
VIII	4	4	0	0	0	0	0	12	2	**22**
	80	**32**	**9**	**8**	**9**	**6**	**4**	**12**	**16**	**176**

Section 4

Level of Courses

4.1 NHEQF levels:

The NHEQF levels represent a series of sequential stages expressed in terms of a range of learning outcomes against which typical qualifications are positioned/located. NHEQF level 4.5 represents learning outcomes appropriate to the first year (first two semesters) of the undergraduate programme of study, while Level 8 represents learning outcomes appropriate to the doctoral-level programme of study.

Table: 5: NHEQF Levels

NHEQF Level	Examples of higher education qualifications located within each level	Credit Requirements
Level 4.5	Undergraduate Certificate. Programme duration: First year (first two semesters) of the undergraduate programme, followed by an exit 4-credit skills-enhancement course(s).	40
Level 5	Undergraduate Diploma. Programme duration: First two years (first four semesters) of the undergraduate programme, followed by an exit 4-credit skills-enhancement course(s) lasting two months.	80
Level 5.5	Bachelor's Degree. Programme duration: First three years (Six semesters) of the four-year undergraduate programme.	120
Level 6	Bachelor's Degree (Honours/ Honours with Research). Programme duration: Four years (eight semesters).	160
Level 6	Post-Graduate Diploma. Programme duration: One year (two semesters) for those who exit after successful completion of the first year (two semesters) of the 2-year master's programme	160
Level 6.5	Master's degree. Programme duration: Two years (four semesters) after obtaining a 3- year Bachelor's degree (e.g. B.A., B.Sc., B.Com. etc.).	80
Level 6.5	Master's degree. Programme duration: One year (two semesters) after obtaining a 4 -year Bachelor's degree (Honours/ Honours with Research) (e.g. B.A., B.Sc., B.Com. etc.).	40
Level 7	Master's degree. (e.g., M.E./M.Tech. etc.) Programme duration: Two years (four semesters) after obtaining a 4-year Bachelor's degree. (e.g., B.E./B.Tech. etc.)	80
Level 8	Doctoral Degree	Credits for course work, Thesis, and published work

4.2. Course Code based on Learning Outcomes:

Courses are coded based on the learning outcomes, level of difficulty, and academic rigor. The coding structure is as follows:

i. 0-99: ***Pre-requisite courses*** required to undertake an introductory course which will be a pass or fail course with no credits. It will replace the existing informal way of offering bridge courses that are conducted in some of the colleges/ universities.

ii. 100-199: ***Foundation or introductory courses*** that are intended for students to gain an understanding and basic knowledge about the subjects and help decide the subject or discipline of interest. These courses may also be prerequisites for courses in the major subject. These courses generally would focus on foundational theories, concepts, perspectives, principles, methods, and procedures of critical thinking in order to provide a broad basis for taking up more advanced courses.

iii. 200-299: ***Intermediate-level courses*** including subject-specific courses intended to meet the credit requirements for minor or major areas of learning. These courses can be part of a major and can be pre-requisite courses for advanced-level major courses.

iv. 300-399: ***Higher-level courses*** which are required for majoring in a disciplinary/interdisciplinary area of study for the award of a degree.

v. ***400-499: Advanced courses*** which would include lecture courses with practicum, seminar-based course, term papers, research methodology, advanced laboratory experiments/software training, research projects, hands-on-training, internship/apprenticeship projects at the undergraduate level or First year post- graduate theoretical and practical courses.

vi. 500-599: ***Courses at first-year PG degree level*** for a 2-year post-graduate degree programme

vii. 600-699: ***Courses for second year of 2-year PG*** or 1-year post-graduate degree programme

viii. 700 -799 & above: Courses limited to doctoral students.

Section 5

Graduate Attributes & Learning Outcomes

5.1 Introduction

As per the NHEQF, each student on completion of a programme of study must possess and demonstrate the expected ***Graduate Attributes*** acquired through one or more modes of learning, including direct in-person or face-to-face instruction, online learning, and hybrid/blended modes. The graduate attributes indicate the quality and features or characteristics of the graduate of a programme of study, including learning outcomes relating to the disciplinary area(s) relating to the chosen field(s) of learning and generic learning outcomes that are expected to be acquired by a graduate on completion of the programme(s) of study.

The graduate profile/attributes must include,

- capabilities that help widen the current knowledge base and skills,
- gain and apply new knowledge and skills,
- undertake future studies independently, perform well in a chosen career, and
- play a constructive role as a responsible citizen in society.

The graduate profile/attributes are acquired incrementally through development of cognitive levels and describe a set of competencies that are transferable beyond the study of a particular subject/disciplinary area and programme contexts in which they have been developed.

Graduate attributes include,

- ***learning outcomes that are specific to disciplinary areas*** relating to the chosen field(s) of learning within broad multidisciplinary/interdisciplinary/ transdisciplinary contexts.
- ***generic learning outcomes*** that graduate of all programmes of study should acquire and demonstrate.

5.2 Graduate Attributes:

Table: 6: The Learning Outcomes Descriptors and Graduate Attributes

Sl.no.	**Graduate Attribute**	**The Learning Outcomes Descriptors** ***(The graduates should be able to demonstratethe capability to:)***
GA1	Disciplinary Knowledge	acquire knowledge and coherent understanding of the chosen disciplinary/interdisciplinary areasof study.
GA 2	Complex problem solving	solve different kinds of problems in familiar and non-familiar contexts and apply the learning to real-life situations.

GA 3	Analytical & Criticalthinking	apply analytical thought including the analysis and evaluation of policies, and practices. Able to identify relevant assumptions or implications. Identify logical flaws and holes in the arguments of others. Analyse and synthesize data from a variety of sources and draw valid conclusions and support them with evidence and examples.
GA 4	Creativity	create, perform, or think in different and diverseways about the same objects or scenarios and deal with problems and situations that do not have simple solutions. Think 'out of the box' and generate solutions to complex problems in unfamiliar contexts by adopting innovative, imaginative, lateral thinking, interpersonal skills, and emotional intelligence.
GA 5	Communication Skills	listen carefully, read texts and research papers analytically, and present complex information in a clear and concise manner to different groups/audiences. Express thoughts and ideas effectively in writing and orally and communicate with others using appropriate media.
GA 6	Research-related skills	develop a keen sense of observation, inquiry, and capability for asking relevant/ appropriate questions. Should acquire the ability to problematize, synthesize and articulate issues and design research proposals, define problems, formulate appropriate and relevant research questions, formulate hypotheses, test hypotheses using quantitative and qualitative data, establish hypotheses, make inferences based on the analysis and interpretation of data, and predict cause-and-effect relationships. Should develop the ability to acquire the understanding of basic research ethics and skills in practicing/doing ethics in the field/ in personal research work.
GA 7	Collaboration	work effectively and respectfully with diverse teams in the interests of a common cause and work efficiently as a member of a team.
GA 8	Leadership readiness/qualities	plan the tasks of a team or an organization and setting direction by formulating an inspiring vision and building a team that can help achievethe vision.
GA 9	Digital and technological skills	use ICT in a variety of learning and work situations. Access, evaluate, and use a variety of relevant information sources and use appropriate software for analysis of data.
GA 10	Environmental awareness and action	mitigate the effects of environmental degradation, climate change, and pollution. Should develop the technique of effective waste management, conservation of biological diversity, management of biological resources and biodiversity, forest and wildlife conservation, and sustainable development and living.

5.3 Programme Learning Outcomes (PLO)

The term 'programme' refers to the entire scheme of study followed by learners leading to a qualification. Individual programmes of study will have defined learning outcomes that must be attained for the award of a specific certificate/diploma/degree. Programme Learning Outcomes describe what students are expected to know or be able to do by the time of graduation. PLOs are statements about the knowledge, skills and attitudes (attributes) the graduate of a formal engineering program should have. PLOs deal with the general aspect of graduation for a particular program, and the competencies and expertise a graduate will possess after completion of the program. The identified PLOs are as follows

- **PLO1- Knowledge of Computer Application:** Acquiring knowledge on basics of Computer Science and ability to apply to design principles in the development of solutions for problems of varying complexity.

- **PLO2- Ability to Solve Complex Problems:** Improved reasoning with strong mathematical ability to identify, formulate and analyse problems related to computer science and exhibit a sound knowledge on data structures and algorithms.
- **PLO3- Analytical and Critical Thinking:** Ability to devise and conduct experiments, interpret data and provide well-informed conclusions. Possessing a sound knowledge on computer application software and designing and developing apps for applicative problems.
- **PLO4- Develop and Demonstrate Creativity:** Ability to design and development of algorithmic solutions to real-world problems and acquire a minimum knowledge on statistics and optimisation problems. Establishing excellent skills in applying various design strategies for solving complex problems.
- **PLO5- Enhance Communication Skills:** Must have a reasonably good communication knowledge both oral and written.
- **PLO6- Formulate Research-Related Skills:** Develop the ability to identify social problems and issues and devise realistic solutions through detailed research by following ethics.
- **PLO7- Develop Ability to Collaborate:** Develop the ability to work in teams and figure out the possibilities to collaborate with relevant organisations while solving the problems at hand.
- **PLO8- Develop Leadership Qualities:** Develop the qualities that will help in leading a team efficiently and extract maximum throughput out of team effort.
- **PLO9- Execute Digital and Technological Skills: Identify**, select and use a modern scientific and IT tool or technique for modelling, prediction, data analysis and solving problems in the area of Computer Science and mmakingmobile-based application software.
- **PO10- Identify Environmental Issues, Develop Awareness and Action:** Exhibiting professional ethics to maintain integrity in a working environment and also having concern on societal impacts due to computer-based solutions for problems.

5.4 Programme Specific Outcomes (PSOs)

- **PSO1- Knowledge of Computing Systems:** An ability to understand the principles and working of computer systems.
- **PSO2- Project Development Skills:** An ability to understand the structure and development methodologies of software systems.
- **PSO3: Software Development Skills: Familiarity** and practical competence with a broad range of programming languages and open-source platforms.
- **PSO4: Mathematical Skills:** An ability to apply mathematical methodologies to solve computational tasks, model real-world problems using appropriate data structures and a suitable algorithm.

5.5 Course Learning Outcomes (CLOs)

The programme learning outcomes are attained by learners through the essential learnings acquired on the completion of selected courses of study within a programme of study. The term 'course' is used to mean the individual courses of study that make up the scheme of study for a programme.

Course learning outcomes are specific to the learning for a given course of study related to a disciplinary or interdisciplinary/multi-disciplinary area of learning. Some courses of study are highly structured, with a closely laid down progression of compulsory/core courses to be taken at different phases/stages of learning.

5.5 The Qualification Specifications:

Table: 5: NHEQF Qualification specifications

Qualification type	Purpose of the qualification
Undergraduate Certificate	The students will be able to apply technical and theoretical concepts and specialized knowledge and skills in a broad range of contexts to undertake skilled or paraprofessional work and/or to pursue further study/learning at higher levels.
Undergraduate Diploma	The students will be able to apply specialized knowledge in a range of contexts to undertake advanced skilled or paraprofessional work and/or to pursue further learning/study at higher levels.
Bachelor's degree	The students will be able to apply a broad and coherent body of knowledge and skills in a range of contexts to undertake professional work and/or for further learning.
Bachelor's degree (Honors/ Honors with Research)	The students will be able to apply the knowledge in a specific context to undertake professional work and for research and further learning.
	The students will be able to apply an advanced body of knowledge in a range of contexts to undertake professional work and apply specialized knowledge and skills for research and scholarship, and/or for further learning relating to the chosen field(s) of learning, work/vocation, or professional practice.

Section 6

Course Structure and Syllabus of the Framework

BCA Course Structure for the Session 2025-2026

1st Semester							
Sl. No.	**Subject Code**	**Names of subjects**	**Level of Course**	**Credit**	**L**	**T**	**P**
Major							
1	CAP052M101	Discrete Structures	100	3	3	0	0
2	CAP052M102	Introduction to C Programming	100	3	2	0	1
Minor							
3	CAP052N101	Fundamentals of Web Design	100	3	2	1	0
Interdisciplinary							
4	IKS992K101	Introduction to Indian Knowledge System-I	100	3	2	1	0
Ability Enhancement Courses (AEC)							
5	AEC982A101	Communicative English and Behavioural Science-I	100	2	2	0	0
Skill Enhancement Courses (SEC)							
6	CAP052S101	Windows Programming using C#	100	3	2	1	0
Value Addition Courses (VAC)							
7	VAC-1	Basket Course	100	3	3	0	0
MOOCS							
8	MOOCS	**One 8-week Course from SWAYAM /MOOCS as per the direction of the Department**	100	2	2	0	0

		TOTAL		**22**			
2nd Semester							
Sl. No.	**Subject Code**	**Names of subjects**	**Level of Course**	**Credit**	**L**	**T**	**P**
Discipline Specific Major (Major)							
1	CAP052M201	Data Structures	100	3	2	0	1
2	CAP052M202	Computer Architecture	100	3	3	0	0
Minor							
3	CAP052N201	Server-Side Programming	100	3	2	1	0
Interdisciplinary							
4	IKS992K201	Indian Knowledge System II	100	3	2	1	0
Ability Enhancement Courses (AEC)							
5	AEC982A201	Communicative English and Behavioural Science-II	100	2	2	0	0
Skill Enhancement Courses (SEC)							
6	CAP052S201	Computer Hardware and Networking	100	3	2	1	0
Value Addition Courses (VAC)							
7	VAC992V2409	Basket Course (Cybersecurity – RSIT-List Offered by the University)	100	3	3	0	0
MOOCS							
8	MOOCS	**One 8-week Course from SWAYAM /MOOCS as per the direction of the Department**	100	2	2	0	0
		TOTAL		**22**			
3rd Semester							
Sl. No.	**Subject Code**	**Names of subjects**	**Level of Course**	**Credit**	**L**	**T**	**P**
Major							
1	CAP052M301	Java Programming	200	4	3	0	1
2	CAP052M302	Database Management Systems	200	4	3	0	1
Minor							
3	CAP052N301	Front-End Development with React (Offered to Others)	200	4	3	1	0
Interdisciplinary							

4	CAP052I301	Introduction to Python (Offered to all by RSIT-IDC, Practical 3hours)	200	3	0	0	3
Ability Enhancement Courses (AEC)							
5	CEN982A301 BHS982A302	**Communicative English III:** Fundamentals of Business Communication **Behavioural Science III**	200	1+1	2	0	0
Skill Enhancement Courses (SEC)							
6	CAP052S301	SEC-3 (System Administration)	200	3	2	1	0
MOOCS							
7	MOOCS	**One 8-week Course from SWAYAM /MOOCS as per the direction of the Department**	200	2	2	0	0
		TOTAL		**22**			
4th Semester							
Sl. No.	**Subject Code**	**Names of subjects**	**Level of Course**	**Credit**	**L**	**T**	**P**
Major							
1	CAP052M401	Operating Systems	200	4	3	0	1
2	CAP052M402	Data Communication Networks	200	4	3	0	1
3	IKS052K403	Indian Knowledge System (Related to Computer Science offered by IKS)	200	4	3	1	0
Minor							
4	CAP052N401	Front End Development with Angular	200	3	2	1	0
5	CAP052N402	Server-Side Programming with Node JS	200	3	2	1	0
Ability Enhancement Courses (AEC)							
6	AEC982A101	Communicative English and Behavioural Science-IV	200	2	2	0	0
MOOCS							
7	MOOCS	**One 8-week Course from SWAYAM /MOOCS as per the direction of the Department**	200	2	0	0	0
		TOTAL		**22**			

5th Semester							
Sl. No.	**Subject Code**	**Names of subjects**	**Level of Course**	**Credit**	**L**	**T**	**P**
Major							
1	CAP052M501	Web Technology	300	4	3	0	1
2	CAP052M502	Python Programming	300	4	3	0	1
3	CAP052M503/ CAP052M504	Foundation of Artificial Intelligence/ Statistical Computing	300	4	3	1	0
Minor							
4	CAP052N501	Web Integration and Application	300	4	3	1	0
MOOCS							
5	MOOCS	One 8-Week Course from SWAYAM /MOOCS as per the direction of the Department	300	2	0	0	0
Internship							
6	CAP052I501	Summer Internship	300	4	0	0	0
		TOTAL		**22**			
6th Semester							
Sl. No.	**Subject Code**	**Names of subjects**	**Level of Course**	**Credit**	**L**	**T**	**P**
Major							
1	CAP052M601	Software Engineering	300	4	3	0	1
2	CAP052M602	Cryptography and Network Security	300	4	3	0	1
3	CAP052M603/ CAP052M604	Introduction to Machine learning /Introduction to Data science	300	4	3	1	0
4	CAP052M605/ CAP052M606	Introduction to Deep Learning /Introduction to Big Data Analytics	300	4	3	0	1
Minor							
5	CAP052N601	Secure Web Development	300	4	3	1	0
MOOCS							
6	MOOCS	One 8-Week Course from SWAYAM /MOOCS as per the direction of the Department	300	2	0	0	0

		TOTAL		**22**			

7th Semester							
Sl. No.	**Subject Code**	**Names of subjects (Suggested)**	**Level of Course**	**Credit**	L	**T**	**P**
Major							
1	CAP052M701	Cloud Computing	400	3	3	0	0
2	CAP052M702	Introduction to Data Warehousing	400	3	3	0	0
3	CAP052M703	Introduction to Natural Language Processing	400	3	3	0	0
4	CAP052M704	Wireless Communication Network	400	3	3	0	0
5	CAP052M711	Cloud Computing Lab	400	1	0	0	2
6	CAP052M712	Introduction to Data Warehousing Lab	400	1	0	0	2
7	CAP052M713	Introduction to Natural Language Processing Lab	400	1	0	0	2
8	CAP052M714	Wireless Communication Network Lab	400	1	0	0	2
Minor							
5	CAP052N701	Cloud-Based Web Development	400	4	3	1	0
MOOCS							
6	MOOCS	One 8-week Course from SWAYAM /MOOCS as per the direction of the Department	400	2	0	0	0
		TOTAL		**22**			

8th Semester							
Sl. No.	**Subject Code**	**Names of subjects (Suggested)**	**Level of Course**	**Credit**	**L**	**T**	**P**
Major							
1	CAP052M801	Soft Computing	400	3	3	0	0
2	CAP052M811	Soft Computing Lab	400	1	0	0	2
Minor							
2	CAP052N801	Web Page Ranking and Optimization	400	4	3	1	0
MOOCS							
3	MOOCS	One 8-week Course from SWAYAM /MOOCS as per the direction of the Department	400	2	0	0	0
Dissertation							

4		Dissertation	400	12			
Advanced Level Core Course instead of Dissertation							
5	CAP052M802	Soft Computing	400	4	3	1	0
6	CAP052M803	Blockchain Technologies	400	4	3	1	0
7	CAP052M804	Quantum Computing	400	4	3	1	0
		Total		22			

6.2 Detailed Syllabus of all the Courses Semester-wise

SYLLABUS (1st SEMESTER)

Paper I/Subject Name: Discrete Structures		**Subject Code: CAP052M101**
Course Type: Major		**Course Level:100**
L-T-P-C – 3-0-0-3	**Credit Units: 03**	**Scheme of Evaluation: T**

Course Objective:

The objectives of the course are to make the students learn the concept of mathematical logic, sets, relations, and functions, generating functions and recurrence relations, and Graph Theory for solving engineering-related problems.

Prerequisites: None

Course Outcomes

On successful completion of the course, the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	**Define** basic concepts of discrete structures and terminology used.	**BT 1**
CO 2	**Explain** applications of discrete structures in computer science	**BT 2**
CO 3	**Apply** concepts of Counting, Probability, Relations, and Graphs	**BT 3**
CO 4	**Analyse** and evaluate various methodologies of proving a theorem.	**BT 4**

Detailed Syllabus:

Modules	**Topics**	**Course content**	**Periods**
I	**Sets, Relations and Functions**	Operations and Laws of Sets, Binary, Relation, Partial Ordering Relation, Equivalence Relation, Functions, Inverse and Composite Function, Finite and infinite Sets, Countable and uncountable Sets, Poset, Lattice. The Well-Ordering Principle, The Division algorithm: Prime numbers, The Greatest Common Divisor, The least common multiple, Euclidean Algorithm, The Fundamental Theorem of Arithmetic, Congruence, Euler's phi function.	**15**
II	**Graph Theory and Combinatorics**	Graphs and their properties, Degree, subgraphs, walks, paths and circuits, connected and disconnected graphs, Isomorphism, Eulerian and Hamiltonian graphs, Complete graphs, Bipartite graph, Trees, Properties of trees, Pendant vertex, Distance and Centers, Binary tree, Spanning trees, Planar graphs, Matrix representation of graphs, Chromatic number, Chromatic polynomial, Five colors theorem. Pigeon-hole principle, permutation and combination, Recurrence relations, Generating functions.	**15**
III	**Algebraic Structures**	Algebraic Structures with one Binary Operation, Semi Groups, Monoids, Groups, Congruence Relation and Quotient Structures, Free and Cyclic Monoids and Groups, Permutation Groups, Normal Subgroups, Algebraic Structures with two Binary Operation, Rings, Integral Domain and Fields.	**15**

IV	**Propositional Logic**	Proposition, connectives, tautology, contradiction, logical equivalence, normal forms-DNF, CNF, argument, Validity of argument, fallacy, Rules of Inference, Quantifiers. Boolean Algebra and Boolean Ring, Identities of Boolean Algebra, Duality, Representation of Boolean Function.	**15**
Total			**60**

Credit Distribution		
Lecture/ Tutorial	**Practicum**	**Experiential Learning**
3*20 NCH = 60 NCH	-	30 NCH (Problem Solving, Internship, Seminar, Case Study, Discussion)

Text Books:

1. *A text book of Discrete Mathematics*, Sarkar S. K., Revised Edition, 2016, S Chand & Co Ltd.

Reference Books:

1. Deo N; *Graph Theory with applications to engineering and computer science*, New Edition, 2009, PHI Learning Private Limited.
2. Chandrasekaran N. and Umaparvathi, *Discrete Mathematics*, Eastern Economic Edition, 2013, PHI
3. *Discrete Mathematics and its Applications,* Rosen, K.H., 6th Edition, 2006, McGraw Hill.
4. Tremblay, J.P. and Manohar, R., *Discrete Mathematical Structures with Applications to Computer Science*, 35th Reprint, 2007, Tata McGraw Hill

Paper II/Subject Name: Introduction to C Programming		**Subject Code: CAP052M102**
Course Type: Major		**Course Level:100**
L-T-P-C – 2-0-2-3	**Credit Units: 03**	**Scheme of Evaluation: T**

Objective:

The objectives of the course are to give the students exposure to computer programming and make them capable of using the concepts to solve basic as well as advanced computing problems.

Prerequisites: None

Course Outcomes

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	**Define** different constructs and building blocks present in C programming Language	**BT 1**
CO 2	**Demonstrate** the working of C programming language and its control structures.	**BT 2**
CO 3	**Apply** the programming concepts to solve various problems.	**BT 3**
CO 4	**Analyse** and debug the errors while writing the programs.	**BT 4**
CO 5	**Assess** and **design** a new algorithm to solve a new real-life problem	**BT 5**

Detailed Syllabus:

Modules	Topics	Course content	Periods
I	**C Programming Fundamentals**	History and importance of C language, Basic structure of programs, programming style, execution of C programs. Character set, Tokens, Keywords and Identifiers, Constants, variables, data types, statements, comments, declaration of storage class, assigning values to variables. Basic idea of Computer Algorithms and Flow Charts. Managing I/O, reading and writing characters, formatted Input/output. Arithmetic operators, relational operators, logical operators, assignment operators, increment & decrement operators, conditional operators, bitwise operators, special operators. Arithmetic expressions, operator precedence & associativity.	**11**
II	**Decision Making, Branching & Lopping**	Importance of decision making, decision making with *if* statement, *if-else* statement, nested *if-else* statements, *switch-case* statement, *goto* statement, the *?:* operator, examples. Importance of loping, the *while* statement, *do-while* statement, *for* statement, nested looping, examples.	**11**
III	**Arrays, Strings & User-Defined Functions**	Significance of Arrays, creation and use of one- & two-dimensional arrays, Dynamic arrays. Declaration and use of string variables, reading and writing strings, operations on strings. Benefits of user-defined functions, creation and use of user-defined functions, parameter passing, return types.	**11**
IV	**Advanced Programming Concepts**	Creation and use of Structures and Unions in programs. Introduction to Pointers, declaration & initialization of pointer variables, accessing a variable through its pointer. Defining, opening & closing files in C, Input/output operations on files.	**11**
Total			**44**

Introduction to C Programming Lab Syllabus

Total Lab Hours for the semester = 30 (2 hours per week)

Minimum 20 Laboratory experiments based on the following-

1. Character set, Tokens, Keywords and Identifiers, Constants, variables, data types, statements, comments, declaration of storage class, assigning values to variables.
2. Managing I/O, reading and writing characters, formatted Input/output.
3. Arithmetic operators, relational operators, logical operators, assignment operators, increment & decrement operators, conditional operators, bitwise operators, special operators. Arithmetic expressions, operator precedence & associativity.
4. Importance of decision making, decision making with if statement, if-else statement, nested if-else statements, switch-case statement, goto statement, the ?: operator.
5. Importance of loping, the while statement, do-while statement, for statement, nested looping.
6. Significance of Arrays, creation and use of one & two dimensional arrays, Dynamic arrays.
7. Declaration and use of string variables, reading and writing strings, operations on strings.
8. Benefits of user-defined functions, creation and use of user-defined functions, parameter passing, return types.
9. Creation and use of Structures and Unions in programs.
10. Use of Pointers, declaration & initialization of pointer variables, accessing a variable through its pointer.
11. Defining, opening & closing files in C, Input/output operations on files.

Credit Distribution

Lecture/ Tutorial	Practicum	Experiential Learning
2 * 22 NCH = 44 NCH	2 * 15 NCH = 30 NCH	8 * 2 NCH = 16 NCH (Problem Solving, Seminar, Case Study, Discussion, Internship, Projects)

T ext Book:

1. *Computer Fundamentals and Programming in C,* Reema Thareja, 2nd Edition, 2016, Oxford University Press, Delhi.

Reference Books:

1. E Balaguruswamy, *Computing Fundamentals and C Programming*, 1st Edition, 2017, McGraw Hill.
2. Venugopal and Prasad, *Mastering C*, 2nd Edition, 2017, Tata McGraw Hill.
3. Yashawant Kanetkar, *Let us C,* 15th Edition, 2017, BPB Publication.

- **Detailed Syllabus of the Minor Course**

Paper III/Subject Name: Fundamentals of Web Design		**Subject Code: CAP052N101**
Course Type: Minor		**Course Level:100**
L-T-P-C – 2-1-0-3	**Credit Units: 04**	**Scheme of Evaluation: T**

Objective:

The objectives of the course are to enable the students to build a robust foundation for computational thinking and make them learn client-side web development.

Prerequisites: None

Course Outcomes

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	**Define** basic building and design blocks of an website.	**BT 1**
CO 2	**Understand** the basic characteristics and concepts of web development.	**BT 2**
CO 3	**Build** static web pages and manipulate data using JavaScript and work with the HTML Canvas	**BT 3**
CO 4	**Analyse** and **evaluate** websites in terms of its design and basic processing at the client side.	**BT 4 & 5**

Detailed Syllabus:

Modules	Topics	Course content	Periods
I	**Introduction to Web and creating website**	The Internet: Client & Server, IP address and URL, The World Wide Web (WWW), Installing Visual Studio Code, Installing the Prettier VSCode extension, Install Ubuntu in Windows, using WSL, Install Ubuntu using virtual machine software, making and hosting website. Introduction to HTML tags, Looking inside websites using "Inspect Element"	**15**
II	**Styling and Working with Strings**	Working with modern HTML and CSS to produce an attractive, informative multi-page website based on the client's requirements, Creating a multipage website using HTML5, Control the look of a website using CSS, Formating a web page to display	**15**

		complex information, Adding graphical elements and maps to a website, Implement web forms to capture user input, Testing a website for compliance with standards and to ensure that it works with a range of browsers, Implementation of CSS using Bootstrap, Styling and Working with Strings: Introduction to strings, Joining strings together, Switching to the VSCode editor: Putting HTML and JS together, Adding comments to HTML and JS, Find the length of a string, Search for a string inside another string, String equality comparison, Sort a collection of strings, Split strings by a pattern,	
III	**Functions**	Numbers, Booleans, Objects and Arrays, Number Data Type, Numbers Boolean Data Type, Boolean - comparisons and logical operations, Object Literals - create, read & update + nesting objects, Arrays - handling ordered values, Functions: Explicitly return a value from a function, Passing a function as an argument , introduction to Firebase.	**15**
IV	**Advanced Techniques of JavaScript**	Iterating over Arrays: Iterating over an array using the for each method, Generate an HTML list from an array, Using the index of the array value during iteration, Nested Array iteration, Transforming Arrays, Generate an HTML list from an array using the map function, Using index of array value with map, Transforming Nested Arrays, Filtering Arrays: Filter an array based on some criteria, A minimal UI for filtering flight search results, Use the index of the array value with filter, Building a game with Canvas,HTML canvas element, introduction to AJAX, JSON, RESTful API.	**15**
Total			**60**

Credit Distribution		
Lecture/ Tutorial	**Practicum**	**Experiential Learning**
3*20 NCH = 60 NCH	-	30 NCH (Problem Solving, Seminar, Case Study, Discussion, Internship, Project)

Text Book:

1. *Internet and World Wide Web How to program*, Deitel H.M. and Deitel P.J, 4th Edition, 2012, Pearson International, New Delhi
2. *Web Technology*, Gopalan N.P. and Akilandeswari J., 2nd Edition, 2014, Prentice Hall of India, New Delhi.
3. *Java How to Program*, Paul Dietel and Harvey Deitel, 8th Edition, 2014, Prentice Hall of India, New Delhi

Reference Books:

1. Uttam K. Roy, *Web Technologies*, 2010, Illustrated Oxford University Press.
2. Godbole A. S. & Kahate A., *Web Technologies*, 2nd Edition, 2006, TMH, New Delhi.

- **Detailed Syllabus of Skill Enhancement Course (SEC-I)**

Paper VI/Subject Name: Windows Programming using C#		**Subject Code: CAP052S101**
Course Type: SEC		**Course Level: 100**
L-T-P-C – 2-1-0-3	**Credit Units: 03**	**Scheme of Evaluation: T**

Objective:

The objectives of the course are to enable the students to learn concepts on C# and .NET framework.

Prerequisites: None

Course Outcomes

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	**Define** semantic syntax and control structures of C# and .NET	**BT 1**
CO 2	**Understand** introductory programming concepts using C#	**BT 2**
CO 3	**Apply** logical alternatives with C# decision structures utilizing iteration, class methods, fields, and properties.	**BT 3**
CO 4	**Simplify** forms, classes, and controls into C# solutions utilizing arrays and file/database access methods	**BT 4**

Detailed Syllabus:

Modules	**Topics**	**Course content**	**Periods**
I	**Introduction to .NET and C#**	Installation, Components of .NET, Common Language Specification (CLS), Common Language Runtime (CLR), Microsoft Intermediate Language ("MSIL" or "IL"), The Common Type System (CTS), .NET Framework Base Classes, Web Services, Web Forms, and Windows Forms, The .Net Languages, Execution of Sample Programs, Command Line Arguments, Programming Examples, And Multiple Main Methods. Keywords, Identifiers, Literals, Variables, Data Types, Boxing and Unboxing. Operator Precedence and Associativity, Arithmetic Operators, Relational Operators, Logical Operators, Assignment Operators, Increment and Decrement Operators, Conditional Operators, Bitwise Operators, Special Operators, Type Conversions	**11**
II	**Branching, Looping and Methods**	Decision Making Statements, The Switch Statement, The? Operator, Decision Making and Looping, Jumps in Loops, Labelled Jumps, Single Dimensional Arrays, Multidimensional Arrays, Jagged Arrays, System. Array Class, Array List Class, Strings, Regular Expressions, Declaring Methods, Main Method, Invoking Methods, Nesting of Methods, Method Parameters	**11**
III	**Structures, Classes, Objects and OOP Concepts**	Defining a Structure, Assigning Values to Members, Copying Structures, Structures with Methods, Nested Structures, Classes Vs Structures, Guidelines to use Structures; Enumerations-Enumerator Initialization, Enumerator Base Types, Enumerator Type Conversion, Constructors & Destructors, Member Initialization, 'this' Reference Variable, Nesting of Classes, Members, Properties, Classical Inheritance, Containment	**11**

		Inheritance, defining a Subclass, Visibility Control, Subclass Constructor, Method Overriding, Hiding Methods, Abstract Classes, Abstract Methods, Sealed Classes, Sealed Methods, Polymorphism	
IV	**Exception Handling, Interfaces and Windows Application**	An Overview, Exception Handling Syntax, Multiple Catch Statements, The Exception Hierarchy, General Catch Handler, using 'Finally', Nested Try Blocks, User Defined Exceptions, Operators – Checked and Unchecked, Defining Interfaces, Extending Interfaces, Implementing Interfaces, Explicit Interface Implementation, Abstract Classes and Interfaces, Delegates, Multicast Delegates, Events, The Console Class, Console Input and Output, Formatted Output, Custom Numeric Format. Developing Windows Applications, Developing Web Applications.	**11**
Total			**44**

Total Lab Hours for the semester = 30 (2 hours per week)

Minimum 20 Laboratory experiments based on the following-

- Basic C# programs
- Classes and Objects
- Inheritance
- Operator Overloading
- Threading, Events and Delegates
- Working with Windows Forms Controls, Validating data
- Creating Custom Dialog Box and Designing an MDI application with Menu
- Retrieving Data from Database & Working with Disconnected Environment

Credit Distribution		
Lecture/ Tutorial	**Practicum**	**Experiential Learning**
2 * 22 NCH = 44 NCH	2 * 15 NCH = 30 NCH	8 * 2 NCH = 16 NCH (Problem Solving, Seminar, Case Study, Discussion, Internship, Projects)

Text Book:

1. *Programming in C#*, E Balagurusamy, 3rd Edition, 2010, Tata McGraw Hill, New Delhi

Reference Books:

1. Poul Klausen, *Introduction to programming and C# Language*, Bookbon, 1st 2012, New Delhi.

- **Detailed Syllabus of Indian Knowledge System-I Course**

Paper IV/Subject Name: Introduction to Indian Knowledge System-I		**Subject Code: IKS992K101**
Course Type: IKS		**Course Level: 100**
L-T-P-C – 3-0-0-3	**Credit Units: 03**	**Scheme of Evaluation: T**

Objectives:
This foundation course is designed to present an overall introduction to all the streams of IKS relevant to the UG programme. It would enable students to explore the most fundamental ideas that have shaped Indian Knowledge Traditions over the centuries.

Prerequisite: None

Course Outcomes:

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	**Illustrate** literature of Indian civilization-the Vedic – Itihasas, languages, mathematics, and Ayurveda.	**BT 2**
CO 2	**Explain** observation of the motion of celestial bodies in the Vedic corpus	**BT 3**

Modules	Topics	Course content	Periods
I	**Bharatavarsha —A Land of Rare Natural Endowments**	Demographical features of the ancient Bharatvarsha, Largest cultivable area in the world. Protected and nurtured by Himalayas. The Sindhu-Ganga plain and the great coastal plains. The great rivers of India. Climatic changes: Abundant rains, sunshine and warmth, vegetation, animals and mineral wealth. Most populous country in the world. India's prosperity held the world in thrall. Splendid geographical isolation of India and the uniqueness of Indian culture.	**10**
II	**Foundational Literature of Indian Civilization:**	The Vedic Corpus. The Itihasas— Ramayana and Mahabharata, and their important regional versions. The Puranas. Foundational Texts of Indian Philosophies, including the Jaina and Bauddha. Foundational Texts of Indian Religious Sampradayas, from the Vedic period to the Bhakti traditions of different regions. i. **The Vedangas and Other Streams of Indian Knowledge System:** The Vedic Corpus: Introduction to Vedas and synopsis of the four Vedas and Sub-classification of Vedas; Messages in Vedas; Introduction to Vedāṅgas : Siksha, Vyakarana, Chandas, Nirukta, Jyotisha and Kalpa ; Vedic Life: Distinctive Features. Other streams of Indian Knowledge System such as Ayurveda, Sthapatya, Natyasastra, Dharmasastra, Arthasastra, etc. The Indian way of continuing the evolution of knowledge through commentaries, interpretations and revisions of the foundational texts. The large corpus of literature in Indian languages. **ii. Indian Language Sciences:** Language Sciences and the preservation of the Vedic corpus. Varnamala of Indian languages based on classification of sounds on the basis of their origin and effort involved. The special feature of the scripts of most Indian languages, that each symbol is associated with a unique sound. Word formation in Sanskrit and Indian languages. Major insights in the Science of Vyakarana as established by Panini. Important texts of Indian Language Sciences —Siksha or phonetics, Nirukta or etymology, Vyakarana or Grammar, Chandas or Prosody. Navyanyaya and Navya-vyakarana in Navadvipa, Varanasi and West and South India. iii. **Indian Mathematics:** Numbers, fractions and geometry in the Vedas. Decimal nomenclature of numbers in the Vedas. Zero and Infinity. Simple constructions from Sulba-sutras. The development of the decimal place value system which resulted in a simplification of all arithmetical operations. Linguistic representation of numbers. Important texts of Indian mathematics. Brief introduction to the development of algebra, trigonometry and calculus. How Indian mathematics continued to flourish in the 18/19/20th centuries. Kerala School. Ramanujan.	**24**

III	**Indian Astronomy**	Ancient records of the observation of the motion of celestial bodies in the Vedic corpus. Sun, Moon, Nakshatra & Graha. Astronomy as the science of determination of time, place and direction by observing the motion of the celestial bodies. The motion of the Sun and Moon. Motion of equinoxes and solstices. Elements of Indian calendar systems as followed in different regions of India. Important texts of Indian Astronomy. Basic ideas of the planetary model of Aryabhata and its revision by Nilakantha. Astronomical instruments. How Indian astronomy continued to flourish in the 18/19th centuries. Astronomical endeavours of Jaisingh, Sankaravarman, Chandrasekhara Samanta.	**15**
IV	**Indian Health Sciences**	Vedic foundations of Ayurveda. Ayurveda is concerned both with maintenance of good health and treatment of diseases. Basic concepts of Ayurveda. The three Gunas and Three Doshas, Pancha-mahabhuta and Sapta-dhatu. The importance of Agni (digestion). Six Rasas and their relation to Doshas. Ayurvedic view of the cause of diseases. Dinacharya or daily regimen for the maintenance of good health. Ritucharya or seasonal regimen. Important Texts of Ayurveda. Selected extracts from Astāngahrdaya (selections from Sūtrasthāna) and Suśruta-Samhitā (sections on plastic surgery, cataract surgery and anal fistula). The large pharmacopeia of Ayurveda. Charaka and Sushruta on the qualities of a Vaidya. The whole world is a teacher of the good Vaidya. Charaka's description of a hospital. Hospitals in ancient and medieval India. How Ayurveda continued to flourish till 18/19th centuries. Surgical practices, inoculation. Current revival of Ayurveda and Yoga.	**17**
		Total	**66**

Credit Distribution		
Lecture/ Tutorial	**Practicum**	**Experiential Learning**
3 * 22 NCH = 66 NCH	-	8 * 3 NCH = 24 NCH (Problem Solving, Seminar, Case Study, Discussion, Internship, Projects)

Textbooks

1. *Samskrta Śāstrom ka Itihās*, Baladev Upadhyaya, 2010, Chowkhambha, Varanasi
2. *A Concise History of Science in India*, D. M. Bose, S. N. Sen and B. V. Subbarayappa, Eds., 22nd Edition, 2010, Universities Press, Hyderabad

Reference Books:

1. Dharampal, *Some Aspects of Earlier Indian Society and Polity and Their Relevance Today, 1987,* New Quest Publications, Pune
2. Dharampal, *Indian Science and Technology in the Eighteenth Century: Some Contemporary European Accounts*, 2021, Dharampal Classics Series, Rashtrotthana Sahitya, Bengaluru
3. Dharampal, *The Beautiful Tree: Indian Indigenous Education in the Eighteenth Century*, 2021, Dharampal Classics Series, Rashtrotthana Sahitya, Bengaluru.
4. J. K. Bajaj and M. D. Srinivas, *Timeless India Resurgent India*, 2001, Centre for Policy Studies, Chennai.

- **Detailed Syllabus of Ability Enhancement Course: 1+1 = 2 credits**

Paper V/Subject Name: Introduction to Effective Communication		**Subject Code: CEN982A101**
Course Type: AEC		**Course Level: 100**
L-T-P-C – 1-0-0-1	**Credit Units: 01**	**Scheme of Evaluation: T**

Objectives:

The objectives of this course are to make the students understand the four major aspects of communication by closely examining the processes and figuring the most effective ways to communicate with interactive activities.

Prerequisites: None

Course Outcomes:

On successful completion of the course the students will be able to

SI No	Course Outcome	Blooms Taxonomy Level

CO 1	**Identify** the elements and processes that make for successful communication and **recognise** everyday activities that deserve closer attention in order to improve communication skills	**BT 1**
CO 2	**Contrast** situations that create barriers to effective communication and **relate** them to methods that are consciously devised to overcome such hindrance	**BT 2**
CO 3	**Use** language, gestures, and para-language effectively to avoid miscommunication and **articulate** one's thoughts and build arguments more effectively	**BT 3**

Detailed Syllabus		
Units	**Course Contents**	**Periods**
I	Introduction to Effective Communication • Listening Skills o The Art of Listening o Factors that affect Listening o Characteristics of Effective Listening • Guidelines for improving Listening skills	**5**
II	• Speaking Skills o The Art of Speaking o Styles of Speaking o Guidelines for improving Speaking skills o Oral Communication: importance, guidelines, and barriers	**5**
III	• Reading Skills o The Art of Reading o Styles of Reading: skimming, surveying, scanning • Guidelines for developing Reading skills	**5**
IV	• Writing Skills o The Art of Writing o Purpose and Clarity in Writing o Principles of Effective Writing	**5**
Total		**20**

Credit Distribution		
Lecture/Tutorial	**Practicum**	**Experiential Learning**
20 hours	-	10 hours - Movie/ Documentary screening - Peer teaching - Seminars - Field Visit

Textbooks:

1. *Business Communication: Essential Starategies for 21st Century Managers,* Shalini Verma, 2nd Edition, 2014, Vikas Publisher

References Books:

1. P.D. Chaturvedi and Mukesh Chaturvedi, *Business Communication,* 4th Edition, 2017, Pearson Education

2. Meenakshi Raman and Sangeeta Sharma, *Technical Communication: Principles and Practice*, 3rd Edition, 2015, Oxford University Press

Paper V/Subject Name: Behavioural Sciences -I		**Subject Code: BHS982A102**
Course Type: AEC		**Course Level: 100**
L-T-P-C – 1-0-0-1	**Credit Units: 01**	**Scheme of Evaluation: T**

Objectives:

The objective of the course is to increase one's ability to draw conclusions and develop inferences about attitudes and behaviour, when confronted with different situations that are common in modern organizations.

Prerequisites: None

On successful completion of the course the students will be able to

SI No	Course Outcome	Blooms Taxonomy Level
CO 1	**Understand** self & process of self-exploration	**BT 2**
CO 2	**Learn** about strategies for development of healthy self-esteem.	**BT 2**
CO 3	**Apply** the concepts to build emotional competencies.	**BT 3**

Detailed Syllabus:

Modules	Course Contents	Periods

I	**Introduction to Behavioral Science** Definition and need of Behavioral Science,Self: Definition components, Importance of knowing self, Identity Crisis,Gender and Identity, Peer Pressure, Self image: SelfEsteem, Johari Window ,Erikson's model.	**5**
II	**Foundations of individual behavior** Personality- structure, determinants, types of personalities.Perception: Attribution, Errors in perception. Learning- Theories of learning: Classical, Operant and Social	**5**
III	**Behaviour and communication.** Defining Communication, types of communication, barriers to communication, ways to overcome barriers to Communication, Importance of Non-Verbal Communication/Kinesics, Understanding Kinesics, Relation between behaviour and communication.	**5**
IV	**Time and Stress Management** Time management: Introduction-the 80:20, sense of time management, Secrets oftime management, Effective scheduling. Stress management: effects of stress, kinds of stress-sources of stress, CopingMechanisms. Relation between Time and Stress.	**5**
Total		**20**

Credit Distribution		
Lecture/Tutorial	**Practicum**	**Experiential Learning**
20 hours	-	10 hours - Movie/ Documentary screening - Peer teaching - Seminars - Field Visit

Text books:

1. *Theories and Models in Applied Behavioural Science*, 1991, J William Pfeiffer (ed.), Management; Pfeiffer & Company

Reference Books:

1. Blair J. Kolasa, *Introduction to Behavioural Science for Business*, 1969, John Wiley & SonsInc
2. K.Alex, *Soft skills*; 2014, S. Chand.

Paper IX/Subject Name: Basket Course 1		**Subject Code: VAC-1**
Course Type: VAC		**Course Level: 100**
L-T-P-C – 3-0-0-3	**Credit Units: 03**	**Scheme of Evaluation: T/P**

Detailed Syllabus of Value Addition Course (VAC-I) :* These subjects are Basket Courses that needs to be opted from other Departments/ Schools by the students of RSIT**

List of Value-Added Course For UG 1st Sem			
Area	**Sl no**	**Course Title**	**Course Availability**
Knowing India	1	India: Land of Diversity	Open for all
	2	Understanding Sankardeva	Open for all
	3	Introduction to Indian Art: An Appreciation	Not available for Bachelor of Fine Arts
	4	Gandhian Studies	Open for all
	5	Innovation and Startup Ecosystem of India	Open for all
	6	History of India: Ancient to Modern	Not available for BA History
	7	Indian Architectural Heritage	Open for all
	8	Film and Society: An Indian Perspective	Not available for BA JMC
	9	Cultural Heritage Tourism of India	Not available for BA/BSc TTM

Healthcare / Yoga	10	Community Health and Social Work	Not available for BSW
	11	Nutrition and Dietetics for Optimal Health	Not available for BSc Nutrition and Deictics
	12	Sports Psychology	Not available for BA Psychology/Applied Psychology
	13	Comprehensive Healthcare	Open for all
	14	Yoga	Open for all
	15	Stress Management	Open for all
Environment Science and Education	16	Climate Writing	Open for all
	17	Climate Change	Open for all
	18	Chemistry of the Environment	Open for all
	19	Renewable Energy and Sustainable Technology	Open for all
	20	Eco tourism	Not available for BA/BSc TTM
	21	Disaster Management	Open for all
Digital Technology	22	Office Automation	Not available for RSIT
	23	Introduction to Graphic Design	Not available for B.Des (Communication Design, Product Design and Graphic Design)

SYLLABUS (2nd SEMESTER)

Paper I/Subject Name: Data Structures		**Subject Code: CAP052M201**
Course Type: Major		**Course Level: 100**
L-T-P-C – 2-0-2-3	**Credit Units: 03**	**Scheme of Evaluation: T**

Objective:

The objectives of the course are to expose the students with the concepts of algorithm design and various types of data structures.

Prerequisites: Basics of C Programming

Course Outcomes

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	**Define** various data structures used in programming.	**BT 1**
CO 2	**Understand** the basic constructs of data structure and its implementation.	**BT 2**
CO 3	**Utilise** the appropriate data structures to solve a given problem.	**BT 3**

CO 4	**Analyse** and **evaluate** the data structures used for problem solving	**BT 4 & 5**

Detailed Syllabus:

Modules	Topics	Course content	Periods
I	**Linear Data Structure- I**	Introduction: Why we need data structure? Concepts of data structures: Data and data structure, Abstract Data Type and Data Type. Algorithms and programs, basic idea of pseudo-code. Algorithm efficiency and analysis, time and space analysis of algorithms – order notations. Array: Different representations – row major, column major. Sparse matrix - its implementation and usage. Array representation of polynomials. Linked List: Singly linked list, circular linked list, doubly linked list, linked list representation of polynomial and applications.	**11**
II	**Linear Data Structure- II**	**Stack and Queue:** Stack and its implementations (using array, using linked list applications. Queue, circular queue, dequeuers. Implementation of queue- both linear and circular (using array, using linked list), applications. **Recursion:** Principles of recursion – use of stack, differences between recursion and iteration, tail recursion. Applications - The Tower of Hanoi, Eight Queens Puzzle.	**11**
III	**Nonlinear Data Structures**	**Trees:** Basic terminologies, forest, tree representation (using array, using linked list). Binary trees - binary tree traversal (pre-, in-, post- order), threaded binary tree (left, right, full) - non-recursive traversal algorithms using threaded binary tree, expression tree. Binary search tree-operations (creation, insertion, deletion, searching). Height balanced binary tree – AVL tree (insertion, deletion with examples only). **Graphs:** Graph definitions and concepts (directed/undirected graph, weighted/un-weighted edges, sub-graph, degree, cut-vertex/articulation point, pendant node, clique, complete graph, connected components – strongly connected component, weakly connected component, path, shortest path, isomorphism). Graph representations/storage implementations – adjacency matrix, adjacency list, adjacency multi-list. Graph traversal and connectivity – Depth-first search (DFS), Breadth-first search (BFS) – concepts of edges used in DFS and BFS (tree-edge, back-edge, cross-edge, and forward-edge), applications. Minimal spanning tree – Prim's algorithm (basic idea of greedy methods). B-Trees operation	**11**
IV	**Searching, Sorting**	**a. Sorting Algorithms:** Bubble sort and its optimizations, insertion sort, shell sort, selection sort, merge sort, quick sort, heap sort (concept of max heap, application – priority queue), radix sort. **b**. **Searching Algorithms:** Sequential search, binary search, interpolation search.	**11**
Total			**44**

Subject Name: Data Structures using C++ Lab Syllabus

Total Lab Hours for the semester = 30 (2 hours per week)

Minimum 20 Laboratory experiments based on the following-

1. Some common programs of C as revision.
2. Programs on Arrays- Traversal, Insertion, Deletion, Polynomial Representation, etc.
3. Programs on Linked List- Creation Insertion, Deletion, Polynomial Representation, etc.

4. Programs on Stacks-Creation, Push Pop, Infix to Postfix Conversion, Evaluation.
5. Programs on Queues-Creation, Insertion, Deletion, etc.
6. Programs on Trees- Binary Tree Creation, Tree Traversal, BST
7. Programs on Searching- Linear Search, Binary Search
8. Programs on Sorting- Bubble Sort, Insertion Sort, Selection Sort, Quick Sort, Merge Sort, Heap Sort.

Credit Distribution		
Lecture/ Tutorial	**Practicum**	**Experiential Learning**
2 * 22 NCH = 44 NCH	2 * 15 NCH = 30 NCH	8 * 2 NCH = 16 NCH (Problem Solving, Seminar, Case Study, Discussion, Internship, Projects)

Text Book:

1. *Data structures, Algorithms and Applications in C++*, S.Sahni, 2nd Edition, 2004, University Press (India) Pvt. Ltd.
2. *Data structures and Algorithms in C++,* Michael T.Goodrich, R.Tamassia and .Mount, 2nd Edition, 2011, John Wiley and Sons

Reference Books:

1. Seymour Lipschutz, *Data Structures*, 1st Edition (reprint) 2017, McGraw Hill Education.
2. Yashavant P. Kanetkar, *Data Structure through C++*, 2nd Edition, 2003, BPB Publications.

Paper II/Subject Name: Computer Architecture		**Subject Code: CAP052M202**
Course Type: Major		**Course Level:100**
L-T-P-C – 3-0-0-3	**Credit Units: 03**	**Scheme of Evaluation: T**

Objective:

The objectives of the course are to make the students understand the machine instruction, basic computer organization and memory hierarchy with pipelining processing.

Prerequisites: Basics of Digital Logic and Computer Design

Course Outcomes

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	**Define** the different hardware and its working in a Computer Systems in architectural level	**BT 1**
CO 2	**Demonstrate** computer architecture concepts related to design of modern processors, memories, and I/O	**BT 2**
CO 3	**Solve** problems related to computer Organization and Architecture	**BT 3**
CO 4	**Analyse** the performance of commercially available computers in architectural level.	**BT 4**

Detailed Syllabus:

Modules	**Topics**	**Course Content**	**Periods**
I	**Introduction to Computer Hardware and Digital Logic**	Introduction to computer hardware- what is computer hardware, History of computing, the digital computer, PC versus workstation. Gates, circuits, and combinational logic- Analog and digital systems, Fundamental gates, applications of gates,	**15**

		Introduction to Digital Works, introduction to Boolean algebra, Special-purpose logic elements, Programmable logic, Sequential logic, Combinational Circuits.	
II	**Machine Instruction**	Instruction Set Architecture, Assembly language Programming, Addressing modes, Instruction cycle, Registers and storage, RISC versus CISC architecture, Inside CPU.	**15**
III	**Computer Arithmetic & Information Representation**	Bits, bytes, words, and characters, Number bases, Number base conversion, Special-purpose codes, Error-detecting codes, Data-compressing codes, Binary arithmetic- half-adder, full-adder, addition of words, Signed numbers- Sign and magnitude representation, Complementary arithmetic, Two's complement representation, One's complement representation, Floating point numbers- Representation, Normalization, Floating point arithmetic, Multiplication and division.	**15**
IV	**CPU, Buses, Peripherals and Memory**	Input-Output device such as Disk, CD-ROM, Printer etc., Interfacing with IO device, Keyboard & Display Interface. Buses and input/output mechanisms- The bus, I/O fundamentals, Direct Memory Access, Parallel and serial interfaces. Computer memory- Static and Dynamic memory, Random and Serial Access Memories, Memory hierarchy, Memory technology, Cache memory	**15**
Total			**60**

Credit Distribution		
Lecture/ Tutorial	**Practicum**	**Experiential Learning**
3*20 NCH = 60 NCH	-	30 NCH (Problem Solving, Seminar, Case Study, Discussion, Internship, Project)

Text Book:

1. *Computer System and Architecture*, Moris Mano, 3rd Edition, 2007, PHI.
2. *Structured Computer Organization,* A. S. Tanenbaum, 5th Edition, 2009, Prentice Hall of India

Reference Books:

1. V. C. Hamacher, Z. G. Vranesic and S. G. Zaky*, Computer Organization,* 5th Edition, 2002 McGraw Hill.
2. J. L. Hennessy and D. A. Patterson, *Computer Architecture: A Quantitative Approach,* 4/e, 2006, Morgan Kaufmann.
3. D. V. Hall, *Microprocessors and Interfacing,* 2nd Edition, 2006, McGraw Hall.

- **Detailed Syllabus of Minor Course**

Paper III/Subject Name: Server-Side Programming		**Subject Code: CAP052N201**
Course Type: Minor		**Course Level: 100**
L-T-P-C – 2-1-0-3	**Credit Units: 03**	**Scheme of Evaluation: T**

Objective:

The objectives of the course are to teach students the process to build web applications using the Ruby on Rails framework.

Prerequisites: None

Course Outcomes

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	**Define** building blocks of web application in Rubby on Rails framework	**BT 1**
CO 2	**Understand** the process of building web applications using Rails database	**BT 2**
CO 3	**Build** simple sever side web applications.	**BT 3**
CO 4	**Compare** and **criticise** the design of web applications.	**BT 4 & 5**

Detailed Syllabus:

Modules	**Topics**	**Course content**	**Periods**
I	**Introduction**	Using of GitHub, collaboration of code with others using the git tool, an introduction to Ruby, set up a developer environment and VSCode for Ruby and use irb, basics of Ruby programming language, the use of Ruby hashes and how to write recursive methods, POSIX command line and best practices of git	**15**
II	**Object oriented Programming and Database**	Introduction to object-oriented programming, define classes and also understand the difference between two types of relationships between classes - Composition and Inheritance Introduction to databases and set up a PostgreSQL database connect to a database from a Ruby application Active Record models to manipulate data. RubyGems development of Rails application and connection to the PostgreSQL database	**15**

III	**HTML, CSS & ERB Pipeline**	Basics of the CRUD pattern, designing their HTML pages with CSS and experimenting with using classes, selectors and layouts, basics of the MVC pattern, render dynamic data inside their HTML pages using ERB templates,	**15**
IV	**HTML forms and Rails form helpers & User Authentication**	Accept user input on their application via form element in HTML and also using Rails form helper creation of resources using forms, and learn about Cross Site Request Forgery (CSRF), authenticity tokens, ActiveRecord association, migration and validation password storage and play around with browser cookies, sessions, user authentication	**15**
Total			**60**

Credit Distribution		
Lecture/ Tutorial	**Practicum**	**Experiential Learning**
3*20 NCH = 60 NCH	-	30 NCH (Problem Solving, Seminar, Case Study, Discussion, Internship, Project)

Text Book:

1. *Learn Rails 6: Accelerated Web Development with Ruby on Rails*, Adam Notodikromo ,1st Edition, 2020, Apress

Reference Books:

1. Joseph Joyner, *Ruby on Rails For Beginners: Rails Web Development Programming and Coding Tutorial,* 2nd Edition, 28 September 2015, Minhails Konoplovs

- **Detailed Syllabus of Skill Enhancement Courses (SEC-II)**

Paper VI/Subject Name: Computer Hardware and Networking		**Subject Code: CAP052S201**
Course Type: SEC		**Course Level: 100**
L-T-P-C – 2-1-0-3	**Credit Units: 03**	**Scheme of Evaluation: T**

Objective:

The objectives of the course are to explain the different hardware components of a computer system and learn its assembling and disassembling along with various networking devices.

Prerequisites: None

Course Outcomes

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	**Define** different types of Computers and Networking hardware and software	**BT 1**
CO 2	**Understand** basic idea of installation process and components of a PC	**BT 2**
CO 3	**Experiment** with some hardware components to assemble a computer system or network system.	**BT 3**
CO 4	**Analyse** and **evaluate** different computer systems, network and server for their use.	**BT 4 & 5**

Detailed Syllabus:

Modules	**Topics**	**Course content**	**Periods**
I	**Basics of Computer**	Basic Introduction About (Hardware & Software) OS installation (Windows & Linux) , Operating Systems (Edition, Requirement, Types of Installation, Driver Installation) Dual OS installation, Dos Command, Backup and Restore, User Control, Control Panel Computer Peripherals – (Input and Output Devices, Primary Component, Computers Language, Serial and parallel Communication, SMPS) Motherboard (Type, form factor, BUS, IRQ, Chipset, I/O Ports and Connectors, CMOS) Memory (Type, Memory Modules, Development of RAM Comparison of RAM, Virtual Memory, BIOS, POST) Hard Disc (Type, Port, File systems, jumper Setting, Disk Type, Components) Processor (Type, ZIF and SEC, Supports, Virtual Support, Cache, Cores information) External Drives (CD and DVD Drive, Blue-ray, Floppy Disk, Modem, and Printers) Ubuntu (H/W Requirement, basic Command, installation)Assembling and Dis-assembling components, Component upgrade Troubleshooting	**15**

II	**Network Devices and IP Addressing**	Introduction (Types of Networks, Topology, protocols, and Ports) Networking devices (Routers, Switches, Hub, Repeater, NIC Cards, Bridge) Networking Media (Wire, Wireless, Cables, Crimping, UTP) Networking Layers (OSI, TCP/IP) IP Addresses (Version, Classes, Types) Subnetting (VLSM, FLSM, CIDR, Super netting) Setting IP addresses, Sharing files and folders. Network troubleshooting with PING test, ipconfig etc.	**15**
III	**Basics of Networking**	Routing, Routing Components, Ports, Network Simulators (CISCO Packet Tracer), Networking Functions (Static, and Default Routing, Password) Dynamic Routing 1 (RIP1, RIP2, Troubleshooting Commands) Dynamic Routing 2 (IGRP, EIGRP, and OSPF) Routing Security (Standard, Extended, Named ACL) Switching 1 (Types, Command, Password, VLAN, and Commands) Switching 2 (Inter VLAN and Commands, Trunking Protocol, VTP, STP) WAN Security (Static Dynamic, and PAT NAT), Basic Network Troubleshooting	**15**
IV	**Servers**	Basics of configuring NFS, NIS, DNS, FTP, Squid Proxy, DHCP server Mail server, Web server(Apache), File server(Samba), ip tables and firewall	**15**
Total			**60**

Credit Distribution		
Lecture/ Tutorial	**Practicum**	**Experiential Learning**
3*20 NCH = 60 NCH	-	30 NCH (Problem Solving, Seminar, Case Study, Discussion, Internship, Project)

Text Book:

1. Computer Hardware & Networking With Free CD, A Panel of Authors, 2nd Edition, 2021, Computech Publications

Reference Books:

1. Ajit Mittal and Ajay Rana, *Mastering Pc Hardware And Networking,* 1st Edition, 2014, Khanna Book Publishing.
2. Joginder Singh Saini and Jagdeep Singh Saini, *Royal new pattern computer hardware & network maintenance,* 1st Edition, 2017, Royal Book Dept.

- **Detailed Syllabus of Indian Knowledge System Course**

Paper IV/Subject Name: Introduction to Indian Knowledge System-II		**Subject Code: IKS982I201**
Course Type: IKS		**Course Level: 100**
L-T-P-C – 3-0-0-3	**Credit Units: 03**	**Scheme of Evaluation: T**

Objectives:
The objective of this course id to present an overall introduction to all the streams of IKS relevant to the UG programme. It would enable students to explore the most fundamental ideas that have shaped Indian Knowledge Traditions over the centuries.

Prerequisite: Basic knowledge of IKS-I

Course Outcomes:
On completion of this course students will be expected to –

CO	Contents	BT Level
CO_1	**Recall** about classical literature in Sanskrit and other languages	BT 1
CO_2	**Recall** traditional Indian knowledge system and Indian education	BT 1
CO_3	**Summarize the Indian** Art, Architecture, Agriculture, Polity and Economy	BT 2

Detailed Syllabus:

Module	Course Contents	Periods
I	**Classical Literature in Sanskrit and Other Indian Languages**: The nature and purpose of Kavya. Drisya and Sravya Kavyas. The ideas of Indian aestheticians on what constitutes the soul of Kavya. Important examples of classical literature in Sanskrit and other Indian languages **Indian Education**: Preservation of culture, tradition and Dharma through education. Svadhyaya, Pravachana. Also continuity of the family and the vamsha, who are the carriers of knowledge, tradition and Dharma. The extent, inclusiveness and the sophistication of indigenous education in early19th century India. **The Purpose of Knowledge in India**: Para Vidya and Apara Vidya. The corpus connected with Para Vidya. Learning and formalization of concepts associated with Para Vidya also form part of Apara. Apara Vidya. Nature and purpose of sciences, technologies, and all human knowledge concerning the world and the society. The concept of Rita, Dharma. The cycle of mutual dependence of humans and all aspect of creation. Yajna and the inviolable discipline of sharing and caring.	14
II	**Methodology of Indian Knowledge System**: Systematization of knowledge fields as Sastra. Each Sastra has a clearly defined purpose in Vyavahara. The means of valid knowledge (Pramanas). Perception (Pratyaksha), Inference (Anumana) and Textual Tradition (Agama), as discussed in the canonical texts of all the disciplines. The importance of Pratyaksha and Agama in relation to Anumana. **Indian Architecture and Town Planning**: The importance of Sthapatya-veda. The ancient cities of the Indus Saraswati region. Town planning and drainage systems. Examples of the significance of architecture and materials in Ramayana and Mahabharata. Public opulence and private austerity in Indian architecture. Why there are many more of Temples than Palaces. Important texts of Architecture and Sculpture. The prevalence of high Indian architecture in almost all parts of India except the Ganga plains. Examples of high Indian architecture from ancient and medieval periods from different parts of India. The building of Jaipur in the 18th century. How temple art and architecture continue to flourish in modern India. **Indian Fine Arts:** The importance of Gandharva-veda. Natyasastra on the nature and purpose of fine arts. Basic concepts of Indian music and dance. Important texts of Indian music, dance and painting. Indian musical instruments. Different schools of music, dance and painting in different regions of India. Important examples of Indian painting in various part of India. Musicology as a science. Harmonising Lakshya and Lakshana (practise and theory). Major developments in the science and practice of music the 17/18/19th centuries. The current revival of music and dance in India.	22
III	**Indian Agriculture**: The significance of agriculture and irrigation as emphasised in the Ramayana, Mahabharata and other texts. Mention of Indian agriculture by the Greek historians and later travellers. Significance of agriculture and irrigation for the kings of Indian tradition. Major water-bodies of the ancient times. The Ery system of south India. Excellence of Indian agricultural technologies as observed by more recent European observers. Productivity of Indian agriculture in medieval Thanjavur and eighteenth century Allahabad, Chengalpattu, etc. Indian attitude towards agriculture, based on Walker and later reports. **Indian Textiles**: India as the ancient home of cotton and silk fabrics. Weaving	15

	formed the most significant part of Indian economy after agriculture. Varieties of textiles and dyes developed in different regions of India. India as a leading exporter of textiles in the world in the 17/18/19th centuries. **Indian Metallurgy:** Vedic references to metals and metal working. Mining and manufacture in India of Zinc, Iron, Copper, Gold, etc., from ancient times. Indian texts which refer to metallurgy. Important specimens of metal workmanship preserved/found in different parts of India. The significance and wide prevalence of ironsmith and other metal workers in the pre-modern era. European observers on the high quality and quantity of Indian iron and steel in the 18/19th centuries.	
IV	**Indian Polity and Economy**: Indian conception of well-organised Polity and flourishing Economy as expounded in the foundational texts. The notion of Bharartavarsha as a Chakravarti-Kshetra and important attributes of Chakravartin. King as the protector of Dharma. King as the strength and support of the weak. King as the protector of Varta. King as the protector of the times. Meaning of Varta: Krishi, Gopalana and Vanijya forming the basis of Varta and the core of economic activity in society. The importance of sharing. Grama as the centre of the polity. **The Outreach of Indian Knowledge System**: The outreach of Indian Knowledge System beyond Indian boundaries forms the ancient times. Outreach to East, Southeast, Central and Southeast Asia of Indian phonetic script, decimal value place system-based arithmetic, algebra, astronomy and calendar, medical pharmacopeia, architecture, methods of making iron and steel, cotton textiles, etc. The transmission of Indian linguistics, knowledge of plants, iron and steel metallurgy, textiles and dyeing, shipbuilding etc., to Europe in 17/18/19th centuries. Current global outreach of Ayurveda, Yoga and Indian Fine Arts.	15
	Total	66

Credit Distribution		
Lecture/ Tutorial	**Practicum**	**Experiential Learning**
3 * 22 NCH = 66 NCH	-	8 * 3 NCH = 24 NCH (Problem Solving, Seminar, Case Study, Discussion, Internship, Projects)

Textbooks:

1. *Samskrta Śāstrom ka Itihās,* Baladev Upadhyaya, 2010, Chowkhambha, Varanasi.
2. *A Concise History of Science in India,* D. M. Bose, S. N. Sen and B. V. Subbarayappa, Eds., 2nd Edition, 2010, Universities Press, Hyderabad

Reference Books:

1. Astāngahrdaya, Vol. I, Sūtrasthāna and Śarīrasthāna, Translated by K. R. Srikantha Murthy, Vol. I, Krishnadas Academy, Varanasi, 1991.
2. Dharampal, Some Aspects of Earlier Indian Society and Polity and Their Relevance Today, New Quest Publications, Pune, 1987.
3. Dharampal, Indian Science and Technology in the Eighteenth Century: Some Contemporary European Accounts, Dharampal Classics Series, Rashtrotthana Sahitya, Bengaluru, 2021
4. Dharampal, The Beautiful Tree: Indian Indigenous Education in the Eighteenth Century, Dharampal Classics Series, Rashtrotthana Sahitya, Bengaluru, 2021.
5. J. K. Bajaj and M. D. Srinivas, Indian Economy and Polity in Eighteenth century Chengalpattu, in J. K. Bajaj ed., Indian Economy and Polity, Centre for Policy Studies, Chennai, 1995, pp. 63-84.

6. J. K. Bajaj and M. D. Srinivas, Annam Bahu Kurvita Recollecting the Indian Discipline of Growing and Sharing Food in Plenty, Centre for Policy Studies, Chennai, 1996.
7. J. K. Bajaj and M. D. Srinivas, Timeless India Resurgent India, Centre for Policy Studies, Chennai, 2001.
8. M. D. Srinivas, The methodology of Indian sciences as expounded in the disciplines of Nyāya, Vyākarana, Ganita and Jyotisa, in K. Gopinath and Shailaja D. Sharma (eds.), The Computation Meme: Explorations in Indic Computational Thinking, Indian Institute of Science, Bengaluru, 2022 (in press).

- **Detailed Syllabus of Ability Enhancement Course: 1+1=2 Credits**

Paper V/Subject Name: Approaches to Verbal and Non-Verbal Communication		**Subject Code: CEN982A201**
Course Type: AEC		**Course Level: 100**
L-T-P-C – 1-0-0-1	**Credit Units: 01**	**Scheme of Evaluation: T**

Course Objectives

To introduce the students to the various forms of technical communication and enhance their knowledge in the application of both verbal and non-verbal skills in communicative processes.

Course Outcomes

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	**Identify** the different types of technical communication, their characteristics, their advantages and disadvantages.	**BT 1**
CO 2	**Explain** the barriers to communication and ways to overcome them.	**BT 2**
CO 3	**Discover** the means to enhance conversation skills.	**BT 3**
CO 4	**Determine** the different types of non-verbal communication and their significance.	**BT 3**

Detailed Syllabus

Modules	Topics (if applicable) & Course Contents	Periods
I	**Technical Communication** Communicating about technical or specialized topics, Different forms of technology-enabled communication tools used in organisations Telephone, Teleconferencing, Fax, Email, Instant messaging, Blog, podcast, Videos, videoconferencing, social media	**5**
II	**Communication Barriers** Types of barriers: Semantic, Psychological, Organisational, Cultural, Physical, and Physiological. Methods to overcome barriers to communication.	**5**
III	**Conversation skills/Verbal Communication** Conversation – Types of Conversation, Strategies for Effectiveness, Conversation Practice, Persuasive Functions in Conversation, Telephonic Conversation and Etiquette Dialogue Writing, Conversation Control.	**5**
IV	**Non-verbal Communication** Introduction; Body language- Personal Appearance, Postures, Gestures, Eye Contact, Facial expressions Paralinguistic Features-Rate, Pause, Volume, Pitch/Intonation/ Voice/ modulation Proxemics , Haptics, Artifactics, Chronemics	**5**
	Total	**20**

Credit Distribution		
Lecture/Tutorial	**Practicum**	**Experiential Learning**
20 hours	-	10 hours - Movie/ Documentary screening - Peer teaching - Seminars - Field Visit

Textbooks:

1. Rizvi, M. Ashraf. *Effective Technical Communication*. 2017. McGraw-Hill.
2. Chaturvedi, P. D. and Chaturvedi, Mukesh. *Business Communication.* 2014. Pearson.
3. Raman, Meenakshi and Sharma, Sangeeta. *Technical Communication: Principles and Practice*, 2nd Edition. 2011. Oxford University Press.

Reference Books:

1. Hair, Dan O., Rubenstein, Hannah and Stewart, Rob. *A Pocket Guide to Public Speaking.* 5th edition, 2015. St. Martin's. ISBN-13:978-1457670404
2. Koneru, Aruna. *Professional Communication*. 2017. Tata McGraw Hill ISBN-13: 978-0070660021
3. Raman, Meenakshi and Singh, Prakash. *Business Communication*. 2nd Edition. 2012. Oxford University Press
4. Sengupta, Sailesh. *Business and Managerial Communication*. 2011. PHI Learning Pvt. Ltd.

Paper V/Subject Name: Behavioural Sciences -II		**Subject Code: BHS982A102**
Course Type: AEC		**Course Level: 100**
L-T-P-C – 1-0-0-1	**Credit Units: 01**	**Scheme of Evaluation: T**

Course Objectives

To increase one's ability to draw conclusions and develop inferences about attitudes and behaviour, when confronted with different situations that are common in modern organizations.

Course Outcomes

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	**Understand** the concept of leadership spirit and to know its impact on performance of employees.	**BT 2**
CO 2	**Understand** and apply the concept of Motivation in real life.	**BT 2**
CO 3	**Develop** an elementary level of understanding of culture and its implications onpersonality of people	**BT 3**

Modules	**Course Contents**	**Periods**
I	**Culture and Personality** Culture: Definition, Effect, relation with Personality, Cultural Iceberg, Overview of Hofstede's Framework, Discussion of the four dimensions of Hofstede's Framework.	**5**
II	**Attitudes and Values** Attitude's definition: changing our own attitudes, Process of cognitive dissonance Types of Values, Value conflicts, Merging personal and Organizational values	**5**
III	**Motivation** Definition of motivation with example, Theories of Motivation (Maslow, McClelland's theory& Theory X and Y)	**5**

IV	**Leadership** Definition of leadership, Leadership continuum, types of leadership, Importanceof Leadership, New age leaderships: Transformational & transactional Leadership, Leaders as role models.	**5**
	Total	**20**

Credit Distribution		
Lecture/Tutorial	**Practicum**	**Experiential Learning**
20 hours	-	10 hours - Movie/ Documentary screening - Peer teaching - Seminars - Field Visit

Text books:

1. J William Pfeiffer (ed.) Theories and Models in Applied Behavioural Science, Vol 3,Management, Pfeiffer &Company
2. Blair J. Kolasa, Introduction to Behavioural Science for Business, John Wiley & SonsInc.
3. Organizational Behaviour by Kavita Singh (Vikas publishers, 3rd Edition).

- **Detailed Syllabus of Value-Added Course (VAC-II)**

Paper VII/Subject Name: Basket Course 2		**Subject Code:** VAC992V2409
Course Type: VAC		**Course Level: 100**
L-T-P-C – 3-0-0-3	**Credit Units: 03**	**Scheme of Evaluation: T/P**

***** These subjects are Basket Courses that needs to be opted from other Departments/ Schools by the students of RSIT**

SYLLABUS (3rd SEMESTER)

Paper I/Subject Name: JAVA Programming		**Subject Code:** CAP052M301
Course Type: Major		**Course Level:200**
L-T-P-C – 3-0-2-4	**Credit Units: 04**	**Scheme of Evaluation: T**

Objective:

The objectives of the course are to teach the concepts and implementations of object-oriented programming using JAVA language.

Prerequisites: Basics of Procedural or Object-Oriented Programming

Course Outcomes

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	**Define** basic structures, constructs, control structure and syntax of JAVA	**BT 1**
CO 2	**Understand** basic idea of object-oriented programming using JAVA	**BT 2**
CO 3	**Apply** the concepts of Java, multithreading and Exception handling to develop efficient and error free codes.	**BT 3**
CO 4	**Analyse** and **evaluate** JAVA programs for its efficiency	**BT 4 & 5**

Detailed Syllabus:

Modules	**Topics**	**Course content**	**Periods**
I	**Introduction**	A look at procedure-oriented programming, Object-oriented paradigm, Basic concepts of object-oriented programming (OOP) (encapsulation, inheritance, polymorphism), How Java differs from C and C++, Applications of OOP. Overview of JAVA, Use of math functions, comments, Constructing a java program, Introduction of JVM, Command line argument, Data types, Variables: declaration, scope, Type Conversion and Type Casting, Constants, Operators, Evaluation of Expression, Precedence of Operators, Control statements: selection, iteration, and jump, Introduction to Socket Programming.	**15**
II	**Classes and Objects**	Class: definition and example, Declaring objects, Method overloading and overriding, Binding: concept of binding, static vs. dynamic binding, Using this and super keywords, Access Control, Inheritance: Extending a class, Final, Abstract classes, Constructors Arrays: one-dimensional and multi-dimensional, Strings: string processing functions	**15**
III	**Packages, Interfaces, Exception Handling**	Defining a package, accessing a package and using a package, Interfaces: multiple inheritance, Defining interfaces, implementing interfaces and extending interfaces. Exception handling fundamentals, Exception type: using try…catch, Multiple catch clauses, Throw and Throws Creating threads, Extending the thread class, Stopping and blocking a thread, Life cycle of thread, Threads methods, Thread exceptions, , JDBC,	**15**
IV	**Applets and Files**	Introduction: local and remote applets, How to write applets, Building applet code, Applet life cycle, Creating an executable applet I/O basics, concept of streams, Stream classes: byte stream classes, character stream classes, I/O exceptions, Creation of files, Random	**15**

		access files	
Total			**60**

Text Books:

1. *Programming with Java: A Primer*; Balagurusamy E., 3rd Edition, 2005, Tata McGraw-Hill, New Delhi
2. *Thinking in Java*, Eckel B., 4th Edition, 2006, PHI.

Reference Books:

1. Maurice N. et al, *Java Generics and Collections*, 1st Edition, 2006, O'REILLY Publication.
2. Booch G., Rumbaugh J. Jacobson I., *The Unified Modeling Language User Guide*, 2nd Edition, 2005, Pearson Education.
3. Schildt H., *The Complete Reference Java,* 7th Edition, 2007, Tata McGraw-Hill, New Delhi

JAVA Programming Lab

Objective:

The objectives of this course are to make the students understand and analyze practically the utility of JAVA programming language.

Prerequisites: Basics of Procedural or Object-Oriented Programming

Detailed Syllabus:

Total Lab Hours for the semester = 48 (4 hours per week)

Minimum 20 Laboratory experiments based on the following-

- Write a program in java that outputs your name in giant letters.
- Write a program in Java to find the day of the week of a given date.
- Write a program in Java called Grades Statistics, which reads in n grades (of int between 0 and 100, inclusive) and displays the average, minimum, maximum, and standard deviation.
- Write a program in Java to compute execution time by generating random numbers.
- Write a program in Java to implement the following:
    a. Tokenize the paragraph into single word.
    b. Find the number of word in a paragraph?
    c. Find the number of similar words from the input word.
    d. Find the number of occurrence of each word.
- Write a program in Java to implement some inheritance hierarchy.
- Design and implement an address book object that contains a person's name, home address and phone number, business address and phone number, and numbers for their fax machine, cellular phone, and pager. Write a program in Java to this test plan for the object and implement a driver [finally prepare a package].
- Write a program in Java to demonstrate the use of try, catch, finally throw and throws keywords and demonstrate the following points in the program.
    a. Multiple catch blocks.
    b. try-catch-finally combination.
    c. try-finally combination.
    d. Exception propagation among many methods.
    e. Use of getMessage(), printStackTrace() function of Throwable class.
    f. Nested try blocks
- Write a program that does the following.
    a. Prompts the user for an input file name through a dialog box.
    b. Prompts the user for an output file name through a dialog box.
    c. Copies the input file into the output file, subject to the removal of the space characters listed below from each line.
        i. The leading space characters
        ii. The trailing space characters
        iii. The space characters that are preceded by space characters
- Write a program in Java to design forms.

- Write a program in Java to design a student information form to enter data into the database.
- Write a program in Java to connect some form designed with the back-end database and test them by inserting some records.

Text Books:

1. *Programming with Java: A Primer*; Balagurusamy E., 3rd Edition, 2005, Tata McGraw-Hill, New Delhi
2. *Thinking in Java*, Eckel B., 4th Edition, 2006, PHI.

Reference Books:

1. Maurice N. et al, *Java Generics and Collections*, 1st Edition, 2006, O'REILLY Publication.
2. Booch G., Rumbaugh J. Jacobson I., *The Unified Modeling Language User Guide*, 2nd Edition, 2005, Pearson Education.
3. Schildt H., *The Complete Reference Java,* 7th Edition, 2007, Tata McGraw-Hill, New Delhi

Credit Distribution		
Lecture/ Tutorial	**Practicum**	**Experiential Learning**
3* 20 NCH = 60 NCH	2 * 15 NCH = 30 NCH	8 * 2 NCH = 16 NCH (Problem Solving, Seminar, Case Study, Discussion, Internship, Projects)

Paper II/Subject Name: Database Management Systems		**Subject Code: CAP052M302**
Course Type: Major		**Course Level:200**
L-T-P-C – 3-0-2-4	**Credit Units: 04**	**Scheme of Evaluation: T**

Objective:

The objectives of the course are to make the students learn about databases and the process of designing and constructing data models.

Prerequisites: C/C++, Concepts of Data Structures.

Course Outcomes

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	**Define** various terms used in Database Management system	**BT 1**
CO 2	**Understand** the basic concepts and applications of database systems	**BT 2**
CO3	**Apply** the basic concepts to design Database	**BT 3**
CO 4	**Evaluate** the process Database design, transaction processing and concurrency control	**BT 4**

Detailed Syllabus:

Modules	Topics	Course content	Periods
I	**Introduction**	Introduction to Data System, Drawbacks of Conventional File System, Purpose of database systems, DBMS Components, Architecture, Data Independence, Data modelling, Entity Relationship Model, Relational, Network, Hierarchical and object-oriented models, Data Modelling using the Entity Relationship Model.	**15**
II	**Relational Databases**	Relational databases, relational algebra, relational calculus. Data definition with SQL, insert, delete and update statements in SQL, views, data manipulation with SQL, triggers and assertions, cursors, Embedded SQL	**15**
III	**Normalization**	Relational Database Design guidelines, Integrity Constraints, Domain Constraints, Referential integrity, Functional Dependency, Normalization using Functional Dependencies, Normal forms (1NF, 2NF, 3NF, BCNF), Multi-valued Dependencies and Forth Normal Form, Join Dependencies and Fifth Normal Form, Pitfalls in Relational Database Design, Lossless Non-additive Join Property of Decomposition, Dependency Preserving Decomposition	**15**
IV	**Transaction Processing, Concurrency and Recovery**	Introduction. ACID Properties, Schedules and Recoverability -Serializability of Schedules- Concurrency Control, Database Recovery Concepts- Caching, Checkpoints, Transaction Rollback, Case Study-Recovery Techniques in DBMS	**15**
Total			**60**

Text Book:

1. *Fundamentals of Database System,* Elmasri, Navathe, 7th Edition, 2016, Pearson Education Asia
2. *Database System Concepts*, Korth H.F., Silberschatz A.; 6th Edition, 2013, Mc Graw Hill.
3. *Introduction to Database Management System*, Kahate A., 1st Edition, 2004, Pearson Educations
4. *DataBase Management System*, Paneerselvam, 2nd Edition, 2011, PHI Learning

Reference Books:

1. Date C.J.*, An Introduction to Database Systems,* 8th Edition, 2003, Pearson Education Asia
2. Desai B.C., *An Introduction to Database Systems,* Revised Edition, 2012, Galgotia Publications

Database Management Systems Lab

Objective:

The objectives of the course to teach the student database design and query processing through MySql.

Prerequisites: C/C++, Concepts of Data Structures

Detailed Syllabus:

Total Lab Hours for the semester = 48 (4 hours per week)

Minimum 20 Laboratory experiments based on the following-

- Creation, altering and dropping of tables and inserting rows into a table (use constraints while creating tables) examples using SELECT command.
- Queries (along with sub Queries) using ANY, ALL, IN, EXISTS, NOTEXISTS, UNION, INTERSET,
- Queries using Aggregate functions (COUNT, SUM, AVG, MAX and MIN), GROUP BY, HAVING and Creation and dropping of Views.
- Queries using Conversion functions (to_char, to_number and to_date), string functions (Concatenation, lpad, rpad, ltrim, rtrim, lower, upper, initcap, length, substr and instr), date functions (Sysdate, next_day, add_months, last_day, months_between, least, greatest, trunc, round, to_char, to_date)
- Creation of simple PL/SQL program which includes declaration section, executable section and exception – Handling section (Ex. Student marks can be selected from the table and printed for those who secured first class and an exception can be raised if no records were found)
- Insert data into student table and use COMMIT, ROLLBACK and SAVEPOINT in PL/SQL block.
- Develop a program that includes the features NESTED IF, CASE and CASE expression. The program can be extended using the NULLIF and COALESCE functions.
- Program development using WHILE LOOPS, numeric FOR LOOPS, nested loops using ERROR Handling, BUILT –IN Exceptions, USE defined Exceptions, RAISE- APPLICATION ERROR.
- Programs development using creation of procedures, passing parameters IN and OUT of PROCEDURES.
- Program development using creation of stored functions, invoke functions in SQL Statements and write complex functions.
- Develop programs using features parameters in a CURSOR, FOR UPDATE CURSOR, WHERE CURRENT of clause and CURSOR variables.
- Develop Programs using BEFORE and AFTER Triggers, Row and Statement Triggers and INSTEAD OF Triggers

Text Book:

1. *Fundamentals of Database System,* Elmasri, Navathe, 7th Edition, 2016, Pearson Education Asia
2. *Database System Concepts*, Korth H.F., Silberschatz A., 6th Edition, 2013, Mc Graw Hill.

Reference Books:

1. Date C.J.*, An Introduction to Database Systems,* 8th Edition, 2003, Pearson Education Asia
2. Desai B.C., *An Introduction to Database Systems,* Revised Edition, 2012, Galgotia Publications

Credit Distribution		
Lecture/ Tutorial	**Practicum**	**Experiential Learning**
2 * 22 NCH = 44 NCH	2 * 15 NCH = 30 NCH	8 * 2 NCH = 16 NCH (Problem Solving, Seminar, Case Study, Discussion, Internship, Projects)

- **Detailed Syllabus of Minor Course**

Paper III/Subject Name: Front-End Development with React		**Subject Code: CAP052N301**
Course Type: Minor		**Course Level: 100**
L-T-P-C – 3-1-0-4	**Credit Units: 04**	**Scheme of Evaluation: T**

Objective:

The objectives of the course are to teach the students about React & Type Script to enable them to create web pages.

Prerequisites: Fundamentals of Web Development and Server Programming

Course Outcomes

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	**Define** semantics and syntax of Typescripts.	**BT 1**
CO 2	**Understand** static types and know how to port untyped JavaScript	**BT 2**
CO 3	**Apply** the concepts learnt to create Single Page Web Applications (SPA) using React, Typescript and Tailwind CSS.	**BT 3**
CO 4	**Inspect** different elements of front-end development	**BT 4**

Detailed Syllabus:

Modules	Topics	Course content	Periods
I	**React Fundamentals and Sate Management**	Introduction to TypeScript by setting up a development environment, the TypeScript programming language and the React framework, and demonstrates some of the basic concepts that underpin the use of React for building dynamic reactive user interfaces. the Hooks feature of React on the usage of call-back functions and how to use them to build dynamic components that maintain an internal state. Standard hooks and the creation and use of custom hooks. This module also demonstrates state management by building a form and accepting user input.	**09**
II	**Client-side routing**	The concept of client-side routing as a separate behaviour from server-side route management. Demonstration of the various aspects of client-side routing such as the use of path parameters, query parameters, programmatic navigation and the operation of links and URLs that are handled client-side.	**09**
III	**Modelling and managing complex states**	Managing complex states using the state reducer pattern, and then demonstrates the pattern by implementing it using Reacts use Reducer hook. Introduction to APIs to interface client-side code with the server-side, creating model types to allow interaction to take place, maintain a session with the backend, and working with pageable APIs	**09**
IV	**Production React Apps**	Front-end development including the importance of accessibility and WAI-ARIA standards, and use of third-party packages from the NodeJS ecosystem. Production-specific optimizations of a React application, build & deployment process, and configuration of a progressive web app.	**09**
Total			**36**

Textbooks:

1. *Learn React with TypeScript 3: Beginner's guide to modern React web development with TypeScript 3,* Carl Rippon, 2018, Pact Publishing.
2. *Full-Stack React, TypeScript, and Node: Build cloud-ready web applications using React 17 with Hooks and GraphQL* , David Choi, 2020, Packt Publishing Limited.

Reference Books:

1. Frank Zammetti, *Modern Full-Stack Development: Using TypeScript, React, Node.js, Webpack, Python, Django, and Docker*, 2nd Edition, 2022, APress

Credit Distribution		
Lecture/ Tutorial	**Practicum**	**Experiential Learning**
3*20 NCH = 60 NCH	2*15 NCH=30 NCH	30 NCH (Problem Solving, Seminar, Case Study, Discussion, Internship, Project)

- **Detailed Syllabus of Interdisciplinary Subject**

Paper IV/Subject Name: Introduction to Python		**Subject Code: INT052I301**
Course Type: IS		**Course Level: 200**
L-T-P-C – 2-0-2-3	**Credit Units: 03**	**Scheme of Evaluation: T**

Objective:

The objectives of the course are to teach the students about Programming with Python and use it to solve real world problems.

Prerequisites: Fundamentals of Computers

Course Outcomes

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	**Define** uses systematic, syntax and control structures of Python	**BT 1**
CO 2	**Understand** the basic concepts and terminologies of Python Programming	**BT 2**
CO 3	**Apply** the concepts learnt to write efficient programs	**BT 3**
CO 4	**Analyze** and **evaluate** the codes to fix the errors	**BT 4 & 5**

Detailed Syllabus:

Modules	**Topics**	**Course content**	**Periods**

I	**Introduction to Python**	Introduction to Python Programming: Python interpreter/shell, indentation; identifiers and keywords; literals, numbers, and strings; operators (arithmetic operator, relational operator, Boolean operator, assignment, operator, ternary operator and bitwise operator) and expressions	**09**
II	**Programming With Python**	Input and output statements, defining functions, control statements (conditional statements, loop control statements, break, continue and pass, exit function.), default arguments,	**09**
III	**Python Functions and Strings**	Python Functions , Python Lambda, Python Arrays, Python Classes/Object, Inheritance, Iterator, Polymorphism , Scope, Modules, Dates, Maths, JSON,RegEx, PIP, User Input , Strings	**09**
IV	**Python Modules**	Introduction to Numpy, Pandas,SciPy, Dijango	**09**
Total			**36**

Introduction to Python Programming Lab

Detailed Syllabus:

Total Lab Hours for the semester = 30 (2 hours per week)

Minimum 20 Laboratory experiments based on the following-

1. **Hello World Program:**
   - Write a simple Python program to print "Hello, World!" to the console.
2. **Variable Declaration and Printing:**
   - Practice declaring variables of different types (int, float, string) and printing their values.
3. **Basic Arithmetic Operations:**
   - Write Python scripts to perform basic arithmetic operations such as addition, subtraction, multiplication, and division.
4. **Conditional Statements:**
   - Create programs using if-else statements to perform tasks based on certain conditions.
5. **Loops (for and while):**
   - Practice writing for and while loops to iterate over sequences or execute code repeatedly.
6. **Lists and List Operations:**
   - Explore lists in Python and perform operations like appending, removing, and accessing elements.

   Level: Intermediate
7. **Functions:**
   - Define and call functions to encapsulate reusable code blocks. Practice passing arguments and returning values from functions.
8. **String Manipulation:**
   - Work on tasks involving string manipulation, such as concatenation, slicing, and searching.
9. **File Handling:**
   - Write Python scripts to read from and write to files. Practice handling exceptions during file operations.
10. **Dictionaries and Sets:**
    - Experiment with dictionaries and sets in Python. Perform operations like adding, removing, and accessing elements in dictionaries and sets.
11. **Object-Oriented Programming (OOP) Concepts:**
    - Introduce students to OOP concepts like classes, objects, inheritance, and polymorphism. Have them implement simple classes and explore inheritance hierarchies.
12. **Exception Handling:**
    - Practice handling exceptions using try-except blocks to gracefully manage errors in Python programs.
13. **Data Structures and Algorithms:**
    - Implement common data structures (e.g., stacks, queues, linked lists) and algorithms (e.g., sorting, searching) using Python.
14. **Regular Expressions:**
    - Introduce regular expressions and their usage in Python for pattern matching and text processing tasks.

15. **Modules and Packages:**
    - Explore the concept of modules and packages in Python. Have students create their own modules and packages and import them into other scripts.
16. **GUI Programming with Tkinter:**
    - Introduce GUI programming using Tkinter. Have students create simple graphical user interfaces (GUIs) for basic applications

Credit Distribution		
Lecture/ Tutorial	**Practicum**	**Experiential Learning**
3*20 NCH = 60 NCH	2*15 NCH=30 NCH	30 NCH (Problem Solving, Seminar, Case Study, Discussion, Internship, Project)

Textbooks:

1. *Introduction to computation and programming using Python.* Guttag, J.V., 2nd Edition, 2016, MIT Press.

Reference Books:

1. Kamthane, A. N., & Kamthane, A.A. *Programming and Problem Solving with Python*, 2017, McGraw Hill Education.
2. Liang, Y. D., *Introduction to Programming using Python.* 2013, Pearson Education.

- **Detailed Syllabus of Ability Enhancement Courses (AEC-III)**

Paper VI/Subject Name: Fundamentals of Business Communication		**Subject Code: CEN982A301**
Course Type: AEC		**Course Level: 200**
L-T-P-C – 1-0-0-1	**Credit Units: 01**	**Scheme of Evaluation: T**

Objective:

The objectives of the course are to develop essential business communication skills, including effective writing, speaking, and interpersonal communication, to enhance professional interactions, collaboration, and successful communication strategies within diverse corporate environments.

Prerequisites: Basic understanding of the need to groom oneself for employment and the need for preparation of the same.

Course Outcomes

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	**Define** and **list** business documents using appropriate formats and styles, demonstrating proficiency in written communication for various business contexts.	**BT 1**
CO 2	**Demonstrate** confident verbal communication skills through persuasive presentations, active listening, and clear articulation to	**BT 2**
CO 3	**Apply** effective interpersonal communication strategies, including conflict resolution and active teamwork, to foster positive relationships and contribute to successful organizational communication dynamics	**BT 3**

Detailed Syllabus:

Modules	**Topics**	**Course content**	**Periods**
I	**Business Communication: Spoken and Written**	The Role of Business Communication • Classification and Purpose of Business Communication • The Importance of Communication in Management • Communication Training for Managers • Communication Structures in Organizations • Information to be Communicated at the Workplace • Writing Business Letters, Notice, Agenda and Minutes	**5**
II	**Negotiation Skills in Business Communication**	The Nature and Need for Negotiation o Situations requiring and not requiring negotiations • Factors Affecting Negotiation o Location, Timing, Subjective Factors • Stages in the Negotiation Process o Preparation, Negotiation, Implementation • Negotiation Strategies	**5**
III	**Ethics in Business Communication**	Ethical Communication • Values, Ethics and Communication • Ethical Dilemmas Facing Managers • A Strategic Approach to Business Ethics • Ethical Communication on Internet • Ethics in Advertising	**5**

IV	**Business Etiquettes and Professionalism**	Introduction to Business Etiquette • Interview Etiquette • Social Etiquette • Workplace Etiquette • Netiquette	**5**
Total			**20**

Credit Distribution		
Lecture/ Tutorial	**Practicum**	**Experiential Learning**
1*20 NCH = 20 NCH	-	10 NCH -Group Discussion -Case -Presentation -Quiz

Text Book:

1. *Business Communication,* Shalini Verma, 2nd Edition, 2024, Vikas

Reference Books:

1. PD Chaturvedi and Mukesh Chaturvedi, *Business Communication,* 4th Edition, 2017, Pearson
2. Meenakshi Raman and Sangeeta Sharma, *Technical Communication,* 3rd Edition, 2015, OUP

Objective:

The objectives of the course are to increase one's ability to draw conclusions and develop inferences about attitudes and behaviour, when confronted with different situations that are common in modern organizations and to enable the students to understand the process of problem solving and creative thinking.

Prerequisites: None

Course Outcomes

On successful completion of the course the students will be able to:		
Sl No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	**Understand** the process of problem solving and creative thinking.	**BT 2**
CO 2	**Develop** and enhance of skills required for decision-making	**BT 3**

Detailed Syllabus:

Modules	**Topics**	**Course content**	**Periods**
I	**Problem Solving Process**	Defining problem, the process of problem solving, Barriers to problem solving (Perception, Expression, Emotions, Intellect, surrounding environment)	**5**
II	**Thinking as a tool for Problem Solving**	What is thinking: The Mind/Brain/Behaviour Critical Thinking and Learning: -Making Predictions and Reasoning. -Memory and Critical Thinking. - Emotions and Critical Thinking.	**5**
III	**Creative Thinking**	Definition and meaning of creativity, - The nature of creative thinking: Convergent and Divergent thinking, - Idea generation and evaluation (Brain Storming) - Image generation and evaluation. - The six-phase model of Creative Thinking: ICEDIP model	**5**
IV	**Building Emotional Competence**	Emotional Intelligence – Meaning, components, Importance and Relevance Positive and Negative emotions Healthy and Unhealthy expression of emotions	**5**
Total			**20**

Credit Distribution		
Lecture/ Tutorial	**Practicum**	**Experiential Learning**
1*20 NCH = 20 NCH	-	10 NCH -Group Discussion -Case -Presentation

		-Quiz

Text Book:

1. *Theories and Models in Applied Behavioural Science,* J William Pfeiffer, 1996, Pfeiffer &Company.

Reference Books:

1. Blair J. Kolasa, *Introduction to Behavioural Science for Business*, 1969, John Wiley & Sons Inc

- **Detailed Syllabus of Skill Enhancement Courses (SEC-III)**

Paper VI/Subject Name: System Administration		**Subject Code: INT052S301**
Course Type: SEC		**Course Level: 200**
L-T-P-C – 2-1-0-3	**Credit Units: 03**	**Scheme of Evaluation: T**

Objective:

The objectives of the course are to make the students familiar with system administration and tools and techniques used in it.

Prerequisites: Basics of Operating Systems

Course Outcomes

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	**Define** various system admirations command and tools	**BT 1**
CO 2	**Understand** the need of basic system administration and tools associated with it .	**BT 2**
CO 3	**Apply** system administration command and tools to administer Unix/Linux machines as standalone workstations or in a network	**BT 3**
CO 4	**Analyse** different commands of Linux system	**BT 4**

Detailed Syllabus:

Modules	**Topics**	**Course content**	**Hours**
I	**The System Administrator and User Management**	Overview of system administration roles and responsibilities Introduction to different operating systems (Linux, Windows) Basics of command-line interface (CLI) and shell scripting Boot and Shut Down: Run levels, Processes and daemons, Configure startup scripts. User Management: Add user, User groups, User and system security, Collapse User environment, Shell startup scripts, What not to do in startup scripts, Other dot files	**15**
II	**File Management, Networking and Backup**	File system structure: Manage disk storage, Partition, Format, Fix errors on disk, Mount Links: hard, symbolic, Permission Permission bits, Special permission, ACLs, Quotas. Networking: Network concepts overview, History, ISO/OSI., Layers description, Name to address translation, File sharing with NFS, NIS, Services and inetd. Backup strategy, Selecting the backup devices and software, Automating the backup procedure, Third party product overview, Auto-mounter Requirements and Mechanism	**15**
III	**Backup System Administration Tools**	Monitor processes: truss/strace, ps top.\, Monitor network: lsof, netstat, Working with files: strings, awk, od, du, df, find, Misc: which, whereis, dmesg, Logfiles, Operating System Installation, System installation, Linux/Solaris installation, Patches, Installing and removing packages (RPM), Download compile and install using source code, Kernel reconfig, Get the kernel source code, Add new adapter and update drivers, Kernel upgrade.	**15**
IV	**The proc File system and System Monitoring**	Map of /proc, Process entries, Hardware information, Kernel information, Kernel settings, Swap space tunings, Detecting physical memory shortage, System resource loads: CPU, I/O, Disk, Raid disks, Setting limits to processes, Measuring network load.	**15**
Total			**60**

Credit Distribution		
Lecture/ Tutorial	**Practicum**	**Experiential Learning**
3*20 NCH = 60 NCH	-	30 NCH (Problem Solving, Seminar, Case Study, Discussion, Internship, Project)

Text Book:

1. *Essential System Administration: Tools and Techniques for Linux and Unix Administration,* Aeleen Frisch, 3rd Edition, 2013, O'Reilly Media

Reference Books:

1. Evi Nemeth, Synder, Hein, Whaley, MAckin, *UNIX and Linux System Administration Handbook,* 5th Edition, 2017, Addison Welsley

SYLLABUS (4th SEMESTER)

Paper I/Subject Name: Operating Systems		**Subject Code: CAP052M401**
Course Type: Major		**Course Level:200**
L-T-P-C – 3-0-2-4	**Credit Units: 04**	**Scheme of Evaluation: T**

Objective:

The objectives of the course are to teach the basic concepts and functions of operating systems and make them understand the principles of concurrency.

Prerequisites: Concepts of Computer Organization and Architecture

Course Outcomes

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	**Define & Name** terminology and processes associated with Operating System	**BT 1**
CO 2	**Understand** the basic concepts of Operating systems.	**BT 2**
CO 3	**Apply** the principles of scheduling, and concurrency to solve various problems related to OS	**BT 3**
CO 4	**Analyze** and **evaluate** different OS systems in terms of process management, memory management and I/O systems.	**BT 4 & 5**

Detailed Syllabus:

Modules	Topics	Course Contents	Hours
I	**Operating Systems Overview**	Introduction and history of Operating systems, structure and operations; processes and files. **Computer System Overvie**w- Basic Elements, Instruction Execution, Interrupts Memory Hierarchy, Cache Memory, Direct Memory Access, Multiprocessor and Multicore Organization. **Operating system overview**-objectives and functions, Evolution of Operating System.- Computer System Organization- Operating System Structure and Operations- System Calls, System Programs, OS Generation and System Boot	**09**
II	**Process Management and Concurrency Control**	**Processes**-Process Concept, Process Scheduling, Operations on Processes, Interprocess Communication; Threads- Overview, Multicore Programming, Multithreading Models; Thread and SMP Management. **Process Synchronization** – Critical Section Problem, Mutex Locks, Semaphores, Monitors; CPU Scheduling and scheduling algorithms. **Deadlocks**- Shared resources, resource allocation and scheduling, resource graph models, deadlock detection, deadlock avoidance, deadlock prevention algorithms	**09**
III	**Storage Management**	Memory Management requirements, Memory partitioning: Fixed and Variable Partitioning, Memory Allocation: Allocation Strategies (First Fit, Best Fit, and Worst Fit), Fragmentation, Swapping, and Paging. Segmentation, Demand paging, Virtual Memory: Concepts, management of VM, Page Replacement Policies (FIFO, LRU, Optimal, Other Strategies), Thrashing. 32 and 64 bit architecture Examples; Allocating Kernel Memory, OS Examples	**09**
IV	**I/O and File Systems**	I/O Devices, Organization of I/O functions, Operating System Design issues, I/O Buffering, Overview of mass storage structure- disks and tapes. Disk structure – accessing disks, Swap Space. Disk Scheduling (FCFS, SCAN, C-SCAN, SSTF), RAID, Disk Cache. Disk Protection– Goals, Principles, Domain. **File System Interface**: File Concepts – Attributes – operations – types – structure – access methods. File system mounting. Protection. File system implementation. Directory implementation – allocation methods. Free space Management.	**09**
TOTAL			**36**

Text Books:

1. *Operating System Concepts,* Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, 9th Edition, 2012, John Wiley and Sons Inc.

Reference Books:

1. William Stallings, *Operating Systems – Internals and Design Principles*, 7th Edition, 2011, Prentice Hall.
2. Andrew S. Tanenbaum, *Modern Operating Systems*, 2nd Edition, 2001, Addison Wesley.
3. D M Dhamdhere, *Operating Systems: A Concept-Based Approach*, 2nd Edition, 2007, Tata McGraw-Hill Education.

Operating Systems Lab

Objective:

The objectives of the course are to make the students learn about process and disc scheduling practically along with the working of system calls.

Prerequisites: Fundamentals of Computer Programming

Detailed Syllabus:

Total Lab Hours for the semester = 48 (4 hours per week)

Minimum 20 Laboratory experiments based on the following-

1. Basic Linux Commands and Overview.
2. Write Shell Script for followings.
    - To find the global complete path for any file.
    - To broadcast a message to a specified user or a group of users logged on any terminal.
    - To copy the file system from two directories to a new directory in such a way that only the latest file is copied in case there are common files in both the directories.
    - To compare identically named files in two different directories and if they are same, copy one of them in a third directory.
    - To delete zero sized files from a given directory (and all its sub- directories).
    - To display the name of those files (in the given directory) which are having multiple links.
    - To display the name of all executable files in the given directory.
    - Write a script to display the date, time and a welcome message (like Good Morning etc.). The time should be displayed with "a.m." or "p.m." and not in 24 hours notation.
    - Write a script to display the directory in the descending order of the size of each file.
3. Implementation of FCFS (First Come First Serve) CPU Scheduling.
4. Implementation of SJF (Shortest Job First) CPU Scheduling.
5. Implementation of Round Robin (RR) CPU Scheduling.
6. Implementation of Priority CPU Scheduling Algorithm.
7. Implementation of FIFO Replacement Algorithm.
8. Implementation of Optimal Page Replacement Algorithm.
9. Implementation of LRU Page Replacement Algorithm by Stack method
10. Implement the producer-consumer problem using threads.

Credit Distribution		
Lecture/ Tutorial	**Practicum**	**Experiential Learning**
2 * 20 NCH = 60 NCH	2 * 15 NCH = 30 NCH	30 NCH (Problem Solving, Seminar, Case Study, Discussion, Internship, Projects)

Text Books:

1. *Operating System Concepts,* Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, 9th Edition, 2012, John Wiley and Sons Inc.

Reference Books:

1. William Stallings, *Operating Systems – Internals and Design Principles*, 7th Edition, 2011, Prentice Hall.
2. Andrew S. Tanenbaum, *Modern Operating Systems*, 3rd Edition, 2009, Addison Wesley.
3. D M Dhamdhere, *Operating Systems: A Concept-Based Approach*, 2nd Edition, 2007, Tata McGraw-Hill Education.

Paper II/Subject Name: Data Communication and Networks		**Subject Code:CAP052M402**
Course Type: Major		**Course Level:200**
L-T-P-C – 3-0-2-4	**Credit Units: 04**	**Scheme of Evaluation: T**

Objective:

The objectives of the course are to make the students understand the significance and concepts of computer networks along with the layered architecture.

Prerequisites: Basics of internet technologies and graph theory

Course Outcomes

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	**Define** various networking model and their workings	**BT 1**
CO 2	**Understand** the significance and concepts of computer networks.	**BT 2**
CO 3	**Apply** networking concepts to solve problems and develop networks.	**BT 3**
CO 4	**Analyse** and **evaluate** basic protocols and design issues for layered model.	**BT 4 & 5**

Detailed Syllabus:

Modules	**Topics**	**Course Contents**	**Hours**

I	**Data Link Layer and Medium Access Sub-layer**	Design issues, Framing, Error detection and correction codes: checksum, CRC, hamming code, Data link protocols for noisy and noiseless channels, Sliding Window Protocols: Stop & Wait ARQ, Go-back-N ARQ, Selective repeat ARQ, Data link protocols: HDLC and PPP Static and dynamic channel allocation, Random Access: ALOHA, CSMA protocols, Controlled Access: Polling, Token Passing, IEEE 802.3 frame format, Ethernet cabling, Manchester encoding, collision detection in 802.3, Binary exponential back off algorithm	**15**
II	**Network Layer**	Design issues, IPv4 classful and classless addressing, subnetting, Routing algorithms: distance vector and link state routing, Congestion control: Principles of Congestion Control, Congestion prevention policies, Leaky bucket and token bucket algorithms	**15**
III	**Transport Layer**	Elements of transport protocols: addressing, connection establishment and release, flow control and buffering, multiplexing and de-multiplexing, crash recovery, introduction to TCP/UDP protocols and their comparison	**15**
IV	**Application Layer**	World Wide Web (WWW), Domain Name System (DNS), E-mail, File Transfer Protocol (FTP), SMTP, HTTP, Introduction to Network security	**15**
	TOTAL		**60**

Text Books:

1. *Data and Computer Communication*, William Stallings, 10th Edition, 2013, PHI.
2. *Data Communications and Networking*, Behrouz A Forouzan, 4th Edition, 2017, Tata McGraw Hill
3. *Computer Networks*, Tannenbaum, 3rd Edition, 1996, Pearson Education.

Reference Books:

1. L.L. Peterson & B.S. Davie, *Computer Networks: A Systems Approach*, 5th Edition, 2011, Morgan Kaufmann
2. Anuranjan Misra, *Computer Networks*, 2006, Acme Learning, Morgan Kaufman Publication, New Delhi
3. BhushanTrivedi, *Computer Networks*, Reprint Edition, 2011, Oxford press

Data Communication and Networks Lab

Objective:

The objectives of the course are to make the students learn socket programming and to make them familiar with simulation tools.

Prerequisites: Fundamentals of Computer Programming and Data Communication

Detailed Syllabus:

Total Lab Hours for the semester = 48 (4 hours per week)

Minimum 20 Laboratory experiments based on the following-

- To study various topologies for establishing computer networks.
- To learn the usage of various basic tools (crimping, krone etc.) used in establishing a LAN.
- To familiarize with switch and hub used in networks.
- To learn the usage of connecters and cables (cabling standards) used in networks
- To make certain copper and fiber patch cords using different standards.
- To familiarize with routers & bridges
- Use commands like ping, ipconfig for trouble shooting network related problems.
- NIC Installation & Configuration (Windows/Linux)
- TCP/UDP Socket Programming
- Multicast & Broadcast Sockets
- Develop a program to compute the Hamming Distance between any two code words.
- Develop a program to compute checksum for an _m' bit frame using a generator polynomial.
- IPC (Message queue)
- Implementation of a Prototype Multithreaded Server

- Implementation of o Data Link Layer Flow Control Mechanism (Stop & Wait, Sliding Window)
- Data Link Layer Error Detection Mechanism (Cyclic Redundancy Check)
- Data Link Layer Error Control Mechanism (Selective Repeat, Go Back N)

Credit Distribution		
Lecture/ Tutorial	**Practicum**	**Experiential Learning**
3 * 20 NCH = 30 NCH	2 * 15 NCH = 30 NCH	30 NCH (Problem Solving, Seminar, Case Study, Discussion, Internship, Projects)

Text Books:

1. *Data and Computer Communication*, William Stallings, 10th Edition, 2013, PHI.
2. *Data Communications and Networking*, Behrouz A Forouzan, 4th Edition, 2017, Tata McGraw Hill
3. *Computer Networks*, Tannenbaum, 3rd Edition, 1996, Pearson Education.

Reference Books:

1. L.L. Peterson & B.S. Davie, *Computer Networks: A Systems Approach*, 5thEdition, 2011, Morgan Kaufmann
2. Anuranjan Misra, *Computer Networks*, 2006, Acme Learning, Morgan Kaufman Publication, New Delhi
3. Bhushan Trivedi, *Computer Networks*, Reprint Edition, 2011, Oxford press

Paper III/Subject Name: Indian Knowledge System		**Subject Code IKS**
Course Type: Major		**Course Level: 200**
L-T-P-C – 3-1-0-4	**Credit Units: 04**	**Scheme of Evaluation: T**

- **Detailed Syllabus of Minor Course**

*** Syllabus will be provided by the Centre of IKS , RGU

Paper III/Subject Name: Front-End Development with Angular		**Subject Code: CAP052N401**
Course Type: Minor		**Course Level: 200**
L-T-P-C – 2-1-0-3	**Credit Units: 03**	**Scheme of Evaluation: T**

Objective:

The objectives of the course are to teach the students about Angular to enable them to create web pages.

Prerequisites: Fundamentals of Web Development and Server Programming

Course Outcomes

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	**Define** Angular framework and its use.	**BT 1**
CO 2	**Understand** the fundamentals of the Angular framework and its architecture.	**BT 2**
CO 3	**Develop** Angular applications using components, modules, services, and dependency injection.	**BT 3**
CO 4	**Implement** routing and navigation to create single-page applications (SPAs).	**BT 4**

Detailed Syllabus:

Modules	**Topics**	**Course content**	**Periods**
I	**Introduction to Angular**	Overview of front-end development and Angular framework Setting up Angular development environment (Node.js, npm) Creating and running a basic Angular application	**15**
II	**Angular Components & Modules**	Understanding Angular components and component architecture, Creating and using components, templates, and data binding, Component communication using input/output properties and event emitters Introduction to Angular modules and their role in application organization, Creating and importing modules in Angular applications, Implementing services for data sharing and business logic	**15**
III	**Angular Routing and Navigation**	Configuring routes and route parameters in Angular applications Implementing navigation and routing guards Lazy loading modules for optimized application loading	**15**
IV	**Reactive Programming with Angular**	Understanding reactive programming concepts and observables, Managing application state with RxJS operators Building reactive forms for user input and validation Making HTTP requests and handling responses in Angular Integrating external APIs and services into Angular applications Error handling and authentication with HTTP interceptors	**15**
Total			**60**

Textbooks:

1. *Angular Development with TypeScript by Yakov Fain and Anton Moiseev*
2. *Full-Stack React, TypeScript, and Node: Build cloud-ready web applications using React 17 with Hooks and GraphQL* , David Choi, 2020, Packt Publishing Limited.

Reference Books:

1. Frank Zammetti, *Modern Full-Stack Development: Using TypeScript, React, Node.js, Webpack, Python, Django, and Docker*, 2nd Edition, 2022, APress

Credit Distribution		
Lecture/ Tutorial	**Practicum**	**Experiential Learning**
3*20 NCH = 60 NCH	-	30 NCH (Problem Solving, Seminar, Case Study, Discussion, Internship, Project)

- **Detailed Syllabus of Minor Course**

Paper III/Subject Name: Server-Side Programming with Node JS		**Subject Code: CAP052N402**
Course Type: Minor		**Course Level: 200**
L-T-P-C – 2-1-0-3	**Credit Units: 03**	**Scheme of Evaluation: T**

Objective:

The objectives of the course are to teach the students about Node JS and it's frame work to enable them to create back end of web sites.

Prerequisites: Fundamentals of Web Development and Server Programming

Course Outcomes

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	**Define basic** semantics and syntax of Node JS to work in server-side programming	**BT 1**
CO 2	**Understand** the principles and advantages of server-side programming with Node.js.	**BT 2**
CO 3	**Apply** asynchronous programming techniques using callbacks, promises, and async/await	**BT 3**
CO 4	**Implement** data storage and retrieval using databases (e.g., MongoDB, MySQL) with Node.js.	**BT 4**

Detailed Syllabus:

Modules	**Topics**	**Course content**	**Periods**
I	**Introduction to Node JS & Asynchronous Programming**	Overview of server-side programming and Node.js Installing Node.js and npm, Writing and running basic Node.js applications Understanding asynchronous programming and non-blocking I/O, using callbacks, promises, and async/await for handling asynchronous operations, Error handling and best practices for asynchronous programming	**15**
II	**Express.js framework**	Introduction to Express.js framework for building web applications and APIs Creating routes, handling requests, and sending responses with Express Middleware concept and implementation in Express.js	**15**
III	**Data Storage & Retrieval**	Working with databases in Node.js (MongoDB, MySQL) Connecting to databases and executing CRUD operations Implementing data validation and error handling, Database Integration, Authentication and Authorization	**15**
IV	**Error Handling and Middleware**	Implementing error handling middleware in Express.js Using third-party middleware for request processing and logging, Best practices for middleware development and management Deployment Strategies and Production Considerations	**15**
Total			**60**

Credit Distribution		
Lecture/ Tutorial	**Practicum**	**Experiential Learning**

3*20 NCH = 60 NCH	-	30 NCH (Problem Solving, Seminar, Case Study, Discussion, Internship, Project)

Textbooks:

1. *"Node.js Design Patterns" by Mario Casciaro*.
2. *Full-Stack React, TypeScript, and Node: Build cloud-ready web applications using React 17 with Hooks and GraphQL* , David Choi, 2020, Packt Publishing Limited.

Reference Books:

1. Frank Zammetti, *Modern Full-Stack Development: Using TypeScript, React, Node.js, Webpack, Python, Django, and Docker*, 2nd Edition, 2022, APress

- **Detailed Syllabus of Ability Enhancement Courses (AEC-IV)**

Paper VI/Subject Name: Employability and Communication		**Subject Code: CEN982A401**
Course Type: AEC		**Course Level: 200**
L-T-P-C – 1-0-0-1	**Credit Units: 01**	**Scheme of Evaluation: T**

Objective:

The objectives of the course are to to enhance employability and maximize the students' potential by introducing them to the principles that determine personal and professional success, thereby helping them acquire the skills needed to apply these principles in their lives and careers.

Prerequisites: None

Course Outcomes

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	**Demonstrate** understanding the importance of verbal and non-verbal skills while delivering an effective presentation	**BT 2**
CO 2	**Develop** professional documents to meet the objectives of the Workplace	**BT 3**
CO 3	**Define** and identify different life skills and internet competencies required in personal and professional life.	**BT 3**

Detailed Syllabus:

Modules	**Topics**	**Course content**	**Periods**
I	**Presentation Skills**	Importance of presentation skills, Essential characteristics of a good presentation, Stages of a presentation, Visual aids in presentation, Effective delivery of a presentation	**5**
II	**Business Writing**	Report writing: Importance of reports, Types of reports, Format of reports, Structure of formal reports, Proposal writing: Importance of proposal, Types of proposal, structure of formal proposals, Technical articles: Types and structure	**5**
III	**Preparing for Jobs**	Employment Communication and its Importance, Knowing the four-step employment process, writing resumes, Guidelines for a good resume, Writing cover letters, Interviews: Types of interview, what does a job interview assess, strategies of success at interviews, participating in group discussions.	**5**
IV	**Digital Literacy and Life Skills**	Digital literacy: Digital skills for the '21st century', College students and technology, information management using Webspace, Dropbox, directory, and folder renaming conventions. Social Media Technology and Safety, Web 2.0. Life Skills: Overview of Life Skills: Meaning and significance of life skills, Life skills identified by WHO: self-awareness, Empathy, Critical thinking, Creative thinking, Decision making, problemsolving, Effective communication, interpersonal relationship, coping with stress, coping with emotion. Application of life skills: opening and operating bank accounts, applying for pan, passport, online bill payments, ticket booking, gas booking	**5**
Total			**20**

Credit Distribution		
Lecture/ Tutorial	**Practicum**	**Experiential Learning**
1*20 NCH = 20 NCH	-	10 NCH -Group Discussion -Case -Presentation -Quiz

Text Book:

1. *Business Communication,* PD Chaturvedi and Mukesh Chaturvedi, 4th Edition, 2017, Pearson

Reference Books:

1. Shalini Verma, *Business Communication,* 2nd Edition, 2024, Vikas
2. Meenakshi Raman and Sangeeta Sharma, *Technical Communication,* 3rd Edition, 2015, OUP

Paper VII/Subject Name: Behavioral Science-IV		**Subject Code: BHS982A404**
L-T-P-C – 1-0-0-1	**Credit Units: 01**	**Scheme of Evaluation: T**

Objective:

The objectives of the course are to increase one's ability to draw conclusions and develop inferences about attitudes and behaviour, when confronted with different situations that are common in modern organizations.

Prerequisites: None

Course Outcomes

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**

CO 1	**Understand** the importance of individual differences.	**BT 2**
CO 2	**Develop** a better understanding of self in relation to society and nation	**BT 3**
CO 3	**Facilitation** for a meaningful existence and adjustment in society	**BT 4**

Detailed Syllabus:

Modules	Topics	Course content	Periods
I	**Managing Personal Effectiveness**	Setting goals to maintain focus, Dimensions of personal effectiveness (self disclosure, openness to feedback and perceptiveness), Integration of personal and organizational vision for effectiveness, A healthy balance of work and play, Defining Criticism: Types of Criticism, Destructive vs Constructive Criticism, Handling criticism and interruptions.	**5**
II	**Positive Personal Growth**	Understanding & Developing positive emotions, Positive approach towards future, Impact of positive thinking, Importance of discipline and hard work, Integrity and accountability, Importance of ethics in achieving personal growth.	**5**
III	**Handling Diversity**	Defining Diversity, Affirmation Action and Managing Diversity, Increasing, Diversity in Work Force, Barriers and Challenges in Managing Diversity.	**5**
IV	**Developing Negotiation Skills**	Meaning and Negotiation approaches (Traditional and Contemporary), Process and strategies of negotiations. Negotiation and interpersonal communication. Rapport Building – NLP.	**5**
Total			**20**

Credit Distribution		
Lecture/ Tutorial	**Practicum**	**Experiential Learning**
1*20 NCH = 20 NCH	-	10 NCH -Group Discussion -Case -Presentation -Quiz

Text Book:

1. *Theories and Models in Applied Behavioural Science,* J William Pfeiffer, 1996, Pfeiffer & Company.

Reference Books:

1. Blair J. Kolasa, *Introduction to Behavioural Science for Business*, 1969, John Wiley & Sons Inc

SYLLABUS (5th SEMESTER)		
Paper I/Subject Name: Web Technology		**Subject Code: CAP052M501**
L-T-P-C – 3-0-2-4	**Credit Units: 04**	**Scheme of Evaluation: T**

Objective:

The objectives of the course are to provide knowledge on the basic web concepts, scripting languages and Internet protocols

Prerequisites: Basics of computer programming

Course Outcomes

On successful completion of the course, the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	**Understand** the basic concept of web development	**BT 2**
CO 2	**Apply** the concepts learnt to develop simple web applications	**BT 3**
CO 3	**Assess** and **evaluate** two web applications based on various design factors.	**BT 4 & 5**

Detailed Syllabus:

Modules	Topics	Course content	Periods
I	**Introduction to Web Technology**	World Wide Web: Introduction to TCP/IP and WAP, DNS, Email, TelNet, HTTP and FTP. Introduction to Browser and search engines, Working of the search engines, Miscellaneous Web Browser details, Introduction to Web Servers: Features of web servers, caching, case study-IIS, Apache, Configuring web servers. Internet Principles – Basic Web Concepts – Client/Server model – retrieving data from Internet – HTM and Scripting Languages – Standard Generalized Mark –up languages – Next Generation – Internet –Protocols and Applications.	**15**
II	**HTML,CSS, Java Script**	Web Pages - types and issues, tiers; comparisons of Microsoft and java technologies, WWW-Basic concepts, web client and web server, http protocol (frame format), universal resource locator (url), HTML different Tags, sections, image & pictures, listings, tables, frame, frameset, form. The need of dynamic web pages; an overview of DHTML, cascading style sheet (css), comparative studies of different technologies of dynamic page creation. Java Script : Data types, variables, operators, conditional statements, array object, date object, string object, Dynamic Positioning and front end validation, creating rollovers, building smarter forms, Event Handling, working with cookies, DOM, node and objects, creating sliding menu, pop-up menu, slideshow with caption	**18**
III	**XML and AJAX**	XML – Server side includes – communication – DTD – Vocabularies – DOM methods – Introduction of XML, Validation of XML documents, DTD, Ways to use XML, XML for data files, HTML Vs XML, Embedding XML into HTML documents, Converting XML to HTML for Display, Rewriting HTML as XML, Firewalls– Proxy Servers. AJAX technologies, Action, XML Http Request database operations, security, issues	**18**
IV	**J2SE, J2EE, Severlet and JSP**	Data Types, Arrays, Type Casting, Classes and Objects, Inheritance, Interfaces, Exception Handling, Multithreading,J2EE as a framework, Client Server Traditional model, Comparison amongst 2-tier, 3-tier and N-tier Architectures, Thin and Thick Clients. J2EE Servlet 2.x Specification, Writing small Servlet Programs, Deployment Descriptor, Inter Servlet Collaboration, Session: Definition, State on web, Different ways to track sessions, JSP Technology Introduction-JSP and Servlets- Running JSP Applications Basic JSP- JavaBeans Classes - Support for the Model- View- Controller Paradigm- Case Study- Related Technologies.	**15**
Total			**66**

Web Technology Lab

Detailed Syllabus:

Total Lab Hours for the semester = 48 (4 hours per week)

Minimum 20 Laboratory experiments based on the following-

- Web page design: Designing web pages with HTML- use of tags, hyperlinks, URLs, tables, text formatting, graphics & multimedia, imagemap, frames and forms in web pages.
- Cascading Style Sheet in web pages.
- Creating interactive and dynamic web pages with JavaScript: JavaScript overview; constants, variables, operators, expressions & statements; user-defined & built-in functions; client-side form validation; using properties and methods of built-in objects.
- Extensible Markup Language (XML): Introduction- using user-defined tags in web pages; displaying XML contents; XML DTDs; use of XSL.
- Server-side scripting: overview of CGI, ASP, and JSP.

- Server side scripting using PHP; PHP basics, HTML form data handling, Web database connectivity- introduction to ODBC; PHP with database connectivity.
- Exposure to Advanced Web Technologies (as far as possible; not to be made compulsory): Distributed Object based models- DCOM, CORBA, EJB; Web services and Related Technologies- ISAPI, SOAP, UDDI, WSDL; Other Advanced Web Technologies- AJAX, ISAPI, .NET. Web Security.

National Credit Hours		
Lecture/ Tutorial	**Practicum**	**Experiential Learning**
3 * 22 NCH = 66 NCH	2 * 15 NCH = 30 NCH	8 * 2 NCH = 16 NCH (Problem Solving, Seminar, Case Study, Discussion, Internship, Projects)

Text Book:

1. *Internet and World Wide Web How to program*, Deitel H.M. and Deitel P.J, 4th Edition, 2012, Pearson International, New Delhi
2. *Web Technology*, Gopalan N.P. and Akilandeswari J., 2nd Edition, 2014, Prentice Hall of India, New Delhi.
3. *Java How to Program*, Paul Dietel and Harvey Deitel, 8th Edition, 2014, Prentice Hall of India, New Delhi

Reference Books:

1. Uttam K. Roy, *Web Technologies*, 2010, Oxford University Press.
2. Godbole A. S. & Kahate A., *Web Technologies*, 2nd Edition, 2006, TMH, New Delhi.

Paper II/Subject Name: Python Programming		**Subject Code: CAP052M502**
L-T-P-C – 3-0-0-3	**Credit Units: 03**	**Scheme of Evaluation: T**

Objective:

The objectives of the course are to teach the students techniques to build and develop Python codes.

Prerequisites: Fundamentals of Computer Programming

Course Outcomes

On successful completion of the course, the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	**Understand** the basic concepts and terminologies of Python Programming	**BT 2**
CO 2	**Apply** the concepts learnt to write efficient programs.	**BT 3**
CO 3	**Analyze** and **evaluate** the codes to fix the errors	**BT 4 & 5**

Detailed Syllabus:

Modules	**Topics**	**Course content**	**Hours**
I	**Algorithmic Problem Solving**	Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simpler strategies for developing algorithms (iteration, recursion).	**15**

II	**Data, Expressions, Statements**	Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments	**18**
III	**Control Flow, Functions**	Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. .	**18**
IV	**Lists, Tuples, Dictionaries**	Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing – list comprehension	**15**
Total			**66**

Python Programming Lab

Detailed Syllabus:

Total Lab Hours for the semester = 48 (4 hours per week)

Minimum 20 Laboratory experiments based on the following-

1. Write a program to add two numbers.
2. Write a program that declares 3 integers, determines and prints the largest and smallest in the group.
3. Write a program for the factorial of a number.
4. Write a program to calculate simple interest.
5. Write a program to find out whether a given year is a leap year or not.
6. Write a program to implement linear search and binary search.
7. Write a program to find that given number is Armstrong or not.
8. Write a program to print the Fibonacci Series.
9. Write a program to convert a decimal number into binary numbers.
10. Python Program to find the sum of an array.
11. Write a program to find the largest number of elements in the array.
12. Write a program to check if a string is a palindrome or not.
13. Maintain book records as per their serial numbers in the library using a dictionary.
14. Write a program to concatenate two dictionaries into one.
15. Perform the following operations on the dictionary: 1) Insert, 2) delete, 3) change, and 4) update.
16. Write a program to calculate the addition of two numbers using methods.
17. Program to calculate the average of numbers using function.
18. Fibonacci series using recursion.
19. Write a program to create a module of factorial in Python.
20. Write A Program to Find the Area of a Rectangle Using Classes
21. Write A Program to Append, Delete, and Display Elements of a List Using Classes
22. Write A Program to Create a Class and Compute the Area and the Perimeter of the Circle
23. Write A Program to Create a Class that Performs Basic Calculator Operations
24. Write A Program to Create a Class in which One Method Accepts a String from the User and
25. Another Prints it.
26. Write A Program that Reads a Text File and Counts the Number of Times a Certain Letter
27. Appears in the Text File.
28. Write A Program to Read a Text File and Print all the Numbers Present in the Text File.
29. Write programs to visualize data using NumPy
30. Write programs to analyse data using NumPy

National Credit Hours		
Lecture/ Tutorial	**Practicum**	**Experiential Learning**

3 * 22 NCH = 66 NCH	2 * 15 NCH = 30 NCH	8 * 2 NCH = 16 NCH (Problem Solving, Seminar, Case Study, Discussion, Internship, Projects)

Text Books:

1. *An Introduction to Python – Revised and updated for Python 3.2,* Guido van Rossum and Fred L. Drake Jr, 2011, Network Theory Ltd

Reference Books:

1. Timothy A. Budd, *Exploring Python*, 2015, Mc-Graw Hill Education (India) Private Ltd.
2. Kenneth A. Lambert, *Fundamentals of Python: First Programs*, 2nd Edition, 2012, CENGAGE Learning.
3. Charles Dierbach, *Introduction to Computer Science using Python: A Computational Problem- Solving Focus*, 1st Edition, 2013, Wiley India Edition.
4. Paul Gries, Jennifer Campbell, and Jason Montojo, *Practical Programming: An Introduction to Computer Science using Python 3*, 2nd edition, 2013, Pragmatic Programmers, LLC.

- **Detailed Syllabus of Department Specific Elective (DSE-III/IV)**

Paper III/Subject Name: Foundation of Artificial Intelligence		**Subject Code: CAP052M503**
L-T-P-C – 3-1-0-4	**Credit Units: 04**	**Scheme of Evaluation: T**

Objective:
The objectives of the course are to provide undergraduate students with an in-depth understanding of Artificial Intelligence (AI), focusing on core concepts, mathematical foundations, algorithms, and real-world applications.

Prerequisites: Strong foundation in programming (Python recommended), Linear Algebra, Probability & Statistics, and Data Structures & Algorithms

Course Outcomes

On successful completion of the course, the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	Demonstrate understanding of fundamental AI principles, including search algorithms and knowledge representation	BT 1 & 2
CO 2	Implement AI search techniques, constraint satisfaction problems, and optimization techniques	BT 3
CO 3	Design and analyze AI models for reasoning, learning, and decision-making	BT 4

Detailed Syllabus:

Modules	**Topics**	**Course content**	**Hours**
I	**Introduction to AI**	Definition and history of AI, AI applications, Turing Test, Rational Agents, Search strategies (uninformed: BFS, DFS; informed: A*, Iterative Deepening, Hill Climbing), Constraint Satisfaction Problems (CSP)	**8**
II	**Knowledge Representation and Reasoning**	Logic-based AI (Propositional & First-Order Logic), Rule-based systems, Bayesian Networks, Markov Decision Processes (MDP), Game Theory (Minimax, Alpha-Beta Pruning)	**12**

III	**Machine Learning and Neural Networks**	Supervised vs. Unsupervised Learning, Classification and Regression, Decision Trees, Naïve Bayes, SVMs, Neural Networks (Backpropagation, CNNs, RNNs), Introduction to Reinforcement Learning	**14**
IV	**AI Applications & Advanced Topics**	Natural Language Processing (NLP), Computer Vision, AI in robotics and autonomous systems, Deep Reinforcement Learning, Ethical considerations and bias in AI, Security in AI (adversarial attacks, fairness, explainability)	**14**
Total			**48**

National Credit Hours		
Lecture/ Tutorial	**Practicum**	**Experiential Learning**
4 * 22 NCH = 88 NCH	-	8 * 4 NCH = 32 NCH (Problem Solving, Seminar, Case Study, Discussion, Internship, Projects)

Textbook:

1. Artificial Intelligence: A Modern ApproachStuart Russell, Peter Norvig 4th Edition, 2020, Pearson

Reference Books:

5. Artificial Intelligence Elaine Rich, Kevin Knight, Shivashankar B. Nair 3rd Edition, 2008, McGraw-Hill

Paper IV/Subject Name: Statistical Computing		**Subject Code: CAP052M504**
L-T-P-C – 3-1-0-4	**Credit Units: 04**	**Scheme of Evaluation: T**

Objective:

The objective of this course is to teach the basic rules of probability and to use them in modelling uncertainty in obtaining and recording data.

Prerequisites: Basic concepts of Mathematics

Course Outcomes

On successful completion of the course, the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	**Learn** about the types of data, Mean and Median, Standard Deviation and Variance, Range, IQR, and Finding Outliers, etc.	**BT 1**
CO 2	**Illustrate** Probability Distributions: random variable, Mean and Standard deviation of discrete random variable, etc.	**BT 2**
CO 3	**Apply** Sampling Distribution, Central Limit theorem, Sampling distribution of the Sample mean and Proportion. Large Sample Estimation, Point estimation on datasets	**BT 3**

CO 4	**Analyse** Linear regression and test the usefulness of the linear regression model, estimate and predict using the fitted line, etc.	**BT 4**

Detailed Syllabus:

Modules	Topics	Course content	Periods
I	**Univariate Data and Probability**	Types of data, Mean and Median, Standard Deviation and Variance, Range, IQR and Finding Outliers, Graphs and Describing Distributions, Counting Techniques, Combinations and Permutations, Sets and Venn Diagrams, Basic Probability Models, General Probability Rules	**12**
II	**Discrete and Continuous Distributions**	Probability Distributions: Random Variable, Discrete random variable, Mean and Standard deviation of discrete random variable, Discrete Probability Distributions: Binomial, Poisson, and Hypergeometric probability distribution, Continuous Probability distribution: Normal distribution, Density Curves, The Normal Distribution, Standard Normal Calculations, Sampling Distribution of x and pˆ	**12**
III	**Sampling**	Sampling Distribution: sampling plans and experimental designs, Sampling distribution of a statistic, Central Limit theorem, Sampling distribution of the Sample mean and Proportion. Large Sample Estimation: Point estimation, Interval estimation, Confidence interval of population mean, Population proportion, difference between two population means, difference between two population proportions.	**12**
IV	**Variance and Linear Regression**	Analysis of Variance: One-way classification, Two-way classification. Linear regression and Correlation: Method of least squares, Analysis of variance for linear regression, Testing the usefulness of the linear regression model, Estimation and Prediction using the fitted line. Carl Pearson's coefficient of Correlation, Test of hypothesis concerning the Correlation coefficient.	**12**
Total			**48**

National Credit Hours		
Lecture/ Tutorial	**Practicum**	**Experiential Learning**
4 * 22 NCH = 88 NCH	-	8 * 2 NCH = 16 NCH (Problem Solving, Seminar, Case Study, Discussion, Internship, Projects)

Text Book:

1. *Probability and Statistics*, William Mendenhall, Robert J. Beaver, Barbara M. Beaver, 14th Edition, CENGAGE Learning.
2. *Probability and Statistics*, E. Rukmangadachari, 1st Edition, 2012, Pearson Education.

Reference Books:

1. Vijay K. Rohatgi, *An Introduction to Probability and Statistics*, 2nd Edition, 2008, Wiley

- **Detailed Syllabus of MINOR**

Paper V/Subject Name: Web Integration and Application		**Subject Code: CAP052N501**
L-T-P-C – 3-1-0-4	**Credit Units: 04**	**Scheme of Evaluation: T**

Objective:

The objective of this course is to introduce students to modern web integration techniques, covering API development, database integration, and cloud deployment.

Prerequisites: Basic understanding of web development, JavaScript, and databases.

Course Outcomes

On successful completion of the course, the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	Understand API development and integration with front-end applications	**BT 1 & 2**
CO 2	Implement RESTful APIs and GraphQL for web integration	**BT 3**
CO 3	Integrate databases and deploy applications to the cloud	**BT 4**

Detailed Syllabus:

Modules	**Topics**	**Course Contents**	**Hours**
I	**Development Workflow and Integration**	Advanced Git workflows, branch management, pull requests, code reviews, and merging strategies. JavaScript bundling, import maps, and integrating JS into non-JS backends. Introduction to compile-to-JS languages (TypeScript, WebAssembly).	**15**
II	**Testing and Deployment**	Importance of testing, unit testing, integration testing, hybrid testing, common pitfalls, and best practices. CI/CD pipelines, automated testing, deployment automation, linking CI/CD with remote servers.	**18**
III	**Application Environments and Containerization**	Differences between development, testing, staging, and production environments. Role of staging in production workflows. Fundamentals of containerization, Docker images, deploying containerized web applications.	**15**
IV	**Security, Internationalization, and Debugging**	Implementing i18n and l10n, adapting web applications for different languages, time zones, and regional formats. Runtime error detection, logging strategies, debugging workflows, using testing to ensure bug fixes.	**18**
TOTAL			**66**

National Credit Hours		
Lecture/ Tutorial	**Practicum**	**Experiential Learning**
3 * 22 NCH = 66 NCH	-	8 * 3 NCH = 24 NCH (Problem Solving, Seminar, Case Study, Discussion, Internship, Projects)

Text Book:

1. *Internet and World Wide Web How to program*, Deitel H.M. and Deitel P.J, 4th Edition, 2012, Pearson International, New Delhi
2. *Web Technology*, Gopalan N.P. and Akilandeswari J., 2nd Edition, 2014, Prentice Hall of India, New Delhi.
3. *Java How to Program*, Paul Dietel and Harvey Deitel, 8th Edition, 2014, Prentice Hall of India, New Delhi

Reference Books:

1. Uttam K. Roy, *Web Technologies*, 2010, Oxford University Press.
2. Godbole A. S. & Kahate A., *Web Technologies*, 2nd Edition, 2006, TMH, New Delhi.

SYLLABUS 6th SEMESTER

Paper II/Subject Name: Software Engineering		**Subject Code: CAP052M601**
L-T-P-C – 3-0-2-4	**Credit Units: 04**	**Scheme of Evaluation: T**

Objective:

The objectives of the course are to explain the fundaments of software engineering principles and practices, including project management, configurations management, requirements definition, system analysis, design, testing, and deployment.

Prerequisites: None

Course Outcomes

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	**Demonstrate** the various phases of project development.	**BT 2**
CO 2	**Select** appropriate process model for development depending on the user requirements.	**BT 3**
CO 3	**Analyze** and **assess** the model developed in terms of risks management and reuse.	**BT 4 & 5**

Detailed Syllabus:

Modules	**Topics**	**Course content**	**Hours**
I	**Introduction to Process Models and Software Requirement Specification**	Importance of Software Project Management, Activities Methodologies, Categorization of Software Projects, Setting objectives, Software life cycle models: Waterfall, prototyping, Evolutionary, Spiral models and Agile Model. Software Requirements: Functional and non-functional requirements, user requirements, system requirements, interface specification, the software requirements document. Requirements engineering process: Feasibility studies, requirements elicitation and analysis, requirements validation, requirements management.	**15**
II	**Software Process Management, Activity Planning and Agile Development**	Project planning and control, Effort and Cost estimation techniques-LOC, Function Point, COCOMO, project scheduling using PERT and GANTT charts, Critical path (CRM) method, cost-time relations: Rayleigh-Norden results, Staffing Pattern,S oftware configuration management, Introduction to Agility- Agile methods – Extreme Programming – SCRUM – Managing interactive processes.	**18**
III	**Software Design and Risk Estimation**	Basics of Software Design, Procedural Design Methodology, Modularity, Cohesion, Coupling, DFD and Structure Chart, Object-Oriented concepts, Introduction to UML: Class and interaction Diagrams, Object-Oriented Analysis and Design, Object-oriented Software Modelling.Risk Management- Risk Identification, Risk Assessment, Risk Containment	**18**
IV	**Software Testing, Maintenance**	Software testing fundamentals- Internal and external views of Testing-white box testing – basis path testing-control structure testing-black box testing- Regression Testing – Unit Testing – Integration Testing – Validation Testing – System Testing And Debugging	**15**
Total			**66**

Software Engineering Lab

Detailed Syllabus:

Total Lab Hours for the semester = 48 (4 hours per week)

Minimum 20 Laboratory experiments based on the following-

1. Choose a hypothetical system of significant complexity and write an SRS for the same.
2. Draw one or more Use Case diagrams for capturing and representing requirements of the system.
3. Draw Use case diagrams that include template showing description and steps of the Use Case for various scenarios.

4. Draw basic class diagrams to identify and describe key concepts like classes, types in your system and their relationships.
5. Draw sequence diagrams OR communication diagrams with advanced notation for your system to show objects and their message exchanges.
6. Draw activity diagrams to display either business flows or like flow charts.
7. Draw component diagrams assuming that you will build your system using existing components along with a few new ones.
8. Draw deployment diagrams to model the runtime architecture of your system

National Credit Hours		
Lecture/ Tutorial	**Practicum**	**Experiential Learning**
3 * 22 NCH = 66 NCH	2 * 15 NCH = 30 NCH	8 * 2 NCH = 16 NCH (Problem Solving, Seminar, Case Study, Discussion, Internship, Projects)

Text Books:

1. *Software Project Management,* Bob Hughes, Mike Cotterell and Rajib Mall, 5th Edition, 2012, Tata McGraw Hill, New Delhi
2. *System Analysis and Design,* Elias m. Awad, 2nd Edition, 2010, Galgotia Publications Pvt. Ltd.
3. *System Analysis & design,* Perry Edwards, 2nd Edition, Tata McGraw-Hill Education.

Reference Books:

1. S. Skidmore, *Introduction to system Analysis*, 2nd Edition, 2000, Macmillan Education.
2. S. Skidmore, *System Design*, 2nd Edition, 2000, Macmillan Education.
3. Kieron Conway, *Software Project Management: From Concept to Deployment,* 1st Edition, 2000, Dreamtech Press.
4. S. A. Kelkar, *Software Project Management: A Concise Study,* 3rd Edition, 2012, PHI Publication.

Paper V/Subject Name: Cryptography and Network Security		**Subject Code: CAP052M602**
L-T-P-C – 3-0-2-4	**Credit Units: 04**	**Scheme of Evaluation: T**

Objective:

The objectives of the course are to explain the basics of cryptography, kinds of security threats in networks and to learn to find the vulnerabilities in programs and to overcome them and to teach about the models and standards for security.

Prerequisites: Concepts of Number Theory and Networking

Course Outcomes

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	**Understand** and **illustrate** basic cryptographic algorithms, message and web authentication and security issues.	**BT 2**
CO 2	**Demonstrate** the current legal and ethical issues towards information.	**BT 2**
CO 3	**Identify** the applications of different protocol like SSL, TLS etc.	**BT 3**

CO 4	**Analyze** and **assess** the security services and mechanisms	**BT 4**

Detailed Syllabus

Modules	Topics	Course Contents	Hours
I	**Introduction**	Need for Security, Security Approaches, Principles of Security, Types of Attacks, Brute Force Attack, Encryption, Decryption, Crypto system, Cryptographic Techniques: Substitution Ciphers, Transposition Ciphers, Product Ciphers, Stegenography, Block Cipher, Stream Cipher.	**12**
II	**Symmetric and Asymmetric Key Cryptography**	Overview, Algorithm Modes and Types, Data Encryption Standard: Simplified DES, The Strength of DES, Differential and Linear Cryptanalysis. Triple DES, Blowfish. Confidentiality using Conventional Encryption: Placement of Encryption Function, Traffic Confidentiality, Key Distribution, Random Number Generation. Modular Arithmetic, Public Key Cryptography and RSA: Principles of Public Key Cryptosystems, Difference with Symmetric Key Cryptography, The RSA Algorithms, Key Management, Diffie Hellman Key Exchange.	**12**
III	**Authentication Protocols**	Message Authentication: Authentication Requirements, Authentication Functions, Message Authentication Codes, MD5 Message Digest Algorithms, Digital Signatures and Authentication Protocols: Digital Signatures, Authentication Protocols, Digital Signature Standards.	**12**
IV	**Security Protocols**	Security Applications and Protocols- Authentication Applications: Secure HTTP, HTTPS, ERT, SSH, Kerberos. Email Security: PGP, S/MIME. IP Security: Overview, IPSec architecture.	**12**
TOTAL			**48**

National Credit Hours		
Lecture/ Tutorial	**Practicum**	**Experiential Learning**
4 * 22 NCH = 88 NCH	-	8 * 4 NCH = 32 NCH (Problem Solving, Seminar, Case Study, Discussion, Internship, Projects)

Text Books:

1. *Cryptography and Network Security*, Atul Kahate, 2nd Edition. 2003, Tata McGraw Hill.
2. *Cryptography and Network security,* Fourozan, 3rd Edition, 2007, McGraw Hill

Reference Books:

1. William Stallings, *Cryptography and Network Security*: *Principles and Practices*", 5th Edition, 2010, Prentice Hall.
2. Michael Howard, David LeBlanc, John Viega, *24 Deadly Sins of Software Security: Programming Flaws and How to Fix Them*, 1st Edition, 2009, Mc Graw Hill Osborne Media.

- **Detailed Syllabus of Discipline Specific Elective (DSE-V/VI/VII)**

Paper III/Subject Name: Introduction to Machine Learning		**Subject Code: CAP052M603**
L-T-P-C – 3-1-0-4	**Credit Units: 04**	**Scheme of Evaluation: T**

Objective:

The objective of this course is to introduce students to fundamental machine learning techniques, including supervised and unsupervised learning, regression, classification, feature engineering, optimization techniques, and model evaluation. The course also emphasizes practical implementation using Python and machine learning libraries.

Prerequisites:
Basic programming knowledge (Python preferred), Linear Algebra, Probability & Statistics, and an understanding of basic data structures.

Course Outcomes

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	Understand fundamental machine learning concepts and applications	**BT 1 & 2**
CO 2	Implement supervised learning techniques such as regression and classification	**BT 3**
CO 3	Analyze unsupervised learning techniques including clustering and dimensionality reduction	**BT 4**

Detailed Syllabus:

Modules	**Topics**	**Course content**	**Hours**
I	**Introduction to Machine Learning**	Overview of AI vs ML vs DL, Types of Learning (Supervised, Unsupervised, Reinforcement Learning), Applications of ML in different domains, ML pipeline (Data Preprocessing, Feature Engineering, Model Building, Evaluation), Introduction to ML tools (Scikit-Learn, TensorFlow, PyTorch)	**12**
II	**Supervised Learning**	Linear Regression (Simple & Multiple), Polynomial Regression, Logistic Regression, Decision Trees, Random Forests, Naïve Bayes, Support Vector Machines (SVM), K-Nearest Neighbors (KNN), Model Evaluation Metrics (Accuracy, Precision, Recall, F1-Score, ROC Curve	**12**
III	**Unsupervised Learning**	Introduction to Clustering, K-Means Clustering, Hierarchical Clustering, DBSCAN, Principal Component Analysis (PCA), t-SNE for Dimensionality Reduction, Applications of Unsupervised Learning (Anomaly Detection, Market Segmentation	**12**
IV	**Model Optimization and Practical Application**	Overfitting & Underfitting, Cross-Validation, Bias-Variance Tradeoff, Feature Selection & Engineering, Hyperparameter Tuning (Grid Search, Random Search, Bayesian Optimization), Deployment of ML Models (Flask, FastAPI, Streamlit)	**12**
Total			**48**

National Credit Hours		
Lecture/ Tutorial	**Practicum**	**Experiential Learning**
4 * 22 NCH = 88 NCH	-	8 * 4 NCH = 32 NCH (Problem Solving, Seminar, Case Study, Discussion, Internship, Projects)

Textbook:

1. Pattern Recognition and Machine Learning, Christopher M. Bishop, 2006

Reference Books:

1. Machine Learning, Tom M. Mitchell, 1997
2. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, Aurélien Géron, 2nd Edition, 2019
3. Introduction to Statistical Learning, Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, 2013
4. Machine Learning Yearning, Andrew Ng, 2018

Paper III/Subject Name: Introduction to Data Science		**Subject Code: CAP052M604**
L-T-P-C – 3-1-0-4	**Credit Units: 04**	**Scheme of Evaluation: T**

Objective:
The objective of this course is to introduce students to data science fundamentals, including data collection, preprocessing, exploratory analysis, statistical modeling, and basic machine learning techniques. The focus will be on structured and semi-structured data before transitioning to big data analytics in the next course.

Prerequisites: Statistical Computing (as it covers probability, hypothesis testing, and statistical modeling), /Basic Python or R programming.

Course Outcomes

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	Understand the fundamental concepts and scope of Data Science	**BT 1 & 2**
CO 2	Perform data collection, cleaning, and preprocessing for structured and semi-structured data	**BT 3**
CO 3	Conduct exploratory data analysis (EDA) and apply statistical techniques for insight generation	**BT 4**

Detailed Syllabus:

Modules	Topics	Course Contents	Hours
I	**Introduction to Data Science & Data Types**	Overview of Data Science, Key applications in real-world industries, Structured vs Semi-Structured vs Unstructured data, Data Science Workflow, Tools & Technologies (Python/R, Jupyter, SQL, Excel, BI Tools)	**12**
II	**Data Collection, Preprocessing & Wrangling**	Data collection techniques (APIs, Web Scraping, Databases), Handling missing values, Outlier detection, Encoding categorical variables, Data Transformation (Scaling, Normalization, Feature Engineering)	**12**
III	**Exploratory Data Analysis (EDA) & Statistical Techniques**	Descriptive Statistics, Data Visualization (Histograms, Box plots, Pair plots, Heatmaps), Correlation & Covariance, Hypothesis Testing (t-test, ANOVA, Chi-Square test), Feature Selection	**12**
IV	**Machine Learning for Structured Data**	Introduction to Supervised & Unsupervised Learning, Linear & Logistic Regression, Decision Trees, Model Evaluation (Accuracy, Precision, Recall, F1-Score, RMSE), Preparing for Big Data Analytics	**12**

		(Data Pipeline Concepts)	
TOTAL			**48**

National Credit Hours		
Lecture/ Tutorial	**Practicum**	**Experiential Learning**
4 * 22 NCH = 80 NCH	-	8 * 4 NCH = 32 NCH (Problem Solving, Seminar, Case Study, Discussion, Internship, Projects)

Textbook:

1. Doing Data Science, Cathy O'Neil & Rachel Schutt, 2013

Reference Books:

1. Data Science for Business, Foster Provost & Tom Fawcett, 2013
2. Python for Data Analysis, Wes McKinney, 2017
3. Introduction to Statistical Learning, Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, 2013
4. Data Science from Scratch, Joel Grus, 2019

Paper IV/Subject Name: Introduction to Deep Learning		**Subject Code: CAP052M605**
L-T-P-C – 3-1-0-4	**Credit Units: 04**	**Scheme of Evaluation: T**

Objective:
The objective of this course is to introduce students to deep learning techniques, neural networks, and their applications in various domains such as computer vision, natural language processing, and generative models. The course focuses on theoretical understanding as well as hands-on implementation using TensorFlow and PyTorch.

Prerequisites: Understanding of Machine Learning concepts, Linear Algebra, Probability & Statistics, and basic optimization techniques.

Course Outcomes

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	Understand the fundamentals of deep learning and artificial neural networks	**BT 1 & 2**
CO 2	Implement deep neural networks and optimization techniques	**BT 3**
CO 3	Analyze convolutional and recurrent neural networks and their applications	**BT 4**

Detailed Syllabus:

Modules	**Topics**	**Course Contents**	**Hours**

I	**Introduction to Deep Learning & Neural Networks**	History and Evolution of Neural Networks, Perceptron Model, Activation Functions (Sigmoid, ReLU, Tanh, Softmax), Feedforward Neural Networks, Loss Functions, Backpropagation and Gradient Descent (SGD, Momentum, Adam, RMSprop)	**12**
II	**Convolutional Neural Networks (CNNs)**	Introduction to Convolutional Layers, Pooling Layers, CNN Architectures (LeNet, AlexNet, VGG, ResNet), Transfer Learning, Object Detection & Image Classification, CNN Applications in Real-World	**12**
III	**Recurrent Neural Networks (RNNs) & Sequence Models**	Introduction to Sequential Data, RNN Architecture, Vanishing Gradient Problem & LSTMs/GRUs, Attention Mechanism, Transformers & BERT, NLP Applications (Text Classification, Sentiment Analysis, Machine Translation)	**12**
IV	**Generative Models & Advanced Deep Learning Topics**	Autoencoders & Variational Autoencoders (VAEs), Generative Adversarial Networks (GANs), Reinforcement Learning Basics, Deep Learning Frameworks, Hyperparameter Optimization & Model Compression	**12**
TOTAL			**48**

National Credit Hours		
Lecture/ Tutorial	**Practicum**	**Experiential Learning**
4 * 22 NCH = 88 NCH	-	8 * 4 NCH = 32 NCH (Problem Solving, Seminar, Case Study, Discussion, Internship, Projects)

Textbook:

1. Deep Learning, Ian Goodfellow, Yoshua Bengio, Aaron Courville, 2016

Reference Books:

1. Neural Networks and Deep Learning, Michael Nielsen, 2015
2. Hands-On Deep Learning with TensorFlow and Keras, Rajdeep Dua, 2020
3. Deep Learning for Computer Vision, Adrian Rosebrock, 2019
4. Transformers for NLP, Denis Rothman, 2021

Paper III/Subject Name: Introduction to Big Data Analytics		**Subject Code: CAP052M606**
L-T-P-C – 3-1-0-4	**Credit Units: 04**	**Scheme of Evaluation: T**

Objective:

The objectives of the course are to make the students analyse the components of cloud computing and its business perspective and to explain the evaluation of the various cloud development tools.

Prerequisites: Concepts of Databases and Networks

Course Outcomes

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	**Understand** how to leverage the insights from big data analytics and the various NoSql alternative database models.	**BT 2**
CO 2	**Apply** different analytic techniques on real-time streaming data	**BT 3**
CO 3	**Analyze** resultant data using various statistical measures	**BT 4 & 5**

Detailed Syllabus:

Modules	Topics	Course Contents	Hours
I	**Introduction to Big Data and Hadoop Framework**	Big Data – Definition, Characteristic Features – Big Data Applications - Big Data vs Traditional Data - Risks of Big Data - Structure of Big Data - Challenges of Conventional Systems - Web Data – Evolution of Analytic Scalability - Evolution of Analytic Processes, Tools and methods - Analysis Vs Reporting - Modern Data Analytic Tools. Distributed File Systems - Large-Scale File System Organization – HDFS concepts - MapReduce Execution, Algorithms using MapReduce, Matrix-Vector Multiplication – Hadoop YARN	**12**
II	**Data Analysis**	Statistical Methods: Regression modelling, Multivariate Analysis - Classification: SVM & Kernel Methods - Rule Mining - Cluster Analysis, Types of Data in Cluster Analysis, Partitioning Methods, Hierarchical Methods, Density Based Methods, Grid Based Methods, Model Based Clustering Methods, Clustering High Dimensional Data - Predictive Analytics – Data analysis using R	**12**
III	**Mining Data Streams**	Streams: Concepts – Stream Data Model and Architecture - Sampling data in a stream - Mining Data Streams and Mining Time-series data - Real Time Analytics Platform (RTAP) Applications - Case Studies - Real Time Sentiment Analysis, Stock Market Predictions.	**12**
IV	**Big Data Frameworks**	Introduction to NoSQL – Aggregate Data Models – Hbase: Data Model and Implementations – Hbase Clients – Examples – Cassandra: Data Model – Examples – Cassandra Clients – Hadoop Integration. Pig – Grunt – Pig Data Model – Pig Latin – developing and testing Pig Latin scripts. Hive – Data Types and File Formats – HiveQL Data Definition – HiveQL Data Manipulation – HiveQL Queries	**12**
TOTAL			**48**

National Credit Hours		
Lecture/ Tutorial	**Practicum**	**Experiential Learning**
4 * 22 NCH = 88 NCH	-	8 * 4 NCH = 32 NCH (Problem Solving, Seminar, Case Study, Discussion, Internship, Projects)

Text Books:

1. *Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics,* Bill Franks, 1st Edition, 2012, Wiley and SAS Business Series.
2. David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph", 2013

Reference Books:

1. Michael Berthold, David J. Hand, *Intelligent Data Analysis,* 2nd Edition, 2007, Springer.
2. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, *Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses*, 1st Edition, 2013, Wiley.
3. P. J. Sadalage and M. Fowler, *NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence*", 1st Edition, 2012, Addison-Wesley Professional

- **Detailed Syllabus for Minor**

Paper III/Subject Name: Secure Web Development		**Subject Code: CAP052N601**
L-T-P-C – 3-1-0-4	**Credit Units: 04**	**Scheme of Evaluation: T**

Objective:

The objective of this course is to introduce students to the fundamentals of web security, covering common threats, secure coding practices, authentication mechanisms, and compliance with security standards. The course focuses on theoretical concepts with minimal hands-on security testing.

Prerequisites: Basic understanding of Web Development (HTML, CSS, JavaScript, Backend Basics), Basic knowledge of Networking (HTTP/HTTPS, IP Addresses, Firewalls),

Course Outcomes

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	Understand fundamental security principles in web development	**BT 1 & 2**
CO 2	Identify and explain common security threats and vulnerabilities	**BT 3**
CO 3	Describe secure authentication and access control mechanisms	**BT 4**

Detailed Syllabus:

Modules	**Topics**	**Course Contents**	**Hours**
I	**Introduction to Web Security**	Importance of Web Security, Basics of HTTP & HTTPS, OWASP Top 10 Overview (Common Vulnerabilities such as SQL Injection, XSS, CSRF, Security Misconfigurations, Data Breaches)	**12**
II	**Authentication, Authorization & Secure Communication**	Introduction to Authentication (Username-Password, Two-Factor Authentication), Role-Based Access Control (RBAC), Introduction to Data Encryption (SSL/TLS, HTTPS, Hashing, Digital Certificates)	**12**
III	**Web Application Security & Testing**	Security Testing Basics, Common Attacks (SQL Injection, XSS, CSRF), Introduction to Security Tools (Burp Suite, OWASP ZAP), Basic Secure Coding Guidelines	**12**
IV	**Compliance, Privacy, and Secure Deployment**	Overview of Data Protection Laws (GDPR, HIPAA, PCI-DSS), Secure Hosting Practices, Introduction to Cloud Security, Security in DevOps (Basic Overview of CI/CD Security)	**12**
TOTAL			**48**

National Credit Hours		
Lecture/ Tutorial	**Practicum**	**Experiential Learning**
4 * 22 NCH = 88 NCH	-	8 * 4 NCH = 32 NCH (Problem Solving, Seminar, Case Study, Discussion, Internship, Projects)

Textbook:

1. Web Security for Developers, Malcolm McDonald, 2020

Reference Books:

1. OWASP Top Ten Web Application Security Risks, OWASP Foundation, 2021
2. Web Application Security: A Beginner's Guide, Bryan Sullivan & Vincent Liu, 2011
3. Security in Computing, Charles P. Pfleeger, 5th Edition, 2015

7th Semester							
Sl. No.	**Subject Code**	**Names of subjects (Suggested)**	**Level of Course**	**Credit**	L	**T**	**P**
Major							
1	CAP052M701	Cloud Computing	400	3	3	0	0
2	CAP052M702	Introduction to Data Warehousing	400	3	3	0	0
3	CAP052M703	Introduction to Natural Language Processing	400	3	3	0	0
4	CAP052M704	Wireless Communication Network	400	3	3	0	0
5	CAP052M711	Cloud Computing Lab	400	1	0	0	2
6	CAP052M712	Introduction to Data Warehousing Lab	400	1	0	0	2
7	CAP052M713	Introduction to Natural Language Processing Lab	400	1	0	0	2
8	CAP052M714	Wireless Communication Network Lab	400	1	0	0	2
Minor							
5	CAP052N701	Cloud-Based Web Development	400	4	3	1	0
MOOCS							
6	MOOCS	One 8-week Course from SWAYAM /MOOCS as per the direction of the Department	400	2	0	0	0
		TOTAL		**22**			
8th Semester							
Sl. No.	**Subject Code**	**Names of subjects (Suggested)**	**Level of Course**	**Credit**	**L**	**T**	**P**
Major							

1	CAP052M801	Soft Computing	400	3	3	0	0
2	CAP052M811	Soft Computing Lab	400	1	0	0	2
Minor							
2	CAP052N801	Web Page Ranking and Optimization	400	4	3	1	0
MOOCS							
3	MOOCS	One 8-week Course from SWAYAM /MOOCS as per the direction of the Department	400	2	0	0	0
Dissertation							
4		Dissertation	400	12			
Advanced Level Core Course instead of Dissertation							
5	CAP052M802	Soft Computing	400	4	3	1	0
6	CAP052M803	Blockchain Technologies	400	4	3	1	0
7	CAP052M804	Quantum Computing	400	4	3	1	0
		Total		22			

Detailed Syllabus for 7th and 8th Semesters

Subject Name: Cloud Computing **Subject Code: CAP052M701**
L-T-P-C – 3-0-0-3 **Credit Units: 03** **Scheme of Evaluation: T**

Objective:

To introduce the concepts and technologies that enable scalable data analytics using cloud platforms. This course covers cloud architecture, storage systems, distributed computing, big data services, and deployment of analytics pipelines on cloud environments such as AWS, Azure, and Google Cloud.

Prerequisites: Computer Networks, Operating Systems, Basics of Big Data, Python/Java Programming

Course Outcomes:

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

SI No	Course Outcome	Bloom's Taxonomy Level
CO 1	Understand cloud computing architecture, service models, and infrastructure.	BT 2
CO 2	Apply distributed computing frameworks to handle big data in cloud environments.	BT 3

SI No	Course Outcome	Bloom's Taxonomy Level
CO 3	Design and deploy scalable big data pipelines using cloud-native services	BT 4

Module	Topics	Course Content	Periods
I.	**Introduction to Cloud Computing**	Cloud computing definition, characteristics, service models (IaaS, PaaS, SaaS). Deployment models (Public, Private, Hybrid). Virtualization and containers (Docker). Cloud security basics.	**22**
II.	**Cloud File System**	Introduction to Hadoop ecosystem: HDFS, YARN, MapReduce. Apache Spark architecture and RDDs. Hive and Pig for data querying. NoSQL (HBase, MongoDB).	**22**
III.	**Cloud Platforms for Big Data**	Overview of AWS, Azure, and GCP. Services for big data: AWS EMR, S3, Athena, Redshift; Azure HDInsight, Synapse; GCP BigQuery, Dataflow. Data lake and warehouse concepts.	**22**
IV.	**Cloud Data Analytics**	Deploying ML pipelines with cloud services (AWS SageMaker, Azure ML Studio, Google AI Platform). Streaming data with Kafka, Kinesis, and Flink. CI/CD for data engineering in the cloud. Cost and scalability optimization.	**22**
		TOTAL	**88**

Subject Name: Cloud Computing Lab **Subject Code: CAP052M711**
L-T-P-C – 0-0-2-1 **Credit Units: 01** **Scheme of Evaluation: P**

Total Practice Hours = 30 (2 hours/week)

Minimum 10 lab experiments selected from:

1. Set up and deploy virtual machines and containers in AWS/GCP
2. Configure and run a Hadoop job on a cloud-based cluster
3. Load and query datasets using Hive on AWS EMR
4. Develop and run PySpark programs on cloud notebooks
5. Store and retrieve big data from AWS S3 / Azure Blob Storage
6. Perform SQL queries using Google BigQuery
7. Set up data pipeline using Kafka + Spark Streaming
8. Use cloud-based NoSQL (Firebase/MongoDB Atlas) for data access
9. Deploy a machine learning model using SageMaker or GCP AI Platform
10. Implement a real-time dashboard using cloud analytics
11. Explore CI/CD tools for cloud-based data pipeline automation
12. Mini-project on building an end-to-end cloud big data solution

Credit Distribution		
Lecture/ Tutorial	**Practicum**	**Experiential Learning**
4 * 22 NCH = 88 NCH	2 * 15 NCH = 30 NCH	8 * 4 NCH = 32 NCH (Problem Solving, Seminar, Case Study, Discussion, Internship, Projects)

Textbook:

1. **Cloud Computing: Concepts, Technology & Architecture** by Thomas Erl, Pearson, 1st Edition

Reference Books:

1. **Cloud Computing for Big Data** by Prasad Mukhedkar and Kalpana Sharma, Wiley
2. **Hadoop: The Definitive Guide** by Tom White, O'Reilly Media
3. **Architecting the Cloud** by Michael J. Kavis, Wiley
4. **Designing Data-Intensive Applications** by Martin Kleppmann, O'Reilly

Subject Name: Introduction to Data warehousing		**Subject Code: CAP052M702**
L-T-P-C – 3-0-0-3	**Credit Units: 03**	**Scheme of Evaluation: T**

Objective:

To provide comprehensive knowledge of relational database concepts along with advanced topics in data warehousing. This course aims to teach students how to design, query, normalize, and manage databases, and to introduce modern warehousing techniques.

Prerequisites: Basic SQL and relational database design, Understanding of Normalization & Indexing, Fundamentals of Transaction Management

Course Outcomes:

On successful completion of the course, the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	Understand fundamental concepts of database design and data models	**BT 1 & 2**
CO 2	Apply SQL for data retrieval, manipulation, and transactions	**BT 3**
CO 3	Analyze and optimize relational schema using normalization techniques	**BT 4**
CO 4	Design and implement data warehouses using dimensional modeling	**BT 5**

Detailed Syllabus:

Modules	Topics	Course content	Periods
I	**Fundamentals of DBMS**	Introduction to DBMS and RDBMS; data models (hierarchical, network, relational); entity-relationship (ER) model; keys and constraints; relational algebra and calculus; database architecture and design; schema, instance, and independence	**22**
II	**Structured Query Language & Normalization**	Basic and advanced SQL: DDL, DML, DCL, joins, subqueries, views, indexes, triggers, stored procedures. Integrity constraints and transaction control. Normalization: 1NF to BCNF, multi-valued and join dependencies, lossless decomposition	**22**
III	**Data Warehousing Concepts**	Introduction to data warehousing; data warehouse architecture; differences between OLTP and OLAP; data marts; schemas: star, snowflake, fact constellation; ETL process: data extraction, cleaning, loading; metadata and warehouse governance	**22**
IV	**OLAP and Warehouse Implementation**	OLAP operations: slicing, dicing, roll-up, drill-down; MOLAP, ROLAP, HOLAP architectures; indexing in DW; data cube computation; performance optimization; case studies in warehouse implementations; BI tools overview (e.g., Power BI, Tableau)	**22**
Total			**88**

Subject Name: Introduction to Data Warehousing Lab **Subject Code: CAP052M712**

L-T-P-C – 0-0-2-1 **Credit Units: 01** **Scheme of Evaluation: P**

Total Lab Hours for the semester = 30 (2 hours per week)

Minimum 15 Laboratory experiments based on the following-

Experiment No.	Title	Objective
1	Advanced SQL Queries	Write and optimize complex SQL queries using Joins, Subqueries, and Aggregations.
2	Indexing and Performance Tuning	Implement indexing strategies and measure query performance improvements.
3	NoSQL Data Models	Design and implement NoSQL data models in MongoDB.
4	Replication and Sharding in MongoDB	Configure database replication and horizontal partitioning in MongoDB.
5	Query Execution Plan Analysis	Analyze query execution plans to optimize database queries.
6	Transaction Management	Implement ACID transactions and concurrency control in MySQL/PostgreSQL.
7	Distributed Databases	Set up a simple distributed database system and test query performance.
8	Graph Database Implementation	Store and query graph data using Neo4j and Cypher queries.
9	Cloud Database Deployment	Deploy and manage a relational database on AWS RDS or Google Cloud SQL.
10	Stream Processing with Apache Kafka	Implement real-time data streaming using Apache Kafka.
11	Two-Phase Commit Implementation	Simulate the two-phase commit protocol for distributed transactions.
12	Database Security & SQL Injection Testing	Perform SQL Injection attacks and apply security patches.
13	Big Data Querying	Execute SQL queries over large datasets using Apache Hive or Google BigQuery.
14	Data Warehouse Implementation	Design a basic data warehouse schema and implement ETL pipelines.
15	Time-Series Databases	Implemented and queried time-series data using InfluxDB.
16	Full-Text Search in Databases	Implement full-text search indexing in PostgreSQL or Elasticsearch.
17	Cloud NoSQL Database Integration	Worked with Firebase Realtime Database and Firestore.
18	Performance Benchmarking	Compare performance differences between relational and NoSQL databases.

Credit Distribution		
Lecture/ Tutorial	**Practicum**	**Experiential Learning**
2 * 22 NCH = 44 NCH	2 * 15 NCH = 30 NCH	8 * 2 NCH = 16 NCH (Problem Solving, Seminar, Case Study, Discussion, Internship, Projects)

Textbook:

1. Fundamentals of Database Systems, Elmasri & Navathe, 7th Edition

Reference Books:

1. NoSQL Distilled, Pramod J. Sadalage & Martin Fowler
2. Hadoop: The Definitive Guide, Tom White
3. Graph Databases, Ian Robinson, Jim Webber
4. Database System Concepts, Silberschatz, Korth & Sudarshan

Subject Name: Introduction to Natural Language Processing **Subject Code: CAP052M703**
L-T-P-C – 3-0-0-3 **Credit Units: 043** **Scheme of Evaluation: T**

Objective:

The objectives of the course are to enable students to understand the application of AI in the field of Natural Language Processing, learn the fundamentals of NLP, and design NLP-based applications.

Prerequisites: Probability & Statistics, Linear Algebra, Machine Learning, Python

Course Outcomes

On successful completion of the course, the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	**Understand** fundamental NLP concepts, text processing techniques, and linguistic properties.	**BT 2**
CO 2	**Apply** traditional ML algorithms for text classification, sentiment analysis, and topic modeling.	**BT 3**
CO 3	**Analyze** and **assess** deep learning models for NLP tasks, including transformers and attention mechanisms.	**BT 4 & 5**
CO 4	**Design** and implement NLP applications such as chatbots, summarization, and text generation.	**BT 6**

Detailed Syllabus:

Module	Topics	Course Content	Periods

I.	**Introduction**	Overview of NLP: Definition and importance of NLP, Applications: Chatbots, Machine Translation, Sentiment Analysis, Speech Recognition, Challenges in NLP: Ambiguity, Data Sparsity, Context Understanding, Text Processing & Linguistic Basics, Text Normalization: Tokenization, Stemming, Lemmatization, Stopword Removal and Part-of-Speech (POS) Tagging, Named Entity Recognition (NER), Regular Expressions & Text Representation, Regex for text preprocessing, Bag-of-Words (BoW), TF-IDF, Word Frequency Analysis, Word	**22**
II.	**Classical NLP Techniques and Language Modelling**	N-gram Language Models: Unigram, Bigram, Trigram Models, Probability Estimation: Smoothing Techniques (Laplace, Kneser-Ney), Perplexity and Evaluation of Language Models, Text Classification & Sentiment Analysis, Naïve Bayes Classifier for Text Classification, Logistic Regression & SVM for NLP Tasks, Sentiment Analysis Using ML Techniques,	**22**
III.	**Deep Learning for NLP**	Neural Networks for NLP: Basics of Neural Networks for NLP, Word Embeddings with Neural Networks (Word2Vec, GloVe), Feedforward and Recurrent Neural Networks (RNNs), Sequence Models & Attention Mechanism, Recurrent Neural Networks (RNNs), Long Short-Term Memory (LSTM) & Gated Recurrent Unit (GRU), Attention Mechanism & Self-Attention, Transformers & Pretrained Language Models, Transformer Architecture (Vaswani et al.), BERT, GPT	**22**
IV	**NLP Applications**	Conversational AI & Chatbots: Rule-Based Chatbots vs. AI-Based Chatbots, Intent Recognition and Response Generation, DialogFlow, Rasa, GPT-based Chatbots, Speech Processing & Text-to-Speech (TTS). Speech Recognition Models (CMU Sphinx, DeepSpeech, Whisper), Text-to-Speech Synthesis (Tacotron, WaveNet), Bias & Ethics in NLP, Challenges of Bias in NLP Models, Fairness in NLP & Model Interpretability,	**22**
TOTAL			**88**

Subject Name: Introduction to Natural Language Processing Lab		**Subject Code: CAP052M713**
L-T-P-C – 0-0-2-1	**Credit Units: 01**	**Scheme of Evaluation: P**

Total Practice Hours for the semester = 30 (2 hours per week)

Minimum 10 Laboratory experiments based on the following-

- Implement tokenization, stemming, and lemmatization using NLTK/spaCy.
- Perform POS tagging and Named Entity Recognition (NER).
- Build word embeddings using Word2Vec and visualize embeddings.
- Train an N-gram model and evaluate it using perplexity.
- Implement Naïve Bayes and SVM for sentiment analysis.
- Perform topic modeling using LDA on a real-world dataset.
- Implement RNN, LSTM, and GRU models for text generation.
- Fine-tune BERT for text classification.
- Train a Seq2Seq model for machine translation.
- Build and deploy a chatbot using Rasa or OpenAI GPT API.
- Train a speech-to-text model using DeepSpeech.
- Deploy an NLP model as an API using Flask.

Credit Distribution

Lecture/ Tutorial	Practicum	Experiential Learning
4 * 22 NCH = 88 NCH	2 * 15 NCH = 30 NCH	8 * 4 NCH = 32 NCH (Problem Solving, Seminar, Case Study, Discussion, Internship, Projects)

Text Books

1. *Speech and Language Processing,* Daniel Jurafsky & James H. Martin, 2nd Edition, 2008, Pearson
2. *Natural Language Processing with Python,* Steven Bird, Ewan Klein, Edward Loper, 1st Edition, 2009, O'Reilly

Reference Books:

1. Nitin Indurkhya & Fred J. Damerau, *Handbook of Natural Language Processing*, 2nd Edition, 2010, Taylor & Francis

Subject Name: Wireless Communication Network		**Subject Code: CAP052M704**
L-T-P-C – 3-0-0-3	**Credit Units: 013**	**Scheme of Evaluation: T**

Objective:

To provide undergraduate students with a foundational understanding of wireless communication principles, network architecture, and emerging wireless technologies, supported by hands-on lab work for practical insights.

Prerequisites:

• Basics of Communication Systems
• Computer Networks

Course Outcomes:

On successful completion of the course, the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	**Understand the** fundamentals of communication protocol concepts	**BT 2**
CO 2	**Apply** multiple access techniques to get acess of medium	**BT 3**
CO 3	**Analyze** and **assess** Wireless Communication models	**BT 4 & 5**
CO 4	**Design** and implement Wireless Communication to send messages	**BT 6**

Detailed Syllabus:

Module	Topics	Course Content	Periods
I	**Introduction to Wireless Communication**	Overview of wireless communication systems, evolution of wireless technologies, frequency reuse, wireless channel characteristics, path loss, shadowing, fading, modulation techniques (ASK, FSK, PSK, QAM).	22
II	**Mobile and Cellular Communication**	Cellular concepts, frequency planning, handoff mechanisms, GSM architecture, multiple access techniques (FDMA, TDMA, CDMA), wireless propagation models, antenna systems.	22
III	**Wireless Networking**	Wireless LANs: IEEE 802.11 standards, Bluetooth, Zigbee, Wi-Fi architecture, MAC protocols, wireless routing protocols (AODV,	22

	and Standards	DSR), spectrum management.	
IV	**Emerging Trends and Security**	4G, 5G, and beyond; Internet of Things (IoT) and wireless sensor networks; network security issues, encryption in wireless networks, case studies on wireless applications.	22

Subject Name: Wireless Communication Network Lab		**Subject Code: CAP052M714**
L-T-P-C – 0-0-2-1	**Credit Units: 01**	**Scheme of Evaluation: P**

Total Practice Hours for the semester = 30 (2 hours per week)

Minimum 8 Laboratory experiments based on the following-

Laboratory Work:

1. Study and analysis of basic wireless components and frequency bands.
2. Simulation of wireless channel models using MATLAB/NS3.
3. Implementation of modulation techniques (ASK, FSK, PSK).
4. Evaluation of path loss models in indoor and outdoor scenarios.
5. Configuration of Wi-Fi and wireless routers.
6. Simulation of routing protocols in wireless networks.
7. Hands-on with GSM and Bluetooth modules.
8. Implementing a basic mobile communication simulation in NS2/NS3.
9. Study of MAC protocols in 802.11.
10. Case study on IoT device connectivity over Wi-Fi/Bluetooth.

Textbook:

1. Wireless Communications: Principles and Practice, Theodore S. Rappaport, 2nd Edition, 2002, Pearson Education.

Reference Books:

1. Mobile Communications, Jochen Schiller, 2nd Edition, 2003, Pearson.

2. Wireless and Mobile Networks, William Stallings, 1st Edition, 2005, Pearson.

3. Wireless Communication, Upen Dalal, 1st Edition, 2009, Oxford University Press.

Credit Distribution		
Lecture/ Tutorial	**Practicum**	**Experiential Learning**

4 * 22 NCH = 88 NCH	2 * 15 NCH = 30 NCH	8 * 4 NCH = 32 NCH (Problem Solving, Seminar, Case Study, Discussion, Internship, Projects)

Subject Name: Cloud-Based Web Development		**Subject Code: CAP052N701**
L-T-P-C – 3-1-0-4	**Credit Units: 04**	**Scheme of Evaluation: T**

Objective:

To provide students with an understanding of modern web development using cloud platforms. The course focuses on building, deploying, and maintaining web applications leveraging cloud services and architectures.

Prerequisites:

- Basic knowledge of web development
- Familiarity with HTML, CSS, JavaScript
- Fundamentals of programming and databases

Course Outcomes:

SI No	Course Outcome	Bloom's Taxonomy Level
CO 1	Understand cloud computing concepts and deployment models	BT 1 & 2
CO 2	Develop dynamic web applications with frontend and backend integration	BT 3
CO 3	Utilize cloud-based tools and services for web application deployment	BT 4 & 5

Detailed Syllabus:

Module	Topics	Course Content	Periods
I	**Introduction to Cloud & Web Architecture**	Basics of cloud computing, service models (IaaS, PaaS, SaaS), deployment models (public, private, hybrid). Introduction to web development architectures: client-server, RESTful APIs, microservices. Overview of cloud providers (AWS, Azure, GCP).	22
II	**Front-End and Back-End Development**	Front-end development using HTML5, CSS3, JavaScript, React.js or Vue.js. Backend development using Node.js/Express or Flask/Django. API development and integration. JSON and Fetch/Axios APIs.	22
III	**Cloud-Based Deployment and Services**	Hosting applications on cloud (Heroku, AWS, GCP, Azure). Deployment using CI/CD tools (GitHub Actions, Jenkins). Cloud storage and database integration (Firebase, MongoDB Atlas, Amazon RDS).	22

IV	**Security, Monitoring & Case Studies**	Authentication & authorization using Oauth, Firebase Auth, JWT. Logging and monitoring services (CloudWatch, Firebase Analytics). Case studies of cloud-based apps (e-commerce, real-time chat, etc).	22

Cloud-Based Web Development Practice Session

Total Practice Hours for the semester = 30 (2 hours per week)

Minimum 10 Laboratory experiments based on the following-

1. Setup of a basic cloud account and project on AWS/GCP.
2. Design of a responsive front-end using HTML, CSS, and JS framework.
3. Development of a back-end API using Node.js or Django.
4. Connection of front-end with back-end via RESTful API.
5. Firebase/Cloud DB integration for real-time data.
6. Implement user authentication using Firebase/Auth0.
7. Deploying a full-stack app on Heroku or Netlify.
8. Using GitHub Actions to automate deployment.
9. Setting up cloud monitoring and logging.
10. Mini-project: Build and deploy a cloud-hosted web app (e.g., portfolio, blog, e-store

Textbook:

1. Cloud Computing: Concepts, Technology & Architecture, Thomas Erl, 1st Edition, 2013, Pearson.

Reference Books:

1. Full Stack Development with Node.js and React, David Choi, 1st Edition, 2021, Apress.

2. Web Development with Node and Express, Ethan Brown, 2nd Edition, 2019, O'Reilly.

3. Architecting Cloud Computing Solutions, Kevin L. Jackson & Scott Goessling, 1st Edition, 2018, Packt Publishing.

Credit Distribution		
Lecture/ Tutorial	**Practicum**	**Experiential Learning**
4 * 22 NCH = 88 NCH	2 * 15 NCH = 30 NCH	8 * 4 NCH = 32 NCH (Problem Solving, Seminar, Case Study, Discussion, Internship, Projects)

Detailed Syllabus for 8th Semester

Subject Name: Soft Computing		**Subject Code: CAP052M801**
L-T-P-C – 3-0-0-3	**Credit Units: 03**	**Scheme of Evaluation: T**

Objective:

To introduce undergraduate students to the concepts and techniques of soft computing, including fuzzy logic, neural networks, genetic algorithms, and hybrid systems, and to provide hands-on experience with tools and applications.

Prerequisites:

- Basics of Mathematics and Logic
- Programming knowledge in Python or MATLAB

Course Outcomes:

SI No	Course Outcome	BT Level
CO 1	Understand the fundamentals of soft computing and its components	BT 1 & 2
CO 2	Apply fuzzy logic principles to model uncertainty in systems	BT 3
CO 3	Design and simulate neural networks for classification and prediction	BT 4 & 5

Detailed Syllabus:

Module	Topics	Course Content	Periods
I	**Introduction to Soft Computing**	Definition and importance of soft computing, comparison with hard computing, components of soft computing, soft computing techniques: fuzzy systems, neural networks, evolutionary computation.	22
II	**Fuzzy Logic and Systems**	Fuzzy sets and operations, membership functions, fuzzification, defuzzification, fuzzy inference system, fuzzy logic control, applications of fuzzy systems.	22
III	**Artificial Neural Networks**	Biological neuron, artificial neuron model, perceptron, multilayer perceptron, backpropagation algorithm, self-organizing maps, applications of neural networks.	22
IV	**Genetic Algorithms and Hybrid Systems**	Genetic algorithm concepts, operators, fitness function, selection, crossover, mutation, applications in optimization. Introduction to hybrid systems combining fuzzy, neural and GA techniques.	22

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Subject Name: Soft Computing Lab		**Subject Code: CAP052M811**
L-T-P-C – 0-0-2-1	**Credit Units: 02**	**Scheme of Evaluation: P**

Total Practice Hours for the semester = 30 (2 hours per week)

Minimum 8 Laboratory experiments based on the following-

Laboratory Work:

1. Implementation of fuzzy logic system in MATLAB or Python.

2. Design of fuzzy membership functions and defuzzification methods.

3. Build and train a perceptron model for logical operations.

4. Implementation of backpropagation algorithm for classification.

5. Develop a self-organizing map for clustering data.

6. Solve an optimization problem using genetic algorithms.

7. Combine fuzzy and neural network systems for function approximation.

8. Apply soft computing techniques for time-series prediction.

9. Simulation of hybrid model using Python libraries (scikit-fuzzy, TensorFlow).

10. Mini-project: Real-life application using soft computing techniques.

Textbook:

1. Soft Computing and Intelligent Systems Design, F. O. Karry and C. de Silva, 1st Edition, 2004, Pearson

Reference Books:

1. Neural Networks, Fuzzy Logic, and Genetic Algorithms, S. Rajasekaran and G. A. Vijayalakshmi Pai, 1st Edition, 2003, PHI.

2. Introduction to Soft Computing, Samir Roy and Chakraborty, 1st Edition, 2013, Pearson.

3. Artificial Intelligence and Soft Computing, Amit Konar, 1st Edition, 2006, CRC Press.

Credit Distribution		
Lecture/ Tutorial	**Practicum**	**Experiential Learning**
4 * 22 NCH = 88 NCH	2 * 15 NCH = 30 NCH	8 * 4 NCH = 32 NCH (Problem Solving, Seminar, Case Study, Discussion, Internship, Projects)

Subject Name: Web Page Ranking and Optimization **Subject Code: CAP052N801**
L-T-P-C – 3-1-0-4 **Credit Units: 04** **Scheme of Evaluation: T**

Objective:

To equip students with an understanding of web search technologies, page ranking algorithms, and techniques for optimizing web content for better visibility and performance in search engines.

Prerequisites:

- Basics of Web Development
- Introduction to Data Structures and Algorithms

Course Outcomes:

SI No	Course Outcome	BT Level
CO 1	Understand web search architecture and information retrieval principles	BT 1 & 2
CO 2	Analyze and implement web page ranking algorithms	BT 3 & 4
CO 3	Apply on-page and off-page optimization strategies	BT 4 & 5

Syllabus:

Module	Topics	Course Content	Periods
I	**Introduction to Web Search and Information Retrieval**	Overview of web search systems, crawling and indexing, search engine architecture, basics of information retrieval, ranking and relevance, keyword analysis.	22
II	**Page Ranking Algorithms**	PageRank algorithm, HITS algorithm, link analysis, TF-IDF, click-through data, user behavior modeling, introduction to learning-to-rank models.	22
III	**Search Engine Optimization (SEO)**	On-page SEO: keywords, metadata, URL structure, internal linking; Off-page SEO: backlinks, social media signals, domain authority. SEO tools and techniques.	22
IV	**Performance and Optimization**	Web performance optimization: page load speed, caching, mobile-friendliness, structured data. Monitoring search analytics, metrics (bounce rate, CTR, conversions). Case studies and real-world tools.	22

Web Page Ranking and Optimization Practice Session

Laboratory Work:

1. Build a simple web crawler to collect webpage data.

2. Implement PageRank algorithm for a sample web graph.

3. Simulate HITS algorithm and analyze hub-authority scores.

4. Perform keyword research using tools like Google Keyword Planner.

5. Optimize a sample web page for on-page SEO factors.

6. Analyze backlinks and domain authority using Moz/SEMRush.

7. Use Google Analytics and Search Console for site performance.

8. Evaluate page speed and apply optimization techniques.

9. Build a static website and apply SEO techniques.

10. Mini project: Optimize and rank a website using all learned techniques.

Textbook:

1. Introduction to Information Retrieval, Christopher D. Manning, Prabhakar Raghavan, and Hinrich Schütze, 1st Edition, 2008, Cambridge University Press.

Reference Books:

1. Search Engine Optimization (SEO) Secrets, Danny Dover, Erik Dafforn, 1st Edition, 2011, Wiley.

2. Web Analytics 2.0, Avinash Kaushik, 1st Edition, 2009, Wiley.

3. Mining the Web: Discovering Knowledge from Hypertext Data, Soumen Chakrabarti, 1st Edition, 2002, Morgan Kaufmann.

Courses In lieu of Research Work

Subject Name: Cyber Space and Cyber Security **Subject Code: CAP052M802**
L-T-P-C – 3-1-0-4 **Credit Units: 04** **Scheme of Evaluation: T**

Objective:

To provide undergraduate students with a foundational understanding of cyberspace and cybersecurity, covering the principles, practices, tools, threats, laws, and ethical issues in the digital world.

Prerequisites:

• Basic knowledge of computer systems and the internet.

Course Outcomes:

SI No	Course Outcome	BT Level
CO 1	Understand the concept of cyberspace and basic cybersecurity principles	BT 1 & 2
CO 2	Identify various types of cyber threats and attacks	BT 2 & 3
CO 3	Apply basic cybersecurity tools and practices for protection	BT 3 & 4

Detailed Syllabus:

Module	Topics	Course Content	Periods

I	**Introduction to Cyberspace**	Cyberspace: definition, evolution, characteristics. Components of cyberspace: networks, protocols, web, email, social media. Digital identity, digital footprint. Cyber ethics, netiquette.	22
II	**Cyber Threats and Vulnerabilities**	Types of threats: malware, phishing, ransomware, denial of service. System vulnerabilities and exploits. Insider threats, social engineering. Case studies of cyber-attacks.	22
III	**Cybersecurity Measures**	Security principles: confidentiality, integrity, availability. Authentication and authorization, firewalls, antivirus software, intrusion detection systems. Security policies and practices.	22
IV	**Cyber Law and Ethics**	Overview of IT Act 2000 and amendments. Cybercrime types and laws. Data privacy and protection regulations. Ethical hacking, responsible disclosure, digital rights and responsibilities.	22

Cyber Space and Cyber Security Practice Session

Practice Session:

1. Simulate phishing attacks and demonstrate countermeasures.

2. Configure and test a basic firewall setup.

3. Perform malware analysis using sandboxing tools.

4. Implement multi-factor authentication mechanisms.

5. Set up network packet capture and analysis using Wireshark.

6. Secure a system using antivirus and security patches.

7. Configure password policies and user roles in a local network.

8. Simulate a DDoS attack and study its mitigation.

9. Explore digital footprints using OSINT tools.

10. Case study presentation on a real-world cyber attack.

Textbook:

1. Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Sunit Belapure and Nina Godbole, 1st Edition, 2011, Wiley.

Reference Books:

1. Cybersecurity and Cyberwar: What Everyone Needs to Know, P.W. Singer and Allan Friedman, 1st Edition, 2014, Oxford University Press.

2. Computer Security: Principles and Practice, William Stallings and Lawrie Brown, 4th Edition, 2018, Pearson.

3. Introduction to Cyber Security, Chwan-Hwa (John) Wu and J. David Irwin, 1st Edition, 2013, CRC Press.

Credit Distribution		
Lecture/ Tutorial	**Practicum**	**Experiential Learning**

4 * 22 NCH = 88 NCH	2 * 15 NCH = 30 NCH	8 * 4 NCH = 32 NCH (Problem Solving, Seminar, Case Study, Discussion, Internship, Projects)

Subject Name: Blockchain Technologies **Subject Code: CAP052M803**
L-T-P-C – 3-1-0-4 **Credit Units: 04** **Scheme of Evaluation: T**

Objective:

To introduce students to the principles, architecture, and applications of blockchain technologies. The course will provide knowledge on decentralized systems, consensus algorithms, cryptocurrency, and smart contracts with hands-on exposure to blockchain development environments.

Prerequisites:

- Basics of Computer Networks and Cryptography
- Programming fundamentals

Course Outcomes:

SI No	Course Outcome	BT Level
CO 1	Understand blockchain architecture and distributed ledger technology	BT 1 & 2
CO 2	Analyze consensus mechanisms and smart contract frameworks	BT 3 & 4
CO 3	Apply blockchain principles in real-world applications	BT 4 & 5

Detailed Syllabus:

Module	Topics	Course Content	Periods
I	Introduction to Blockchain	History and fundamentals of blockchain, structure of a block, characteristics of blockchain, public vs private vs consortium blockchain, use cases across industries.	22
II	Consensus Mechanisms and Cryptography	Consensus algorithms: Proof of Work (PoW), Proof of Stake (PoS), Practical Byzantine Fault Tolerance (PBFT), Cryptographic principles: hash functions, digital signatures, Merkle trees.	22
III	Smart Contracts and Ethereum	Ethereum architecture, EVM, Solidity programming basics, developing and deploying smart contracts, ERC-20 tokens, Gas, Remix IDE.	22
IV	Blockchain Applications and Challenges	Blockchain in supply chain, finance, healthcare, and identity management. Scalability and interoperability issues. Security, privacy, regulatory and governance challenges.	22

Blockchain Technologies Practice Session

Practice Session:

1. Setup and explore a local Ethereum test network using Ganache.

2. Create and deploy a simple smart contract using Solidity.

3. Implement a basic cryptocurrency token using ERC-20 standard.

4. Interact with smart contracts using Web3.js or ethers.js.

5. Build a decentralized voting application on Ethereum.

6. Configure a private blockchain network using Hyperledger Fabric.

7. Evaluate blockchain performance using block explorers and metrics.

8. Simulate double-spending and analyze blockchain defense mechanisms.

9. Use Metamask for interacting with Ethereum DApps.

10. Mini Project: Develop a full-stack decentralized application (DApp).

Textbook:

1. Mastering Blockchain, Imran Bashir, 3rd Edition, 2020, Packt Publishing.

Reference Books:

1. Blockchain Basics: A Non-Technical Introduction, Daniel Drescher, 1st Edition, 2017, Apress.

2. Blockchain Applications: A Hands-On Approach, Arshdeep Bahga and Vijay Madisetti, 1st Edition, 2017, VPT.

3. Ethereum: Blockchains, Digital Assets, Smart Contracts, Andreas M. Antonopoulos and Gavin Wood, 1st Edition, 2022, O'Reilly.

Credit Distribution		
Lecture/ Tutorial	**Practicum**	**Experiential Learning**
4 * 22 NCH = 88 NCH	2 * 15 NCH = 30 NCH	8 * 4 NCH = 32 NCH (Problem Solving, Seminar, Case Study, Discussion, Internship, Projects)

Subject Name: Quantum Computing		**Subject Code: CAP052M804**
L-T-P-C – 3-1-0-4	**Credit Units: 04**	**Scheme of Evaluation: T**

Objective:

To introduce undergraduate students to the fundamental principles of quantum computing, quantum mechanics for computation, and the development of quantum algorithms with exposure to quantum programming frameworks.

Prerequisites:

- Linear Algebra and Basic Probability
- Discrete Mathematics and Basic Programming Knowledge

Course Outcomes:

SI No	Course Outcome	BT Level
CO 1	Understand fundamental principles of quantum mechanics relevant to computing	BT 1 & 2
CO 2	Apply quantum gates and circuits to simple computational problems	BT 2 & 3
CO 3	Analyze and simulate quantum algorithms	BT 3 & 4

Detailed Syllabus:

Module	Topics	Course Content	Periods
I	Quantum Computation Foundations	Introduction to quantum computing. Differences from classical computing. Quantum bits (qubits), quantum states, Dirac notation, superposition and entanglement.	22
II	Quantum Gates and Circuits	Single and multi-qubit gates (Pauli, Hadamard, Phase, CNOT, Toffoli). Quantum circuit representation and simplification. Quantum measurement and state collapse.	22
III	Quantum Algorithms	Deutsch-Jozsa algorithm, Grover's search algorithm, Shor's factoring algorithm. Quantum teleportation and superdense coding. Overview of quantum supremacy and limitations.	22
IV	Quantum Programming and Applications	Introduction to Qiskit and IBM Quantum Experience. Creating and simulating quantum circuits. Applications in cryptography, optimization, and machine learning.	22

Quantum Computing Practice Session

Practice Session:

1. Simulate single and multiple qubit operations using Qiskit.

2. Construct and analyze quantum gates and circuits.

3. Implement Deutsch-Jozsa algorithm using IBM Q platform.

4. Run Grover's search on a simple dataset.

5. Perform quantum teleportation using Qiskit simulator.

6. Simulate quantum entanglement and measurement outcomes.

7. Visualize Bloch sphere representations of qubit states.

8. Create a quantum coin toss experiment.

9. Explore noise and decoherence using Qiskit Aer.

10. Mini project: Quantum algorithm simulation for real-world problem.

Credit Distribution		
Lecture/ Tutorial	**Practicum**	**Experiential Learning**
4 * 22 NCH = 88 NCH	2 * 15 NCH = 30 NCH	8 * 4 NCH = 32 NCH (Problem Solving, Seminar, Case Study, Discussion, Internship, Projects)

Textbook:

1. Quantum Computation and Quantum Information, Michael A. Nielsen and Isaac L. Chuang, 10th Anniversary Edition, 2010, Cambridge University Press.

Reference Books:

1. Quantum Computing: An Applied Approach, Jack D. Hidary, 1st Edition, 2019, Springer.

2. Learn Quantum Computing with Python and Q#, Sarah Kaiser and Christopher Granade, 1st Edition, 2021, Manning Publications.

3. Programming Quantum Computers, Eric R. Johnston et al., 1st Edition, 2019, O'Reilly.